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DMICS
Disaster Management, Initiatives and Convergence Society
Envisioning a Disaster Resilient Future

World Congress on Disaster Management

Third World Congress on Disaster Management

Vishakhapatnam | India

Edited by
Dr S. Ananda Babu
President and Convener
DMICS-WCDM

This book is a compendium of 54 papers presented at the Third World Congress on Disaster Management held in Vishakhapatnam in November 2017. Authored by researchers, policy makers and practitioners, the papers cover a wide range of themes arranged around four themes of decoding disasters, tracking disasters, responding to disasters and building resilience to disasters.

Dr S. Ananda Babu is a PhD from Osmania University (OU), India. He is a societal awareness specialist and scholar, an author and editor of numerous books including *Disaster Risk Reduction, Community Resilience and Responses*. In addition, Dr S. Ananda Babu is the Founder President of the Disaster Management, Initiatives and Convergence Society (DMICS) and the Convener of the World Congress on Disaster Management (WCDM) established in 2005. In the aftermath of the Indian Ocean Tsunami, to enhance understanding and awareness among people about the risk of various types, dimensions of disasters and the measures to be taken for reducing the risks, for better preparedness, response and recovery, the DMICS and the WCDM takes on the task of creating awareness through multi-disciplinary research, publications and multi-stake holder's consultations.

Macmillan Publishers India Pvt. Ltd
www.macmillaneducation.in

ISBN 93-5455-281-1
9789354552816

Building Resilience to Disasters for Sustainable Development

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Papers Presented at the Third World Congress on Disaster Management, Vishakhapatnam, November 6–10, 2017

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MACMILLAN

First published 2022

MACMILLAN PUBLISHERS INDIA PRIVATE LIMITED

Delhi Bengaluru Chennai Kolkata Mumbai
Ahmedabad Bhopal Chandigarh Coimbatore
Cuttack Guwahati Hyderabad Jaipur Lucknow Madurai
Nagpur Patna Pune Thiruvananthapuram Visakhapatnam

ISBN: 978-93-5455-281-6

Published by Macmillan Publishers India Private Ltd,
21, Patullos Road, Chennai 600002, India

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BUILDING RESILIENCE TO DISASTERS

Preface

The Third World Congress on Disaster Management (WCDM) was held in Vishakhapatnam on November 6–10, 2017 on the overarching theme of *Building Resilience to Disasters for Sustainable Development*. The Congress was structured in seven Plenary Sessions, 26 Thematic Sessions and one Special Feature Event that was attended by more than 1500 participants from various parts of India and abroad.

While the Plenary Sessions were addressed by eminent speakers, and the Special Feature Event was an assembly of students for the campaign on Making School Safe, the Thematic Sessions were attended by a mix of researchers, policy makers and practitioners who presented their research findings, policy perspectives and field experiences. 54 out of a total of 148 such presentations at the Thematic Sessions were submitted as papers. This volume is a compendium of these papers.

The papers have been published in the same form these were received without any peer review to provide a flavour of the raw ideas that emerged from the Thematic Sessions of the conference. Many of these papers presented by the young researchers and practitioners may not have the rigours of academic disciplines, but these do reflect the cross-current of thoughts that went around in these sessions of the Conference. These provide new ideas and insights that provide value to the current discourses on the subject.

These papers have been arranged under four broad themes – decoding disasters, tracking disasters, responding to disasters and building resilience to disasters. Understandably the papers do not cover every aspect of the themes, these discuss only those aspects that the authors have chosen to highlight.

The Conference secretariat has brought the papers together, but the credit lies solely and exclusively with the authors.

Dr S. Ananda Babu
Convener
Third World Conference on Disaster Management

Acknowledgements

The DMICS team and WCDM organising committee would like to convey utmost thanks to the Government of Andhra Pradesh for its outstanding collaboration and support to the Third World Congress on Disaster Management.

The organising committee would also like to thank the co-partners: NDMA, NIDM & NDRF – Ministry of Home Affairs, Government of India, Indian Coast Guard, JNU-SCDR, Care India, Oxfam India, Caritas India, NAPSIPAG, Save the Children, UN Volunteers, IIT-Roorkee, ONGC, UNICEF, Nature and VNL for their unconditional support and contributions.

We sincerely thank all the speakers, presenters and delegates for their dedication and active participation in the conference activities.

Our special thanks to Dr P. G. Dhar Chakrabarti, Dr Muzaffar Ahmad, Maj. Gen Dr Naresh Chander Badhani, Prof. (Dr) Namrata Agrawal, Dr A. Kishan, Prof. B. Gopal Rao, Mr Ray Kancherla, Dr Ram Bhavani, Mr Mohan Kasthala, Mr Pavan Parlapalli, Prof. V. Prakasam, Dr A. Gayatri Devi, Ms Suparna Dutta, Mr Y. Satyanarayana, Mr D. Sridhar, Mr Mahesh for their constant support and remarkable contribution.

We also thank Gitam University, Vishakhapatnam for their hospitality and providing us with a wonderful venue.

The support of Macmillan Publishers India Private Limited in publishing the Third WCDM proceedings is also appreciable.

DECODING DISASTERS

Decoding Disasters: A Key to Disaster Management with Regard to India

Supriya David[a]

Abstract

It is rightly said that "Prevention is better than cure". In 2004, the devastating tsunami was generated in the Indian Ocean after a magnitude 9 earthquake which was one of the deadliest disasters in recent history as the aftermath of the effect was over 230,000 deaths in 14 countries. The energy released on the earth's surface by the earthquake and subsequent tsunami was estimated to be the equivalent of 1,500 times that of the Hiroshima atomic bomb. In recent years, India has been witnessing, the incidence of extreme weather events. Nationally, natural disasters have cost the nation Rupees 56 lakh crore between 2007 and 2012 (the 11th plan period)only accounting for homes damaged, farmland affected and cattle lost, not including the impact on local economies. Some of this loss could have been prevented. According to the National disaster Management Authority states don't adhere to flood plain management plans.

In a study published in journal *Heliyon*, on decoding disasters, it indicates that devastating tsunamis could be mitigated by using acoustic-gravitybwaves to redistribute the huge amounts of energy stored within the wave, potentially saving lives and billions of pounds worth of damage. According to Usama Kadri from Cardiff University in UK, many lives could ultimately be saved by using acoustic gravity waves.

It is in this context the paper will highlight how Acoustic gravity waves (AGW's) which are naturally occurring sound waves can be triggered against Tsunamis caused by earthquakes, landslides and other violent geological events. They travel thousands of meters below the surface, if we can find a way to engineer these waves, they can be fixed at an incoming tsunami and will react with the wave in such a way that reduces its amplitude or height causing its energy to dissipate over a large area. By the time the tsunami reaches the shoreline, the reduced height of the tsunami would minimise the damage caused to both the civilians and the environment. This process of firing AGW's at a tsunami could be repeated continuously, until the tsunami is completely dispersed.

Within the last two decades, Tsunamis have been responsible for the loss of almost half a million lives, widespread long lasting destruction, profound environmental effects and global financial crisis. It has been observed that administration has become short to deal with issues of intense concern. Up until now, little attention has been paid to trying to mitigate Tsunamis hence the paper will focus on mitigation strategies and recommend suggestions to be taken at the global level with countries joining hands together to tackle the issue of grave concern.

Keywords: decoding, tsunami-genic earthquakes, acoustic gravity waves (AGWs), mitigation, flood plain management plans

Introduction

Among numerous challenges that human civilisation faces today, natural disaster remains the most destructive force and causes more fatality than any other threat (Badatya 2018). According to the Centre for Research on Epidemiology of Disasters (CRED) database, about 22,455 natural disasters occurred since the beginning of twentieth century killing more than 38.57 million people and injuring another 8.7 million people. In total, more than 7.5 billion people were affected and the property of nearly USD 3 billion was destroyed between 1900 and 2016 due to nature's fury (Ibid). The Asian continent, being the worst disaster-prone region, witnessed approximately 9,351 disasters affecting nearly 6.7 billion people of which, about 27 million lost their life and injured another 5 million (Bhatiya 2014). The total damage to the property was also very high as compared to any other continent, pushing the region further backwards. Amongst regions of the Asian Continent, South Asia remains the most disaster-prone area.

Constricts of seven nations - Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Srilanka – South Asia is one of the poorest regions of the world and the home for one- fifth of world's population (Gilbert 2017). People of this region have been susceptible to various periodical disasters including cyclones, droughts, earthquakes, floods,

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landslides and tsunamis. All the countries of South Africa are marked as high disaster prone states and continue to occupy high ranks in the World Risk Index. Apart from human losses, the menace of disaster contributes to prolonged poverty and poor living conditions in the vulnerable regions of the world. The people of developing countries lack standardised housing and anti-disaster infrastructure due to which the destruction is much higher in these countries as compared to the developed countries. In addition to it, the poor infrastructure and high human settlement in low lying areas, wide economic disparity and inadequate governmental support make this region more vulnerable to natural disasters. Most of the countries of the subcontinent lack effective relief mechanism, emergency medical facility, suffer from widespread corruption and weak governance for decades. The poor state of disaster combating capacities is largely related to the weak economic status of the region. As a result of which, the rate of casualty remains very high in this region.

Organising administrative machinery, dealing with disasters, is a vital responsibility of governance. Strong and effective emergency management has been a first need in all corners of the world. Responsiveness of governance becomes evident in the manner in which it addresses the crucial task of ameliorating suffering and reducing losses. Public servants have a responsibility for formulating policies and building capacities for dealing with such situations. The public perceives governments will learn from their own experiences and from that of others. Yet a common complaint has been that the government agencies are ill prepared for the next big damage to loss of life and damage to property. Disasters had serious consequences for states and their economies. Despite developments in science and technology, the cost of disasters has been increasing.

Disasters extract a very high price in social, psychological and economic terms. Their impact was felt in trails of destruction, families torn apart, children orphaned, livelihood destroyed and communities traumatised. They had a long term impact on the social health of families and in turn, the community. At the individual and family levels, loss of livelihood or a diminished earning capacity had an equally damaging effect. It was held that damages to domestic and business constructions imposed a burden that was never recovered through government compensation packages or insurance payouts. The total impact was likely to be more, since an accurate estimation was difficult due to serious methodological difficulties in calculating primary and secondary losses.

The opportunity cost of relief and reconstruction expenditures was also a reason for its enormous resilience. Losses of infrastructure and public assets imposed a heavy financial burden on government resources. At the same time, the uncertainty associated with disasters made it more difficult to make appropriate budgetary allocations. Firstly, it cost resources to restore normalcy and to invest in mitigation programs. Secondly, from an opportunity cost perspective, countries were forced to spend resources on disaster management that would have otherwise been more productively invested.

The economically disruptive effects of disaster is infinitely more in developing countries as compared to the developed countries, as the world's poorest stayed in these countries. The impact of disasters was much higher in poorer countries because even small economic losses were critical due to abysmally low capacities, instead of being forced to spend on repairing downed electric lines, damaged infrastructure, providing emergency shelters, feeding displaced people or compensating losses. Otherwise the states would have spent scarce resources on more pressing priorities of laying new roads, connecting inaccessible areas, fighting disease and epidemics or investing in education and other sectors of human development.

An Overview on Disasters and Associated Vulnerabilities in India

The Indian subcontinent suffered from numerous natural and manmade disasters. It endured the devastation of natural hazards such as droughts, epidemics, pandemic, floods, cyclones, earthquakes and the rarely occurring tsunamis, industrial mishaps, terrorist incidents, transportation accidents in urban locations, communal and caste riots has taken a heavy toll. The experience and vulnerability profile indicated a very high degree of resilience.

Among disaster agents, floods and cyclones were most frequent and earthquakes have a second highest average death toll per event after the rarely occurring tsunamis. The situation is alarming from a vulnerability perspective. Disaster literature, in general, and about India, in particular, noted an increase in number of great natural disaster events that was attributed to the growth of population and urban sprawl. There have been catastrophic natural disasters like the 1993 Latur earthquake in Maharashtra, 1998 Kandla cyclone in Gujarat, 1999 super cyclone that battered coastal Orissa, the Republic day earthquake of 2001 of Gujarat ,the calamitous 2004 Indian Ocean

Earthquake and Tsunami that swept coastal villages in Tamil Nadu, Andaman and Nicobar islands, 2006 Surat Flood, 2011 North Indian Cold Wave, 2012 Indian Cold Wave, Heat waves, 2013 North India Floods, 2016 Siachen Glacier avalanche, 2019- 2021 locust infestation, 2020 Dahej Chemical plant explosion, 2020 Uttarakhand Forest fires, Maharashtra, Bihar, Saurashtra and Uttarakhand floods 2021, Kinnaur landslide, Cyclone Gulab, Tauktae, Yaas, Chamoli disaster, Assam Eathquake 2021, Nipah virus outbreak in Kerala 2021 etc.

As far as manmade hazards are concerned the 1984 Bhopal Gas Tragedy has been one of the worst accidents in the history of the industrial world. India is experiencing massive and rapid urbanisation. It is estimated that by 2025 the urban component, which was only 25.7 per cent in 1971 will be more than 50% (Thakur 2014). High density areas with poorly built and maintained infrastructure are subjected to natural hazards, environmental degradation, fires, floods and earthquakes. Urbanisation dramatically increases vulnerability whereby communities are forced to live on environmentally unstable areas such as by the sides of steep hills which are prone to landslides, besides the rivers that regularly faces flood or on poor quality grounds causing their dwellings get collapsed easily.

The hilly region of India has wide variations in topography geology, soil climate, flora and fauna and various ethnic groups having different socio-cultural traditions which is a unique geographical entity of India. All the major natural disasters hit this region causing disruption in socio- economic life of people and bring misery to them. Communities settled on river banks who predominantly depend on rain-fed agriculture experience the problem of floods and food insecurity. Natural disasters primarily cyclones bring misery to coastal communities. The damages incurred due to these disasters have grown in the recent past. The main cause is the growing population pressure around the coastal areas and climatic changes resulting in rise in sea levels. The natural occurrences of disasters cannot be stopped from taking place. But we can take preventive measures for undertaking rescue, relief and rehabilitation measures.

The approach towards coping with the effects of natural and man-made disasters have been post disasters management involving many problems such as law and order, evacuation and warning system communications, search and rescue, fire fighting, medical and psychiatric assistance, provision of relief and sheltering etc. After the initial trauma of occurrence of disasters, within no time, hours or few days or weeks, the phase of reconstruction and economic, social and psychological rehabilitation is taken up by the people themselves and by the government authorities and that trauma brings about fear in the minds of the people for a longer period of time or till the next one occurs again in the same area or in some other part.

It is not possible to do away with the devastation of natural hazards completely. But the devastation from the hazards can be minimised by the presence of well functioning warning systems, combined with preparedness on the part of the vulnerable community. It reduces and modifies the scale of disasters. A community region or area that is prepared to face disasters receives and understands warning of implementing hazards and has taken precautionary and mitigation measures will be able to cope better and resume to normalcy sooner. It is therefore important to emphasise on ways and means of preventing and preparing for disasters. This protective approach is better than waiting for history to repeat itself. There is need today, to examine the relation between environmental degradation and vulnerability to disasters and their effects on nature and manmade habitats. It also needs coordinated efforts to reduce vulnerability to disasters. Though preventive measures will not halt natural disasters but the impacts on environment can be checked.

Disaster Management Reforms in India

Government and scholars in India began viewing this domain of public policy with a newfound sense of urgency, considering the vulnerability of the nation and the devastating impact of disasters. It resonated with the goals of disaster research. A greater focus on the subject was also due to the increased international influence to disseminate overseas experiences and best practices. The United Nations declared the 1990s as the International Decade for Natural Disaster Reduction (IDNDR). India also recognised the need for disaster reduction strategies. The 1994 Yokohama strategy of the IDNDR played a significant role in changing its relief-oriented approach to the approach based on prevention and mitigation. A joint program for disaster risk mitigation was taken up in 2002, by the Government of India and United Nations Development Programme (GOI-UNDP) with the assistance of the United States Agency for International Development (USAID) and the European Union (EU). It was aimed at capacity building in seventeen of the most disaster prone states in India. Overseas agencies, like USAID, assisted India in developing climate forecasting systems. India was also exposed to international norms and standards, being the largest recipient of World Bank aid for disaster management programs.

Comprehensive reform was taken up by the federal government. The Ministry of Home Affairs (MHA) was notified as the nodal ministry for Disaster Management in 2002. In the new millennium, the second Administrative Reforms Commission (ARC) was constituted by the federal government, to examine and suggest measures for efficient and sustainable administration at all levels. In terms of reference it included Crisis Management and to suggest ways to quicken the Emergency Responses of administration and to increase the effectiveness of the machinery to meet the crisis preparedness. Soon after this, a Comprehensive Disaster Management Act was passed by the Indian Parliament on December 2005. In place of archaic Relief departments, provinces are encouraged to set up Disaster Management Departments, to appoint Disaster Management Authorities and to promulgate Disaster Management codes in place of outdated Relief codes. Comprehensive reform addressed long-term mitigation and prevention requirements of disaster management. The Indian Metrological Department and the Central water commission took up modernisation and up gradation of flood forecasting, early warning systems. A national core group on landslide mitigation was set up with Geological Survey of India as nodal agency. Another national core group on earthquake mitigation was set up; under its aegis an expert committee was tasked with drafting building bye-laws, town and country planning and zoning regulations.

The Bureau of Indian Standards (BIS) was asked to develop building safety codes, sensitise local government personnel and train municipal architects and engineers. Government of India took the assistance of USAID in strengthening climate forecast system. Large scale changes were mooted for training and human resource development. The National Centre for Disaster Management, 1995, was upgraded to a National Institute of Disaster Management (NIDM) in 2003. The purpose of NIDM was to conduct research, undertake documentation, develop training modules, conduct training programs and assist training institutions and state institutes. After the promulgation of the Disaster Management Act in 2005, NIDM was recognised as a statutory nodal institution. The National Academy of Administration, the country's premier institution was notified as a nodal agency for training the trainers. Natural disaster management cells were set up in state administrative training institutes, which trained government personnel, to increase awareness and spread norms. Academic courses of engineers and architects included subjects on disaster management; topics on disaster management were introduced in curricula of schools and universities to spread awareness.

Apart from all these efforts in building the comprehensive capacity to deal with disasters the 2004 South Asian tsunami exposed numerous shortcomings in states. It highlighted the distance between the centre and the states in adopting policy change. In addition to disproportionately high loss of lives a total unfamiliarity with the disaster agent caught the administration totally unaware. As a consequence of it, India joined an international effort to install tsunami detection system in the Indian Ocean. It became a high priority issue and India went ahead with a plan to install a network of seismic stations with 50 tide gauges and a dozen open ocean tsunameter buoys. By March 2007, it had tested four tsunameter systems.

In cases of manmade disasters statutory safeguards are introduced earlier. The Bhopal gas tragedy in 1984 resulted in bench marks and industrial safety standards in a number of countries. The United Nations has designated the 1990's as the International Decade for Natural Disaster Reduction (IDNDR) to reduce loss of life, property damage and social and economic disruption caused by natural disasters especially in developing countries. Under the influence of IDNDR in the 1990s, a major exercise was undertaken to improve Awareness and preparedness for Emergencies at local level (APELL) by the United Nations Environment Programme (UNEP) in collaboration with government and industry. Its purpose was to minimise technological accidents and environmental emergencies, and their harmful effects. This was done by identifying and raising awareness of industry –related hazards, encouraging risk reduction and mitigation and developing co-ordination between industry, local authorities and community.

A Road Transport Safety (RTS) initiative focused on all hazardous and non-hazardous industrial goods which were launched with the cooperation of UNEP, USAID and National safety council of India (NSCI). Similarly in the oil and natural gas sector, the oil industry safety directorate (OISD) had considered international benchmarks of International Electrotechnical Commission (IEC), Application Programming Interface (API) and National Fire Protection Assistance (NFPA) etc., while developing safety protocols. The Indian federal policy reform was comprehensive and spelt out specific parameters for the different phases of disaster management. In the mitigation and preparedness phases, states were asked to integrate long-term plans with developmental policies. Schemes that addressed prevention and mitigation were given priority. Mitigation measures for earthquakes included designs for quake resistant construction and updating building codes according to the Bureau of Indian standards. States needed to set up specialist disaster response teams in addition to undertaking vulnerability analyses for reaching preparedness milestones. In the response stage, it consisted of emergency plans as well as mock drills. Other steps included emergency support functions of procurement, mobile hospitals, search and rescue teams and communication networks. Equally important were measures enrolling local communities and nongovernmental organisations, which were some of the key shortcoming indentified even by the World Bank. The paradigm shift was a comprehensive overhaul that represented double loop learning as far as federal policy making was concerned. Its objective was from distribution of relief to addressing all phases of generic disaster management. The sum total of changes represented a complete policy overhaul in Indian disaster management.

The nodal agency dealing with the subject, the Ministry of Home Affairs, recorded progress in the country's able management of disasters, although it had realised the need to change and reform in a very fundamental way. Official documents had been a catalogue of to-do concerns, as well as a review of activities in pursuit of a new approach at the federal level. They also recorded policy changes that were taking place, noting the short comings of earlier policies. A few highly useful, empirical studies had assessed the consequences of policy changes. One example was the work of Orissa state Disaster Mitigation Authority which had a valuable assessment of policy implementation. Yet, on the whole, there was no attempt at rigorous, systematic analysis and reaching conclusions for implementing policy reforms. The absence of critical analysis was also found in several works by scholars and scientists associated with government bodies. A few reports were candid in their assessment. For example, the guidelines for construction and building codes recorded an abysmal record in compliance of these non-structural measures.

Literature on Indian Disaster Management

There have been attempts at identifying shortcomings and re-assessing fundamental goals on the literature on Indian Disaster Management. The need for a radically different approach on disaster management is the need of the hour. A very significant feature of official literature was the identification of the central role of provinces in disaster management. While they correctly identified the unit of analysis, it was not used for any systematic comparison. The other major stream of literature on Indian Disaster Management was by scholars as well as activists of non-governmental agencies. They focused on a wide range of themes evaluating government response in specific disasters to community vulnerabilities. It was interesting to note that most of these works based their analysis on one or two incidents and attempted to inductively generalise about the gamut of disaster administration in India. For most part, there was little or no attempt to systematically analyse the field and derive fuller explanations thereby contributing to the growth of the discipline in theory and practice. The studies did not look at the whole field, in broad terms, and across states and disaster events. Literature in this category had covered sociological issues, community's perception of acceptable risk, socio- economically vulnerable groups and general lessons about disaster management. There had been case studies of specific events, comparison of different events of the same disaster type, general opinion of pieces of information about the sub-field of Indian disaster management among others. Majority of these scholars and groups were critical of policy interventions. They called for introspection and identification of weaknesses, in addition to outright criticism. The state was considered to be ineffective in preventing avoidable loss of life or property due to rigid bureaucratisation, short sighted planning and lack of structured involvement of community and non-governmental agencies. If there had been lack of adequate mitigating measures in some cases, preparedness was found to be inadequate in others. Recovery in most had been below par, if not nonexistent. Scholars in some cases and international organisations too, noted grave shortcomings of lack of transparency and poor consultation, and no institutionalised involvement of local governments and non-governmental organisations. They stressed an urgent need to involve Panchayat Raj Institutions (PRIs) in an effort to de-bureaucratise and involve non-governmental organisations. Even the new Disaster Management Act of 2005 was found to exemplify the top-down policy that was characteristic of disaster management as well as public administration in India. International organisations also made important contributions to the literature. Their report on specific events or on the state of Indian Disaster Management also included chronicles of successful initiatives, post-tsunami reconstruction and recovery in Gujarat. If lack of preparedness was a cause for devastation in the

2004 tsunami, absence of infrastructure affected supply of emergency provisions as well as medical assistance in others. A need to comprehensively address recovery operations was also articulated. They agreed with scholars that administration had failed in discharging its duties. Amidst all these, students of public administration are disappointed for the lack of adequate concern about policy factors, as well as lack of critical and rigorous analysis. It was difficult to draw generalised conclusions. Only a few organisations had undertaken a general study of Indian Disaster management, and spelt out lessons that needed to be learnt. The exercise by the Independent Evaluation Group of the World Bank employed a comparative approach although the unit of analysis was a nation. They found a series of shortcomings in India, such as a need to address long-term objectives, improve coordination and establish procurement procedures, community participation and others.

Decoding Disasters

Although, in recent years, technology has evolved in quantum leaps, still it is not widely used for mitigating natural disasters that have devastating consequences in the regions of the world where the lack of preparedness and basic infrastructure are characteristic. Such disasters are unpredictable in nature and will continue to be a threat to mankind in the years to come. However, it has been observed that where technology is available, strategies to lessen the impact of a disaster are employed in advance to mitigate the loss of lives and property. In developed countries, where technology is applied, the integration of state-of–the-art wireless communications and information technologies has become the foundation in the development of solutions to monitor, to alert and to mitigate such unpredictable events. Historical databases and behavioral models of the environment, which are extracted with ubiquitous sensing from the site, provide accurate and reliable data to authorities. The timely access to relevant information on hazardous environmental conditions provides time for the community to apply preparedness procedures that are capable of alleviating damage and reducing the number of causalities derived from the event. The contrast in disaster preparedness from developed to underdeveloped countries is still subject to lack of information and infrastructure, is evident. In the underdeveloped countries disaster management in reduced to response and recovery efforts from the governments after the event has occurred. Little can be done by the time civil defense and other assisting agencies assure at ground zero.

Disaster management procedures can be compared over time in those regions of the world where technology is currently present for monitoring and alerting. Even though warnings were issued, at the time, they were not taken seriously and many chose to stay at home and not seek shelter. The technology available in underdeveloped countries currently is insufficient to provide their populations with reliable systems for disaster monitoring and management. The lack of infrastructure and technology necessary for collaboration in the mitigation and management of disasters put at risk lives and properties that could be preserved. The tsunami which hit South Asia at the end of 2004 was the most devastating of all time leading to many deaths and several billions of dollars in property damage. The lack of communication channels from other disaster monitoring sites to authorities in the South Asia region, to warn that a catastrophe was imminent, contributed to the several thousand of lives that were lost. In recent years, disasters caused by mankind have been as devastating as the ones caused by nature. The common ground between the two is their unpredictable nature and their consequences.

Manmade disasters are even harder to predict since the parameters involved in the monitoring of such events are more subjective. In the case of man-made disasters technology can be applied for the creation of databases for suspects, the development of bio-chemical sensors and for the development of an interoperable communication technology among the emergency workers. Money and effort are normally invested to mitigate the effects of natural disasters after they have occurred. However, in order to lessen the effects of such events it is necessary to anticipate their occurrence. A monitoring system that provides authorities accurate and reliable information prior to a natural disaster provides the community time to apply preparedness procedures, which will save lives and minimise property loss. The majority of the current commercially available monitoring and alerting systems for disasters use telemetry solutions that are expensive and are difficult to install and are configured on centralised schemes that often compromise the reliability of the system. Traditionally, space technology and telemetry systems have been used in the remote sensing of the environment at risk. However, the emergence of Wireless Sensor Networks (WSNs), in recent years has prompted researchers to investigate the possibility of Implementing WSNs for disaster monitoring and management.

Space Technology for Remote Sensing

Satellite remote sensing is the most sophisticated technology used for environmental monitoring in the prediction of natural disasters. The satellites carry onboard sensors that are capable of providing information on every natural feature that prevails on the surface of the earth. Depending on the type of disaster being monitored, different onboard sensors are employed. For example, thermal sensors capture fire hazards, infrared sensors are more suitable for floods and microwave sensors can record soil moisture. The two main types of satellites used to observe the Earth, are the geostationary and the polar orbiting satellites. The geostationary satellites are primarily used for meteorological observation whereas the polar- orbiting satellites are particularly important in the monitoring of natural disasters. The data extracted from the satellites are transmitted back to ground stations where the information is processed by computers & designed for complex signal processing. The data extracted from the satellites is applied precisely to detect, map, measure and analyse the environment. The accuracy, the extended coverage and the spatial continuity obtained from satellite readings are among the main advantages available from this technology for remote sensing. The satellite remote sensing provides real time assessment of the event, which is helpful in identifying evacuation zones to safe zones away from the disaster. Unfortunately, not all countries can rely on space technology for remote sensing. In fact, most developing countries have limitation in terms of hardware, software and human resources. The satellite solution requires powerful high-end computers for signal processing, software such as a Geographical Information System (GIS), to implement data analysis; statistics based behavioral models and most importantly qualified professionals to operate the system. The cost to set up and operate a solution of this magnitude and complexity is also an issue for developing countries.

Telemetry-Based Solutions for Remote Sensing

Many of the remote sensing solutions used for disaster management are based on Telemetry systems. Remote sensing solutions make use of remote terminal units that are coupled with sensors to collect data and in a point to point strategy transmit the data to a Central terminal unit. The remote terminals can be powered by a solar panel or by using an Uninterruptible Power Supply (UPS). The medium used for communication consists of elements such as cable, radio, telephone and satellite. Telemetry based solutions utilise Ultra High Frequency, Very High Frequency and cellular networks for communication. However, a centralized scheme compromises the reliability of the solutions since each section might be isolated in the event of terminal unit failure or malfunction. In addition to it, these invasive architectures are difficult to deploy and to operate. The installation process is time consuming and once established the infrastructure is permanent and not easily extendable.

Wireless Sensor Networks for Remote Sensing

It is a novel approach to minimise the loss of lives and property as the result of a disastrous event. A very limited number of major projects have implemented Wireless sensor networks for natural disaster monitoring and response. The results from experiments showed that WSNs lend themselves well for natural disaster monitoring. However, these experiments also exposed issues that still need to be addressed in order to improve overall performance and reliability.

Identifying Sensing Parameters

For each type of disasters to be monitored, application specific sensors are needed. Identifying the sensing parameters requires structuring the chain of events that will eventually trigger the disaster. The sensors are selected according to the requirements determined by the local authorities. The solution is designed to comply with the necessity of each customer.

Identifying Locations to Deploy Sensors

Understanding the environment at risk optimises the response of the network by extracting the most relevant data at the most appropriate location. These locations are usually determined by professionals of the environmental field in conjunction with Civil defense authorities. Such locations are characterised by their tendency to trigger events that lead to a disaster. By extracting the data from the field at these strategic locations, the parameters being investigated are likely to break safeguards at earlier stages of the monitoring process, which provides more time for authorities to alert the population and to apply preparedness procedures.

Identifying the Available Infrastructure

The remote sensing solution for disaster monitoring must be adaptable not only to the environment but also to the available infrastructure. Even though the network can be extended to reach higher networks the basic remote sensing architecture should be independent of any complementary network and its architecture must be sufficient and efficient in providing the reliable data expected from a monitoring and alerting solution.

Internet Connectivity

The Internet can perform a two-fold functionality for the monitoring and alerting system. One of the features of the network gateway includes running an Apache HTTP (Hypertext Transfer Protocol) server. The data collected from the sensed field and stored in the local database is transmitted to the Local Office primarily through the GPRS (General Packet Radio Service) network. Another possibility is to publish the database files in the HTTP server and let the workstation at the Local Office download the file remotely. This redundancy is important in order to guarantee that the database files will reach the central workstations for data processing. The other functionality of the internet is in data dissemination. The data can be made available to the general public after it has been processed by the local office. This provides the people with almost real-time information on the monitoring of a disaster.

Conclusion

Natural hazards have been occurring with amazing frequency since the creation of society and are inevitable. Most often, our past experiences on specific hazards teach us how to understand and anticipate future hazards and consider present situations. In many third world or developing countries including India, 'decoding disasters' and providing much needed timely information to reduce the risk of becoming victims takes a secondary thought. These countries are still adopting the old approach of 'disaster management'. India is vulnerable to a large number of disasters due to changing demographics, socio-economic conditions, unplanned urbanisation and environmental degradation. The natural hazards that trigger disasters do not select their victims. Unfortunately, the victims of disaster both in developed and developing countries are already socially, economically and politically disadvantaged. Lack of responsiveness of government officers, no early warning systems, inadequate resources for mass evacuation, improper coordination amongst various government departments, and lack of standard operating procedures among others has been usually observed coping with disasters. There are serious gaps pertaining to the issues of planning, coordination, shortage of resources and weaknesses of non-structural measures.

Communication and Information Technologies provide a proactive approach to disaster management. Effective and accurate monitoring system alerts the authorities and the population in advance leading to relatively small number of casualties. Early detection of the event provides time which is necessary for the population and authorities to apply preparedness procedures in the hours anticipating the disaster. The response and recovery from the event can be planned out by local authorities prior to the disaster and carried out quickly and effectively in the hours following the event. When technology is not available the disaster is unforeseen by the population and authorities. Response and recovery is more difficult because there has been no time for the authorities to prepare for the disaster. The panic caused by the unexpected event leads to an even greater number of injuries and deaths. In addition, the technology is too expensive for the developing countries to afford.

Identifying vulnerabilities and capacities is vital to creating lasting change and resilience. An integrated and holistic approach to risk reduction and focus on disaster and development, community involvement, mitigation and prevention, capacity building and social justice is the need of the hour.

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Disaster Management of Millennials as Human Resource

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Abstract

We anticipate a global disaster scenario for the availability and allocation of human resources—indeed, a phase transition in societal structure—caused by the AI-powered, large-scale automation and the common man's inability to cope and align with the inevitable socio-economic forces unleashed by it. In this paper, we discuss three aspects of this potential disaster: (i) its inevitability, (ii) its magnitude, and finally, (iii) available options in managing the disaster. In our view, the principal contributors to this disaster is the inevitable phase transition predicted by graph theory in mathematics, triggered by the exponential rise in socio-economic connectivity between humans and AI-powered machines, and the dynamics of the predator-prey game (as modeled by the logistic equation) where humans battle with AI-machines to capture available but finite employment opportunities. At current rates of exponential science rooted technology advances, the combination of phase transition from graph theory and the logistic map gives us enough warning to suggest that employment opportunities for the millennials will rapidly fluctuate and many of them will face socio-economic chaos in their lives. The scope of managing the disaster will be extremely limited and restricted largely to the survival of the creatively intelligent. This disaster will be global because of humanity's unrelenting march towards a techno-singularity as foreseen by Ray Kurzweil.

Keywords: disaster management, human resources, millennials, automation

Introduction

We see incipient signs of an impending human resources related disaster hitting the millennials at a most vulnerable stage in their career, the period when they need to be productively employed long enough and remuneratively enough to save for a comfortable retired life in their sunset years. While they were growing up, little did they imagine that in their adulthood they would be competing for jobs, on a large scale, with AI-powered machines, which neither need jobs nor a livelihood. The sudden appearance of this stark and unique possibility has not only caught everyone unawares, but it has also left them without any benefit of hindsight based on which they can plot a disaster management policy for the millennials. The novelty of the situation prompted us to examine the problem, not from a social-sciences perspective (because it lacks in-depth understanding of science and technology), but from a physicist's perspective where one tries to understand a new phenomenon through mathematical abstractions. We found two that appear to underlie the dynamics of the impending disaster affecting the millennials (and the entire human race), namely, phase transition as understood in graph (network) theory, and the logistic map as studied in chaos theory. Both play fundamental roles in understanding complex systems.

We note that socio-economic systems are inherently non-linear with multitudes of feedback loops, and their dynamics show an amazing variety of complexity. The system's behaviour can change abruptly, sometimes due to seemingly ignorable changes in the information flow in the loops. It is the sudden unexpected change, *e.g.*, from a sedate state to a wildly fluctuating state with little or no warning that makes us helpless. However, surprisingly, the essential features of that complexity can be found in amazingly simple systems. Indeed, Robert May, a theoretical ecologist and former President of the Royal Society (2000–2005), in his seminal work on the relationship between complexity and stability in natural communities, said:

Not only in research, but also in the everyday world of politics and economics, we would all be better off if more people realised that simple nonlinear systems do not necessarily possess simple dynamical properties (Robert M, May, 1976).

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Our first observation of note was that we live in an Internet connected world where information (and rumours) can and does fly to-and-fro extremely rapidly, which increases the probability of sudden unexpected events, *e.g.*, an economic collapse (phase transition) via random fluctuations in the stock and money markets around the world followed by chaos. This at once led us to the phase transition phenomenon that mathematicians had discovered in random graphs in 1960 (Erdős and Rényi, 1960), as a model for the anticipated disaster awaiting the millennials because of their massively Internet-connected world. Our next step was to find a suitable model that might indicate what might follow the phase transition event in light of Kurzweil's brilliant analysis of the exponential advances being made in science and their role in advancing modern technology (Kurzweil, 2001 and Kurzweil, 2005). These advances are so rapid and novel that their unintended effect is to make the common man helpless in coping and aligning with the inevitable socio-economic forces unleashed by them. Millions of human job seekers now increasingly face the possibility of unemployment because superior and winning AI-driven robots that neither need a job nor a livelihood are their likely competitors. Here, we zeroed in on the dynamics displayed by the logistic map that captures the core aspect of a predator-prey battle competing for finite resources (May, 1976).

To identify what was driving the phase transition and the feedback loop in the logistic map, we looked at the socio-economic environment to determine the major force drivers. This was crucial because we believe the key to disaster management would depend on the extent to which we can control or mitigate those forces. We identified three: (i) technology advancing at an exponential rate (Kurzweil, 2001), (ii) global warming driven by enormous natural thermal activities, and (iii) rise of populism driven by uncertain job opportunities. Each is capable of causing a massive disaster; all three randomly pummeling humanity portends a massive disaster for the millennials during their lifetime. How should the millennials face this disaster if their only options are manageable and unmanageable chaos, or tolerable and intolerable disorder?

The Force Triad

Exponentially Advancing Technology

A defining feature of the post-industrial economy is the unprecedented scale of knowledge creation, especially those related to digital technologies. Just a half-century ago, advances witnessed today, were in the realm of science fiction. The doubling of computer processing speeds every 18 months (Moore's Law), was just a harbinger that growth of knowledge and its novel applications was growing at an exponential rate. In his 1999 book *The Age of Spiritual Machines* (Kurzweil, 1999), Ray Kurzweil proposed *The Law of Accelerating Returns*: the rate of change in a wide variety of evolutionary systems tends to increase exponentially. He explained it further in 2001 under the title *The Law of Accelerating Returns* (Kurzweil, 2001). He wrote:

An analysis of the history of technology shows that technological change is exponential, contrary to the common-sense "intuitive linear" view. So we won't experience 100 years of progress in the 21st century — it will be more like 20,000 years of progress (at today's rate). The "returns," such as chip speed and cost-effectiveness, also increase exponentially. There's even exponential growth in the rate of exponential growth. Within a few decades, machine intelligence will surpass human intelligence, leading to The Singularity — technological change so rapid and profound it represents a rupture in the fabric of human history. The implications include the merger of biological and non-biological intelligence, immortal software-based humans, and ultra-high levels of intelligence that expand outward in the universe at the speed of light. (Kurzweil, 2001).

The millennials must deal with this highly non-linear phase of human evolution where guessing the future is already impossible because our intuitions are based on linear extrapolations. They should therefore expect all kinds of unpredictable upheavals in their life even though vast amounts of information and knowledge can be drawn out of thin air in an instant, where distance is irrelevant if there is a desire to communicate with either man or machine, where artificial intelligence vastly surpasses the native intelligence of most humans, and where humans are destined to be the progenitors of new species of humanoids far surpassing them in intelligence, ability, and strength. The enabler of today's exponential growth is the three-decades of exponential growth of computing power (Moore's law) and energy efficient computing (Koomey's law). The millennials were born when Moore's law was already operating. A lack of shared historical knowledge of the past has thus created an unbridgeable generation gap between parents and their millennial progenies.

Information overload and explosion of ideas and inventions facilitated by the convergence of telecommunication, media and computing technologies has caused massive unintended effects. Confusion abounds because politically biased, socially prejudiced, and rationally untenable conclusions are freely spread via social and regular media. Loss of privacy through hacking is widespread. Human gullibility often assumes propaganda as useful information and gossip going viral on social media is always entertaining. Cohesion between nations and tolerance among religions are rapidly declining. Human affairs are too often driven by base self-serving whims and prejudices rather than altruism; humans now too readily rationalise prejudices. In recent decades, liberal immigration and free trade has eased the path for the gifted, the talented, the expert, the wealthy to move into richer pastures breaking barriers of nationality and religion. The resulting large-scale migration has sucked out talent from many countries and stalled their growth. Lacking growth, chaos and violence erupt once jobless masses overcome a certain psychological barrier of staying rational.

The millennials' world is dominated by *knowledge workers*, first identified by Peter Drucker in 1957 (Drucker, 1959). He predicted, "the most valuable asset of a 21st century institution, whether business or non-business, will be its knowledge workers and their productivity." (Drucker, 1999). The knowledge worker makes a living by thinking. Today, the workplace demands that their thinking be both *creative* and *productive* and preferably, *disruptive*. In essence, make past skills obsolete.

A single indicator highlights the severity of the problem. Since 1900, the ability to crunch numbers has increased 10^{18}-fold per constant U.S. dollar! (Jurvetson, 2016). Number crunching drives automation, and AI (Artificial Intelligence). From the abacus, to mechanical calculators to electronic computers to quantum computers has been a giant leap where machines not just hyperbolically outperform every human in arithmetical calculations, but now even 'outthink' wide swathes of human experts whether it be a game of chess, Go, poker, or *Jeopardy*, or detecting and diagnosing cancer and prescribing remedies, driving cars, doing robotic surgery, managing digitally-connected appliances and homes, and so on. The world is turning into an Internet of Intelligent Things (IoIT).

In 1936, Alan Turing proved that mathematics, once formalised, is completely mechanizable (Turing, 1937) and thereby created computer science. Now it appears that human intelligence and emotion are mechanizable too. Perhaps not surprising since Max Tegmark notes: "Our reality isn't just described by mathematics – it is mathematics …. Not just aspects of it, but all of it, including you." In other words, "our external physical reality is a mathematical structure" (Tegmark, 2014). To this we add another powerful observation, from Karl Popper, whose influence on modern scientists far exceeds that of any other philosopher: "We are products of nature, but nature has made us together with our power of altering the world, of foreseeing and of planning for the future, and of making far-reaching decisions for which we are morally responsible. Yet, responsibility, decisions, enter the world of nature only with us" (Popper, 1947, p. 59). The scientific view of the Universe does not require a God hypothesis.

Warning Signs from Global Warming

Scientific understanding of global warming is improving but not among politicians who must enact legislation to control it. Political complacency finds shelter in the very slow rate at which climate changes take place. An average change of 0.5°C in temperature per century must be scientifically measured for detection, its cause ascertained, and its consequences determined before policies to deal with the problem can be framed. Climate changes are slow because the vast oceans have immense heat capacity, which gives the climate abundant thermal inertia to smoothen surface temperatures. Hence, energy imbalances and changes in average global surface temperature are not immediately detectable with precision (Lindsey, 2009, p. 7). It usually takes years, sometimes decades for its full impact to be felt. When measurable changes are so slow and the evidence statistical, election sensitive politicians find it expedient to question scientific evidence to push forward more pressing political deals. Thermal inertia thus causes political inertia. For example, in the U.S., "Trust in climate scientists is low among Republicans; considerably higher among liberal Democrats" (Funk and Kennedy, 2016). The U.S. President Donald Trump, *e.g.*, has described climate change as a hoax and linked childhood vaccines to autism. In 2012, the American Sociological Review reported a dramatic loss of scientific faith among US conservatives, from nearly 50 per cent who reported a "great deal" of trust in 1974 to only 35 per cent four decades later. The "politicisation" of science is a major part of the problem because people like to hear stories rather than dry facts (Le Roux, 2017). There is a dire need for scientists to make science understandable to non-scientists. If current scientific understanding of global warming is reasonable, the world is heading towards a disaster. A recent editorial in *Nature* notes:

From extreme rainfall to rising sea levels, global warming is expected to wreak havoc on human lives. Sometimes, the most straightforward impact — the warming itself — is overlooked. Yet heat kills. The body, after all, has evolved to work in a fairly narrow temperature range. Our sweat-based cooling mechanism is crude; beyond a certain combination of high temperature and humidity, it fails. To be outside and exposed to such an environment for any length of time soon becomes a death sentence. And that environment is spreading. (*Nature Editorial*, 2017).

The Popularity of Populism

One danger of supporting populist political leaders is that they win votes by disparaging experts. "Aversion to "expertise" and rejection of "establishment" authorities is a central element in the politics of populism." (Ignatieff, 2017). Populism rises in anger when people feel betrayed by government. It grows with mounting public discontent over the status quo. In the West, a huge swath of the middle-class feel left behind by exponentially rapid technological change, the globalised economy, and growing inequality between the rich and the poor. In January 2017, Oxfam reported that eight billionaires own the same wealth as the poorest half of the world's population. In 2015, the richest one percent owned more wealth than the rest of the planet. Such inequality "threatens to pull our societies apart. It increases crime and insecurity, and undermines the fight to end poverty" (Oxfam, 2017). Populism is to be feared because it can metamorphose into terrorism. Indeed, horrific and recurrent incidents of terrorism are already here.

Humane societies now wonder if they have extended the welcome mat too easily and freely to refugees and others without first understanding the resources (education, jobs, healthcare, religious support, etc.) and the assimilation time required to successfully integrate them into their society. There is now growing unease at the unforeseen visible and potential consequences of an acquired diversity in terms of ethnicity, religion, and race, and the realisation that governments and the elite ignore these public concerns. Gradually, majority sentiment swings from tolerance and altruism to nativism, xenophobia, racism, and religious phobia. Refugees, immigrant communities, and minorities become scapegoats (Roth, 2017; HRW, 2017). Individual human rights become a luxury, and collective rights of "the majority" are sought to be enforced either by bloodshed or the ballot. Human rights are enforceable only if the powerful agree to partially disarm themselves, and the hapless *gradually* gather power by fair and meritorious means and harmoniously integrate with society. Throughout history, religious intolerance appears to have been an insurmountable barrier in times of social instability, especially if job opportunities are at stake.

Thus, populists maneuver to limit the rights of refugees, migrants, or minorities, because of intersecting concerns about cultural identity, economic opportunity, and terrorism. The leaders who rise to power do so by claiming to speak for "the people," articulating the majority will, and defending the nation from perceived threats and evils. Eventually, when the majority will prevails, it creates a conflict situation where the government seeks to protect the country while the judiciary must necessarily protect the rights of the individual if those rights are adversely affected by government action. It is this possibility that poses the gravest danger to democracy; it threatens to tear apart the checks and balances that constrain both governmental and judicial powers. When checks and balances fail, so does democracy. The gathering wave of populism as reflected in recent events, for example, the September 2014 referendum on Scottish independence, Brexit (2016), U.S. Presidential election (2016), Turkish constitutional referendum (April 2017), French Presidential election (May 2017) are harbingers of difficult times ahead. The real problems facing many nations are job scarcity, deprivation, ethnic tension and loss of trust in government, including in France the cradle of Liberté, Egalité, Fraternité. When sustainable employment becomes scarce, populism rises. As populism spreads, individual rights descend and the rights of dominant groups ascend. Democracies weaken because majoritarian populists erode constitutional checks and balances, press freedom, and judicial independence. Human rights and democracy can simply drown in a sea of gossip-fed manipulation because humans naturally seek information that confirm their beliefs and ignore those that oppose them. Knowledge is power, but now so is ignorant opinion. Independent thinkers become targets. In the end, democracy cannot survive if people fail to discharge their constitutional obligation to protect and care for their members. Free speech must also be responsible speech. Indeed, are we witnessing a socio-economic phenomenon governed by the predator-prey game?

Disaster Anticipation

In our force triad, the forces are interactive. Each is capable of causing chaotic global destruction, especially, if perturbed into instability. Unfortunately, each force is suspiciously close to reaching instability. Our anticipation is based on three fundamental scientific results unearthed in the 20th century: (i) phase transition in random graphs; (ii) the weather is a chaotic system; and (3) chaotic activity is embedded in the logistic map. We know all three of them mathematically; they are not amenable to our intuitive common sense but they are within the "reasoning" reach of AI systems.

Phase Transition in Random Graphs

Consider a set of n unlinked nodes, where $n \gg 1$. Now randomly choose two nodes and link them. Repeat the process m times. (It does not matter if one or both nodes at any stage of choosing are already connected to other nodes.) This process creates a random graph with n nodes and m links.

In 1960, Erdös and Rényi (Erdős and Rényi, 1960); Krivelevich and Sudakov, 2012) discovered a remarkable topological property of random graphs, namely, for small m, the graph is likely to be fragmented into many small clusters of nodes, called components. As m increases, the components grow, at first linking to isolated nodes and later coalescing with other components. Then a phase transition occurs at $m = n/2$, where many clusters cross-link spontaneously to form a single giant component. For $m > n/2$, this giant component contains on the order of n nodes (more precisely, its size scales linearly with n as $n \to \infty$), while its closest rival contains only about log n nodes. Furthermore, the nodes in the giant component are connected to each other by short paths: the maximum number of 'degrees of separation' between any two nodes grows slowly, like log n (Strogatz, 2001). Phase transition in random graphs thus gives us the basic involuntary mechanism by which a society at various levels of evolution spontaneously reorganises itself as nodes (people, machines, resources, *etc*.) randomly link or delink.

In a globally networked world of men and machines, billions of nodes generate stuff and trillions of links transport stuff. Stuff can be any material, service, message, thought, etc. Phase transition is independent of stuff. Thus, in the rapidly networking millennials' world, we should witness major dynamic restructurings in various socio-economic contexts because many of the links will be short-lived. Immediately before transition, existing rule of law begins to crack, and in the transition, it breaks down. Hence, post-transition, new laws and their enforcement mechanisms must be framed to establish order. Since this phase transition is a statistical phenomenon, the only viable option of managing it is to manage groups and temporarily suspend individual rights. The millennials were born soon after the world entered into a phase transition triggered by exponentially advancing technology and the Internet of Things (IoT) was sprouting. Post-transition, the millennials will face the enormous task of restructuring society by redefining its system of division of labor between humans, robots, and humanoids (human-machine hybrids). It appears unavoidable that many humans will perish during the transition for lack of jobs at the end of the transition because not enough sunrise sectors are sprouting where humans are indispensable. Robots will dominate main job clusters.

Weather and Chaos

Chaos in weather systems was discovered by Edward Lorenz in computer simulations (Lorenz, 1963). His paper gave birth to chaos theory. He found that a small change in the initial conditions (for example, a butterfly flapping its wings) fed to a meteorological system can drastically change its long-term behaviour. He dubbed it the "butterfly effect," (Lorenz, 1972), a hallmark of chaotic systems. Our present concern is the potential triggering of the "butterfly effect" due to small increases in greenhouse gases in the Earth's atmosphere that may lead to catastrophic climate change. Computer simulations indicate a catastrophe is possible. Conversely, small decreases may avert disasters.

For example, while an immediate apocalyptic event is not predicted, it is sobering to know that one such greenhouse triggered potential catastrophe may be Antarctica's collapse through cracking and melting of ice. Such a collapse has the potential to inundate coastal cities across the world. Indeed, it has the potential to raise the sea level by more than 160 feet. Therefore, descriptions of such catastrophic floods in mythology may not be complete fiction but may be based on the lingering collective memory of mankind (NYT, 2017). Thus, all nations have a moral duty toward mitigating the global warming problem.

Icebergs aside, even more worrisome is the changing temperature patterns in the oceans since they store more than 90 per cent of the heat trapped on Earth by greenhouse-gas emissions. It affects the marine environment along with the rest of the planet. The oceans have warmed by 0.7 °C since the 19th century. The resulting thermal gradients have made ocean waters more stratified, making it harder for nutrients in the waters below to rise to where they are most needed by fish and plankton. This has affected the biochemistry and biodiversity of the oceans that are not yet fully understood. The rising warmth nudges organisms (for example, certain varieties of plankton) to migrate towards the poles by several hundred kilometers a decade in search of cooler waters. The fish follow the plankton. The hitch is that the ecological environment in which fish thrive and breed does not move with them (Economist, 2017a, b). In addition, overfishing and pollution (for example, discarded plastic waste in huge quantities—with over 8m tonnes of it added each year (EMF, 2016, p. 76.)—and fertiliser runoff that adulterate the diet of fish and hence of the fish eaters) too have overstressed the oceans' ecosystem for decades.

Increased concentration of carbon dioxide in the oceans make it more acidic. That harms creatures such as crabs and oysters, whose calcium carbonate shells suffer (acidification makes carbonates more likely to dissolve) as marine chemistry alters. It is feared that almost all corals may vanish by 2050. At present, the problem remains neglected.

The oceans and the atmosphere are vast but not infinite. Given that each species has a narrow ecological environment in which it thrives and requires considerable time to acclimatise, and that not enough is known about either, we run the risk of being obliterated by a sudden phase transition in climate change and/or an accelerated change leading to sudden bifurcations in the predator-prey games created either by Nature or human inspired technology advances.

The Logistic Map (The Predator-Prey Game)

The logistic map is the quadratic recurrence equation

$$x_{n+1} = rx_n(1 - x_n),$$

where the constant $r > 0$ is sometimes called the biotic potential. The logistic map is nonlinear and one-dimensional. It has some surprisingly complicated behaviour, which roused curiosity in the 1950s (May, 1976; Gleick, 1987; Weisstein, no date). Our main concern here is the long-term dynamics the map captures (and not about how it gets there), i.e., the destiny of x. The long-term dynamics, as summarised in the bifurcation diagram (Fig. 1), caused surprise when they were first computed. A striking visual feature in the figure is the cascading proliferation of two-pronged pitchforks, hence the name 'bifurcation' diagram. Surprisingly, the diagram does not depend on the seed value x_0 (and hence, may be chosen randomly between 0 and 1), because there is at most one attracting fixed or periodic orbit at each parameter value. It can be shown that there are many unstable, hence unseen, periodic orbits for larger values of r (Alligood, Sauer, & Yorke, Chapter 9). The plotted points will (within the resolution of the screen) approximate either attracting fixed points or attracting periods or other attracting sets. At $r = 4$ there are no periodic attractors at all; the whole interval from $x = 0$ to 1 is a 'strange attractor'. For $r > 4$, the logistic map has infinitely many periodic points, but no attracting sets, and almost all orbits diverge to $-\infty$.

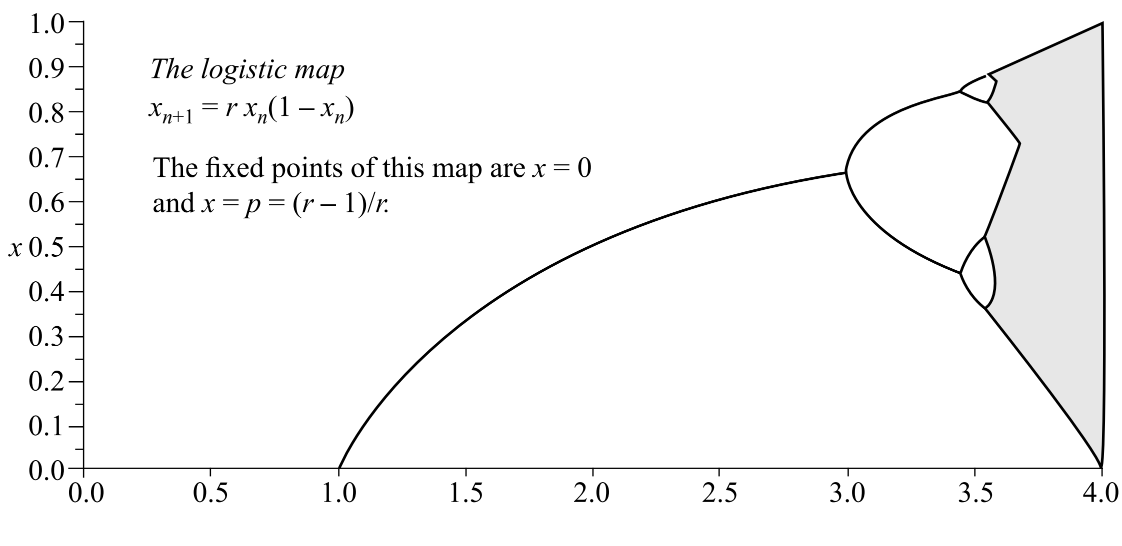

Figure 1: Bifurcation diagram of the logistic map

A bifurcation is a period-doubling change from an N-point attractor to a $2N$-point attractor. In Fig. 1, it occurs at certain discrete values of r. When $r < 1$, $x = 0$ is the one-point attractor. For r between 1 and 3, as r increases the one-point attractor ('attracted' value of x) moves up along a smooth curve. The first bifurcation occurs at $r = 3$ creating two branches and thus the system oscillates between two states. Each branch then bifurcates at $r = 3.45$ and the system oscillates between four states, then each of the new 4 branches bifurcate at $r = 3.54$ and the system oscillates between 8 states, and likewise at $r = 3.564$, 3.569 (approximately), etc., until just beyond 3.57, when the system shows chaotic behaviour, but not for all values greater than 3.57; there are islands of orderly behaviour, but the bifurcation diagram is dominated by chaotic regions, i.e., in these regions the orbit appears to randomly fill out the entire interval [0, 1], or a subinterval. At $r = 4$, the system is chaotic.

The logistic map may be viewed as representing the dynamics of an adversarial situation, say, predator and prey, where in the total population (predators + preys), x_n is the fraction of predators, and hence $(1- x_n)$ the fraction of preys at iteration n; $0 < x_0 < 1$ is the fraction of predators at the start of the dynamics (i.e., players of both sides must be present). The lone parameter r determines the rate at which the dynamics is driven. In general, the logistic map provides a glimpse of the very complex dynamics that can follow when two opposing actors (x and 1-x) collide, for example, love-hate, predator-prey, pride-prejudice, etc. If you can estimate r, the bifurcation diagram lets you anticipate the expected long-term fate of the system, e.g., of society. Thus, if x are human job seekers plus their dependents and $(1 - x)$ are machines competing against humans for jobs, the present global situation indicates that we have just crossed the first bifurcation point in the bifurcation diagram. Therefore, the millennials should expect swings in employment opportunities. Presently, we appear to be on the lower prong of the fork and as automation accelerates, humans will slide further down the prong (lose jobs). If some good fortune strikes, they may be tossed to the upper prong and life may become rosier for a while. The exponential growth of automation also means that as further bifurcation points are crossed, available jobs for humans will show wild swings (this, of course, is of no concern to machines) and so will populism (can it be otherwise?).

Disaster Management

The global population is diverse in terms of aspirations, social stratification, religion, culture, language, political and judicial system. Therefore, any strategy for managing global human disasters, perforce must sidestep individual rights, and improvise on preserving vulnerable groups on an ad hoc basis guided by anticipations, gut feelings and spontaneous interpretations of available information. The normal rule of law, hierarchies, privileges, promises, civilities, etc., must be provisionally suspended. Disaster management then reduces to preventing anarchy and controlling tidal waves of human emotion.

Carnage caused by emotionally-driven populism is to be feared the most because it pits man against man. In global warming, it is Nature against man, acting without fear, favor or malice, governed solely by the laws of Nature, trying to establish a new equilibrium, when necessary, with devastating fury. The rising momentum of technology advances too has created a force of enormous magnitude. Presently, we have no means of measuring it, nor of controlling it. Initial technology advances made human life progressively better; now they are poised to make even highly intelligent humans jobless by replacing them with AI-machines which neither need jobs nor a livelihood! Ironically, these machines are products of human ingenuity of the finest kind. The bifurcation diagram throws hints of where we are and of our future prospects.

Disaster management thus reduces to managing triggers (phase transitions and bifurcation points). Some sensitive triggers are: (i) the rate at which poverty removal programs that create low-skilled jobs are implemented, because they raise aspirations which will be dashed when machines replace them; (ii) the rate of return on investment to society from welfare schemes, especially, if it is negative; and (iii) education and skilling programs that fail to fulfill society's rate of demand for *creative* knowledge workers. When people acquire a life-style, they want respect and freedom and dominance over others. When they are hopelessly unemployable, they will willingly trade freedom and self-respect for employment. Disaster management of human resources must deal with this human fragility implicitly captured in the bifurcation diagram.

If we renounce technology, we can return to the Garden of Eden, but this is unlikely since scientists are enamored by the tremendous aesthetic and intellectual appeal of science. The technologies they enable, fulfill never-ending human needs of functionality and aesthetics. Modern physics is far subtler than any theology. Religion no longer confrontationally interferes with science and scientists, even though the basic scientific beliefs do form a specialised faith. Theologists are rigid in their beliefs, scientists are not. When theologists develop doubts, they often split into warring factions. In contrast, science demands one to incessantly probe, question, correlate, and revise acquired knowledge. In science, the search for knowledge is iterative—it is based on *conjectures and refutations* (Popper, 1968). Scientists are perennially in search of better conjectures, because they believe truth is not knowable. Scientists settle dissent through rational arguments, not by force of arms. That is because physics speaks in mathematics, the ultimate means of communicating objectively with men and machines. Technology can command Nature *only* by obeying her.

Hence, today's engineers must be steeped in science and crave to discover Nature's secrets. The quest for scientific knowledge leads to: (i) Curiosity-driven discovery of laws of Nature; and (ii) use of scientific discoveries to build new technologies to aid in making further discoveries and to fulfill human needs. Amazingly, it is the probabilistic Second Law of Thermodynamics, perhaps the most abstract of all known laws of Nature, that ensures that we command Nature only by obeying her. It says nothing about individual molecules, but how molecules in bulk must go from less probable arrangements to more probable ones. At a societal level, this paradigm matches the limits of human perception, which discerns objects and events on a much coarser scale than the fine scale at which molecules (or even humans) act. It explains why, in disaster situations, the focus must be on managing groups and not on individuals, because it is on the scale of groups that humans perceive order and disorder.

Whenever a disruptive change in technology occurs, we realise technology's immense impact on society. The Industrial Revolution (1760–1840) transformed British life from an agricultural base to a technology base, which, several decades later, led to mass production and assembly lines and modern heavy industry. Technology then spontaneously enabled radical socio-economic changes. The Industrial Revolution was initially driven by idealism, i.e., those who ushered in the revolution did identify their interests with the welfare of the poor. By mid-nineteenth century, the industrialists forged a new ruling class and became the new oppressors.[1] During the Industrial Revolution there were other great revolutions—the American Revolution (1765–1783), the French Revolution (1789–1799), and other lesser European revolutions—running in parallel. Technological innovations blended with socio-economic innovations. While we remember the period for steam engines and railways, we seldom recall contemporary social reforms that included America "inventing" itself. It declared independence from British rule in July 1776, with a potent mix of armed rebellion, technological revolution, and spiritual regeneration (Lienhard, 2000). Till then it was a mere discovered land mass.

Machines extend our physical and mental reach. The millennials experience this more than any previous generation. Digital devices are ubiquitously beside us or on our person; they are functional partners of our minds and increasingly so in decision making. They communicate with our senses and intellects and link us with the world via the Internet of Things (IoT) that include humans and intelligent machines. The line between human intelligence and AI has already blurred.

The 14th century Black Death is perhaps the greatest calamity that ever exhausted humanity. It spread throughout the Mediterranean and Europe, and killed an estimated 30–60% of Europe's population. The world's population is estimated to have reduced from 450 million to 350–375 million. It made many survivors wealthy with the material goods and lands of the dead. Manual labor became scarce, wages skyrocketed, and work took on a manic quality. People worked long hours, chasing capital gain, fearful of the fragility of life. Both medicine and theology of the time failed miserably in coping with the plague (Lienhard, 2000). This phase transition led to a new breed of people shaping the future. AI may well be The Black Death for the 21st century by destroying jobs for humans.

The 20th century saw many remarkable events arriving at a dizzying pace: theory of relativity, quantum mechanics, Gödel's theorem, Turing's halting theorem, heavier-than-air flying machines, the electronic digital computer, the structure and role of DNA in building life (the book of life), information theory, chaos theory, fractal geometry, genetic engineering, AI, the rise of multi-national corporations, globalisation, the university educated knowledge worker, etc. Technological advances in the 21st century now pit machines against human job seekers. Science has debunked the mystery of religion. Earlier, religion had drawn man's activities to itself more strongly than any other power, natural or supernatural. Twentieth century science and technology has irreversibly changed that. While in the past, humans did find eleventh-hour solutions in the face of disaster, it is not clear if it can happen again when machines outsmart highly creative humans.

The industrial economy had already turned scientists and engineers into professionals, who no longer dabbled with invention but were hired by institutions to invent systematically. That economy rather rapidly changed into a post-industrial economy in which jobs in manufacturing fell but rose in services, information, and research. The millennials now require advanced levels of abstract knowledge even at entry level jobs. The primary task of engineers is now networking known elements efficiently into a specific system rather than inventing the elements themselves. Ill-designed systems can produce disasters while outstanding designs can provide amazing benefits, but alas, they may also make humans jobless. Today's technology drivers are computing and bio. The products they spawn are amazingly knowledge intensive and increasingly smaller in physical size (Lienhard, 2000). For scientists and technologists, understanding life is no longer enough, they must create it. Will this pursuit eventually lead to mankind's downfall?

Today, a system is not merely "an assemblage with correlated members" but an assemblage of dynamically correlated members which may themselves be changing in numbers and character. Gaia, the Earth's biosphere is one such in which the millennials are a component. This fragile spherical shell of animal, plant, and bacterial life that surrounds the Earth, extends from the oceans' depths to the outer reaches of the atmosphere. In Gaia, all life is interdependent. Unfortunately, our meagre knowledge prevents us from controlling Gaia or anticipating its phase transitions. Initially, humans gained knowledge about life driven by curiosity; later it became an obsession. New knowledge is often unsettling for humans but will it be so for humanoids—AI enhanced humans—marvels of bio and computing technologies? Humans pitted against humanoids need novel disaster management methods to survive, not better ways of managing the last disaster faced.

What lies ahead are dangerous human animosities, massive disparities in urban lifestyles with people of various income levels increasingly segregated by geography, income and social polarisation. The experience, when people are forced out of familiar environments where they have spent their entire lives and built lifelong connections, can be traumatic. If too many people are forced into it, established communities will suffer from a loss of identity and even culture. Social reconstruction then becomes inevitable.

Conclusion

Humans have feelings, intelligence, and capacity to work. Within these constraints, the scope of disaster management of human resources for the millennials will be limited largely to protecting the survival of the creatively intelligent. The disaster is global, its scale is massive, and society will find itself grossly underprepared to deal with it because of its reluctance to accept it as a possibility. That possibility comes from humanity's unrelenting march towards a technological singularity as foreseen by Kurzweil (Kurzweil, 2005; Kurzweil, 2001), and it is expected to occur within three decades. Its most devastating effect is the growing anxiety among the millennials who face growing polarisation in the labour-market between high- and low-skill jobs, unemployment and underemployment. Migration of job seekers and its socio-economic consequences is now a sensitive political issue. Providing gainful employment for every job seeker is no longer possible because of automation. With technology advances, the millennials face shifts in socio-economic growth, accelerated disruption, and rising societal tensions. For them, the message is short and brief: no education, no skills, no creativity, no job, no life.

Notes

1 Thomas Jefferson was opposed to large-scale industry, believing, "Manufacturing breeds lords and Aristocrats, poor men and slaves."

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Quantifying Vulnerability: Development of a Fuzzy Pathway Based on Multi-criteria Decision-Making

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Abstract

Assessing vulnerability has always been one of the most difficult task for academicians and practitioners alike as it is not only a nation or a state or a district that can be said to be vulnerable but also a community or even a small group of people and all these dimensions must be accounted for. There is no disagreement on the fact that there has been a paradigm shift; preparedness and mitigation, now, weighs more than rescue and relief and thus, it is more logical to exercise this readiness in the smallest of units, i.e., societies and communities and then gradually move to higher units of administration. A community can only be prepared to cope with a hazard, if it is aware of its vulnerabilities and thus it is important to quantify a community's vulnerability to a particular hazard. This research work, specifically, focusses on attempting to quantify the vulnerability of a social group or a community to a specific hazard. Turning general guidelines of national authorities and institutes of disaster management for specific hazards into different criteria and thereby recording the responses of a community's knowledge, represented by fuzzy numbers, this research intends to develop a pathway to use those responses to quantify the vulnerability of that particular community. The use of fuzzy logic takes care of human ambiguity in responses and the involvement of the people of the targeted community as well as practitioners and academicians in the statistical process of determination eliminates subjectivity of the result.

Keywords: dimensions of vulnerability, quantitative assessment of vulnerability, fuzzy logic based evaluation of vulnerability, representation of vulnerability using modified sunburst diagram

Introduction

The latest framework which governs and guides the context of disaster risk reduction and disaster resilience, internationally, is the Sendai Framework. The Sendai Framework (2015–2030), which is supposed to be the beacon for the next fourteen years, clearly outlines four priorities: (i) Understanding disaster risk; (ii) Strengthening disaster risk governance to manage disaster risk; (iii) Investing in disaster reduction for resilience and; (iv) Enhancing disaster preparedness for effective response (Sendai Framework for Disaster Risk Reduction 2015–2030). The first priority emphasises on building our understanding of disaster risk and thus, it falls upon us to take cognisance of the fact that risk is the function of hazard, vulnerability and exposure. Thus, to understand, quantify, assess risk, it is obligatory to understand its constituent elements. UNISDR Terminology on Disaster Risk Reduction (2009), published by the United Nations Office for Disaster Risk Reduction (UNISDR), defines, hazard as "a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation." Hazards are usually characterised by their intensity or magnitude, as in case of earthquakes, categories, as in case of storms like typhoons and hurricanes, toxicity or infectiousness in case of pathogens or other such biological hazards. The same publication defines exposure as "the situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas". It also makes it a point to mention that the measure of exposure will and can include the demographics of people or types of assets in the area under consideration. This data when combined with the vulnerability of each element and the intensity or magnitude of hazard they are exposed to, can quantitatively estimate the risk associated with a particular hazard in a particular area. This brings us to the definition of vulnerability, rather the understanding that UNISDR has of it. "The conditions determined by physical, social, economic and environmental

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factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards" is what vulnerability is (2009 UNISDR Terminology on Disaster Risk Reduction). It is from the very definition, that one understands that the construct of vulnerability has many dimensions. It is also quite prominent, from the very definitions an annotations cited by UNISDR, that there exists an inherent intention to understand risk as a quantity, i.e. a quantitative assessment is far better perceived, humanly, than a qualitative assessment. As it has been already been seen that exposure can be quantified in numerical terms and even hazards can be quantified according to their character but since vulnerability has so many dimensions to it, its quantification becomes difficult. This is the aspect which the research explores.

The second and the fourth pillar of the Sendai framework are also of particular interest to this research. The last pillar instructs to enhance disaster preparedness for an effective and better response. This means that the preparedness level of the respondents, i.e. the people who are affected by a hazard and the institutes and organisations responsible for acting during a hazard, should be at a level which facilitates lean and agile response and to respond better one should be aware of their own vulnerabilities. Vulnerabilities are different for different groups; for individuals of a specific community not knowing what hazards they are susceptible to and how to act when they are affected by it makes them vulnerable, even not knowing how to mitigate the chances of such hazards occurring makes them vulnerable and on the other hand for organisations and institutes not being able to respond to the tune of the hazard or failing to keep up lifeline services or not being able to predict or even be aware of a hazard makes them vulnerable. Thus, vulnerability is at the core of not being prepared and hence not being able to respond. So, instinctively one feels the need to not only understand the vulnerabilities but also quantify it as possible.

The second pillar talks about managing disaster risk through increasing disaster risk governance. It logically follows that since risk is the combined consequence of hazard, which can be identified and assessed and exposure can also be quantified accurately, the onus of the statement falls upon understanding and assessing vulnerability. Thus, once again, vulnerability becomes a cornerstone in the context of disaster risk reduction. Moreover, governance of risk can effectively be strengthened by identifying the weakness of institutes responsible for governing risks.

The above notions triggered the idea of exploring the possibility of quantifying vulnerability which resulted in this body of research. Quantification of vulnerability would lead to better assessment of risk and hence better preparedness. In fact, the process of vulnerability assessment developed and proposed in this research, can prove to be an optimal solution of efficiently creating awareness through trainings, workshops and such events at the expense of national and international funds allocated for the same every year by the government and different agencies. In due course of the research, it was also realised that the process of assessing vulnerability involves collection of huge amounts of data which can be used for many useful ends, thereby opening futures scopes of research.

Literature Review: Identification of Gaps and Bridging Them

Before venturing into the possibility of quantifying vulnerability, one must empathise with its dynamic nature in order to understand its complexity. Vulnerability is a construct with multiple dimensions and quantitatively capturing each dimension at the same time for a specific hazard and a specific area is complicated task. Prima facie, vulnerability is the propensity of 'elements' or a 'set of elements', exposed to a certain hazard, to suffer damage. These elements or set of elements are the different dimensions of vulnerability. To understand the different dimensions of vulnerability and to make sure that each of them is given due attention, the research started by analysing the definitions of vulnerability put forth by different agencies and organisations. Many academicians and researchers like Cutter (1996) and Weichselgartner (2001) were few of the first to think about it. Researchers like Glade (2003), Klein et al. (2003), Adger (2005) and Fuchs et al. (2007, 2016) have also contributed in formulating the definitions and due consideration has been given to those as well. In fact, they have already gone through the difficult job of studying the different perspectives of vulnerability and reviewing them in their work. Perspective wise, there seems to exist two different perspectives, the first one is a scientific perspective and the second one is the social science perspective. Some of the referred to scientific and engineering-oriented definitions of vulnerability have been listed below.

Vulnerability id the degree of loss to a given element or a set of elements at risk resulting from the occurrence of a hazard of a given magnitude in a given area. (Varnes & IAEG Commission on Landslides and other Mass Movements (1984))

Vulnerability depends upon the degree of loss to a given element at risk at a certain severity level. generally, it is expressed as the percentage of loss for the given hazards. (UNDP, 1994)

Vulnerability is the potential to experience adverse impacts. Vulnerability is the ability of an element to withstand hazards of a given type or size. (Alexander, 1999 and 2005)

Vulnerability is a measure of the damage suffered by an element at risk when affected by a hazardous process. (Wisner and Luce, 1993; Dooge, 2004; Wisner et al., 2003 and 2004)

Vulnerability is the measure of the robustness or the fragility of an element or a measure of the exposure to or protection from the expected potentially damaging event. (Vandine et al., 2004 and 2005)

On one hand, when there is a general consensus amongst scientists that vulnerability is usually expressed as the percentage of loss or the measure of fragility, there also exists a consensus amongst social scientists.

Vulnerability is the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of natural hazards. (Blaikie et al., 1994)

Vulnerability is the ability to withstand shocks and stresses to livelihood. (Adger, 2000)

Vulnerability is a complex set of characteristics that includes a person's initial well-being, livelihood and resilience, self-protection, social protection and social and political networks and institutions. (Cannon et al., 2003)

Vulnerability is a multi-dimensional concept that helps identify those characteristics and experiences of communities (and individuals) that enable them to respond and recover from natural hazards. (Cutter et al., 2003)

It would be safe to state that these above mentioned definitions of vulnerability, primarily, can be categorised into two orientations; the first orientation, where vulnerability is the "damage caused to a *system* by a particular hazard or climate-related event" and the second orientation, where vulnerability is "the *state* of a *system* and it is the interaction of hazard with this *state* that produces an outcome". This orientation is what social vulnerability is all about. Since, we are more interested in assessing the vulnerability of the society or a community, it would be adequate to view the society as a system in a particular *state* (vulnerability) and when a hazard affects the system, it is the strength or fragility of the *state* that determines and governs the outcome.

The state of the system, i.e., the vulnerability of the society is the characteristic of the system, expressed through a number of dimensions. These dimensions are to be considered thoroughly, if vulnerability of the society is to be assessed and quantified. Taking hint from studies like the works of Kumpulanien (2006), Williams and Kaputska (2000), and the Draft Disaster Management Plan of Delhi (2014–2015) to accommodate the nuances of Indian context, these dimensions can exhaustively be, (i) physical, (ii) social, and, (iii) institutional. The social dimension can be broken down into further sub-dimensions of socio-cultural and socio-economic. The disaster management plan of Delhi has tried to include factors which influence these dimensions (Draft Disaster Management Plan of Delhi 2014–2015). However, this research consults other such literatures and has put down a robust list of factors that affects, influences and constitutes the main dimensions.

The **physical** dimension is influenced by:

(a) Geology of the area, which includes factors like terrain, fault lines, soil condition, etc.
(b) Hydro-meterology of the area, which includes factors like precipitation, groundwater table, etc.

The **socio-economic** sub-dimension of the greater social dimension, constitutes of:

(a) Types of employment
(b) Industrial density
(c) Type of residential complex
(a) Slums
(b) Housing
  – Condition of the residential complex
  – Occupancy rate
  – Quality of design
  – Quality of construction
  – Quality of material

The **socio-cultural** sub-dimension is composed of:

(a) Literacy or education
(b) Awareness
(c) Involvement and participation in disaster management
(d) Population density

And finally, the **institutional** dimension has the following factors:

(a) Well prepared and tried out disaster management plan of the smallest administrative unit possible
(b) Transportation & communication systems (tried and tested in all eventualities)
(c) Response plans of relief and rescue and availability of facilities during such times
(d) Hazard mapping and resource mapping and allocation
(e) Governance through information (keeping every stakeholder well informed)

From the above dimensions, it becomes clear that vulnerability assessment should be done according to the element under consideration, i.e, whether it is a physical structure or a social structure or economic assets. Taking this point further, assessing the physical dimension is comparatively easy and has been well done in India. For example, we can say that "5,700 km out of 7,516 km of the long coastline of India is vulnerable to cyclones and tsunamis, 58.6% of the landmass is prone to earthquakes of moderate to very high intensity and 12 per cent of the land is prone to floods and river erosion" (Un-starred question no. 1238, Lok Sabha, Ministry of Home Affairs, Government of India). This aspect has been well taken care of so what remains is the analysis of the other two dimensions, social and institutional. It is intuitive that any institution or organisation will be an extension of the society itself, thus, indirectly or directly it is the social dimension that takes primacy over the institutional dimension. To illustrate this, we may note that the education and literacy rate of a society would lead to better awareness and thereby active involvement and participation in activities of disaster management and such attitude would lead to the development of an implementable disaster management plan. Again, awareness would be a driving factor of a good response plan. Awareness will also lead to better quality of constructions and better use of materials through compliance to building codes. Thus, in more than ways, it is the social aspect of vulnerability that should be focussed upon and assessed. Taking a second look into the examples cited above would also reveal that awareness of people of the concerned area, awareness of the people in institutions responsible for disaster management, good governance of such institutions and preparedness of all of these stakeholders is the key to determining whether they are fragile or strong enough to cope with a hazard. So, this body of research tries to quantify the social and institutional dimensions of vulnerability by making awareness and preparedness as the cornerstone.

Now that it has been established that which dimensions are to be focussed upon, it becomes important to understand how it can be done. Vulnerability can be evaluated in terms of currency or even as a value on a specific metric scale designed for the same or as a qualitative term representing social values and perceptions (Glade, 2003). Tangible losses due to vulnerability can be assessed using heuristic, economic, empirical and probabilistic approach. Heuristic approach expresses vulnerability of infrastructure in qualitative terms, thus it is not of our interest. In the economic approach, losses are expressed as costs, i.e. the expense of recovering and restoring the original condition, loss of revenue and income, increase in unemployment, etc. This approach is also well used and fails to quantify the aspects of social and institutional dimensions that the research intends to focus upon. Documented case-studies form the calculative basis of the empirical approach hence it becomes unimportant since awareness and preparedness are subjective factors which cannot be expressed using an empirical formula as the variations would be too stark and too much between different societies and communities to be captured in a single equation and even if it is done, errors of estimations are bound to creep in. Thus, we should refrain from using empirical approach. However, there are good studies for consideration like of Barbolini et al. (2004), Blahut et al. (2009) and Quan Luna et al. (2010, 2011). The use of probabilistic approach has been extensively done by FEMA using fragility curves (HAZUS 2006, Kaynia et al., 2008) but it is more fitting for buildings and structures. Thus, none of the established methods suit the need of the research. Even the disaster management plans of different states and districts of India studied, expresses vulnerability qualitatively. So, the necessity is high but approaches do not seem to exist.

Since the social and institutional dimension, the dimensions under consideration, consists of people and the focus of inquiry would be awareness and preparedness, the primary respondents of any such query should be individuals and thus, fuzzy logic based multi-criteria decision making was understood to be the best solution to deal with the problem at hand and to enhance the readability of the results, it was decided that it would be expressed as modified sunburst diagrams.

Methodology

Introduction to Fuzzy Logic

Zadeh (1965, 1975) is considered to be the 'father of fuzzy logic' who proposed the fuzzy set theory to model the "subjectivity of decision making process". Decision making with vague and subjective data is best done through fuzzy approach using linguistic variables (Dursun & Karsak, 2010; Zadeh, 1975). Evaluating contexts like vulnerability based on classical mathematics and conventional statistics pose a limited opportunity as the opinion and judgements are lucid and subjective. In such cases, linguistic variables according to a fuzzy approach (Zadeh, 1975) is used. Similar approaches have been implemented to select human capital resources in private Greek bank (Polychroniou & Giannikos, 2009), select the type of air-conditioning system to be installed in a library (Xu & Chen, 2007), assess the financial performance of domestic airlines in Taiwan (Wang, 2008). Fuzzy rules have been used to predict the demand for newspapers (Chaudhuri & De, 2011), predict bankruptcy and insolvency of companies (Unahabhokha et al., 2007) and in many such other avenues.

Theoretically, there are many types of fuzzy numbers, however, this paper employs triangular fuzzy number due to their simplicity (Lin et al., 2007) and their ability to approximate most non-triangular ones (Pedrycz, 1994). A similar approach was adopted by Kanji & Agrawal (2017) to predict the completeness of a CSR strategy. A triangular fuzzy number is denoted by a three membered tuple, say, A = (a1, a2, a3), which is graphically represented in Figure 1. a1 represents the lower limit of the fuzzy number, a2 represents the maximum while a3 denotes the upper limit beyond which the fuzzy number ceases.

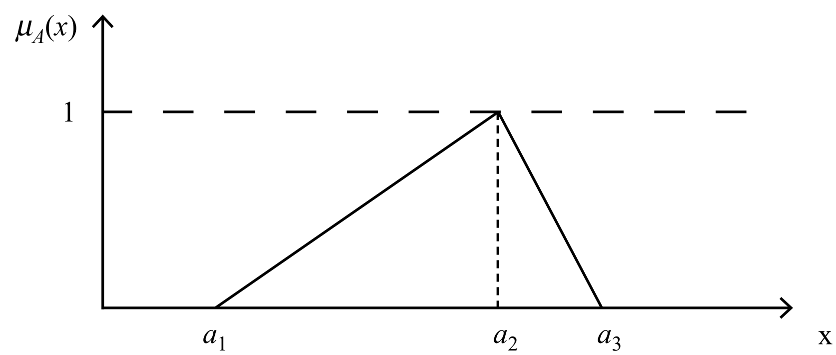

Figure 1: Representation of a triangular fuzzy number
(**Source**: Sirb, 2013)

The linguistic variables (opinions collected from stakeholders or decision makers) are mapped to fuzzy numbers using membership functions which has multiple criteria. Operations of relevance are then performed upon these fuzzy numbers which is elaborately described in the later sections. The resultant fuzzy number is de-fuzzified to represent a value which tries to capture the degree of vulnerability quantitatively and for a better visual understanding the results are plotted in a modified sunburst diagram.

Designing the Membership Function

The primary goal of using fuzzy logic is to enable the modelling of linguistic variables. Human opinion, which is the decisive factor behind the prediction, is usually subjective and vague. In fact, it is difficult to represent such ambiguous opinions through classical logic (Sirb, 2013) and hence fuzzy numbers and their membership functions provide an unique tool to model such linguistic ambiguity.

Table 1: Mapping of IMPORTANCE to its Corresponding Fuzzy Number

Linguistic Value of IMPORTANCE	Corresponding Fuzzy Number
Makes it vulnerable (v)	(0, 0, 2)
Does not affect much (i)	(2, 5, 8)
Makes it strong (s)	(8, 10, 10)

In light of the indicators identified, the research proposes to model two types of linguistic variables (Sirb, 2013; Costa and Menichini, 2013). First, the linguistic variable which defines the importance of an aspect (to be known as indicators henceforth) which influences the two dimensions, social and institutional, of vulnerability minus the factor that deals with the types of residences and second is the linguistic variable which assesses the knowledge, understanding, awareness of stakeholders about indicators. This means, there would be a fuzzy number signifying the importance of an indicator specific to an area and specific to a disaster and a second fuzzy number representing the awareness and knowledge of all stakeholders, i.e. all members of the targeted community and personnels of the institution responsible for disaster management. As triangular membership functions are not only common (Wu and Lee, 2007) but is also easy to use for decision makers (Lin et al., 2007), this research proposes the use of triangular membership functions and hence triangular fuzzy numbers. Table 1 and 2 depicts the linguistic variables of “IMPORTANCE” and “WEIGHT” and their fuzzy numbers.

Table 2: Mapping of WEIGHT to its Corresponding Fuzzy Number

Linguistic Value of WEIGHT	Corresponding Fuzzy Number
Weakness (w)	(0.0, 0.0, 0.1)
Neutral (n)	(0.1, 0.4, 0.7)
Strength (s)	(0.7, 1.0, 1.0)

It is to be noted that IMPORTANCE is practically the importance of each factor in contributing towards developing resilience, i.e, if the IMPORTANCE of an indicator is ‘makes it vulnerable’, it means that it contributes to vulnerability and if it ‘makes it strong’, then it contributes to resilience. Importance of an indicator can be a generic data set, i.e. each indicator can have a fixed IMPORTANCE assigned to it through a discussion involving the stakeholders or it can be decided on a case by case basis. The use of fuzzy logic and the method of quantification developed through this research enables the user the power of this decision; whether to make importance of indicators a fixed list or decided the importance of indicators, each and every time for each and every area under consideration. On the other hand, WEIGHT is totally and completely area specific. The knowledge and awareness about indicators will surely vary from one area to the other.

Selection of Indicators

Indicators of the two dimensions of vulnerability under consideration should be evolved out of the factors. Factors can be added or deleted according to the need of the area but the final indicators should necessarily capture the various nuances aptly. Let us understand this with an example. District East in Delhi is ‘highly’ vulnerable to fire. If we intend to quantify ‘risk’, we need to quantify the constituent elements as well, like hazard, vulnerability and exposure. Since all other parameters are quantified, there is a need to quantify the social and institutional dimensions of vulnerability. In order to quantify this, we need to identify indicators which increase the vulnerability or strengthen its coping ability. Prior to this, an initial survey is necessary to understand the basic reasons and causes of fire. Focusing on these reasons, indicators are to be identified. The following is not an exhaustive list but some of the indicators that might contribute to vulnerability in a fire hazard. Since it was identified that “the risk is primarily due to congestion, low maintenance, high frequency of visitors, storage of flammable materials, disrespect for safety measures in industrial areas”, 70% of fires are due to short-circuiting (illegal tapping and power overloading as a consequence) and 17% due to carelessness (Hazard and Risk Assessment, Draft Disaster Management Plan 2014–2015). Thus, taking account of all these issues, some of the probable indicators can be:

Table 3: Table of Probable Indicators

Institutional	Indicators	Social	Indicators
DM Plan	Does the responsible institute have a disaster management plan for fire? This should clearly include the EOCs, duties and roles of various personnels and the chain of events to be followed.	**Education and literacy**	How well are you (residents) educated?
Local DM Plan	Does the vulnerable area have a plan of their own? Have the people been made aware of how to act in case of a fire?		How many hazards do you know of, to which your area or residence is susceptible?
Transportation	Are the roads leading to the most prone sites big enough to accommodate fire brigades and other services during an emergency?	**Awareness**	Are you aware of the things to do in case of a fire? (The weight should be assigned by the person taking the interview based on the number of things said correctly)
	Is there a contingency plan to take care of congestion on the streets during an emergency?		Are you aware of the use of fire related sign boards, elevators and electrical appliances during fire?
	Is there a facility to extend water hoses if the water tanks are unable to reach the spot?		Do you store your combustible material away from potential sources of ignition?
Response plan and facilities	Have the response plans been acted out as a part of a mock drill?		Do you know how to use a fire extinguisher?
	Are the residents aware of the response plan and the chain of activities in it?		Are you aware of the evacuation routes in your locality?
	Is there a good liaising between life-line services? Do these services have efficient response time?		Are you aware of the fire helplines or medical helplines in case of an emergency?

Resource Mapping	Are there adequate resources like medical kits for use in emergencies? How far have they been stored from the prone areas? If not stored, are there adequate provisions to arrange the same during an emergency?	**Active participation and involvement in disaster management activities**	Do you participate in fire drills or any such awareness activities?
Governance and Implementation	Is due consideration given to building codes during the construction of new buildings?		How frequent are such activities?
	Are there routine checks of fire prone areas and buildings?		Are the children taught about emergencies and disasters in their course? And are they involved and made to participate in drills?
	Are there routine checks in industries to look for prohibited activities?		How are female and old-age people accommodated in the plan, if it exists? If not, how do you plan to take care of them in case of an emergency?
	How well are the rules implemented?	**Employment**	Are you insured?
	Does the population density pose a hurdle to mitigation and management?		Can you survive loss of wages for a couple of days?
	In case of high-rise buildings and structures like malls and markets, are there fire escapes, fire extinguishers and smoke detectors at place?		How many people are dependent on you? (How many bread earners to dependents in a family?)
Industrial Density	Do the industries have regular checks?	**Industrial density**	Are you aware of the hazards posed by the surrounding industries?
	Are they construction wise and planning wise safe or hazardous?		Do the industries take heed of the hazards posed by them through awareness programs or mitigation and preparedness activities?

Collecting Opinion from Stakeholders

Each of these indicators, under their parent dimensions, affect vulnerability; either they increase it or decrease it. So, each of the indicators in the form of a question is to be presented, first, to a panel of experts, who will rate each indicator as either it makes the area vulnerable or does not affect the vulnerability or has a neutral effect on the vulnerability. For example, industries having regular official check will decrease the vulnerability and on the other hand more the number of dependents in a family more vulnerable will it be. Thus, the questions might need to be rephrased slightly when presented to the panel but the agenda should be to record from different expert stakeholders (essentially members of disaster management authorities at the state and district level, NGOs involved in such activities, members of the civil society), how they perceive each indicator; whether it increases or decreases or does not affect vulnerability. If the indicators are arranged in rows and the opinion about them by each member of the expert panel is recorded in corresponding columns, it will lead to the formation of IMPORTANCE matrix.

O1(1)	O1(2)	………	O1(m)
O2(1)	O2(2)	………	O2(m)
. . .	. . .	………	
I1(1)	I1(2)	………	I1(m)
. . .	. . .	………	
D5(1)	D5(2)	………	D5(m)

Figure 2: IMPORTANCE matrix

In the above figure, let O, I and D be the different indicators like awareness, resource mapping, transportation respectively, then, O1, O2 represents the first two factors of awareness and D5 represents the fifth factor of transportation. O1(1) represents the opinion of member 1 about O1 and similarly D5(m) represents the opinion of member no. m about D5.

Building the Averaged IMPORTANCE Matrix

It is obvious that each and every member of the panel will have a different opinion about each indicator and hence there is a need to average the perception of each indicator irrespective of the difference in opinions that the decision-makers might have. Thus, another column is added to the existing matrix to exact the average importance of each indicator.

$$\mathrm{IMP}[\mathrm{O1}] = \frac{\sum_{k=1}^{m} 01(m)}{m} \tag{1}$$

$$\mathrm{IMP}[\mathrm{D5}] = \frac{\sum_{k=1}^{m} D5(m)}{m} \tag{2}$$

O1(1)	O1(2)	………	O1(m)	IMP [O1]
O2(1)	O2(2)	………	O2(m)	IMP [O2]
. . .	. . .	………		
I1(1)	I1(2)	………	I1(m)	IMP [I1]
. . .	. . .	………		
D5(1)	D5(2)	………	D5(m)	IMP [D5]

Figure 3: Averaged IMPORTANCE matrix

De-fuzzification of IMPORTANCE Matrix

The last column added to the IMPORTANCE matrix gives the average importance of each indicator. The resultant column contains fuzzy numbers which represents ambiguity aptly but for human interpretation there is a need to de-fuzzify it. Using the technique proposed by Opricovic and Tzeng (2004), the fuzzy aggregate is converted into a crisp numeral (Sirb, 2013). If IMP[F]=(a_1, a_2, a_3), where F is any sub-factor of a dimension, then,

$$D(IMP[F]) = \left(\frac{[(a_3 - a_1) + (a_2 - a_1)]}{3} + a_1\right) \cdot \frac{1}{10} \quad \text{for all the items. (3)}$$

Normalisation of IMPORTANCE Matrix

The next step is to obtain the normalised importance of all the indicators. The normalised importance of any item, Fm, is given as,

$$N(IMP[F_m]) = \frac{D(IMP[F_m])}{\sum_{n=1}^{k} D(IMP[F_n])} \quad (4)$$

where the denominator is the sum of the de-fuzzified importances of all items and Fm indicates each item from O1 to D5.

It is also to be ensured that,

$$\sum_{l=1}^{k} N(IMP[F_l]) = 1$$

Building the WEIGHT Matrix

Very similar to the process adapted to build the importance matrix, the WEIGHT matrix is built. However, there are certain changes. First of all, the responses of the WEIGHT matrix is collected from the people of the society or community in question. So, in case of the IMPORTANCE matrix there were only 4 or 5 respondents, but in case of WEIGHT matrix the respondents would around hundreds. The question might need to be rephrased to make it more suitable for an ordinary man to understand. Apart from these indicators turned questions, some other relevant details like age and sex should also be collected for future use. Figure 4 depicts the weight matrix, where m is the number of decision makers.

O1(1)	O1(2)	………	O1(m)	IMP [O1]
O2(1)	O2(2)	………	O2(m)	IMP [O2]
. . .	. . .	………		
I1(1)	I1(2)	………	I1(m)	IMP [I1]
. . .	. . .	………		
D5(1)	D5(2)	………	D5(m)	IMP [D5]

Figure 4: Weight matrix

Building the Average WEIGHT Matrix

Similarly, the average WEIGHT matrix is calculated as given by the formula,

$$\mathrm{WT}[\mathrm{O1}] = \frac{\sum_{k=1}^{m} O1(k)}{m}, \text{ where m is the total number of decision makers.} \tag{6}$$

$$\mathrm{W\ T\ [D\ 5]} = \frac{\sum_{k=1}^{m} D5(k)}{m} \text{ and so on and so forth for all the indicators.} \tag{7}$$

De-fuzzification of WEIGHT Matrix

The finally obtained average weight of each indicator is a fuzzy number, WT[F] = (a_1, a_2, a_3), where F is any sub-factor, and requires to be de-fuzzified as per the formula (Opriovic & Tzeng, 2004;
Sirb, 2013),

$$\mathrm{D(WT[F])} = \left(\frac{[(a_3 - a_1) + (a_2 - a_1)]}{3} + a_1\right), \text{ for all the indicators F.} \tag{8}$$

Calculation of Vulnerability Posed by Each Indicator and Total Vulnerability

The N(IMP[F]) for each indicator has already been calculated and the D(WT[F]) has also been calculated. The product of these two gives the strength posed by each indicator and the summation of the products gives the total, quantified strength which when subtracted from 1 yields the vulnerability. For the sake of understanding, lets consider the following figure.

Indicators	N (IMP)	WT	Strength
O1	0.06	0.25	0.01
O2	0.08	0.90	0.07
O3	0.07	0.40	0.03
O4	0.04	0.68	0.03
O5	0.07	0.85	0.06
O6	0.06	0.75	0.05
I1	0.08	0.90	0.07
I2	0.06	0.31	0.02
I3	0.06	0.34	0.02
I4	0.05	0.70	0.04
D1	0.09	0.90	0.08
D2	0.08	0.42	0.03
D3	0.08	0.90	0.07
D4	0.07	0.90	0.07
D5	0.08	0.65	0.05
Strength			**0.71**

Figure 5: Strength matrix (example)

The first factor of the indicator O has been assigned 60% importance in building resilience, however, it is only 25% fortified, therefore this aspect is only 10% fortified and hence 90% vulnerable. Similarly, we get the strength of the indicators and the summation in the last row yields the degree of resilience, per se, of the area or community in question. In other words, the are is 29% vulnerable when considering the social and institutional dimensions of vulnerability.

Representation through a Modified Sunburst Diagram

Let us consider a circle with a radius of 10 units and as many sectors as there are indicators. The arc of a particular sector is then divided into as many factors as the indicator has. The circle with radius of 10 units has concentric circles within it varying in radius from 9 units to 1 unit. In an ideal condition, i.e. when there exists no vulnerability, each of the sector should be filled from the outer most circle to the inner most circle.

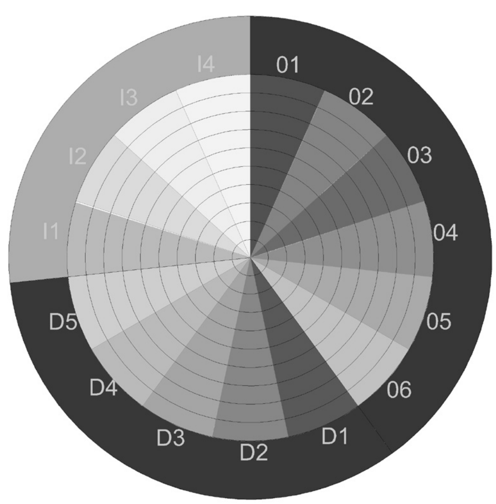

Figure 6: Ideal condition (Resilient Society)

However, it is difficult to have an ideal condition. Hence, the optimal condition is what the expert panel considers as importance of indicators, i.e. if the IMPORTANCE of an indicator, say O1, comes out to be 0.06, i.e, 60%, the sector with the arc representing O1 should be filled till the 6th concentric circle.

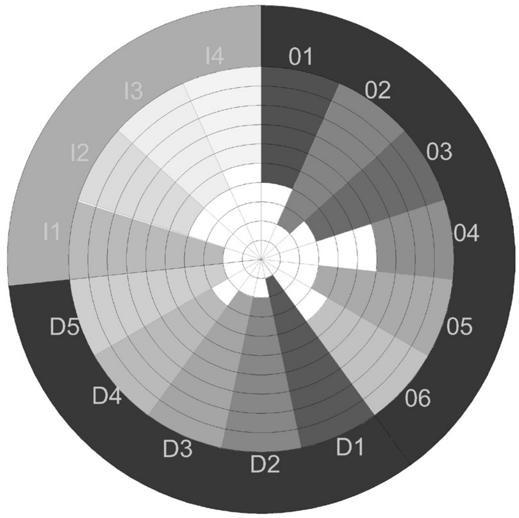

Figure 7: Optimal condition (According to expert opinion)

And finally, to contrast this with the real scenario, we need to develop the sunburst diagram with the strengths of each factor. The visual comparison of the optimal modified sunburst diagram and the actual modified sunburst diagram would yield the idea of what is lacking in preparedness.

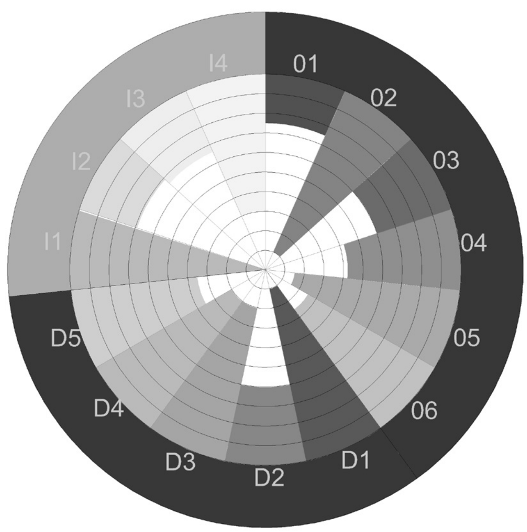

Figure 8: Vulnerability mapping

Validation of the Model: Strengths and Opportunities

The proposed model can be easily validated through extensive ground work. For example, the District East of Delhi has a 'high' vulnerability to fire. If an exercise, similar to the process mentioned in the research, is carried out and the strength equates to something below 50%, thereby indicating vulnerability to be above 50%, we would know that the model is robust.

Such exercise, in a very small scale, is being carried out by the researchers in Mandi (Himachal Pradesh) and smaller pockets of Gurgaon (Haryana).

Strengths and Opportunities

Through this model, each and every indicator that has a bearing on a particular hazard in a particular area has been considered and in due course its strength has also been calculated. So, although the primary intention was to quantify vulnerability, the result shows that resilience of the society in question against a specific hazard has also been quantified.

The result depicts the strength of each factors of each indicators, thereby, indirectly, it informs the authorities of the avenues and aspects where preparation is lacking. Each year huge amounts of money is allocated for carrying out awareness programmes and training and preparedness programmes. Using this model, authorities would know exactly in which avenues, social and institutional capacities, are lacking and consequentially, they can be improved.

There are well laid methods of computing structural and physical vulnerability. Using this model, one can quantify social and institutional vulnerability as well. Now, during the collection of responses from the people of the community, it was advised to collect data like sex and age, which gives the demographic data required to evaluate the exposure. Thus, we have at hand quantified vulnerability, quantified exposure and quantified hazard, which is usually available. Thus, the use of this model opens up a new path to quantify risk.

Conclusion

The research work started with the idea of exploring the possibility of quantifying vulnerability and in due course, presents a model to quantify those dimensions of vulnerability, which, till date, were only qualitatively defined. Not only does it serve the purpose of better assessment, it opens up opportunities for identification of avenues and sectors which contributes to vulnerability and needs due attention to increase resilience against specific hazards. The model also puts forth a novel way of estimating and quantifying risk, which can be explored in a different research. The proposed way of quantification gives a scope of improving resilience in particular avenues and thereby streamlining if funds for training and awareness can also be utilised justly.

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Problematising Disaster Risk Reduction

Vikas Sehra[a]

Abstract

This paper assesses the representation of disaster risks and how the policy formulation has historically come about from its conceptualisation. Paper asserts that from UN strategy to national and local level response, a tussle between narrative of technological and social vulnerability is seen, where prior takes the predominant attention to address the disaster risks. Increased concern with incorporating both the aspects has definitely given a holistic understanding of disaster risks with multiple factors responsible for it. However, such a perspective diffuses the accountability of responses and it's more inclined towards the initial conceptualisation of disaster being natural, though with understanding of multiple pathways to explain associated disaster risks. While the earlier conceptualisation rendered us paralysed to respond to disasters, the current holistic paradigm results in asymmetric response to disaster risks. Hence this paper primarily urges to address the problematisation of disaster risks and not just the operational and definitional aspects of it. Finally, research concludes that such reflections have the capacity to highlight and include de-emphasised areas in disaster risks while at the same time not let its complexity, incapacitate the implementation aspects at ground level.

Keywords: problematisation, disaster management, policy, de-emphasised areas

Introduction

A very grim reality comes to the forefront if we reflect on few excerpts from news this year. Nearly two-million people have so far been affected by the floods in Bihar, including thousands who had to be evacuated from their homes. The worst-hit districts of Kishanganj, Araria, Purnea an Katihar saw over 1 million people affected. At least 10 persons have also reported to have died in the floods (*The Indian Express*, 2017)[1].

About 25 people were feared dead, including six Army personnel, after a massive landslide hit Malpa village on the Kailash Mansaravor Yatra route and washed away an Army camp in the nearby Ghatiyabagad area following a cloudburst in Uttrakhand's Dharchula tehsil in Pithoragarh district (*Times of India*, 2017)[2].

Heavy monsoon rain disrupted life in Tripura as over 2,000 families were displaced after their houses were inundated by the flood water (Economic Times, 2017)[3]. The flood situation deteriorated on Sunday in Assam, where the Army was called out for rescue operations as 10 more people were killed and 22.5 lakh affected in 21 districts (*The Hindu*, 2017)[4].

These excerpts call for reviewing the policies being followed in disaster management. Internationally two major policy frameworks have provided a direction for responding to disaster. Hyogo Framework of Action (HFA) 2005–15 conceived after intergovernmental negotiations in second world conference on disaster risk. And Sendai framework 2015–30 emerged from third Conference on Disaster Risk Reduction. Nationally disaster management act 2005 provided a paradigm shift towards a more proactive approach. Though Disasters have been the central concern of policy for more than a decade now, but still there are repeated failures with new emerging challenges.

One of the significant ways to understand these failures and challenges, is to problematise disaster to bring forth the unaddressed issues to the foreground. This can be done by analysing the policy evolution and revealing the historical causal assumptions that underlie the policy evolution. As policy itself creates and shapes problems to large extent (Berg and Majo, 2017) there is need for more studies problematizing disaster research. As the different or competing understandings of disaster are not strictly chronological but rather overlap and can even recur, such that older views may persist, and sometimes there is a mix of attributions of causality, such that the distinct theoretical ideal types are blended together in reality (Dodds, 2015).

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Thinking in terms of that policy framing itself is the part of the problem enlightens us about its inherent contradictions. A study of problematisations, therefore, offers researchers the possibility of getting inside thinking—including one's own thinking—observing how "things" come to be. It gives access to the spaces within which "objects" emerge as "real" and "true", making it possible to study the strategic relations, the politics, involved in their appearance (Bacchi, 2012). Current paper endeavours to problematise major concept in disaster management. It starts with reflecting on evolution of disaster policy in international framework. And then takes up problematising major concept of resilience and vulnerability. The process of problematising helps to reflect to on perceived assumptions and develop a critique to inform current policy making process of pitfalls involved in normative strategies followed in responding to disasters.

Understanding Policy Evolution of Disaster Response

The initial understanding of disasters evolved from supernatural to natural and up till 1980s it was influenced by hazard paradigm. Which mainly shaped the idea of disaster as uncontrollable extraneous forces. Such an understanding completely excluded consideration of socioeconomic factors. This perception of accidental causal relations left accountability and assigning of responsibility in limbo. Resulting post disaster measures were short term and temporary in form of aid & relief.

Beginning in the 1970s and particularly on 1980s vulnerability paradigm informed the new understanding of disaster. This paradigm focussed on structural constraints and a differentiation between natural hazard & disaster were clearly demarcated. Such, a perspective focussed towards ongoing challenges which make people vulnerable & how it can be reduced? This understanding enlarged the scope of cause to be addressed and post disaster approach towards affected population.

Lastly, an evolving view of the holistic paradigm, informing our contemporary understanding highlights the multiclausal nature of disaster. Such perspective of expands the scope of proactive steps to be taken to address the disaster risks. While it continues the vulnerability paradigm view of addressing socioeconomic constraints with additional focus on mitigation, preparedness and recovery. But such management of risks have inclination towards technological solutions which veers it away from vulnerability paradigm's central idea of addressing structural inequalities.

Such a multiclausal complex perspective of disaster with majorly technological means to address the risks, again leaves accountability and assigning responsibility dispersed. Rather developing countries many times find rescue in lack of technological expertise in justifying their inability to handle the unforeseen or uncontrollable events and fall back on relief, aid and knee jerk reaction of calling defence forces to handle the disaster situations as basic means of addressing risks. Overlapping of disaster and climate change narratives is furtherance of this view and has made the response to disaster again influenced by the idea of uncontrollable events. Reflections of such contradiction can be seen in the Hyogo and Sendai frameworks too. For example, disaster incidents are local in nature and both frameworks also stress on national & local level mobilisation for disaster risks management. But not consider how global structural factors which are out of bounds of local controls and has influence on them affect the status of disaster risks.

The intention here is not to choose one paradigm over other or discard technological solutions or romanticise vulnerability paradigm. But underline the understanding that these must be seen in hyphenated manner. As the social and technology are hybrids and human and non-human, needs to be conceptualised as an assemblage. The huge assemblages of infrastructures that's has encompassed the earth surface in the Anthropocene epoch are scripts of dispossessions which reveal the differentiated vulnerabilities to disasters. Influence of social technical systems in producing networks of roads, cables etc and resulting politics cannot be underestimated. The highly efficient networks which have made our life more convenient also act as catalysts for magnifying the disasters. Such an approach gives more precise and accountable way to look at disaster without compromising on its multicausality and multi stake holder nature. Policy in such paradigm has potential to address both local and global aspects of disaster. It brings together concerns of provisioning and livelihood issues which make the one set of people more vulnerable than others. And technical solutions are not seen just as innovation that can improve the disaster resilience but as infrastructure machinery and networks which also makes people prone to disasters with potential to harness their sociality for mitigation and preparedness. With this approach following three entry points of conceptual intervention can be suggested for reviewing disaster risk reduction.

Problematising Resilience

Problematising resilience requires attention towards transformative attributes and long-term process to help system absorb shocks and stressors. Adaptive capacity of a resilient system helps to preserve functions to develop in future while adjusting to the disturbances in the system. Such function can range from strengthening specific resilience at local level to general resilience at global level.

Resilience strategies are embedded in social political power structures. And though it is mostly portrayed positively but it is not necessarily so. As such measures only act to distribute risks differently in existing socio-political power systems. And lacunas if not predicted only come to forefront when system is exposed to different stressors. Hence, positive adaption measures can even undermine resilience. Walker et al points out that sole technological top down sweeping solutions, maintain the power structures only to redistribute risks differential among already vulnerable population. Hence resilience is not always positive as strengthening of one, can compromise resilience of other in a system. Also, it is just not bouncing back to earlier system but its more than that, as one's gone through disaster individuals are not same and will not be able to bounce back to earlier situation. Rather a system can reach to multiple equilibria, after the disaster. Hence resilience is just not stability of the system, as a exploitative system may be resilient are ought not to preserved in the status quo.

A lack of incorporating the nuanced aspect of resilience has left urban centre more prone to disaster. For example, Jaipur city though being in semi-arid region has been increasingly prone to floods. 2012 floods revealed the lack of urban policy to incorporate resilient strategies. It can be seen from the map of the Jaipur that wards of the old city i.e. ward no. 52, 53, 54, 60, 61, 62, 65, 70, 71 have high built up density (percentage of built-up area to the total area), also the other wards as 25, 26, 24, 41, 42, 43, 44, 45 etc have shown high built up density, but as we go away from the city centre the built-up area becomes less dominant especially in peripheral wards, where it is taken over by agriculture lands, wastelands and forests. Hence wards no. 34, 33, 31, 29, 12, 11, 10, 7, etc., have low built up density and only dispersed outcrops of suburban growth are found. In wards such as 35, 48, 49, 55, 69, 68, 74, 73, 76, 77 the vast expanse of forested area dominates and has been covered with hills, such as Jhalana Dungri hills, Nahargarh hills and Jamvaramgarh hills. This increase has majorly taken place at the cost of agriculture land, wasteland and water bodies. While putting wastelands to some use is no harm but the decreasing agriculture land and water bodies is worrisome trend. As it can be seen that while wards 1, 31, 34 have seen increased built up area at the cost of wasteland but wards 12, 34, 49, 35, 11 have seen increased built up area with decreasing agriculture lands. Further interior wards, such as 39, 46 have seen reduced water bodies.

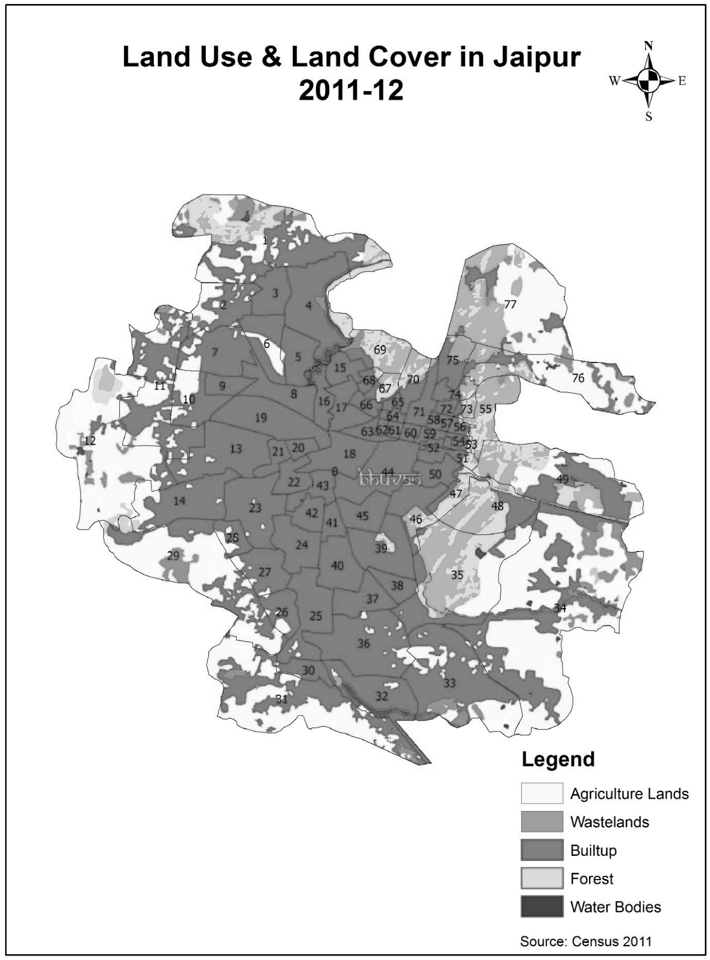
Map 1 Jaipur Land Use and Land Cover 2011–12

Such perception of resilience for continued functionality present even in HFA represents a conservative view. Various engineering usage of "bouncing back" to "resistance" is also found in vulnerability paradigm. But Resilience and vulnerability are discrete concept and former is to be informed as both outcome and process. For metropolitan areas and many cities, this also means good coordination and collaboration between the different local governments that make up the city or metropolitan area. Resilience will also have to be built at each level to slow-onset changes (for example, gradual changes in freshwater availability, gradual rises in temperature) and indirect impacts (stresses on agriculture that raise food prices and reduce availability) (Satterthwaite, 2013). Pelling et al points out that it is still to be deliberated that is resilience spontaneous or planned? Is it normative or descriptive process? And is resilience intervention specific or general at system level.

Furthermore, clarity in needed in terms of how it is to address the change. Pelling identifies resistance, incremental adjustment and transformation. Much work remains to be done to determine the thresholds of resistance, incremental adjustment, and transformation, and the contexts and values in which one approach may outweigh another. These trade-offs should not be denied or hidden beneath a veneer of technical methodology and epistemological confusion, which is a risk, given resilience's current trajectory (Matyas and Pelling, 2015). Lastly, vulnerability is not opposite of resilience and their relationship can be understood in a way that to respond effectively to disasters affected population have move form vulnerable to resilient state. Resilience still remains more of an ecological concept, vulnerability complements by providing set of tools to address societal aspects of disaster.

Problematising Vulnerability

Vulnerability as a concept emerged from environmental sciences to explain internal risk of individual or a system. Form its emergence in 1970s have effectively provided set of tools to identify societal aspects of suffering. And has over the years precipitated into various academic stream and even in disaster studies has been valuable tool for invoking societal aspects of risks. Bankoff notes that the disparate frequency of disaster and the magnitude of disaster impacts in the Global South—which has preoccupied disaster researchers for decades—goes beyond mere geography and demography. He notes that the impacts of disaster have been aggravated by inequalities hard coded into international agreements and, more importantly, "created by particular social systems in which the state apportions risk unevenly among its citizens and in which society places differing demands of the physical environment" (Bankoff 2001:25.in Faas, 2016)).



Map 1

In disaster management it has been influential by contesting naturalness of disaster which brought disadvantaged group at the centre of analysis. And questioned the historicity in manifestation of disaster events. Hence, in such analysis Vulnerability studies focus on unequal exposure, social historicity, and capacity to recover in disaster event. For example, Hyderabad city saw paralyzing floods in 2016 and many areas as Kukatpally, Alwal and Old city area have been prone to frequent flooding every year. If we map socio-economic conditions at ward level, the vulnerability of the population residing these flood prone sites is left exposed. From Map 2 it can be seen that Kukatpally along with nearby HT city area which has seen huge growth of built up area in last decade and has been sites of increasing number of slums, resulting high level of vulnerability. Alwal and old city have performed poorly socioeconomic vulnerability index. Hence, it has become important to problematise vulnerability to bring forth the challenges in responding to extreme events.

Map 2. Socio-Economic Vulnerability in Hyderabad 2011–12

Vulnerability has been approached form the different perspectives. For problematizing vulnerability first must reflect on different framework employed for its usage. Research briefly identifies four models of approaching vulnerability and their limitations for disaster studies.

A hazard-centric model puts hazards at the centre of the analysis. And the vulnerable population in and around the disaster-prone sites as flood plains, volcanos etc. but such analysis ignores the unequal capacities of various affected group and the resulting impact due to differential capacities and recovery pathways to be followed accordingly are overlooked. The resource model looks at vulnerable population from the point of the lack of resource access and entitlements which makes certain group more vulnerable to disaster event then others but still similar to hazard model, it focuses on immediate causes and miss out on spatiotemporal aspects of capacity, susceptibility and recovery. The other two political and pressure and release model address these coming by historicising the disaster events. Both differ in terms the re relative emphasis on social and environmental aspects. Political ecology leans towards the societal aspects and focus on role of power in historically producing landscapes with differential control on scarce resources making one group more vulnerable than others. Such historicising of vulnerability in political ecology, critics argue downplays role of environment. Wisner et al.'s pressure and release model addresses this by analysing political and socio-economic dynamic pressures interact with hazard to create disaters.

But in both political ecology and pressure and release model, the vulnerability is pointed out to be internal, i.e. lack of political mobilisation and entitlements. And they just differ in terms of degree of emphasis on social. vulnerability has been criticised for being presenting the disadvantage as passive agent and who needs perpetual helping hand, such a view dehistoricises the critical concept and robes them agency, unable to consider various perceptions of victims. Similar reflections were seen HFA as Wisner points out that the definition nowhere refers to socio-political power relations. Vulnerability, as much as it is understood as a state of being, implies a relationship in flux between people with disabilities and surrounding constraints and interpretations. Vulnerability is thus a relative state: the normative social structures against which it is compared sketch out its parameters of defencelessness and passivity, or, conversely, integrity and agency (Burghardt, 2013).

Map 2

Conclusion

The research analysis has brought out the complex conceptual interplay highlighting the dysfunctional aspects of policy making. It shows that while we have come long way from disaster's perception as god's act and have move incorporated socio-economic aspects, which make some more vulnerable to disasters than others. But the holistic concept leans towards technocratic consensus and tends to evade the fixing of accountability. The emergence of Resilience concept has been fraught with conceptual disarray. And recent literatures have tried to remove the cobwebs by detaching it form vulnerability as both concept being discrete among themselves. The understanding resilience of must be grounded as process and the perception of reaching for an equilibrium after disaster has to be replaced with more nuanced approach of understanding that there could be multiple equilibrium. Also, the exploitative resilient system must be discarded and more sustainable pathways must be explored. As the case of Jaipur highlighted that urban policy have not been able incorporate these concerns and resulting urban growth has been in many municipal wards at the cost agriculture lands and ecological sensitive sites. Further, there is need to address the unanswered question of approaching resilience through resistance, incremental change and transformation. And its application as specific and global narrative needs more reflections. The vulnerability paradigm has clearly been successful in bringing social pillar in disaster management policy. Various models of approaching the concept differ in their emphasis over society and environment. but the biggest critique has been in seeing vulnerability as inherent and the perception of perpetual help to be given to the subject. Leading to passive view and robing the agency of vulnerable population. As the case of Hyderabad highlighted that frequently flooded sites have been coinciding with poor socio-economic vulnerability. And there is need of incorporating the perspectives of agency in policy making to make it a more collaborative process. By problematising disaster policy evolution along with concepts of resilience and vulnerability, research have contributed in untangling some of the conceptual issues and internal contradictions.

Most significantly it has presented these concepts as not all-catch phrase, but has attempted to ground them in policy implementation. Such reflections have the capacity to highlight and include de-emphasised areas in disaster risks while at the same time not let its complexity, incapacitate the implementation aspects at ground level.

Endnotes

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TRACKING DISASTERS

Macroeconomic Impact of Droughts on Indian States: A Panel Data Analysis

Ashish Sharma[a]

Abstract

Some studies in the past have tried to establish the relationship between natural disasters and macro economy. The outcomes were not unidirectional in these studies, either displaying positive or negative and even neutral impact on the economy. Further the effects vary substantially across disaster, economy and economic sector. Therefore, concluding the direction of impact on the economy is difficult and still lacks a clear consensus among academicians and researchers. An econometric analysis for a developing country like India, with droughts history, may generate relevant evidence to draw appropriate inferences. With this backdrop, the present empirical study examines the macro-economic impact of droughts on the growth rate of Indian states using secondary data, employing panel data analysis from 1992-2015. The result shows that droughts have significant adverse effect on States' Gross Domestic Product (SGDP).The results are consistent with the states having moderate (less than 40 per cent) and less irrigation (less than 20 per cent) facilities, whereas the growth impact is insignificant for the group of states having higher (over 40 per cent) net irrigation. Further analysis reveals that States' Agricultural Gross Domestic Product is not significantly affected by droughts. Interestingly, the outcomes are found to be similar for states having higher, moderate and least net irrigation abilities.

Keywords: natural disasters, droughts, state gross domestic product

Introduction

Climate change and its impact on regional and global economies have grabbed the increased attention of world fraternity in the recent past. IPCC (2014) forecast that Climate change induced extreme events like droughts is likely to increase in frequency and intensity adds more to this concern for economists and policymakers. Droughts have creeping effects[1] on the economy. It generates a challenge on the accuracy of assessment and quantification. Therefore, how does drought affect the economic growth is still a puzzle. An econometric analysis of droughts impact on growth output for a developing country like India, with droughts history (refer Table 7 in the appendix), may generate relevant evidence. Such study may draw appropriate inferences and thus contribute to the existing literature for developing economies. Since drought management is primarily a state subject in India, therefore the outcome of such analysis may be of particular importance for policymakers and state governments to draw appropriate mitigation strategies. Previous studies tried to establish the effect of such natural disasters on the economic growth. These studies are either multi-country analysis or single country and sector-specific studies. The outcomes are not unidirectional in these studies, either displaying positive or negative and even neutral impact on the economic growth. Further the effects vary substantially across disasters, economies and economic sector. Therefore, concluding the direction of impact on the economic growth is difficult and still lacks a clear consensus among academicians and researchers.

With this backdrop, the present empirical study examines the economic impact of droughts on the growth rate of Indian states using secondary data, employing panel data analysis from 1992–2015. The results reveal that droughts adversely affect the State Gross Domestic Product (SGDP), except for the group of states having higher net irrigation. Interestingly the drought's impact remains insignificant on State Agricultural Gross Domestic Product (SAGDP). With best of our knowledge, this is the first ever attempt to generate evidence for state-level economy of India for droughts impact.

Over 50 per cent crops for irrigation depends exclusively on south-west monsoon in India. With a varying degree of rainfall, around 68 per cent of the country is liable to drought in varying degrees (35 per cent of which are considered drought-prone while 33 per cent is chronically drought-prone (Ministry of Water Resources, River

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Development and Ganga rejuvenation, 2017). Historically sizeable states of India faces acute to chronic droughts every year due to climate change, failed monsoon and policy failure etc. In 2015–16, the government declared total 266 districts of 11 states as drought affected[2] (See map in Appendix). The estimate shows that this drought will affect the national economy at least ₹6,50,000 crore (ASSOCHAM INDIA, 2016). It will lead to diversion of financial resources towards drought relief, causing an adverse impact on other key sectors. Therefore the present study is relevant and timely to understand and establish the droughts economic effect on Indian states'.

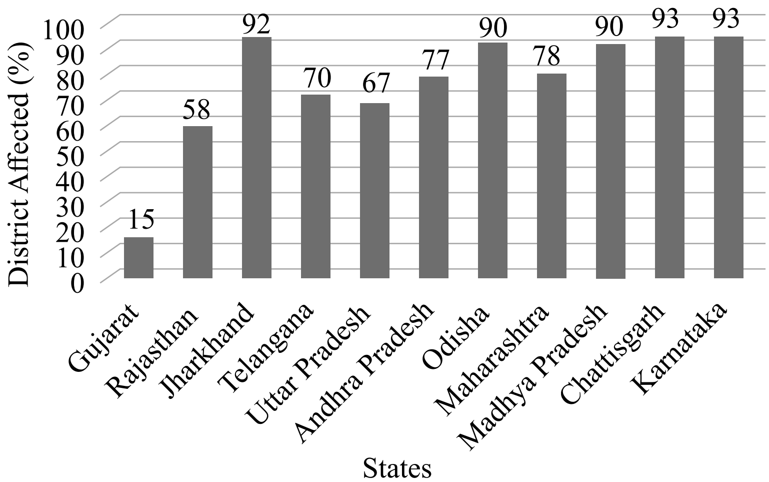

Figure 1: Percentage of drought affected districts- 2015–16 (Ministry of Rural Development)

Drought affects individuals and economy in many ways. According to Amartya Sen (Poverty and Famines, 1981), drought changes the distribution pattern of wealth in society. The crop loss induced inflation causes the sharp rise in food grains prices but lowers the livestock prices, as drought intensifies. The farmers, therefore, become poorer in buying food grains and forced selling of livestock's or land to meet livelihoods challenge. Whereas, the rich people gain by acquiring these assets at lower prices. Further, migration of labour to earn the livelihood is common in drought, which may further cause productivity loss due to decreased labour supply at farmland in subsequent years.

The deficiency of water also directly affects many water-dependent industries like construction, tourism, recreation and horticulture etc. Drought induced direct impacts triggered the indirect effects on other sectors and businesses too. Although drought is a local phenomenon and affects a precise geographic location, its effects do not remain restricted to a local economy. Drought at one place may even exert an adverse effect there but simultaneously may give a positive impact to some distant area. For example, food shortage due to drought at one place may boost the economy of some other region by allowing some other place to supply the increased food products to the affected area. This overall negates the localised effect at the state or national level.

Another challenge with drought is that it is a slow onset event, unlike other natural disasters like floods and earthquake etc. which have the definite term, intensity and measurable impact within a boundary. Drought lacks such measurable characteristics. Mostly it comes unnoticed with a slow pace, may last longer without affecting any structure. Due to lack of sufficient data, quantifying such drought impact is always defying and tough. Therefore, as stated earlier, only empirical findings may give insights about the drought impact on a particular economy.

To assess the drought influence on Indian states', the remaining paper is organised as follows. In the next section, we discuss the previous studies measuring the economic impact of drought. Subsequently, there is a section on data followed by empirical methodology. After that, we document the results and discussion before Merits, limitations and future research scope. Finally, the paper ended with the concluding remarks section.

Literature Review

There are a handful of empirical studies using panel data, which analysed the direct effect of drought on economic growth. Interestingly all these are multi-country studies only, and along with overall disaster impact, they evaluated drought impact also. For example, Fomby et al. (2013) showed the adverse effect of droughts, on overall GDP growth in developing economies. Loayza et al. (2012) found that droughts have the weak negative impact on the GDP growth but a robust negative impact on agricultural growth for developed economies. It is to note that when analysed separately, the impact on developing economies was strongly negative of drought, but there was no effect on industrial and service sector. Raddatz (2009 and 2007) found that climatic disasters like drought negatively impact GDP growth in long term. Skidmore and Toya (2002) established that climatic disasters positively impact the economic growth. Above major studies have provided the mixed evidence for drought effect on economies. Even these directions also vary for developing and developed countries.

Further, there are some studies which measured the effect of overall natural disasters on economies (Refer Appendix Table 6). For example, the impact is found to be negatively affecting the economies (Caselli and Melhotra, 2004; Noy, 2009; Vu and Hammers, 2011; Felbermayr and Groschl, 2014). Whereas by some studies it shows positive (Leiter et al., 2009; Noy and Vu, 2010) or neutral (Albala-Bertrand, 1993) impact. According to Cavallo et al. (2013), only very massive disasters have the adverse effect on GDP level. In all, the outcome of above studies also supported the earlier evidence that the effect is not unidirectional. Negative, positive or neutral impacts of natural disasters on the macro-economic growth and agricultural sector exists.

Apart from above studies, which measured the direct effect of droughts and natural disasters for many years together, there are few empirical studies which evaluated the direct as well as indirect impacts of drought. For example, Russell et al. (1970) estimated the effect of the 1962-1966 drought induced water shortages in Massachusetts. Riebsame et al. (1991) studied the national economic impacts of the 1988 drought in the USA on agriculture and other key sectors of the economy like tourism and Industry. Diersen et al. (2002) and Food and Agricultural Policy Research Institute, analysed the 2002 drought's losses in South Dakota and Missouri in the USA respectively. Kulshreshtha et al. (2003) also estimated the economic costs of 2001 and 2002 droughts on the regional and national economy of Canada. They all employed the Input-Output (I-O) model.

Dercon (2004) analysed the impact of reduced rainfall in Ethiopia and revealed that 10 per cent lower rainfall, 4-5 years earlier, reduced the current economic growth by 1 per cent. The study employed panel data for 1989-1997. In another study, Horridge et al. (2005) observed 1.6 per cent reduction in Australian GDP (1 per cent reduction is due to losses in the agriculture sector and remaining 0.6 per cent is due to secondary effects on the economy) using Computable General Equilibrium (CGE) model for 2002-03 drought.

Following the Noy (2009), Xu and Mo (2013) assessed the impact of the post-disaster relief on economic growth in China. Panel data of 31 Provinces, Municipalities and Autonomous regions (PMAs) from 2004 to 2010 were used. Results showed that disaster relief hurts economic growth. The relief amount was employed for consumption rather than for reconstruction and generating employment. This led to the negative impact on economic growth. With many limitations of the study like very short panel used, simplest model specification etc., the generalisation of such results may not be appropriate.

In all, from the above studies, it is very evident that how drought impacts any economy has no definite direction. Therefore the answer lies more in generating the empirical evidence for a particular economy. With this standpoint, the present econometric analysis is conducted to establish the empirical relationship between droughts impact on the Indian States Gross Domestic Product (SGDP) and States Agriculture Gross Domestic Product (SAGDP) employing panel data from 1992–2015, for 27 Indian states.

Data

We make a pooled cross panel covering 27 states of India over the period 1992–2015 for performing the analysis (We left two states, i.e. Telangana and West Bengal due to data unavailability issues). This is an unbalanced panel because a few states have lesser observations than other. The study employs two dependent variables for output growth, i.e. State Gross Domestic Product (SGDP) growth rate and State Agricultural Gross Domestic Product (SAGDP) growth rate. The Independent variable is State finances for drought relief as a proxy for drought loss. Control variables namely literacy rate as a proxy for education, number of doctors as a proxy for healthcare infrastructure, We include the number of bank branches as a proxy for banking reach and per capita income as a proxy for the level of development. We take in the lagged values of above variables. Further, lagged values of output growth are included as an independent variable as a standard practice like many earlier papers (Noy and Vu, 2009; Noy, 2009; Loayza et al., 2012; Strobl, 2012).

For additional analysis, total natural calamity relief amount (State and central government finances) as a proxy for total loss from the natural disasters is included as Independent variable in place of drought loss. We know that drought relief and the total relief amount variables included is exogenous as it's a discrete non-economic value. Table 5 in Appendices gives the brief definition and sources of all the variables used in the analysis. Further, below, we provide a detailed description of variables and their transformation.

We aptly modified the variables for performing the panel data analysis. We collected the data for calculating output growth rate for SGDP, SAGDP and Per Capita Income (PCI) from Reserve Bank of India (RBI) website. We got the above data for five different base years, i.e. 1980–81, 1993–94, 1999–00, 2004–05 and 2011–12 at current prices. Firstly we converted the different base year series through splicing as a single series of the base year 2011–12. Then we calculated the log (difference) output growth for SGDP and SAGDP using Interpolation and extrapolation, dropping the values for three newly formed states (Chhattisgarh, Jharkhand and Uttarakhand) for period 1992–2000.

To establish the impact of drought on State economy requires the direct drought losses data for all the states from 1992–2015. From best of our knowledge no such data are available; therefore we use the drought relief amount by states finance as a proxy for drought losses. The drought losses data are primarily of drought-hit areas and for agriculture losses only, ignoring other economic impacts on different areas or sectors. These estimate of losses form the basis for drought relief amount by respective states'.

We hypothesise that the higher the amount released more the drought losses should be. We obtained and compiled this data from annual reports of state finance accounts of Comptroller and Auditor General of India (CAG). Similarly, we also collected the disbursed amount (₹ Crore) by Central and States for total natural disasters losses (as a proxy for total disaster loss) for additional analysis purpose from the same source.

Data for the control variable, i.e. State wise Literacy Rates in percentage (LR) is compiled from Office of the Registrar General of India and National Sample Survey Organization reports and averaged out for a few missing periods. Bank infrastructure data (Bank branches) we obtained from the RBI website, and Health setup (number of the registered medical practitioner with state medical council) is compiled from Central Bureau of Health Intelligence and Statistical Abstract of Mizoram, Nagaland and Tripura. In the next section, we discuss in brief about the model specification and methodology employed.

Empirical Methodology

First, we estimate the following equation to analyse the impact of droughts on the growth rate of States' output.

$$Y_{i,t} - Y_{i,t-1} = \ {}_1Y_{i,t-1} + \ {}_2X_{i,t-1} + \ {}_3Z_{i,t-1} + \ {}_{i,t}$$

Where $Y_{i,t}$ and $Y_{i,t-1}$ is the annual output (SGDP and SAGDP) for states at time t and t-1 respectively. $X_{i,t-1}$ Corresponds to disaster loss at t-1 period. There is always a delay in declaring a drought and releasing the relief amount in practice. Therefore we consider the disaster losses lagged values. We use $Z_{i,t-1}$ for three control variables (lagged values) as described in data section above, i.e. Literacy Rates (LR), Number of registered Doctors (DR) with state medical council and Bank Branches (BB). We include the lagged values in the model following the earlier studies like Noy and Vu (2009); Noy, 2009 and Loayza et al. (2012).

With the inclusion of lagged output as an Independent variable, the above model becomes dynamic panel model. Therefore theoretically, employing the fixed effect model will be giving consistent but inefficient estimator. This happens due to systematic bias arising in the lagged dependent variable estimator (Nickell, 1981), which may lead to biases in the coefficients of other variables. To counter this issue, we know that with a long time series (as it is in our case, 24 years) the problem of Nickell bias does not arise in dynamic panel model (Nickell, 1981). Therefore, the fixed effect estimator gives the equivalent results as the GMM (Generalized Method of Moments) method.

Further, we also assume (like Raddatz, 2007; Skidmore and Toya, 2002) that ours Hausman-Taylor methodology employed here take care of the possible endogeneity issues arising from disaster variables. This assumption has the base that our disaster loss regressor is exogenous (non-economic values) as mentioned in the earlier section. After correcting, cleaning and justifying our data, we perform the panel data estimation for 27 states for the period 1992–2015. We estimate the effect of drought losses on SGDP and SAGDP one by one. We confirm the time and year fixed effects before applying the fixed effect model. We also duly address the possible issues of expected heteroscedasticity, cross-sectional dependence and autocorrelation before estimating the final fixed effect panel data results.

Later, completing this primary analysis, we extend the estimation, to compare how the drought impact results vary (if), for the group of states having higher (over 40 per cent), moderate (less than 40 per cent) and least irrigation capabilities (less than 20 per cent)[3]. We extract the data for net irrigation from the Ministry of Agriculture (2000–01) and Directorate of Economics and Statistics, Ministry of Agriculture and Farmers Welfare (2010–11).[4] We expect the greater impact of droughts on the total and agricultural growth output for the least irrigated states than others. This expectation is rational because least irrigated states are expected to be hit harder than others due to the shortfall of natural rain.

Subsequently, we perform the similar analysis by including total natural calamity losses as a regressor in place of drought losses. We know very well that the data for total natural calamity relief is different (includes all natural disaster losses amount including drought) and do not represent drought losses. Our study estimates the results and reports it in Appendices section (Refer Table 3 and Table 4).

Results and Discussion

The result of econometric analysis (Table 1) shows that droughts have significant adverse effect on States' Gross Domestic Product (SGDP).The results are consistent with the states having moderate (less than 40 per cent) and less irrigation (less than 20 per cent) facilities, whereas the growth impact is insignificant for the group of states having higher (over 40 per cent) net irrigation. Further analysis reveals that States' Agricultural Gross Domestic Product is not significantly affected by droughts. Interestingly, the outcomes are found to be similar for states having higher, moderate and least net irrigation abilities. Number of doctors in case of overall states are statistically significant in the analysis. Further, Literacy rates and Per capita income (for irrigated states) and Literacy rates and Bank branches' number (for moderately and Least Irrigated states) are found to be significant at different significance level. Lagged GDP have significant positive impact on SGDP for highly irrigated states' and negative for all other groups of states'.

Table 1: Effect of Droughts on State Output Growth (Dependent Variable: State Gross Domestic Product Growth)

Variable	**Overall States**	**Highly Irrigated States**	**Moderately Irrigated States**	**Least Irrigated States**
lnSGDP	-.0014433*** (.0003714)	.00291** (.0012186)	-.0019112*** (.0004602)	-.0027877*** (.0006426)
Drought	-1.65e-08* (8.47e-09)	4.16e-09 (1.66e-08)	-2.55e-08*** (8.82e-09)	-3.59e-08*** (1.07e-08)
LR	-.0000404 (.0000274)	-.0003489** (.0001273)	-.0000514* (.00003)	-.00015** (.0000597)
DR	3.91e-08 *** (1.30e-08)	3.50e-08 (7.52e-08)	1.86e-08 (1.87e-08)	-1.24e-08 (2.51e-08)
BB	-2.27e-08 (1.58e-07)	-4.58e-07 (3.67e-07)	6.29e-07* (3.64e-07)	1.68e-06*** (5.75e-07)
PCI	-8.76e-10 (1.21e-08)	-3.94e-08* (1.79e-08)	4.72e-10 (1.24e-08)	1.21e-08 (2.63e-08)
Observations	618	206	412	158
No. of states	27	9	18	7
R^2	0.1464		0.1827	0.2370
Wald Chi^2 (p-value)	33.53 (0.000)		37.09 (0.000)	33.58 (0.000)

R2: within	0.1029
F-statistics (p-value)	(0.002)

Note: Numbers in brackets are the corresponding standard errors. Panel fixed effects were included.

* Significant at 10 per cent

**Significant at 5 per cent

***Significant at 1 per cent

Further analysis reveals (Table 2) that States' Agricultural Gross Domestic Product is not significantly affected by droughts. The outcomes are found to be similar for states having higher, moderate and least net irrigation abilities. Literacy rates for overall states are significant according to study result. A Number of doctors (For Irrigated states), Literacy rates and Bank branches number (for moderately Irrigated states) and Literacy rates, Bank branches number and Per capita income (for Least Irrigated states) are found to be significant in the study results (at varying significance level and direction). Unlike the previous finding, lagged GDP has shown the significant negative impact on SAGDP for all group of states.

Table 2: Effect of Droughts on State Agricultural Output Growth (Dependent Variable: State Agricultural Gross Domestic Product Growth)

Variable	Overall States	Highly Irrigated States	Moderately Irrigated States	Least Irrigated States
ln Agri SGDP	-.0024095*** (.0005066)	-.0016673* (.0009122)	-.002897*** (.0006654)	-.0045958*** (.0007567)
Drought	-1.40e-08 (2.02e-08)	-2.16e-09 (3.64e-08)	-1.95e-08 (2.22e-08)	-3.87e-08 (2.66e-08)
LR	-.000117 *** (.0000382)	-.0001168 (.0000948)	-.0001276*** (.0000456)	-.0003647*** (.0000726)
DR	3.59e-08 (3.00e-08)	5.91e-08* (3.27e-08)	-8.71e-09 (4.50e-08)	-3.72e-08 (6.09e-08)
BB	3.21e-07 (2.89e-07)	-7.66e-08 (2.95e-07)	1.22e-06* (6.76e-07)	2.56e-06*** (9.78e-07)
PCI	1.93e-08 (1.45e-08)	2.64e-08 (2.95e-08)	1.71e-08 (1.54e-08)	4.38e-08* (2.59e-08)
Observations	618	206	412	158
No. of states	27	9	18	7
R^2	0.0827	0.0264	0.0992	0.2073
Wald Chi^2 (p-value)	36.34 (0.000)	9.29 (0.158)	31.98 (0.000)	56.73 (0.000)

Note: Numbers in brackets are the corresponding standard errors. Panel fixed effects were included.

* Significant at 10 per cent

**Significant at 5 per cent

***Significant at 1 per cent

The impact of droughts on GDP is significantly negative on overall SGDP's and for rain fed states, despite the substantial reduction in the contribution of agriculture to GDP over the last six decades. This suggests that the indirect impacts of droughts are significant. Gadgil and Gadgil (2007) also found such results, which shows that droughts impact on the purchasing power of the majority of the population remains significant in the era as well.

Virmani (2004) has revealed that there is no change in the effect of rainfall on the GDP from agriculture during 1950 to 2003. However, the contribution of the agricultural sector to overall GDP has decreased from over 50 per cent soon after independence to about 15.11 per cent in 2016–17 at 2011–12 prices. Therefore we expect a substantial reduction of the impact of the monsoon on the economy over the five decades. Since drought is a localised phenomenon, therefore its effect on some district or villages may be offset by the higher production in other parts of the states. Moreover, the impact of drought in one season may even be compensated by higher production in another season. Further, with changes in cropping patterns, technology, usage of fertilisers may also negate the drought impact at the state level. This is exactly happening in Ethiopia after 2015–16 severe drought[5].

Along with state government, the central government under different (plan and non-plan grants) heads also contribute for natural calamity relief. This includes aids for all natural disasters including drought. Therefore an additional analysis for measuring the total natural calamity (relief) effect on state gross domestic product and state agricultural gross domestic product has been performed. Since the natural disasters (relief) consists of drought, floods, earthquake etc., hence the results of this analysis may not be applicable for drawing any firm conclusion for measuring drought impact. Therefore as expected the outcomes of this examination are varying for different states category. The results (Appendix, Table 3) suggests a significant impact on state gross domestic product of high irrigated states (positive) and least irrigated states (negative). The similar impact analysis on state agricultural gross domestic product growth (Appendix, Table 4) reveals a significant positive effect on all states and high irrigated states only. These results required to be interpreted through further detailed analysis, which is currently beyond the scope of this paper but definitely may be taken as a future research assignment.

Merits, Limitations and Future Research Scope

Our study has some definite merits along with few limitations. This state-level panel data analysis, negates the shortcoming of cross-country analysis, as any unobserved identical variation across states of India may be ignored. This is why the analysis remains unaffected, and the reality is expected to be captured more efficiently. But using drought relief amount as a proxy for drought losses has its limitations also. Drought relief amount financed by states is just a part of combined drought relief amount (by State and Central government). Since the exact contribution of Central government for drought mitigation and relief is not available, therefore we have to consider the state finance contribution only for our study. Moreover, the declaration of drought by states and hence the disbursement timing of drought losses amount varies across states for any particular drought year[6]. Therefore, this poses the model specification challenge for analysis. We included the lagged values of drought relief amount because the majority of states declare the drought (and release the drought fund) very late. Moreover, the actual drought losses and the state disbursement is same or not, may be a matter of debate, discussion and further investigation. Apart from drought losses, drought intensity also affects the GDP. Severe the drought, more impact it has on GDP. Our study does not have drought intensity parameter, (like percentage of deficit rainfall as a proxy for drought intensity, lives lost or affected population, etc.). Future researchers may address these data issues for generating deeper insights for drought effect on Indian states.

Furthermore, droughts have not only immediate direct impact on the economic growth but also have long-term lagged effects, which may last for many years. Measuring such long-term effects are though challenging (due to unavailability of required data, sophisticated research tools and techniques) but may be a novel future research avenue.

Concluding Remarks

This paper estimated the impact of droughts on SGDP and SAGDP for Indian states using state-wise panel data for 24 years. Our results show that droughts have an adverse impact on SGDP (except for highly Irrigated states) but insignificant effect on SAGDP for all the other groups of states. These findings are partially in line with earlier key studies. Since there is no such single country, state-level analysis is available; therefore more such empirical evidence in future may throw lights and may or may not support these findings. Further, in future, better data on drought losses may be helpful to generate precise estimates of its economic impact on states. This may overcome the challenges this present study faces regarding data availability for state wise drought losses. Moreover, the present study leaves the scope for measuring other economic impacts (secondary and tertiary economic impacts) for future research. Measuring these effects are important for understanding the complete effect of droughts on any economy but currently beyond the scope of this paper.

Notes

1 Creeping effects: drought effects often accumulate slowly over a considerable period and may last for years after the termination of the drought event.

2 According to the information given by the government on 29 April 2016 in Rajya Sabha Session – 239 Unstarred Question No.1719

3 Authors own creation for comparison.

4 We check for all the states net irrigation at two different points of time, before assigning them in one of the group. We find the near consistency in both the data sets.

5 The drought affected areas contribute only 5 per cent of GDP in Ethiopia. Therefore it affects economy very less. Moreover, the aid from United Nations and other agencies are higher, so Ethiopian government doesn't divert their resources towards drought relief. (For more detail refer Reuter November 12, 2015; Drought won't hurt GDP growth forecasts, Ethiopian says.)

6 Of the eleven states which declared drought over the past year, Karnataka was the first to notify the drought status and Gujarat was the last. Most states declared a drought between October and December, waiting for yield data from crop cutting experiments to take a decision, thus delaying relief operations (Sen & Bera, 2016).

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Appendix

Table 3: Effect of Total Natural Calamity Relief on State Output Growth (Dependent Variable: State Gross Domestic Product Growth)

Variable	Overall States	Highly Irrigated States	Moderately Irrigated States	Least Irrigated States
lnSGDP	-.0014122*** (.0003664)	.0028795** (.0011827)	-.0018291*** (.0004565)	-.0026946*** (.000624)
TNCR	1.67e-14 (1.55e-14)	1.67e-14*** (1.37e-15)	-3.59e-09 (3.94e-09)	-1.64e-08*** (6.17e-09)
LR	-.000039 (.0000274)	-.0003509** (.0001284)	-.00005* (.0000304)	-.0001472** (.0000587)
DR	3.14e-08*** (1.23e-08)	3.83e-08 (7.11e-08)	1.38e-08 (2.00e-08)	-7.25e-09 (2.70e-08)

BB	-2.05e-08 (1.67e-07)	-4.50e-07 (3.48e-07)	5.42e-07 (3.82e-07)	1.56e-06*** (5.79e-07)
PCI	-2.69e-09 (1.20e-08)	-3.86e-08* (1.75e-08)	-1.77e-09 (1.24e-08)	1.17e-08 (2.62e-08)
Observations	618	06	412	158
No.of states	27	9	18	7
R^2	0.1443		0.1769	0.2337
Wald Chi^2 (p-value)	32.29 (0.000)		30.80 (0.000)	27.92 (0.000)
R2: within		0.1066		
F statistics (p-value)				

Note: Numbers in brackets are the corresponding standard errors. Panel fixed effects were included.

* Significant at 10 per cent

**Significant at 5 per cent

***Significant at 10 per cent

Table 4: Effect of Total Natural Calamity Relief on State Agricultural Output Growth (Dependent Variable: State Agricultural Gross Domestic Product Growth)

Variable	Overall States	High Irrigated States	Moderately Irrigated States	Least Irrigated States
lnAgriSGDP	-.0024094*** (.0004918)	-.0016827** (.0009291)	-.002857*** (.0006585)	-.0044834*** (.0007463)
TNCR	1.14e-13** (4.85e-14)	1.12e-13** (4.76e-14)	2.54e-09 (1.02e-08)	-1.29e-08 (1.44e-08)
LR	-.0001168*** (.0000382)	-.0001352 (.0000864)	-.0001251*** (.0000455)	-.0003616*** (.000073)
DR	2.93e-08 (2.63e-08)	5.89e-08** (2.90e-08)	-1.81e-08 (4.64e-08)	-3.67e-08 (6.44e-08)
BB	3.34e-07 (2.91e-07)	-8.44e-08 (3.01e-07)	1.17e-06* (6.91e-07)	2.43e-06** (9.99e-07)
PCI	1.85e-08 (1.48e-08)	3.04e-08 (2.72e-08)	1.50e-08 (1.55e-08)	4.18e-08 (2.61e-08)
Observations	618	206	412	158
No.of states	27	9	18	7
R^2	0.0902	0.0629	0.0982	0.2039
Wald Chi^2 (p-value)	37.61(0.000)	10.48 (0.0627)	34.83 (0.000)	55.95 (0.000)

Note: Numbers in brackets are the corresponding standard errors. Panel fixed effects were included.

* Significant at 10 per cent

**Significant at 5 per cent

***Significant at 10 per cent

Table 5: Variable, Definitions and their Sources

Variable	Definition	Sources
lnSGDP	Log value of lag States' Gross Domestic Product converted on 2011-12 base year	RBI
lnAgriSGDP	Log value of lag States' Agricultural Gross Domestic Product converted on 2011-12 base year	RBI
Drought	Lag of Drought Relief amount by State finances	CAG (State Accounts)
TNCR	Total Natural Calamity relief amount	CAG (State Accounts)
LR	Lag of Literacy Rates in percentage	Office of the Registrar General of India and National Sample Survey Organization
DR	Lag of Number of registered medical doctors with state medical councils	Central Bureau of Health Intelligence and Statistical Abstract of Mizoram, Nagaland and Tripura
BB	Lag of number of bank branches	RBI
PCI	Lag of Per Capita Income converted on 2011-12 base year	EPWRF

Note: RBI is Reserve Bank of India; CAG is Comptroller and Auditor General of India; EPWRF is Economic Political Weekly Research Foundation.

Table 6: Studies Measuring Natural Disasters Impact on Economic Growth

Study (authors, year)	Dependent Variable	No. of Countries in Study	Significant Findings
Albala-Bertrand (1993)	GDP growth	Multi-countries (26)	Neutral or positive on GDP growth.
Skidmore and Toya (2002)	GDP growth	Multi-countries (89)	Positive effect of climatic disasters.
Caselli and Malhotra (2004)	GDP growth	Multi-countries (172)	Negative impacts on growth rate.
Raddatz (2007)	GDP level	Multi-countries (40, Low-income#)	Negative for climatic disasters, no effect of geological disasters,
Toya and Skidmore (2007)	Killed, damage over GDP	Multi-countries (151, Low income, world and OECD)	Better institutions, better schooling, and higher openness mitigate negative effect.
Leiter et al. (2009)	Value added, employment	Multi-countries (4, Europe)	Positive impact.
Noy (2009)	GDP growth	Multi-countries (109, developing#)	Adverse effect with monetary damage, no effect with alternative measures.

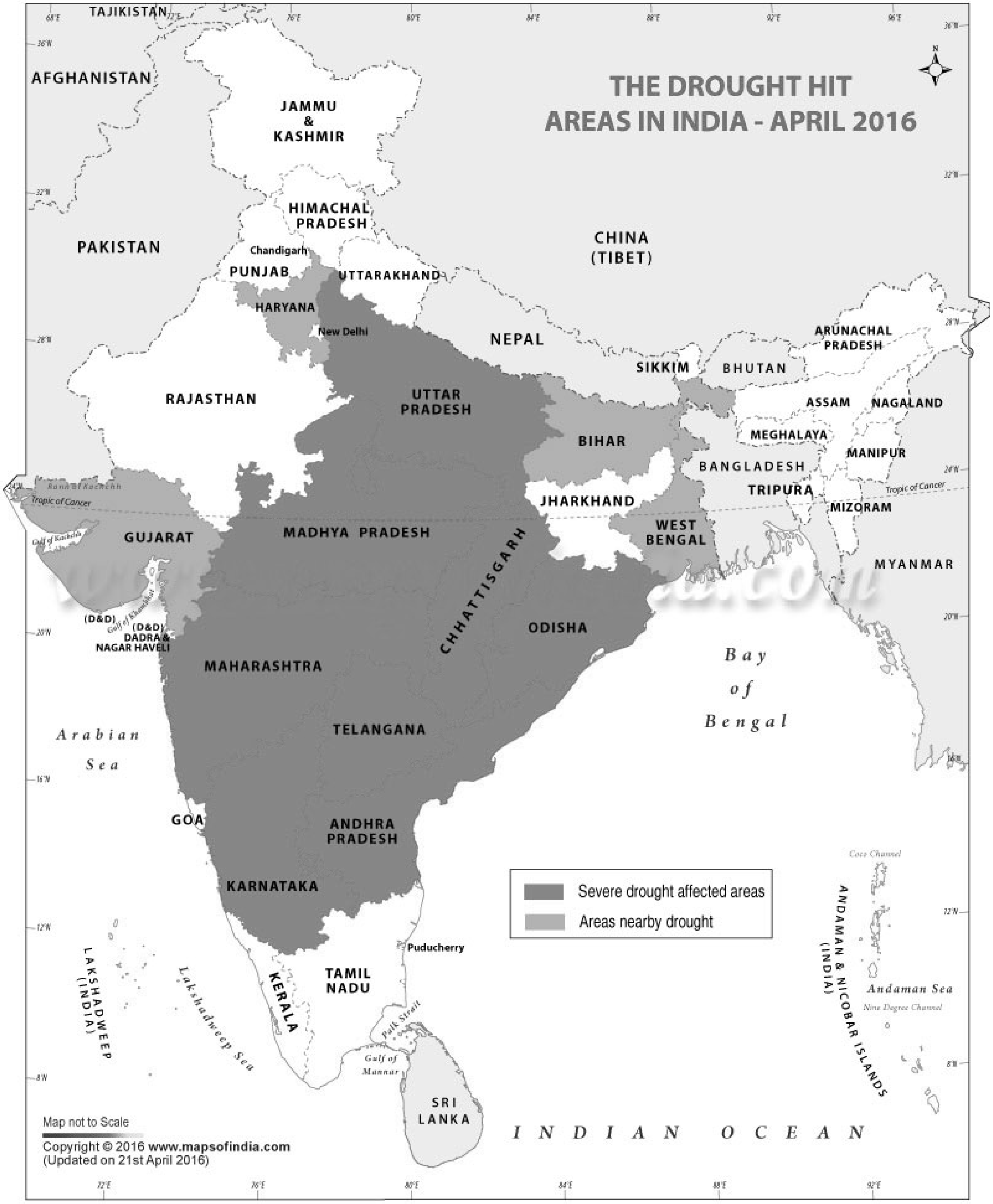
Raddatz (2009)	GDP growth	World, developing# (121)	Negative effect of climate disasters.
Vu and Hammers (2011)	GDP growth	Single country (China)	Adverse impact on output growth.
Loayaza et al. (2012)	GDP growth	Multi-countries (Total 94, developing#, 68 and developed# 26)	Positive impact of floods, negative effect of droughts (in developing countries), no effect of earthquakes and storms.
Fomby et al. (2013)	GDP growth	Multi-countries (84, developing#)	Moderate disasters can have positive effect; positive effect of floods, negative effect of storms and droughts, mixed evidence on earthquakes.
Cavallo et al. (2013)	GDP growth	Multi-countries (196)	No effect of disasters; only very large have a negative effect.
Felbermayr and Groschl (2014)	GDP growth	Multi-countries (108)	Negative impact on growth.

Classification as per World Bank definition

Table 7: Drought History in India

Period	Drought Years	No. of Years
1801–25	1801,04,06,12,19,25	6
1826–50	1832,33,37	3
1851–75	1853,60,62,66,68,73	6
1876–1900	1877,91,99	3
1901–25	1901,04,05,07,11,13,15,18,20,25	10
1926–1950	1939,41	2
1951–75	1951,65,66,68,72,74	6
1976–00	1979,82,85,87,2002,2009	4
2011–2016	2002, 09,14,15	4

Source: Drought Research Unit (DRU), India Meteorological Department (IMD), Pune and State of Indian Agriculture 2015–16 (Ministry of Agriculture and Farmers Welfare)



The Map of Drought Hit States in India, 2016

Drought Crisis in Rajasthan and their Management

Verma Seema[a]

Abstract

Rajasthan is the largest state in India covering an area of 34.22 million hectare i.e. 10.5 % of the country's geographical area but sharing only 1.15 % of its water resources. Rainfall indices and Standardized Precipitation Index (SPI) were obtained for the State and characterised it as the most sensitive and vulnerable state in India. From the analysis of rainfall indices, it is observed that few stations situated in the East and South-eastern side in the state have shown high negative change for annual and monthly rainfall but not such negative change is observed in the case of average number of wet days for the same stations. Similarly from SPI drought analysis both short term and long term, higher tendency of mild droughts is observed than moderate droughts and severe droughts with a noticeable increase in occurrence of severe droughts on longer time scales over the past few centuries India has been adversely affected by drought. Agriculture in India is completely dependent on the climate. Poor monsoon, results in water shortage which results in below average crop yields. During 1871–2012, India has experienced 24 major drought years. In arid regions, such as most of the western Rajasthan has maximum drought severity and recurrence. Most of - western Rajasthan has maximum drought severity and recurrence. The main reasons for – drought in arid regions are lack of efficient assessment and warning systems leading to delay in reaching affected people or region. To measure meteorological, hydrological and agricultural drought severity various indicators are considered. Also some physical indicators to analyse drought should be included such as rainfall, effective soil moisture and surface water availability. This paper highlights and discusses an urgent need to develop an approach to perform efficient drought assessment by looking at various aspects of its management through planning at national, regional level and understanding the climate change impacts and droughts to provide better assessment and management aspects for the society.

Keywords: drought, crisis, indicators, sssessment, drought management

Introduction

Drought is one of the most frequently occurring national disasters in India. With its increased frequency and expanded coverage in the recent years, about one third of the country is either drought prone or under desert areas. These areas are lagging behind in agriculture and also in overall economic growth. Droughts and famines have received the attention of rulers in India right from the 13th and 14th century. Muhammad Tughlakh was perhaps the first Sultan to take systematic steps to alleviate efforts of droughts by distributing grains to drought affected people in Delhi in 1343 AD.

The first Scarcity Manual was prepared by the British Government in 1883, which was followed by other manuals by some provincial governments, The Royal Commission on Agriculture in 1928 recommended promotion of dry land farming to promote agriculture in famine affected regions. However, the efforts were scanty and there was an alarming increase in the frequency of during the British period. Though the term drought is associated with scarcity of water, it means different things to different people. To the agriculturist, it means the deficit of rainfall and soil moisture to support healthy crop growth: to the meteorologist, it indicates the deficiency of rainfall compared to normal' rainfall of the region and to the hydrologist it is the scarcity of water in surface and groundwater resources. According to the National Commission of Agriculture (1976), if the drought occurs in more than 40 per cent of the years in an area, it is classified as chronically drought prone area. As per this classification, Indian arid zone is a chronically drought prone area.

This fact is substantiated by a popular saying in the region that in the course of a decade. One year would be of bumper harvest. Five years of moderate produce. Three years of scanty harvest and one year of disastrous drought. Analysis of rainfall data (1901–1999) indicated that Out of 99 years. The Indian arid zone experienced agricultural

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Drought in one part or the other during 33 to 46 years. which suggests a drought once in three years to alternate year, Often drought persists continuously for 3 to 6 years, as prolonged droughts faced by this region during 1903–05, 1957–60, 1966–71, 1984–87 and 1997–1999. Such prolonged droughts put tremendous stress on natural resources and lead to severe scarcity of food, fodder and water.

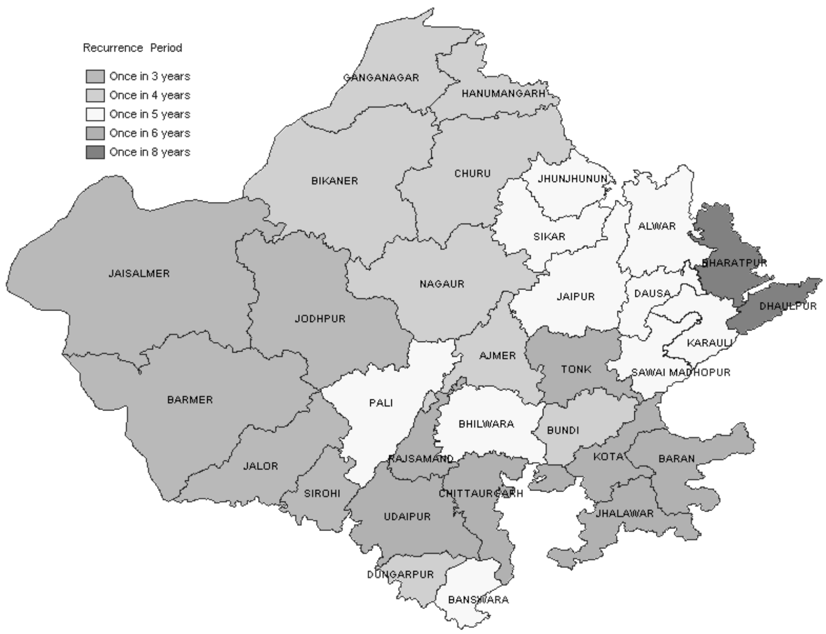

Figure 1: Recurrence period of drought

Drought affects all parts of our environment as well as our communities. Different types of droughts have varying economic, environmental and social impacts. Approximately 16 per cent of India's geographic area, mostly arid, semi-arid and sub-humid is drought-prone (GoI, 2013a). Due to high temporal and spatial variability in rainfall and wide variations in physiographic and climatic conditions in the country, droughts are experienced in varying intensities (moderate or severe) almost every year irrespective of a good monsoon. Since 2001, the country has experienced three major droughts, in the years 2002, 2004 and 2009, severely affecting the various sectors and overall economic development of the country. The latest drought in South Asia (2000–2003) affected more than 100 million people, with severe impacts felt in Gujarat and Rajasthan States in western India, in Pakistan's Sind and Baluchistan provinces, as well as in parts of Iran and Afghanistan. Political instability, war and economic isolation have further exacerbated the effects of drought.

Rajasthan is the largest state in India covering an area of 34.22 million hectare, i.e. 10.5 per cent of the country's geographical area but sharing only 1.15 per cent of its water resources. The estimated per capita water availability in the state during 2001 was 840 m^3 and is expected to be 439 m^3 by the year 2050 against the national average of 1140 m^3 by 2050. More than 70 per cent of its people depend upon agricultural activities. Rajasthan experiences acute weather and consists of four distinctive seasons– Pre-monsoon, Monsoon, Post-monsoon and winter. The average temperature in winter ranges from 2° to 26° C and in peak summer the average temperature range from 28° C to 48° C making the region arid and draught-prone. Most of the area of the state (60-75 per cent) is arid or semi arid. The conventional attitude to a drought as a phenomenon of arid and semi-arid areas is changing because even areas with high average rainfall often face acute water scarcity. In the case of Rajasthan, there have been 52 drought years of varied intensity since 1901. At the village level, the number of drought-free years will be even less. Therefore, every year some parts of Rajasthan are affected by drought. Despite this, the State considers drought as a transient phenomenon where short term relief measures are considered to be a solution. It is estimated that one year's relief fund may be sufficient to develop rain water harvesting structures to meet drinking water requirements in rural areas of western Rajasthan.

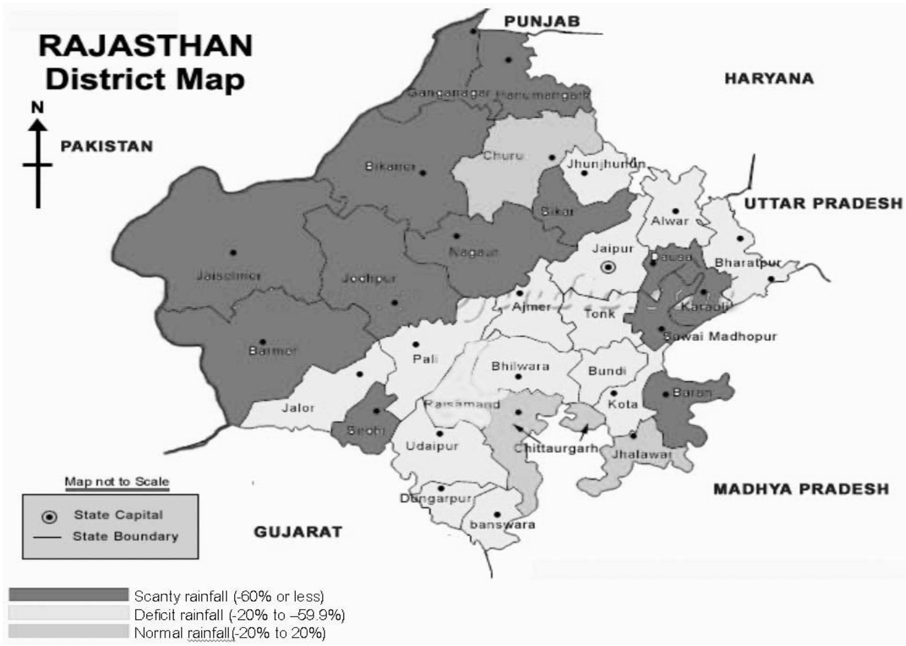

Figure 2: Average rainfall in different districts

Study Area – Western Rajasthan

Western Rajasthan is one of the most chronically drought-prone areas in India (Figure 1). The long-term average of annual rainfall in western Rajasthan is 330 mm, and 85 per cent of the rain (i.e., 280 mm) is received during the main rainy season of southwest monsoon (June to September). Long-term analysis of droughts shows that on an average every 2.5 years is a drought year in the region. Therefore, drought is no stranger in the region. Historical record of droughts in the region is fragmentary, but a compilation suggests the following major droughts in Rajasthan between the middle of 14th century and the middle of 18th century: 1362–63, 1648–49, 1659–60, 1747–48. Marwar region faced several major droughts and attendant famine during 14th to 19th century. There is historical record of a major drought between 1309 and 1313 when Rao Rajpal opened grain depots for his subjects, and also of droughts in 1570 when Emperor Akbar ordered the digging of Kukar Talav at Nagaur. A very severe drought occurred in 1660–61, followed by major ones in 1698, 1747, 1756, 1783 (remembered as Chalisa), 1796 (remembered as Trepanya), 1812–13 (remembered as Panchkal, and as severe as that of 1660–61, with very high human and livestock mortality), 1868–70 (remembered as Trical), 1877–78, 1891–92, 1896–97 and 1898–1900 (remembered as Chhappanya Kal, a Trikal). The last one was so severe that the human death was estimated to be 1 million. The first famine relief work by British government was started in the region during the famine of 1868–70, but an organised Famine Code, named the "Draft Famine Code for Native States" was issued in 1885. In 1897 this code was emulated to issue the Rajputana Famine Code. Since then the Famine Codes have been revised several time for assessing damages and to provide relief to the affected people. These have been consulted even during the post-independent era for assessing drought-related damages and relief. Drought in Western Rajasthan 13 Between 1901 and 2000 western Rajasthan experienced 11 severe droughts. The drought of 1918 was disastrous in nature. During the twentieth century there were 5 occasions when successive years of drought struck the region: 1903–05, 1957–60, 1966–71, 1984–87, 1998–2000. Such long droughts have greater impact on the society because food, fodder and water resources get severely depleted. The major factors that accentuate the impact of drought in the region were summarised in an earlier report of Central Arid Zone Research Institute (CAZRI) as: poor water holding capacity of soils, absence of perennial rivers and forests, poor groundwater quality, high withdrawal from limited groundwater reserve, a paradigm shift in land use and neglect of the traditional coping mechanism that were basic to survival in an arid ecosystem.

Objectives Sought

- While early warning indicators for drought have a considerable degree of ambiguity associated, as they may or may not culminate in a full-blown drought, the government has in place the requisite and institutional and policy framework to address the challenge.
- While the central government plays the role of a facilitator, the primary responsibility of managing drought (or any other natural calamity) is that of the respective State government. With the enactment of the Disaster Management Act in 2005, the National Disaster Management Authority (NDMA) was set up as the apex body for Disaster Management in India, with the Prime Minister as its Chairman. Further, Disaster Management Authorities at the State and District Levels are headed by the Chief Ministers and Collectors/Zila Parishad Chairmen respectively.

Policies and Programmes

In 2009, India launched its National Policy on Disaster Management with a vision to build a safe and disaster resilient India. The policy aims to develop a holistic, proactive, multi-disaster oriented and technology driven strategy through a culture of prevention, mitigation, preparedness and response (GoI, 2009). Some of the major government programmes help mitigate the adverse impacts of drought and build resilience of people by encouraging efficient water management practices, ensuring livelihoods, ensuring economic access to food and supplying fodder among other measures. A major programme of the GoI, significant from the drought relief and management perspective, is the Mahatma Gandhi National Rural Employment Guarantee Scheme.

District-wise contingency plans are prepared by the Central Research Institute for Dryland Agriculture (CRIDA), in collaboration with State Agricultural Universities (SAUs) / Indian Council of Agricultural Research (ICAR) Institutes / Krishi Vigyan Kendras (KVKs) (GoI 2012).Research institutions like the International Crops Research Institute for Semi-arid Tropics, Central Arid Zone Research Institute, Indian Grassland and Fodder Research Institute, Central Soil Salinity Research Institute, Indian Council of Forestry Research and Education and those under the Indian Council of Agriculture Research provide information on various aspects of drought management (Gupta et al. 2011).

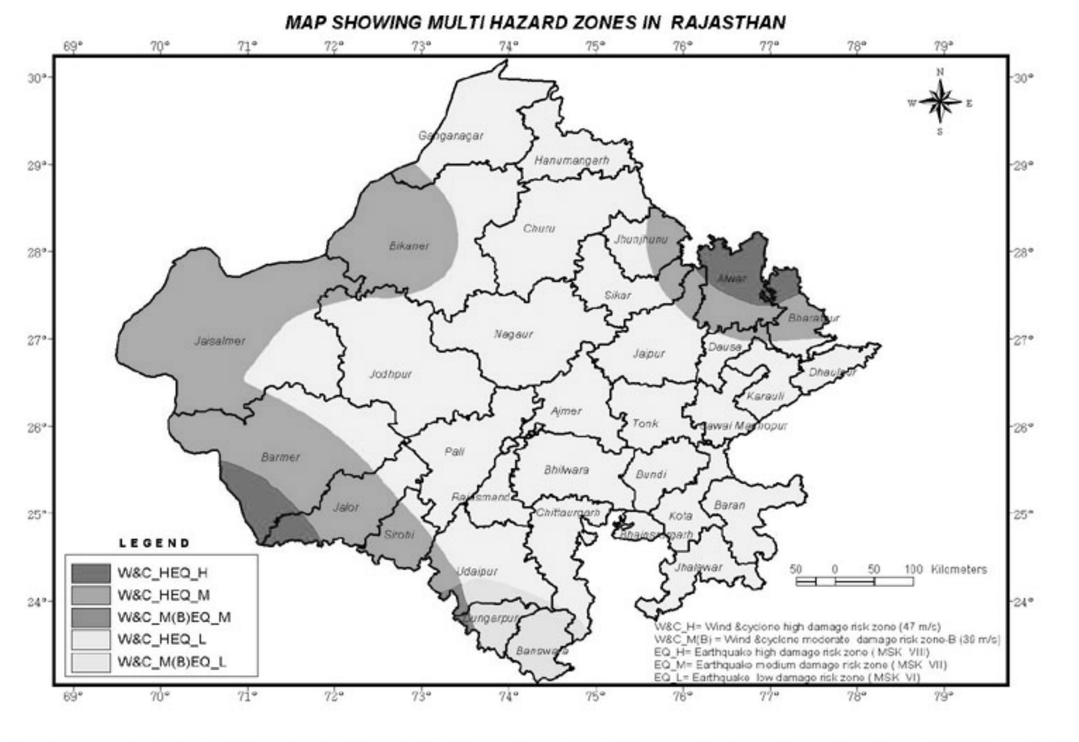

Figure 3: Drought prone zones in Rajasthan

Drought Planning at the National Level

- Further strengthening of the observational network for drought monitoring to bridge the gap between the existing and desired meteorological and hydrological monitoring network
- Improvement in information and communication technologies in an integrated manner for tacking the multifaceted challenge of drought at various spatial scales
- Capacity enhancement for medium and long range drought forecasting
- Better coordination among ministries and departments
- Developing mechanism for context specific and need based forecasting including local language for better understanding

Drought Planning at the Regional Level

- Enhancement of real time monitoring capabilities at a regional level through training and joint monitoring programmes
- Improvement in methodologies and analytical tools for drought analysis and vulnerability assessment at local and regional level
- Organisation of joint training programmes to build human capacity in improved resilience towards drought
- Effective and collaborative implementation of drought relief programmes
- Strengthening effective water and commodities supply system

Possible Measures for Future Drought Management

Drought affects all components of the water cycle; deficit in soil moisture, reduced groundwater levels and dried up ponds and reservoirs. The specific issue of droughts can be planned on the long term basis by drought management committee by keeping in mind the following remedial measures:

- With the water crisis worsening in the desert state of Rajasthan, the state government should focus on community-based water management solutions instead of predominantly engineering-based ones. The first step taken by the government is to revamp most of the ponds and Johars under the Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA).
- All the traditional water harvesting structures and sources should be renovated and people should be encouraged for roof-top rain water harvesting, storm-water harvesting, recycling and reuse of waste water under Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA).
- Authors observed that people getting support from government during drought have become immune to this help and loves a good drought.
- Only less water consuming crops shall be permitted to avoid the use of excessive water in irrigation.
- Publication of public-awareness material on water management for dissemination in schools and public buildings. Movies and documentaries shall be shown to villagers on water management techniques.
- Investment in soil and water management, such as the improved development and management of fragile catchment areas and river basins, including small-scale irrigation;
- Reviewing the appropriateness of current crop production patterns and possibilities in support of more intensified crop diversification policies
- Redirecting research towards more appropriate farming systems
- Improved rangeland and livestock management
- Reviewing institutional arrangements and physical infrastructure

Conclusion and Recommendations

India is endowed with a rich repository of knowledge relating to cloud formation, lightning, wind direction, rains and drought which has evolved over centuries to perceive and manage natural disasters and extreme weather events by disaster prediction, response, mitigation, and effects of weather on crops. Droughts adversely impacts livelihood and economies of a large section of population in the rain-fed, arid and semi-arid regions.

Shortage of drinking water supplies and food insecurity are the other consequences that emerge. Fodder deficit drives away the animals to distress sales. Thus, while climate is the initial causative factor for drought, its implications are governed by the human interactions with the situation. For demarcating drought prone districts, a combination of variables including climatic, area under irrigation and source of irrigation are used.

In the context of increasing climate variability and climate change, there is growing recognition of a need for effective and efficient drought warning systems that rely on accurate and timely assessments of soil crop, micro-climate (because of slow onset nature of drought) and its linkage with livelihoods support programme to trigger mitigation and emergency response programs at grassroots level. Several policy measures undertaken by the Government of India (GoI) help in building capacity for drought prevention, preparedness, mitigation and management. This has also led to a shift in perception of droughts from a 'crisis of an urgent nature' to a management issue (GoI, 2012). In development context agricultural drought, compare to meteorological drought, concerns are centered largely on issues of food security, availability of non-skilled and semi-skilled wages in rural areas, migration, etc.

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Drought and Farmer Suicides in Marathwada: A Natural or Man-Made Disaster, Accountability of Its Management

Nitin Dhaktode[a]

Abstract

On an average, after every seven to ten years of cycle Maharashtra faces severe drought in majority districts. Some of the other regions in the state suffered droughts in the years 1972–73, 1982–83, 1996, 2002–2003 and 2013, 2014, 2015 and 2016. Marathwada is one of the most affected regions due to drought in state due to various geographical and climate change reasons. Drought leads to drastic cut in agricultural production, farmers suicides, migration, water scarcity, starvation, malnutrition, poverty, poor health and education, cattel foodgrain scrasity, etc. Marathwada is known one of the backward regions of the state in terms of employment opportunity, industrialisation, social and economic development. Regain being a part of the erstwhile Hyderabad princely state till 1948 has been caught in an exploitative regime. The exploitation of region does not stop despite becoming a part of integrated India. Under the multiple leaderships as chief ministers from western Maharashtra, Marathwada and now Vidarbha faces discrimination in fund allocation and implementation. Even though there were very strong political leadership from the region including a chief minister twice from Latur district, union cabinet minister etc, district faced severe water scarcity in 2015–2016 when the government had to supply water by train from other regions. Other districts like Osmanabad, Jalna, Beed, Nanded are also hit by drought and faced water scarcity. Marathwada also is rank almost top regions in terms of farmer suicides, large number of farmers have committed suicides due to drought.

To overcome this problem various schemes and programmes related to water conservation, financial support to farmers, micro finance for livelihood, employment guarantee schemes, etc., has been implemented by the central and state governments. However, those have been caught up in various issues related to social and financial corruption. To cope with the drought, there is need to have proper planning, policy design as per the need of region, its quality implementation and evaluation with people's participation. Adequate transparency and accountability should be shown by the government to solve this problem sustainably.

This paper is an attempt to bring the issues of how the drought as natural disaster lead to the man-made disaster in terms of farmers suicides. It seek the answers of question like historically, what are the steps were adopted by the government to control these issues? What can be the possible best coping mechanism to solve this problem sustainably? The paper is based on the primary data collected through interviews of victims/family from the Marathwada and secondary data from various sources like news articles, articles, policy reports, information government website, etc.

Keywords: disaster, drought, Marathwada, farmer, suicide, policy planning, coping mechanism, transparency and accountability

Introduction

"Yes every household has a person on full-time water duty", say's Bharat a small framer with five-and-a-half acres of land from Osmanabad district of Marathwada region in Maharashtra (Sainath, 2013).[1] Water scarcity for agricultural and drinking increasing farmers suicide due to drought in Marathwada has invited well informed debate over the government intervention to cope up with the natural disaster like drought and man-made disaster like farmer suicides. The everyday disturbing news on the farmers suicide is serious worry mentioned by various social, political and psychological scientist in India. The burning issue of farmer suicides has made an impact on the larger development of the region. Historically drought is not knew disaster faced by Marathwada people, it has been witnessed by many generations before independance and after dependances. The key droughts that made the worst impact got recorded are 1972–1973, 1996–1997, 2001 to 2003, 2007, 2012–2015 and recent one 2017, etc.

The farmers suicides in the Maharashtra and specifically in the Marathwada is one of the scariest parts of the State development. In 2015 the state recorded 3,228 farmers suicides whereas in 2016 number was 3,063, just less

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than five percentage of previous year. In the total number of suicide of state the Marathwada region, which has been worst hit by the drought for three years (2013, 2014 and 2015), witnessed 1,053 suicides in 2016 against 1,133 in 2015.[2] on an average nine farmers have committed suicides in two year in Maharashtra (36 districts) in that single Marathwada (eight districts) has witnessed three suicides every day. The situation even became more worst in 2017, according to a report submitted by the Aurangabad Divisional Commissioner on August 14, 2017 Marathwada recorded 580 farmers' suicide between January 1, 2017 and August 13, 2017. Another shocking data of the report says 34 farmers committed suicide between August 7, 2017 to August 13, 2017. Despite of the loan waived by the Maharashtra government in July 2017, farmers continued suicide in Marathwada.[3] Various studies on farmer suicides found that the fundamental reason of the farmers suicide is the severe drought witnessed by farmers of the region. In 2017 status of monsoon till 19th August was, out of 74 days only 29 days rain was recorded that also in the beginning of the Monsoon after which almost 40 days there was not rain due to which the Kharif crop got brunt.

Now the question that arises here is that despite the state having witnessed severe drought before, why was there still no proper planning to overcome the problem? The drought has lead to another serious man-made disaster that is the suicide. Though well known sociologist Foucault argued the suicide is an act done by the individual with the understanding its consequences, still this turns to be the disaster for the family members and for the larger society. When Marathwada has been facing water scarcity for agricultural and drinking water, what were the efforts that state made to meet demand? What are the policies of the state? If the state failed to address the problems then this should be called the man-made disaster rather than natural disaster? When one disaster creates another disaster and state being and constitutionally bound to take the responsibility of the welfare of the society, get failed then why don't people call it state sponsored man-made disasters?

This paper will deal with the problem of drought and farmers suicide as disaster in Marathwada region of Maharashtra. It will throught lights on the how the drought situation has been continued ever after independence and leading another disaster through farmers and agricultural laboures suicide. The author believes, it is important to understand the process of disaster whether it is natural or man-made? What difference has been observed over a period of time etc. Author has used his living experiences of Marathwada as Primary data and largely secondary data from various news articles, academic articles, government reports, etc.

Socio-economic and Geography of Maharashtra and Marathwada

Marathwada is a one of the regions of Maharashtra state. Before coming to the Marathwada, it is important to understand the state of Maharashtra which is know one of the richest state in India with GDP of ₹ 16.8 lakh crore.[4] Maharashtra is the second largest state in India in terms of population and has geographical area about 3.08 lakh sq. km. As per population census, 2011 the population of the State is 11.24 crore which is 9.3 per cent of the total population of India and is highly urbanised with 45.2 per cent people residing in urban areas.[5] Maharashtra is also well known for various reasons including the social reformers and its progressiveness. The progressive kings like Chhatrapati Shivaji Maharaj, Chatrapati Shahu Maharaj, social reformers like Mahatma Jyotiba Phule, Krantijyoti Savitribai Phule, Dr. B. R. Ambedkar and many more have given their lives cultivate the values and principles of humanity, equality, fraternity, social justice for the development of the state and nation.

Maharashtra occupies the western and central part of the country with 30,8000 sq. km land and has a long coastline stretching nearly 720 km along the Arabian Sea. The Sahyadri mountain ranges provide a natural backbone to the State on the west, while the Satpuda hills along the north and Bhamragad-ChiroliGaikhuri ranges on the east serve as its natural borders. The State is surrounded by Gujarat to the northwest, Madhya Pradesh to the north, Chhattisgarh to the east, Telangana to the south east, Karnataka to the south and Goa to the south west.[6] Maharashtra have five regions namely Marathwada, Vidarbha, Desh, Khandesh and Konkan and 6 administrative divisions with 36 district, 355 blocks, 40,959 villages, 2,706 habitations, 534 towns (Census, 2011).[7]

Maharashtra is a highly urbanised state as compare to the all india average 54.8 per cent population in Maharashtra lives in rural areas whereas all India average 68.9 per cent population lives in rural areas.

Table 1: Rural and Urban Population, Maharashtra

Years	1960–61	1970–71	1980–81	1990–91	2000–01	2010–11	2015–16
Rural (in '000)	28,391	34,701	40,791	48,395	55,778	61,556	61,556
Urban (in '000)	11,163	15,711	21,993	30,542	41,101	50,818	50,818
Total (in '000)	39,554	50,412	62,784	78,937	96,879	112,374	112,374
Rural (population %)	71.78	68.84	64.98	61.31	57.58	54.78	54.78
Urban (population %)	28.22	31.16	35.02	38.69	42.42	45.22	45.22

Source: Census 2011 and Maharashtra Government's economic survey of financial year 2016–2017

Compared to the 1960–1961 the percentage of the population in urban areas has increased for more than 17 per cent in 2015–2016 in Maharashtra. The data from various reports shows the migration of the rural population to urban areas over a period of time. The above table shows how the rural migration has happened, this is due to lack of employment in the rural areas. The rural population is largely dependent on the agriculture for their livelihood. The decreasing agricultural production and drought has made rural people migrate to the urban areas for livelihood security. If agriculture could have satisfactorily provided livelihood security to the people then number would not be this large as we can see in the table.

Agriculture Holding of State and Cropping Pattern

The landholding pattern of the state it shows that in 1971 there were only 49,51,000/ holding the total operational land of 21,179 (Hectare (ha)). The average holding was 4.28 (Ha) where in 2010-2011 the land holding number went to 1,36,99,000/ those hold the total operational land of 19,767 (ha). If we see the landholding average it shows 1.44 (ha) per holder. The dependant population on the land is growing rapidly but land as stable capital is as it was, which is getting distributed after every generation. This is also one of the reasons for the rural to urban migration in the state.

The cropping pattern in the state is different in every region and even districts based on the land and rainfall. Districts of Konkan regions, and few districts of Vidarbha receives high rainfall who prefer to take Rice, Jowar, Pulses, Wheat. Most of the districts from Marathwada region received the low rainfall as compared to other regions like Konkan, vidarbha or western Maharashtra. Beed, Aurangabad, Latur are the only district who have privilege to access the water to more than two big rivers like Godavari and Manjara. Osmanabad is one of the lowest rainfall district in the region with 54 cm and don't have any big river due to which in Human Development Index (HDI) it stands at 29th in the state.[8] Most of the district of Marathwada are with poor HDI. However, still Marathwada is one the region after western Maharashtra who take sugarcane production to the highest in Maharashtra. Sugarcane as cash crop has given opportunity to farmers to dig the tubwell as much as deept to exploit the water. That lead the agriculture and drinking water scarcity during the various droughts.

Marathwada at a Glance

The name 'Marathwada' drawn from the Marathi speaking population in region of Hyderabad state. Marathwada is one of the regions of the Maharashtra located on the border of Karnataka and Telangana state. When India got independence on August 15, 1947 Marathwada was still under the rule of Nizam and became part on 17 September, 1948.. Aurangabad was the muluk headquarter for the nizam to get connected with the region. The Aurangabad has the history of Buddhist philosophy the Ajanta and Varul caves are historical proofs of the King Ashoka's rule (Kate, 1987). The Hyderabad state had eighty-five per cent of its population Hindu, but Muslims dominated the army, police and civil service. Most of the top level decision making post were given to Muslim by the king. Despite the Muslim ruled state the Caste was practices brutal in all the region of state. Land was the only major livelihood source for the people but people did not had right to own it. Nizam himself owned about 10 per cent of the land of the state; much of the rest was controlled by large landowners. From his holdings the ruler earned ₹ 25 million a year in rent, while another ₹ 5 million were granted him from the state treasury (Guha, 2007). He exploited the farmers as much as possible and earned the money due to which he was considered the world's richest man in the 1930's decade. Even today most of Telangana, Bidar and Marathwada which is part of Hyderabad state is known for severe drought. After region included in the states based on the language the states could have not come out from the problem of water scarcity and drought.

More than 65 per cent of the population of the Marathwada is economically dependent on the agriculture where the irrigation facility does not support this occupation satisfactorily. Approximately 40 per cent area of Marathwada is drought prone.[9] Marathwada is one of vulnerable regions that get affected by the drought due to its location in interior parts of Peninsular India. Marathwada not only have been witness of the drought as natural disaster but also earthquake of 1993, untimely rain and losses of crop, lives and animals, poor disaster management by the government, etc. The lack of planning, transparency and accountability in the system also been few key reasons of is long time battle against the drought in Marathwada.

Irrigation Facility

Rivers are the key source of irrigation in the Marathwada. Maharashtra has key rivers named Godavari, Bhima, Krishna, Panchganga, Bhima, Tapi and Narmada. The key rivers are tributary rivers for instance Tapi with Purna, Gima and Spina. Godavari with tributary rivers of Penganga, Wardha, Wainganga, Manjara and Purna. Krishna with Koyna and Bhima. West Flowing rivers. Damanganga, Vietnam, Ulaha, Vashishtha, Shashtri, Karli etc. Most the river travels from other regions of the Maharashtra and very few from Marathwada.

The Godavari is the important river flowing through Marathwada, particularly serving the district of Aurangabad, Beed, Parbhani and Nanded. The Godavari Springs from a hill behind the holy spot of Trimbakeshwar and enters Marathwada region near the township of Puntamba, and flows across the region covering almost every district of Marathwada except Osmanabad Jalna and Latur Districts. The Manjara, Bendsura and Wan are the promonet rivers of Beed District along with Godavari. The Penganga, Purna and Dudhana flows through Parbhani. The important rivers of Osmanabad and Latur district are the Manjara and Terna these teams alonwith the Gautami Ganga (Kate, 1987).

Marathwada doesn't have any other big river except Godavari that provides the water for irrigation and drinking purpose of some part. Jayakwadi is one of the largest irrigation project in India that covers the Aurangabad and Jalna district. Terna has two dams namely Terna Dam and Makini Dam. But due to low rain the dam hardly gets filled, also most of the time the river remains dry. Manjra flow from Latur district and some of the part of Beed do have few Dams but the situation of Manjra also is not different than Terna. Most of the time farmers on the bank of the river exploit the water for agriculture land and cash crops, such as sugarcane.

Low rain is the main reason of the drought in region, low rainfall due to less forest is the source of problem. There are no adequate irrigation facilities in the region. Thus no water for the trees, most parts of the region found species of small trees which can survive with less water. It is an interdependent cycle, there are not enough trees therefore no rain, there is no enough water therefore no trees. If we look at the map of Maharashtra, Marathwada looks yellow and dry due to lack of adequate water and tree. Various programmes by government to increase the number of trees also got failed due to water scarcity.

Drought: A Natural or Man-Made Disaster?

The important question in the process of understanding the drought is whether it is a natural or man-made disaster. If this is a natural disaster then what is the process and if man-made then how this can be called a man-made disaster. Before going into the details, it is important to understand the meaning of drought and its process. The word drought (*Dushkal* in Marathi, *Akal* in Hindi) is often used in the Marathwada region to express any problem. The residence of region are use to of drought as problem. Drought is commonly defined as a lack of precipitation over an extended period, usually a season or more, relative to some long-term average condition. History suggests that severe and extended droughts are inevitable and part of natural climate cycles.[10] Droughts are believed to be creeping phenomena because of their slow onset (Gillette, 1950 and Choudhury & Sindhi, 2017), intensity, and uncertainty of duration. Droughts can be meteorological, hydrological, agricultural, or socioeconomic depending on rainfall or runoff deficiencies, the availability of water for crops in the growing season, or the impact of drought on human activities, both direct and indirect (O'Farell et al 2009 and Choudhury & Sindhi, 2017). For the first time in the history of Latur, the District Magistrate imposed section 144 in the district.[11] Latur and Osmanabad are the most affected districts in the region. As P. Sainath found that in 2013 Jalna, Osmanabad were the most affected with regard to drinking water.

Water is one of the most important necessities of human life. Without water the world is incomplete. It is impossible for life to survive without water. A large source of the water is rain for the society. The irrigation and drinking water totally depends on the amount of rainfall. In a country like India, where rain-fed agriculture is the dominant source of food production, drought inherently coexists with farmers, society, and the economy (Choudhury & Sindhi, 2017). Though drought is considered a natural disaster due to low rainfall it is also important to understand other man-made reasons. Without denying the occurrence of extreme and perennial droughts, the effects of which may be disconnected from anthropological factors, it cannot be denied that human activities play a crucial role in influencing the severity of droughts (ibid). The another important question is, what were the efforts of the government to overcome from the problem of drought in various parts of India including Marathwada? The answer seeking process takes us toward the question whether drought are natural or man-made?

Major Droughts and Counter Government Policies

The 1972 drought is known every part of the Maharashtra, out of 26 districts 21 districts faced drought. It was one of the worst droughts ever faced. Marathwada being and most vulnerable part of the state was worst affected area of the drought. The struggle of the Maharashtra farmer is not new for the irrigation facilities in the state. In seventies decade state stand second lowest in irrigation facilities (Ladejinsky, 1973). Though Nehru took extra ordinary efforts for agriculture development including irrigation facilities, Maharashtra did not get much attention for development of irrigation facilities. Two consecutive years drought lead to various other problems such as lack of food grains for human beings and animals, unemployment, it affected the vegetable and milk supply. The high level of migration was started in 1973. Government of Maharashtra come up with the Employment Guarantee Scheme (EGS) (1974) which was made and act in 1977 to assure the employment and curb the rural migration. EGS is now one of the successful programs in the state that assured work in village, created community and agricultural infrastructure which also contributed for the rainfall and water conservation. However main cities like Pune, Mumbai were filled by the rural people in search of work. Latter the government of India made National Employment Guarantee Act in 2005 based on the EGS.

Another drought which hit most of the states of India including Maharashtra and particularly Marathwada was in 1996–1997. The 1996 drought affected 7 districts and 266.75 lakh people. The 1997 drought affected 17 districts.12 During this drought also EGS played an important role to provide the employment for rural unskilled labourers. EGS was one of most effective anti poverty alleviation programme in Maharashtra. As found by Dreze (1990) the public-works programme helped in preventing the famine during the drought of 1970–73 in-spite of the low and declining per capita availability of food-grains in the state. During the drought period the EGS was used as a relief programme (Dev, 1995). "By any criterion the drought of 1970–73 in Maharashtra must have marked an all time record for the scale and reach of public works programme in a famine relief operation" (Dreze-1990, P- 89). After the drought period the government has continued the EGS and used it as an anti-poverty programme (Dev- 1995).

The other words drought was recorded in history in 2001. In 2001, drought affected about 20,000 villages in 23 districts; 28.4 million people and 4.5 million hectares of crops in the State. According to a report from the Government of Maharashtra, number of districts affected by droughts in the year 2002–03 and 2003-04 were 33 and 11, respectively. The situation of droughts in Maharashtra continued to deteriorate in 2004. Following the failure of monsoon in 2003, the Government of Maharashtra (GoM) declared droughts in 11 districts namely, Pune, Satara, Sangli, and Solapur (Pune Division), Nashik and Ahmednagar (Nashik Division) and Beed, Latur, Osmanabad and Aurangabad (Aurangabad Division). Altogether 71 talukas in these 11 districts are seriously affected by the droughts (Vaishampayan & Patil, 2014). The Drought of 2001–2002 not only affected on the agricultural crop and economic instability but also on health, education and other development of the residence of the drought affected areas.

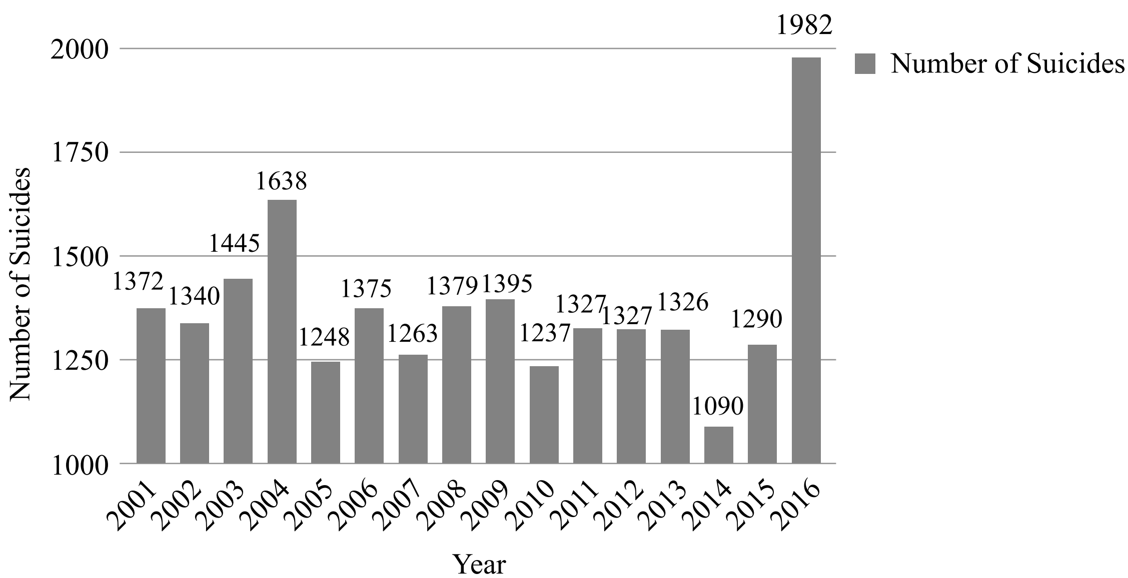
In 2013, 2014, 2015 for consecutive three years Marathwada witnessed the worst drought in the region. Marathwada receives 541 mm rainfall every year whereas in 2015, it was just 259 mm. The drought hit 400 villages where the situation became like a desert. The people were struggling for drinking water and food for the animals.

The Government extended support through the animal shelter with foodgrains but those were just for the sake of showing that the state is working for the people and farmers.

The level of groundwater during the drought went deeper and reached 600 feet in Osmanabad and Latur districts. The Jayakwadi dam had only 6 per cent water left while the water in five other dams—Manjira, Seena, Kolegaon, Majalgaon and Lower Terna—was finished. Till September 2015 more than 43 lakh hectares under Kharif and 20 lakh hectares under Rabi crops get affected, hitting 36 lakh farmers and their families across the state. Even aged people were reported to have told journalists that the three years consecutive drought was the worst than 1972 and never seen such in their lifetime. Government took the decision to stop the groundwater exploitation for irrigation below feet underground. Even the government came up with the idea of artificial rain through cloud seeding which was an unsuccessful effort with a huge amount of money spent on this project.[13] The situation of drought was almost occurred in 2017 when there was not rain for more than 40 days in the monsoon. Most of the Kharif crop got burnt and farmers lost the confidence.

Suicides in Maharashtra and Marathwada

The important disaster which Marathwada has been facing is known as farmers suicides. The news of farmer suicide has become no more shocking for many people from Marathwada since it became an almost every day incidence. Unfortunately state and common people somehow lose their sensitivity to think and fight against such a man-made disaster. However, everyone was shocked by an incident of a 16-year-old daughter of a farmer in drought-hit Latur district of Marathwada allegedly committing suicide by consuming pesticide as her debt-pressed parents could not buy her a monthly state transport 'bus pass' to commute to college.[14] Not only this single girl but there are many who have choose this way because of the expenditure on their daughter's marriages by taking loans and later committed suicide. The daughters who are yet to get married have also committed suicide on seeing the struggle of their fathers. The worst situation occurs when the landless labourers commit suicide during such drought. Most of the landless labourers are dependent on the agriculture land for their livelihood but during the drought they except EGS and NREGA they don't get any assurance. The story of NREGA implementation in the state is very poor.[15]



Number of Suicides from 2001 to 2016

Source: Data from 2001 to 2014 is from state crime records bureau. Data for 2015 is from NCRB and includes suicides by agricultural labourers as well, data for 2016 is from state assembly records from February 1, 2016 to mid- February 2017)[16]

As per the data from various sources mentioned above shown in the graph indicate that the suicides of the farmers and agricultural labourers has suddenly increase in 2014 after droughts of 2001, 2002, 2013 and in 2016 after 2013, 2014, 2015 droughts. If we see the graph it shows that in 2001, 2002, 2004 total 1372, 1340 and 1445 farmers respectively committed suicides in Maharashtra. But the number suddenly went 1638 in 2014 the reason behind this was the three years consecutive drought in Maharashtra especially in Marathwada. Almost similar thing happen in 2013, 2014, 2015 total 1326, 1090 and 1290 farmers respectively committed suicides. The number again went high this time to 1982 in 2016 exactly after three years consecutive drought in state and Marathwada region. This data shows during the drought farmers have committed suicides but the number increased after a year. The reason behind this is the loan taken from banks and landlords during the drought, that adds the pressure on the farmers. The scary picture occurs in the month of August when there was not rain the number of farmers suicides rapidly increased in a week 34 farmers from Marathwada committed suicides. Despite of the 34000 crores 40 lakh loan waivers announcement by government of Maharashtra in the month of July it didn't make any positive contribution to control the suicides.

Suicides are Man-made Disasters

The important thing to understand the weather the drought and suicides are man-made or natural disasters? Maharashtra secures the top in economic development, money is not problem for the state due to the money generated from public taxes. State government has also invested lot in the creation of irrigation facilities. In 2013, Maharashtra had the highest number of major, minor and medium projects dams in the country exclusively for irrigation. However being in top in nation this only could cover 18.9 per cent of land.[17] Thus more than 80 per cent land still depends on the seasonal rain, that is mostly from Marathwada and Vidarbha region. The question that arises here is that why hasn't the government invested in Marathwada for irrigation development projects.

Since 2002 the government has been expending huge amount to create the irrigation project in the state. After spending ₹ 70,000 for a decade long project the government could only achieve the 0.1 per cent of irrigation facilities. A huge amount of money was spent but nothing happened on the ground. It looked like a horrified scam was about to emerge. When the corruption came to light the responsible minister resigned and the Chitale committee was formed for the investigation. Many politicians also faced the CBI inquiry but they managed to shirk their responsibility. Corruption in the agriculture development project, irrigation project occurred and was a serious reason that led to this problem. The decade long data of farmer suicides shows that the number has not been under control. If the state has failed to control the suicides that mean there are some basic problem with policy. Lack of transparency and accountability in the policy planning, implementation and evaluation became key reason for the policy failure.

Poor management in the cropping system led to drought in the state and region. The pattern of cash crops also put farmers in trouble. The cash crop requires fertiliser and if farmers use the fertiliser then it should have enough water, if crops don't get the enough water the whole crop get burned. To plant and harvest a cash crop, farmers have to invest a lot on the seeds and fertilisers and if there is no rain then farmers found themselves in deficit. The standard practice in the Marathwada is, farmers take the loan in advance on the crop, spend it on seeds and fertilisers but if due to water scarcity they loose crop then it becomes challenging to face the deficit.

In the cash crop, sugarcane is the biggest contributor in the drought and farmer suicide in Maharashtra. It has been criticised by many policy makers that the water-guzzling sugarcane is one of the key reasons to lead the drought situation in Maharashtra. The state accounts for almost 40 per cent of sugar production of India. To produce a one kg sugar on an average 2068 liters of water is required. In Maharashtra, almost 72 per cent of available irrigation and well water is directed to the production of sugarcane, leaving little water for cultivation of other crops (ibid). The Chitale committee warned government of Maharashtra to decrease the sugarcane production and promote other crops that need less water. In fact the problem was identified by the Maharashtra Water and Irrigation commission in 1999 and stated: "It is desirable to impose a total ban on water intensive crops like sugarcane in these deficit sub basins… less water intensive crops only and less water intensive economic activities only should be permitted" (ibid).

The political economy didn't allow for any ban or control over sugarcane production. In the Maharashtra politics the political lobby is know as 'sugar lobby' who have strong hold on the sugar industries. Most of the powerful politicians have the sugarcane industries those gives advance money to the farmers to take the crop and take it back from their production. Marathwada which is known for drought have 80 sugarcane industries out of 205 in state. Almost one third industries are located across the districts of Osmanabad, Beed, Latur, Aurangabad, Nanded, Parbhani, Jalna and Hingoli. A similar situation exists in western Maharashtra's drought-prone districts of Solapur and Ahmednagar. Water is being indiscriminately provided just for sugarcane cultivation to keep netas well fed. There has been no attempt in educating farmers to shift to other less water dependent crops and other activities like dairy to supplement income (ibid). All the factories require water that has been provided by the government through various irrigation projects and dams. Since sugarcane is the cash crop, landlord farmers have invested lot to exploit the water, they have dig wells, taken borewells. Everyone knows farmers are committing suicide due to drought/ water scarcity and loans but since the political power holders earns money from the sugarcane industry never put their effort to educate the farmers for crop shifting.

The state government has implemented various programmes for water conservation and increase the number of plantations. Integrated Water Management Programme with the major share of central government was one of the programme. Specifically for the Marathwada the Krishna Khore Vikas Mahamandal was established by the state government. The aim of the programme was to build the canal and water irrigation facilities to get water from Krishna river. But yet that has not been successful due to opposition from western Maharashtra to take away the water. Under the sanitation programme the government has made it clear that the water management and water conservation with planting tree given preference. In the Swachh Bharat Abhiyan also these things are given importance. To implement the NREGA project the preference has been given to pound, tree plantation, building etc. those contribute in agriculture development. However, unfortunately the objectives and aims of the project weren't achieved due to poor implementation and lack of sustainability.

The Maahaautee government came in power in 2014 come up with new programme named Jalukt Shivar targeting drought free Maharashtra before 2019. The government allocated another ₹ 70,000 crore budget for this programme. The key objectives of the programme are to make drought free state, provide employment opportunities to the people, curb the farmers suicides. Under the programme key works are taken on top priority basis

1. The work is to broaden and deepen the river base
2. Removing silt from lakes, ponds, farm ponds, and canals which prevents water percolation
3. Building check dams, canals, small ponds, and wells for individual and community
4. Tree plantation for better conservation of water in soil

The state also set the target to implement water conservation and micro-irrigation on 25 lakh hectares in the state within 15 months. The major support of public in this abhiyan aim to target 60 per cent area. Jalyukta shivar yojna implement on each and every district, taluka and villages.[18] Apart from the the government Jalukt Shivar Programme the Non Profit Organisations also have come up with various programme such as 'water cup' competition by the Pani Foundation. Pani Foundation lead by Bollywood actor Aamir Khan has been working in the field since 2016 received fund from the Tata trust and Reliance Foundation. The foundation is set up by Kiran Rao and Aamir Khan. The idea of the project is to take the voluntary participation of the people through Shramdan and create the water conservation infrastructure in the rural areas. Whichever village does best in the year that get awarded by 'Water Cup' award by the Chief Minister of Maharashtra. The programme has contributed effectively in rural Maharashtra and had a positive impact. However, the demand and targets are yet to be achieved and need consistent work with proper follow up for its sustainability.

Conclusion

Maharashtra being one of the economically developed states is facing crucial issues of drought and farmer suicides along various other social and political issues in the state. The focus on the industrial development and materialist approach along with high levels of corruption became one of the biggest worries for agricultural development in the state. Despite Maharashtra having a progressive history of social reformers the discrimination practices in the state are very much based on caste, class, gender, language and region. Marathwada has been caught up in the discrimination of region and language. Marathwada which was a part of Hyderabad state ruled by the Nizam got over exploited for development. After it became a part of the India and later Maharashtra based on language got secondary status in the states. The political economy of the State didn't leave single opportunity to exploit the region. Most of the big revers are in other region of the State, when the Krishna Khore Project was designed for the water supply the politicians from the Western Maharashtra strongly opposed it. The sugar lobby also in the state assembly didn't allow any ban on the sugarcane production which became one of the key regions for the drought and water scarcity in the region. The drought and water scarcity led to the massive number of farmers suicide in the state and region.

It has been argued by various sociological philosophers including Durkheim (1897) that suicide is an act done with personal will due to various social, political and economic factors by an individual. The person carries an understanding of its consequences but thinks there is no way apart from this and then takes this extreme step. Since the suicide is done with individual choice state also washes their hands off it and through responsibility on individual.[19] But when the suicides of particular homogeneous group in larger number get visible that became a worry points for the state that is bound to protect and prevent the lives of individuals. When suicide due to common region, from one particular group identified then it is state responsibility to work on the cause of the issue. However the long time issue of drought yet has not been solved and the continue farmer suicides are happening. This shows the failure of the state towards their efforts to have sustained solution.

Lack of proper planning, transparency in planning, implementation and evaluation of the policies to deal the issue of farmers suicides is another reason. Government has not been showing its accountability to take care of the farmers and have sustained solution. The irrigation scam of ₹ 70,000 found by the Chitale Committee didn't come out in the public view, politicians manage to hide that and wash their hands from responsibility. Such failures should be brought into the public view and state should be made accountable. Until and unless the state takes adequate participation of the key stakeholders in the policy planning, implementation and evaluation with adequate transparency and accountability problem may not have sustainable solution.

Notes

1 In 2013 drought P. Sainath had field work in the Osmanabad, Jalna and come up with his report and article. He come up with the argument that ow the each family is getting affected due the drought how they spend money to buy the water in villages and cities like Osmanabad and Jalna. Available at: http://www.thehindu.com/opinion/op-ed/when-waterflows-like-money/article4475836.ece, accessed on 31 August 2017

2 Availableat: http://www.hindustantimes.com/mumbai-news/in-maharashtra-despite-good-rain-and-government-schemesfarmer-suicides-down-by-just-5-in-2016/story-7xeKiTrxGn8vPwzdoh85LL.html, accessed on 31 August 2017

3 Available at: http://indiatoday.intoday.in/story/marathwada-farmer-suicides-devendra-fadnavis-loan-waivermaharashtra/1/1028261.html, accessed on 31 August 2017

4 Maharashtra ranks first in India to have the highest wealth. This is richest state due to its industrial development in the state. See the link Available at: http://www.trendingtopmost.com/worlds-popular-list-top-10/2017-2018-2019-2020-2021/india/richest-states-india-best-famous-beautiful-developed/, accessed on 27 August, 2017

5 See the government of Maharasthra's economic survey report 2015-2016 for more details. accessed on 27 August, 2017 https://www.maharashtra.gov.in/PDF/EcoSurvey_2015_16_Eng.pdf

6 See the Maharashtra Government's economic survey of financial year 2016-2017 for more details. https://mahades.maharashtra.gov.in/files/publication/ESM_Eng2016_17.pdf, accessed on 27 August, 2017 also see the NIDM Report 2016- 2017.

7 Ibid

8 See the research study on the cropping patterns in all the districts of Maharashtra. http://shodhganga.inflibnet.ac.in/bitstream/10603/106318/10/10_chapter%205.pdf, accessed on 29 August 2017

9 See the link for more details https://www.maharashtra.gov.in/site/upload/WhatsNew/KCR-23122014.pdf, accessed on 31 August 2017

10 Available at: http://drought.unl.edu/Portals/0/docs/Drought%20in%20the%20US%20Causes%20and%20Issues%20for%20Congress.pdf, accessed on on 31 August 2017

[11] Available at: http://www.business-standard.com/article/current-affairs/fearing-water-riots-latur-imposes-sec-144-steps-uppolice-patrols-116032100156_1.html, accessed on 31 August 2017

[12] This is government report that provides the detailed data about the drought and drought situation in the state. http://nidm.gov.in/PDF/DP/MAHARASHTRA.PDF, accessed on 31 August 2017

[13] News article abou the drought in Marathwada region http://www.downtoearth.org.in/news/marathwada-inthe-grip-of-drought-like-situation-51012, accessed on 31 August 2017

[14] http://www.business-standard.com/article/pti-stories/farmer-s-daughter-ends-life-for-want-of-money-to-have-buspass-115102600474_1.html

[15] See the http://www.nrega.nic.in/netnrega/home.aspx Also the social audit situation and corruption in the Maharashtra. As per the government of India's notification, state government should have implemented the social audit in NREGA but after 6 years of notification and close follow up by the central government, state government yet to establish the social audit directorate.

[16] https://thewire.in/wp-content/uploads/2017/04/Annex-1-%E2%80%93-Farmer-suicides-2016-and-2017.pdf

[17] https://yourstory.com/2016/04/maharashtra-drought-feature/, accessed on 31 August 2017

[18] http://govinfo.me/jalyukta-shivar-yojna-maharashtra/, accessed on 31 August 2017

[19] See the theory of suicied book by Durkhein available on this link available at: http://14.139.206.50:8080/jspui/bitstream/1/1969/1/Durkheim,%20Emile%20-%20Suicide%20A%20Study%20in%20Sociology%202005.pdf

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Cross Border DRR on Koshi Region: Activities and Challenges

Ravi Prakash[a]

Abstract

The Kosi (originated from Nepal) is 720 km long and drains an area of about 74,500km^2 in Tibet, Nepal and Bihar. It flows from Nepal into Bihar (Supaul, Saharsa, Madhubani etc.) India. Saharsa is surrounded by Kosi (sorrow of Bihar) and Balan which have very slow flow rate of water and so, the problem of water logging existed. Water level rises to 5 metres at the time of flood and continues up to 25 days. For approximately 4–6 months in a year, the water level is up to 3 metres.

4–6 months of water logging badly affects the locality not only in terms of livelihood but also towards WASH. About 60% of the population are below the poverty line and their livelihood mainly depends upon migration. 20% of the people are involved in agriculture but only for one season.The rate of dropouts amongst school children is very high. Adolescent girls and women consider menstruation as a disease. 90% of the population have no toilet facility. Water is badly affected with iron, arsenic, etc.

Strengthening the resilience of these communities they need support and knowledge regarding disaster preparedness, health and livelihood enhancement. They also need external support for infrastructure (flood resilient hand pumps, toilets, boats etc.) and awareness program (WASH, MHM, etc.). They need some special opportunity or training on skill development, employability enhancement and farming technique for their livelihood.

Keywords: disaster risk reduction, Kosi Floods, community resilience, training, knowledge management

Background

The Kosi (originated from Nepal) is 720 km long and drains an area of about 74,500 km^2 in Tibet, Nepal and Bihar. It flows from Nepal to Bihar (Supaul, Saharsa, Madhubani, etc.) India. In the past, several authors proposed that the river has shifted its course for more than 133 km from east to west during the last 200 years. But a review of 28 historical maps dating 1760 to 1960 revealed a slight eastward shift for a long duration, and that the shifting was random and oscillating in nature. The Kosi River is known as the "Sorrow of Bihar" as the annual floods affect about 21,000 km^2 of fertile agricultural lands thereby disturbing the rural economy. The Koshi has an average water flow (discharge) of 2,166 cu m/s (76,500 cu ft/s). During floods, it increases to as much as 18 times the average. The greatest recorded flood was 24,200 cu m/s (850,000 cu ft/s) on 24 August 1954. The Kosi Barrage has been designed for a peak flood of 27,014 cu m/s (954,000 cu ft/s).

Saharsa is surrounded by Kosi and Balan rivers. The dam across these rivers is of soil. Embankments on both sides downstream of the barrage with a length of 246 km were constructed to check the westward movement of the river. The embankments have been kept far apart, about 12 to 16 km, to serve as a silt trap. The flow of water downstream is very fast but when it overflows to its embankment, the speed of water is very slow and brings floods to nearby places. Due to the slow flow of water the problem of water logging exists. The water level rises to 5 ft at the time of the flood and continues up to 25 days. Within approximately 4 to 6 months the water level is up to 3 ft.

Problems of the Areas

The following are the main problems of flood affected areas

- 6 to 9 months water logging
- Soil erosion and landslide
- No electricity
- Low livelihood option

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- Migration
- Illiteracy
- Unawareness
- Water is affected with Iron, Arsenic, Fluoride, etc.
- Disease, such as Typhoid, Cholera, Black Fever, Diarrhoea, Malaria, etc.
- No availability of hospital
- No proper transportation

Lifestyle and Livelihood Dependency

This water-logging problem is not only badly affecting the livelihood of locality but also towards Water Sanitation and Hygiene (WaSH). About 73 per cent of population of these regions are below poverty line. Approximately, 75 per cent families of these areas are using hut and 17 per cent families are using mud houses to live. It means only 8 per cent of the families have concrete houses. Status of monthly income is also very poor. Approximately, 51 per cent of the families have monthly incomes of than ₹5000. Only 5 per cent of the families have monthly income more than the ₹15000. The monthly income of families of these areas is very less because of their unorganised livelihood dependency. Approximately 64 per cent of the families have migrated to Punjab, Delhi, Maharashtra, etc., for a period of 6 to 8 months in order to earn. Only 27 per cent of the families are involved in agriculture. They practice agriculture only for one season, i.e. Rabi because of the water logging problem. Only 9 per cent families depend on business (either own or working in it).

Water, Sanitation and Hygiene (WaSH)

Unawareness

Illiteracy and unawareness level among people of these areas are very high. They don't have awareness towards public health. Even after getting so many diseases, they use such hand pumps for all purposes. They spread garbage around their homes. The environment of the localities are not good for health.

Menstrual Hygiene Management

About 52 per cent of the female population is of reproductive age and most of them are menstruating every month. The majority of them have no access to clean and safe sanitary products, or to clean and private space in which to change menstrual cloths or pads and to wash. The situation is worse if it is of flood affected areas. Because of illiteracy and unawareness, they don't understand what is happening to their bodies when they menstruate and how to deal with it. Many of them believe it is a disease.

Water

For water, they are fully dependent on hand pumps. They access the hand pump water for all purposes such as drinking, washing clothes, bathing, cooking food, etc. Maximum hand pumps have borings up to 60 ft only. At this level, water is affected with Arsenic, Iron, Fluoride etc. So, people of these areas are afflicted with water born diseases. They are generally affected by skin disease, black fever, viral fever, etc.

Open Defecation

There is no availability of toilets in these areas. Generally, people defecate in the open. Only a few people use toilets in these areas. It is also seen that the distance between the toilets and the hand pump borings is not enough to conform to sanitation standards. Because of the close proximity of the toilet pits to the hand pumps, water is polluted. People are using this water for drinking and bathing. As a result of using such polluted water they are easily affected by many diseases.

Some people have made temporary toilet on the waterlogged areas. They drain the excreta in to these waterlogged areas. Generally people have to walk through water from one place to another which brings skin and many others diseases.

Infrastructure

In the name of infrastructure followings are existed in flood affected areas

- Damage concrete road
- Earth road
- Mud full road
- Small government schools (maximum are affected by flood for 3 to 4 months)
- Panchayat Bhwan (Maximum are not in working condition)
- Poor conditions of Flood-dwelling
- No availability of public toilet
- Very few available public hand pumps
- Not enough boats available
- Not enough sub health centres

Expected Solution

It is not possible to stop the flood water or to diverge the path of flood water. But it is possible to strengthen the locality to win in battle with disasters like floods. This strengthening will come only by external sources like Government, Non-government Organisations (NGOs), Volunteer Organisations (VOs) etc. After discussion with flood affected people, Government, Non-Government Organisations (NGOs) and Volunteer Organisations (VOs) undertook consideration of the problems of these areas and the following may be the expected solutions.

Disaster Risk Reduction (DRR)

Disaster Risk Reduction (DRR) is a systematic approach to identifying, assessing and reducing the risks of disaster. DRR aims to reduce the damage caused by natural hazards like earthquakes, floods, droughts and cyclones, through an ethic of prevention. This is not easy task to do with the grassroots marginalised people who have to even fight for. But the following may be the path of DRR:

Formation of Village Development Committee (VDC)

It is observed that villagers do not live in unity. They always try to pull the leg of others in all ways. They show their possessiveness only for their own family and relations. If we talk about the overall development of this community, we must form the Village Development Committee (VDC). Members of this VDC must be from different communities/ wards of the village. For the smooth functioning of the VDC, they must be structured with office bearers. There must be rules and regulations (bylaws) for the community.

Strengthening of Village Development Committee (VDC)

Only formation of VDC is not enough, strengthening of VDC is also very important. Strengthening of their skills, awareness, and knowledge level is desired for their development. So, the following trainings may be given to VDC members:

- DRR Map
- Byelaws
- Leadership and
- Financial and Account Management

DRR Map is an important tool to reduce the disaster risk like floods before a flood, during a flood and after a flood. With the help of this map, villagers can make plans to escape from all types of disaster. The following may be the benefits of DRR map:

- Knowledge about nearby safe places
- Knowledge about available nearby natural resources
- Aware about timelines of some hazards like flood

Byelaws are also an important training for village development committees. With this they can understand the importance of rules and regulations for a group or community. These bylaws also help to unite them.

Generally, villagers of these types of areas are illiterate and unaware about their own rights. They are dominated by upper communities/castes/local leaders/government officials etc. They are always suppressed. They have no ability to raise their own voice against injustice. So, Leadership training is also very important for them. This training will bring confidence among members of village development committees.

It is seen that, people of these areas do not have the habit of saving money. Whatever they earn in day, will be finished at night. Their daily food depends upon their daily wage. So, training on Financial and Account Management is also very important.

In addition, frequent meetings of the village development committee is also very important for overall development of these areas.

Construction

In the name of development, these areas have only damaged concrete roads, earth and completely mud roads, small government schools (maximum are affected by flood for 3 to 4 months), panchayat bhawan (maximum are not in working condition), poor conditions of flood-dwelling, no availability of public toilets, inadequate availability of public hand pumps, inadequate availability of boats, and very few sub health centres. Therefore, at least some of the human basic facilities are necessary in such areas.

Distribution

People of these areas are poor and struggle for even their daily food. Involvement of these people for the purpose is tough. So, distributions of some relief materials are also important. These material may be vessels, food items, solar lamps and items related to sanitation and hygiene, boats, etc.

Livelihood Enhancement

Livelihood of the people of these areas generally depends upon

- Daily wage (skilled and unskilled labour)
- Shop keeping (own shop)
- Agriculture and Farming

So, the category of the people of these areas may be

- Literate (experienced and fresher)
- Illiterate (skilled and unskilled) and
- Farmer

Therefore, to enhance their livelihood options, there must be focus on such categories. There must be a skill development programme under the categories of literate people, illiterate people and farmers. Training may be of the following types:

- Personality development training, sales and marketing training, mobile repairing training, etc., for literate youths
- Driving, masonry, Electrician, plumbing etc., for unskilled labour
- Agriculture and Farming for all types of farmers

Water Sanitation and Hygiene (WASH)

The impact of universal access to WASH on global health would be profound. There is the potential to save the lives of the 840,000 people who currently die every year from diseases directly caused by unsafe water, inadequate sanitation and poor hygiene practices, and we could also drastically reduce child malnourishment, and help alleviate physical and mental underdevelopment. Today, 50 per cent of child malnutrition is associated with unsafe water, inadequate sanitation and poor hygiene. Women and girls would have the facilities and knowledge to be able to manage their menstrual cycles in safety and dignity. Similarly, during pregnancy, childbirth, and post-natal care, medical staff, expectant mothers and their families will be better equipped to ensure newborn children are given the safest and healthiest possible start in life

Water quality is affected by both point and non-point sources of pollution. These include sewage discharge, discharge from industries, run-off from agricultural fields and urban run-off. Water quality is also affected by floods and droughts and can also arise from lack of awareness and education among users. The need for user involvement in maintaining water quality and looking at other aspects like hygiene, environment sanitation, storage and disposal are critical elements to maintain the quality of water resources.

It is seeing, in the targeted areas, villagers are using hand pump water for drinking purposes. Hand pump water is infected internally and externally. Internally, maximum of hand pumps have access to low level ground water. Penetration of underground pipes of hand pumps is only 40ft-60ft. At this level, ground water is infected with iron, arsenic, microorganisms, viruses etc.

Externally, catchment of hand pumps are often jam packed and full of harmful garbage. People dispose their garbage near the hand pumps and jam the flow of water. So, water is infected both externally and internally and brings many diseases like Cholera, Diarrhoea, Malaria, Typhoid, Filariasis, etc.

So, the following may be useful to overcome wash related problems

- Wash Campaign and
- Training on Menstruation Hygiene Management

Wash Campaign

It is very important to create awareness amongst the villagers about water sanitation and hygiene through campaigns. Topics of wash campaign may be

- Hand wash campaign
- Cleaning of village
- Water-borne disease
- Mosquito-borne disease
- Safe drinking water and its way of storage, etc.

Training on Menstruation Hygiene Management (MHM)

Menstruation is a normal biological process and a key sign of reproductive health, yet in many cultures it is treated as something negative, shameful or dirty. The continued silence around menstruation combined with limited access to information at home and in schools results in millions of women and girls having very little knowledge about what is happening to their bodies when they menstruate and how to deal with it. A study from UNICEF revealed that 1 out of 3 girls in South Asia knew nothing about menstruation prior to getting it while 10 per cent of girls in India believe that menstruation is a disease (*Water Aid 2013, Menstrual Hygiene Matters*). About 52 per cent of the female population is of reproductive age and most of them are menstruating every month. The majority of them have no access to clean and safe sanitary products, or to clean and private space in which to change menstrual cloths or pads and to wash. The best practice to make an impact on improving of girls and women is in water and sanitation. The time has come to promote, loudly and unashamedly, the role of good Menstrual Hygiene Management (MHM) as a trigger of better, stronger development of women and girls: Personal, Educational and Professional.

Research and Advocacy

People of these areas are only to know live in such areas without knowing the reason. They do not have knowledge about nature / reason of floods. They follow their traditions and battle for life in everyday. Their livelihood dependency and living style are not changeable. So, researches on the following are very important

- Nature of flood
- Needs of locality
- Livelihood options
- Early warning system
- DRR Map

They are unaware of their own human rights. Government officials or local leaders do not provide them information regarding governmental schemes. They are suppressed. So, advocacy is also very important for their welfare. The following process may be useful for their advocacy:

- Liaising with local leaders

- Liaising with block level officers
- Liaising with district level officers
- Liaising with state level officers

Learning from Others

Some of the flood affected places are somehow developed and they don't have many mentioned problems. So, exposure visit of backward areas is very important. They can easily learn from others experience.

Challenges

- Water Logging
- Poverty
- Unawareness
- Orthodox Behaviour
- Dominant People
- Women Participation
- Greediness of Locality
- References missing

Socio-economic and Environmental Impacts of Flash Flood: A Study on Haor Areas in Bangladesh

M. Shamsur Rahman[a]

Abstract

The recent disaster of Haor areas in Bangladesh particularly in the year 2017 due to flash floods is too devastating in terms of social and economical perspective that the communal people are struggling to cope with their lives any more. The harvesting period of crops and the flooding season coincided this year by breaking the year long experience of predicting flood by the farmers. The early on rush of flash floods resulting from upstream transboundary flow of water further aggravated the lives and livelihood of the people living downstream in the Haor area. On the other hand, the local government did not pay enough attention to overcome the miseries of the people affected by flash flood either through construction of adequate hydraulic structures (embankments, detention basins, drainage channels, etc.) or through proper management of land policy and regulations (restraining people from activities in flood prone area, emergency evacuations plan) as part of their preparation for disaster management. With regard to the wetland ecosystem of Haor areas (North-Eastern regions in Bangladesh), the total areas of 858,460 hector land in 7 districts is used for crop and fish cultivation. The consequences of recent flash floods are the major challenge to livelihoods with an estimated damage of approximately 8 million Bangladeshi takas in the fish and agriculture sector alone. The Bangladesh Haor and Wetland Development Board (BHWDB) has taken the initiatives to prepare a comprehensive Master Plan (for the next 20 years i.e. up to FY 2031–32) with a view to preserve, protect and restore the ecosystem as well as to protect the people of this area from natural disasters and improve their livelihood. But, still it is required to emphasise the joint monitoring and collaborative approach of addressing water issues between Bangladesh and India, due to the nature of flooding being transboundary. Besides prediction of flash flooding resulting from contemporary issues of climate change supported by good governance should be taken into consideration.

Keywords: flash flood, hydraulic structure, impact, Haor areas, transboundary

Introduction

The recent disaster caused by flash flood in North Eastern region of Bangladesh popularly known as Haor Region of Bangladesh is unprecedented in terms of damages in socio-economic perspective. The farmers of this regions absolutely depend on their single crop locally termed as 'Boro Paddy' which grows once in a year and on which they are to depend upon rice consumption for the year but also depend upon meeting other expenditures like buying daily necessaries of their lives, education of their children, medicine and buying clothes for themselves and their family members. But this time they have lost 80 per cent their paddy because of the early arrival of flash floods. Along with paddy they also lost other sources of their income like fisheries, chicken, ducks and cattle.

In the winter with recession of flood water, the wet land turns into grazing ground for cattle and buffaloes. The word 'Haor' comes from Bengali word *Sagar,* which means sea. Haor is a wetland eco-system. It is like a large bowl shaped flood plain depression. Simply it can be explained as a big basin containing water which remains stagnant from June to November of the year. Haor regions provide unique opportunity as well as risk. The Haor areas provide an immense opportunity of growing huge quantity of paddy, fish and meat from chicken and ducks. It also involves risk factors if the flash flood and river flood moves rapidly from the upper stream to downstream before its expected time calculated from the past experiences and observations. In this paper an honest and objective search has been attempted to find out the causes of present disaster and what possible measures can be worked out to overcome the difficulties and save farmers from sudden emergent disaster. While analysing the causes of flash flood and its remedies to be explored with joint collaboration of Bangladesh and India. The study also highlights the socio-economic profile and geographical location and hydrological conditions of the Haor areas.

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Geographical Locations of the Haor Region

The Haor Region comprises about 19.5 million hectares of land covering seven districts out of sixty four districts of Bangladesh and these districts are Sylhet, Sunamgonj, Moulvibazar, Habigonj, Brahmmanbaria, Kishoregonj and Netrokona. Most of the Haors are located in greater Districts of Sylhet and Mymensingh. In all there are 373 Haors covering an area of 858460 hectares which is 43 per cent total area of Haor Region. It is a mosaic wetland and habitats rivers, streams, canals and large areas of seasonally cultivated plains, beels (Haors and Bours).

Table 1: Haor Areas at a Glance

Districts	Total Areas (Hectares)	Haor Areas (Hectares)	No. of Haors
Sylhet	3, 99000	189.919	95
Sunamgonj	367000	268.531	105
Habigonj	2637000	109514	14
Moulvibazar	279900	47602	03
Netrokona	274400	29345	52
Kishoregonj	273100	133943	97
Brahmmanbaria	192700	29616	07
Total	**1,999,800**	**858,460**	**373**

Source: Md. Anowar Hossain, Socio-Economic Analysis of Haor- A Case Study of Hakaluki Haor. Master's Thesis in Enviromental Econonmics: December 2013.

Hydrological Features of Haor Areas

Annual rainfall varies in these areas from 2200 mm along the Eastern boundary to 5800 mm in the North East corner and moves as high as 12000 mm towards some catchment at the top extending to India. The Regions start receiving water from catchment slopes of Shillong plateau in the North of India and Tippera Hills in the South East of India. Haor Areas are badly affected by monsoon circulation and during late March to September temperature fluctuates from 25 to 40 degree Celsius. Highest temperature in summer particularly in the month of June is recoded as 40 degree celsius but this hot spell persists for few days only. Winter begins from November to March and temperature also comes down to 20 degree Celsius and some days it comes to 8 degree Celsius even. (UN, IFAD, 2010).

Table 2: Seasons and Extent of Rainfall

Seasons	Duration	Extent of Rainfall
Pre Monsoon	April-May	Increasing rainfall/excessive rainfall for short duration
Monsoon	June-September	Heavy rainfall with long duration about 69 per cent
Post Monsoon	October-November	Decreasing rainfall about 6 to 8 per cent
Dry	December-March	No rain fall about 3 to 4 per cent

Source: Md Anowar Hossain, Cited above.

Socio Economic Analysis of the Haor People

A few selected Studies are available on Haor People. These studies are conducted with a view to attaining academic degrees from the universities (Md Anwar Hossain, 2013; Mohammad Sabbir Hossain, 2013; Md. Mizanur Rahman, Et al, 2014; Mahedul Islam Chowdhury, 2015). The studies suggest that most of the Haor people are poor. They take lands on lease basis from the big land owners who may be called absentee land owners who reside in urban areas and engage themselves in other occupations like business, politics and service sectors. The poor farmers live in tin roofed small houses which are constructed on a raised earthen platform. These houses are locally called as *Hatis*. The density of population is very high even higher than slum area of the city. The literacy rate is also very poor being 38 per cent. The school dropout is 44 per cent. The health and hygiene facilities are equally depressing, only 44 per cent people have access to sanitary latrine and so is the case of accessibility of pure drinking water. Seasonal unemployment is very acute owing to single crop cultivation (Mizanur Rahman Et al, 2014). Though Haor areas –the known sanctuary of fishes no more exists because of over exploitation of fishes. The fisher man becomes a net owner hanging net on the shoulder without any fish and unemployment problem seems alarming, reaching 24 per cent People are now migrating in the cities in search of works to earn their livelihood.

According to Security Atlas of World Food Program's (WFP cited by Bangladesh Government, 2004) Haor basin is one of the highly insecure regions of the country. The study reveals that five Haor districts have been rated as worst performers of fulfilling the targets of Millennium Development Goals (MDG).

Causes of Recent Disaster in Haor Regions

Normally Haor regions are the victims of two kinds of floods namely flash flood and river floods. Flash flood occur in the month of late April or early May and river flood appears in the months of Monsoon beginning from June to August (Md. Sabbir Hossain, 2013). In monsoon period the river flows with strong current with high wave and it is further aggravated by back water of Meghna river which causes massive flooding in depth and breadth and thus affecting sowing seeds boro paddy cultivation. Regarding flash flood Bangladesh is no stranger. She experiences this phenomenon every year and that experience is not harmful to them in any way. But this year's experience is very painful to them and is beyond their capacity to compensate in immediate future. There was immature arrival of flash water and farmers did not get time to harvest their paddy. Huge quantity of water flows down from upstream with tremendous force, which washed away the embankments of Haor Regions. This flash water was further triggered by torrential rain at Cherapunji Hill not very far off from Bangladesh border. This heavy downpour without any stop continued for three days also attributed to the colossal damage to the farmers. The washed away green paddy under deep water became rotten caused toxic water and resulting the death of fisheries, frogs and aquatic species. Along with paddy to be reserved for the whole year they lost plenty of fishes, chicken and ducks because of contaminated water and drinking water turned into serious problems for the Haor dwellers.

National Dailies report that in Hakaluki the largest Haor in Moulvibazar and Tanguar Haor in Sunamgonj, fishes and frogs were found floating dead in large quantities. One of the causes of death of fish and aquatic species suspected is the presence of a Uranium Mine in Shillong. The pit of the mine was kept open and in the monsoon rain water enters in it and the pit over flows with heavy rain and gets mixed with rain water and goes down to Haor. The location of the mine is three km away from Bangladesh border. Bangladesh Press media also reports that one Indian river flows by the side of the mine and is called the Ranikor River. Radioactive chemicals dragged by the rain water into the Ranikor river makes the river water green instead of blue which causes death to fish and aquatic species and this is the reason why it is referred to as the dead river because it has lost its vitality and ability to sustain life. (*The Daily Star*: April 21, 2017)

Damages Caused by Flash Flood Disaster

The term flood damage refers to all kinds of losses caused by flooding. There are different types of losses involving human and animal life, verities of economic losses of tangible and intangible nature (Md. Sabbir Hossain, 2013). Millions of Haor People have been passing through a crisis period as they have lost all their possessions like crops such as rice vegetables, fish, chicken and ducks and sold their cattle at a very cheap price because they have lost their grazing grounds. No comprehensive statistics of losses have yet been worked out by the Government sector but sporadic reports were published in the dailies as stated by the local Officials.

- 20 million farmers lost their livelihood
- Paddy fields covering two hundred thousand hectares were damaged
- 800 thousand metric tons of unclean rice was lost

- Day labourers lost 220,55400 mandays work
- Farmers lost crops amounting to 256 million dollars

Challenges in Haor Regions

A Study launched by CARE Bangladesh (CARE, 2016) identifies the falling cardinal constraints for socio agriculture development of the hoar areas:

- River Bank Erosion and creation of New channels
- Reduction of Navigability of Rivers and Canal Flowing through Haors
- Fragile and insufficient road links
- Weakness in leasing system of Fisheries
- Poor quality of life characterised by poverty, illiteracy and inadequate Infrastructure.

Macro Profile of the Haor Regions

The annual flooding that affects the Haor Regions submerges the land with standing crops, embankments and roads from May to October by heavy monsoon rain water flowing from the plateau of Shillong and Meghaloy towards North Tippera Hill in the East. Excessive water flow also indicates that there has been a dramatic shift in climate change. This speedy moving water force in huge quantity also results in massive floods accompanied by gusty winds which affect their single crop Boro Rice and at the same time their small houses locally known as Hatis (Houses constructed in a raised earthen platform).

During flood season Haor people are also deprived of education, health and minimum nutrients. Livelihood opportunities for people particularly marginalised farmers are extremely restricted by local elites and also the grazing ground for their cows and buffalos because of their conversion to paddy fields. The local elites ensure their political advantage through violence (Master Plan of the Haor Areas,Volume 1).

Women and girls in the haor regions experiencing multiple forms of inequality and discrimination which are reinforced by religious conservatism. They face higher rates of malnutrition and maternal mortality and have limited access to health care and education in the difficulties of transport in the flood season. The level of citizens participation in local development is very poor and marginalised group suffers most. Limited transparency and accountability of local governance undermines the delivery of services including social safety nets to assist the poor marginalised groups (Mahedul Islam Chowdhury, 2015).

Apart from large scale inundation of paddy field there have been sporadic flash floods in pocket areas due to occasional cut off embankments in a number of places across the Haor regions (IFAD, The Rural Poverty Report, 2010).

Observations and Recommendations

- Absolute dependence of Haor Regions on Agricuture sector like Boro Paddy cultivation and Catching Fish should be substituted by suitable alternatives by the Haor planners.
- The livelihood of the Haor people from the clutches of monotony of resources must be freed and diversity of works and employment should be designed and created by joint collaborations of the GO and NGO and creative people with the necessary incentives provided by GO, NGO and individual entrepreneurship.
- At present no hydrological or Metrological Data Analysis Institute exists on the Trans-boundary Catchment and No Joint Monitoring system is provided by both Bangladesh and India to measure the quantum of water flows from upstream to downstream owing to excessive rainfall in the plateau of Shillong and Meghalay. The presence of such institute is indispensable as Joint Monitoring of data will help construction of embankment up to certain height in order to resist the overflow of water and make the embankment stable, Along with the embankment this sluice gates should be constructed maintaining reasonable frequency of distance for draining out the access water. In that case growing paddy awaiting to be ripen will not be submerged. Attention should also be paid for proper engineering maintenance of sluice gates.

- Stop overexploitation of fisheries found in the water bodies framing and managing land policies and its regulation from restraining people from cultivating land for paddy in flood plain.
- Scattered settlements of the people should be discouraged and flood risk map should be drawn by the water experts by the Water Development Board so that people construct their houses in the safer zone which remains out of reach of aggressive flood water.
- Provision should also be made to evacuate the people from sudden and unexpected high wave of floods with strong current to a safer zone or community high-rise buildings to be used as flood shelters.
- Early warnings should be announced through microphones so that people can prepare themselves to move to safer shelters with their valuables.
- Research should be conducted by BARC and BARRI for exploring the early variety of paddy for harvesting paddy before the on rush of flash floods.

Conclusion

Virtually flash flood originates from the excessive rainfall in ChiraPunji in Meghalaya state which is the highest recorder of rainfall in the world hence some effort should be made jointly by India and Bangladesh for arresting large volume of water during pre- and post-monsoon periods by constructing huge dams and storing that access water. This water can be gainfully used in the dry season or lean period for the mutual advantage of both the countries, In case of joint collaboration the experience of Mekong River Commission of South-east Asia can be learned and skillfully used for the larger benefit of the people located in this regions of Haor.

Lastly, it can be added with a note of caution that flash flood is not only the cause of climate change but it is also a man-made disaster while local bureaucratic and political sectors are found idle and ineffective and corrupt while constructing embankments and its proper maintenance in appropriate time to combat the onrush of flash flood and flood water during the periods of pre and post monsoon.

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CARE Bangladesh engaged one social development consultant Sarah Ghallenham who outlined the strategy plan for Haor people, this project was financed by CARE, England. 2016.

Centre for Environmental and Geographical Information Services, Bangladesh Haor and Wetland Development Board under the Ministry of water Resources, Bangladesh Government, prepared a master plan for overall development of the Haor people analysing the challenges they have been facing since time in memorial

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Snow Avalanche Control Measures Schemes in North-Western Himalayas

Ganesh Kumar[a] and Ajay Gairola[b]

Abstract

Avalanche hazard severity has increased with the movement of civil and defense personnel towards snow bound areas of Indian Himalayas. The large variation in terrain feature, weather and snow fall in the north- western part of Himalaya emphases a systematic study of avalanche prone areas for avalanche hazard mitigation. The national highways joining the north western border states like Jammu and Kashmir, Himachal Pradesh and Uttrakhand with the rest part of India shut off many days due to avalanches. The study of avalanche control preventive schemes is made for two strategic important national highways NH-1A and NH-21. The national highway NH-1A is affected by 15 major avalanche sites between Banihal to Quazigund (Jammu and Kashmir, India) in the stretch of 40 km. The national highway from Manali to Leh (NH-21) is going to be diverted through Rohtang Tunnel to avoid 50 major avalanche sites and to reduce a distance by about 40 km. It was observed that the diverted national highway is also facing 18 major avalanche sites lying both sides of Rohtang Tunnel. Ground recognizance, zone planning of avalanche sites, snow and avalanche data, terrain features, road length affected by avalanches and geotechnical investigation have been analysed to optimise avalanche control structures schemes. Supporting structures, snow gallery and diversion walls have been incorporated in the planning of mitigation of the avalanche disaster in the region. The paper deals with the different avalanche control measures and schemes to avoid the avalanche disaster and to keep the national highways open throughout the year.

Keywords: snow, avalanche, formation zones, snowdrift, avalanche control structures

Introduction

The Indian Himalayas has a wide diversity in climatic and snow precipitation patterns. The north-western part of India observes heavy snowfall causing avalanches which cost human life and properties in the winter seasons. The snow characteristics and terrain features assume a wide variation in this region. The snowline varies from 2500 m to 3500 m above the sea level. Mainly avalanches occur in the Western Himalayas, Central Himalayas and North Eastern Himalayas, which are spread over a distance of 2500 km covering 26° N to 37° N latitudes and 72° E to 96° E longitudes. Of these areas, the area falling under Western Himalaya covering the states of Jammu and Kashmir (J&K), Himachal Pradesh and Uttarakhand extending from 30° N to 36°N latitudes, 73° E to 81° E longitudes and altitudes 2000 m to 7000 m is most populated and most affected area of avalanches. The researchers (Sharma S.S. and A. Ganju, 1999; Patra et al. 2005; Vinay et al., 2002) have studied avalanches and avalanche control structures for the Himalayan region. The complex nature of the terrain, high altitude and heavy snow precipitation due to Westerly Disturbances warrant avalanche activities (SS Sharma, 2000). National highway connecting border states are blocked in winter seasons due to avalanches. The Director General Border Roads Organisation (DGBRO), who is responsible for construction and maintenance of the highway, has been fighting a continuous war with a determination to keep the highway operational. To overcome these problems, avalanche control measures schemes have been planned for the national highway NH-1A passing through Jawahar tunnel and the diverted highway NH-21 passing through Rohtang Tunnel (under construction). The national highway NH-1A is affected by 15 avalanche sites namely avalanche site D-1 to avalanche site D-15 between Banihal to Quazigund (Jammu and Kashmir, India). Now the national highway NH-1A is the part of India longest highway NH-44 from Srinagar to Kanyakumari. The avalanche sites affecting the diverted national highway NH-21 between Manali to Keylong (Himachal Pradesh) are named MSP-1 to MSP-13 for south portal side avalanche sites commencing from Manali and MNP-1 to MNP-5 for avalanche sites on north portal of Rohtang Tunnel. The avalanche zone

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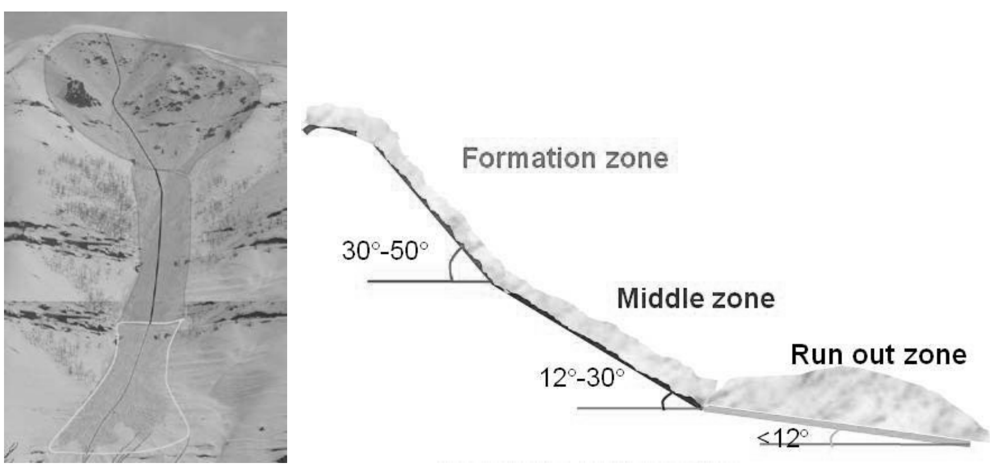
planning, ground survey, snow data analysis and geotechnological investigation were followed to find the suitable avalanche control measures affecting the national highways. Despite the severity ofthe problem and hazards, the avalanche control protective measures for the national highways have been planned to reduce their closure periods.

Due to avalanches and heavy snow precipitations, many avalanche accidents take placein snow bound area of the north-western part of India causing losses of properties and humanlife every year. The national highways in the border states remain to be closed near Rohtangpass, Jawahar tunnel and Khardung La. These closures of highway affect badly the supply of basic life supporting materials like food, fuel, medicines, etc. The different avalanche control schemes have been planned to overcome these problems and to keep open the highway throughout the year. It was observed that most of the avalanche sites affecting national highways pass through the middle zone of avalanche sites and terminate in the valley or river. Therefore, the supporting structures and middle zone avalanche control structures like snow gallery and diversion dams are found optimal avalanche control measures in the north- western Himalayan region. Identification, avalanche hazard mapping, selection of avalanche control structures and mitigation of avalanche hazard have been adopted to mitigate the avalanche disaster from these areas (Robin Fell, et al. 2008).

Prerequisite for Avalanche Protective Measures

A snow avalanche initiates from the top of mountains called formation zone having terrain slope between 30° and 50° due to gravitational force (McClung, D. and Schaerer, P., 1993). Gradually, the avalanche gets maximum momentum in the middle zone and terminates in the runout zone (Figure 1). The terrain feature, snow deposition and weather are the main factors of avalanche. Hence, a detailed study of these parameters is carried out for the most suitable avalanche control structure on the basis of observations and analysis of snow and metrological data taken for more than 20 years. The risk level at the road site indicates the severity of the problem and accordingly procedures are taken for the planning of preventive measures. The following main maneuvers are followed to access the risk involved and suitable avalanche control structures for a particular avalanche site:



Avalanche Path Cross Section

Figure 1: Schematic diagram of avalanche path and its zones

Ground Reconnaissance Survey

The ground reconnaissance survey is the first physical observation and verification of the avalanche occurrences, avalanche site and damages/changes caused by avalanches in the region (Figure 2). Snow and Avalanche Study Establishment (SASE) has permanent observatories at different parts of Himalaya to gather snow and avalanche information during ground reconnaissance and to disseminate the avalanche awareness to the people working in snow boundarea. The instruments like Total Station, GPS, magnetic compass and electronics distance finders are used to gather the information of terrain features, formation zone, aspect and affected road length. The local people interaction and observation of changes in vegetations are made to get the historical data of avalanche occurrences and their influence zones. The case study of the ground reconnaissance for MSP-1 to MSP-13 (south portal of Rohtang Tunnel) is illustrated in Table 1.

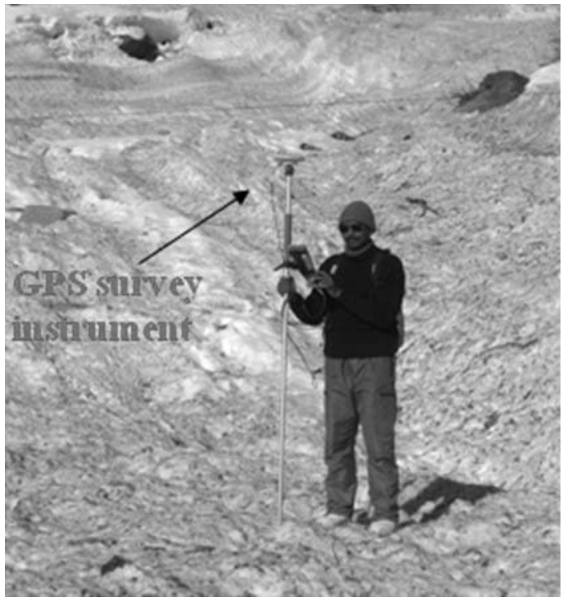


Figure 2: GPS survey of avalanche site (MSP-7)

Table 1: Avalanche Sites Existing on South Portal of Rohtang Tunnel (Himachal Pradesh, India)

S. No.	Name of Avalanche Site	Distance from Manali (kms from.. to..)	Foundation Zone Area (hectares)	Average slope of Formation Zone	Aspect	Frequency	Avalanche Path Feature	Road Affected Length (m)
1.	MSP-1	4.86 to 5.46	5.7	42.0°	W	Low	Unconfined	600
2.	MSP-2	9.46 to 9.51	3.0	30.5°	E	High	Confined	50
3.	MSP-3	9.73 to 9.83	42.2	30.5°	E	High	Confined	130
4.	MSP-4	10.34 to10.84	8.6	31.5°	N	High	Unconfined	500
5.	MSP-5	11.97 to12.12	19.4	35.3°	N	High	Unconfined	350
6.	MSP-6	13.01 to13.90	2.8	42.7°	N	High	Unconfined	80
7.	MSP-7	13.50 to13.62	58.7	39.1°	NE	High	Confined	120
8.	MSP-8	14.05 to14.10	4.1	34.8°	N	High	Unconfined	50
9.	MSP-9	14.35 to14.40	10.9	33.6°	N	High	Confined	50
10.	MSP-10	14.67 to —	16.0	37.4°	N	High	Confined	0
11.	MSP-11	17.31 to17.71	13.5	30.0°	SW	Medium	Confined	400
12.	MSP-12	18.49 to18.59	15.3	31.5°	SW	High	Confined	100
13.	MSP-13	19.22 to19.23	27.1	34.7°	SW	High	Confined	100

Zone Planning

In the zone planning of the avalanche site, marking of avalanche path and its influence zones are demarcated based on terrain slope and estimated avalanche intensity. A topographical map of higher scale (1: 500) or digital elevation model (DEM) of higher resolution is used for zone planning. Avalanche tracks are demarcated in three zones namely formation zone, middle and runout zone (Figure 2). The avalanche triggers in the formation zone and its velocity increases subsequently. The avalanche pressure in the avalanche path is given by equation 1. The avalanche velocity is determined by the equation 2 (Salm et al., 1990).

Avalanche pressure, $P = \rho V2$ .... (1)

Velocity of avalanche, $v = \sqrt{\zeta \times d \times (\sin\theta - \mu\cos\theta)}$ ………………..(2)

Where,

q = Average slope of the formation area

d = Expected or modified fracture depth which is given by

$$d = d_0 \times \frac{0.291}{\sin\theta - 0.202\cos\theta}$$

d_o= fracture depth taken from previous observations etc.

ζ =Turbulence coefficient for the selected avalanches site taken 600 to 800 m/sec^2 generally

= Coefficient of friction = 0.1 – 0.155

The avalanche site is mapped with red zone, blue and yellow zones based on impact pressure and return period as given below.

(a) Red zone: an area where the return period is less than 30 years and impact pressures are greater than or equal to 30 kPa. In this zone, no structure is recommended.

(b) Blue Zone: an area is exposed of 1 kPa to 30 kPa pressure in the return period of 30 to 300 years. A structure can be built with proper design and protective measures.

(c) Yellow zone: it is less affected with avalanche and has less than 1 kPa pressure. A structure is permitted with a specific design and precautionary guidelines.

Zone planning has been carried out for the avalanche sites affecting the national highways fordeterminations of the hazard intensity along the avalanche path (Figure 3).

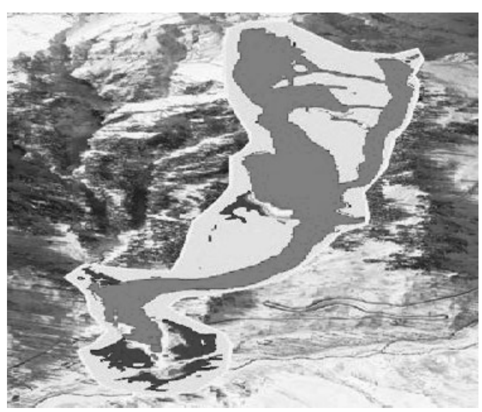


Figure 3: Schematic view of red, blue and yellow zone

Topographical and Aerial Survey

All topographical survey features such as nallahs, streams, exposed sheet rocks, tracks, roads, etc., have been surveyed near the proposed avalanche control structures. The aerial survey was extremely helpful for difficult and inaccessible parts of avalanche sites during the ground reconnaissance. Levels have also been taken at about every 20 m centre to centre and also at all salient points using the high-end total station. The entire survey data captured using Total Station and GPS are transferred to the topographical survey drawings 1:500 scale. Contours have been drawn at 1 m interval based on spot levels for the important national highway like NH-1A and NH-21. The aerial survey is very important to collect information of the area which is difficult to access during the ground recognizance.

Geotechnical and Hydrological Survey

A geotechnical and hydrological survey is important for the construction of avalanche control structures on the site. A geotechnical survey using the in-situ and laboratory test was carried out by bore drilling up to 15m (Figure 4) near avalanche site MSP-7 in Pir Panjal range of Himalayas. Dynamic cone test, plate load test has been conducted to know the bearing capacity and other important geotechnical parameters. The blackish gray colour silty sand with gravel/cobble soil is generally found at the site. The hydrological survey is conducted to know the maximum flood discharge at cloudburst condition in case of the perennial source of water.

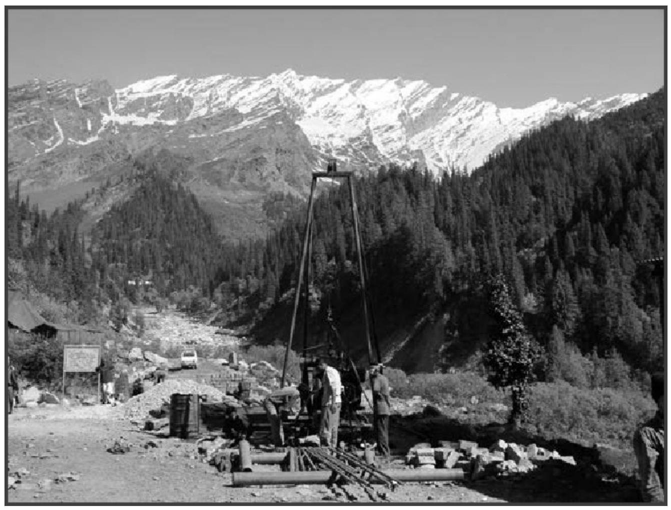


Figure 4: Bore drilling for geotechnical investigation

Avalanche Control Measures

The active and passive methods are applied for mitigation of avalanche hazards. The active method of avalanche mitigating measures consists of permanent avalanche control structures and artificial triggering of avalanches. The avalanche forecasting, hazard mapping and avalanche awareness are carried out under the passive method of avalanche mitigation. The permanent avalanche control structures based on avalanche zone are divided into three groups:

I. Formation zone control structures or supporting structures: snow rake, snow bridge and snow nets
II. Middle zone control structures: snow gallery and diversion dam
III. Runout zone control structure: catch dam and mounds

The snowdrift redistributes the natural precipitated snow and creates snow cornices. To reduce the formation of cornices and overloading of snow mass on formation zone, the snowdrift controlstructures like snow fence, jet roof and baffle wall are used on the ridgeline of mountains (Ganesh Kumar, 2015). Generally, a combination of different avalanche control structures is applied for mitigation of avalanche hazards effectively. A suitable avalanche control structure fora specific avalanche site is planned on the basis of the following main criteria:

- Type and intensity of avalanche hazard,
- Avalanche path terrain
- Type of avalanche expected
- Environmental aspects
- Economical criteria

A case study of the avalanche control measures schemes has been carried out for avalanche site D-10 (Vinay et al., 2002). The supporting structures have been installed in a continuous and discontinuous manner based on terrain topography. The avalanches in this region are influenced by drifted snow mass. Hence snowdrift control structures like snow fence and jet roof (Figure 6). In the middle zone avalanche has the maximum intensity and so a structure called snow gallery is recommended to allow the avalanche flow over it with the safety of traffic inside. Snow galleries and diversion walls are built for safe traffic passage and diversion of the avalanche respectively in the middle zone (Figure 7).

(i) Snow Rake (ii) Snow Bridge (iii) Snow Net

Figure 5: Supporting structures (i) snow rake (ii) snow bridge and (iii) snow net

(i) Snow Fence (ii) Jet roof

Figure 6: Snowdrift control structures (i) Snow fence (ii) Jet roof

Figure 7: Snow Gallery constructed at MSP-7 (Manali, Himachal Pradesh, India)

Discussion

Avalanche hazard management is the identification, assessment and mitigation of avalanche hazards with active and passive methods (Nicole Bischof, 2008). In Himalaya, avalanches sites are extended in a large area having different terrain features and snow characteristics at high altitude of more than 2500 m from mean sea level (MSL). An extensive study of an avalanche site is carried out to fulfill the prerequisite avalanche mitigation scheme. The snow and metrological data has have been observed and analysed for avalanche control protective measures for more than 10 years. A sample of snow and metrological data for the winter season 2016–2017 collected at Banihal top observatory (India) is illustared in Figure 8. and Figure 9.

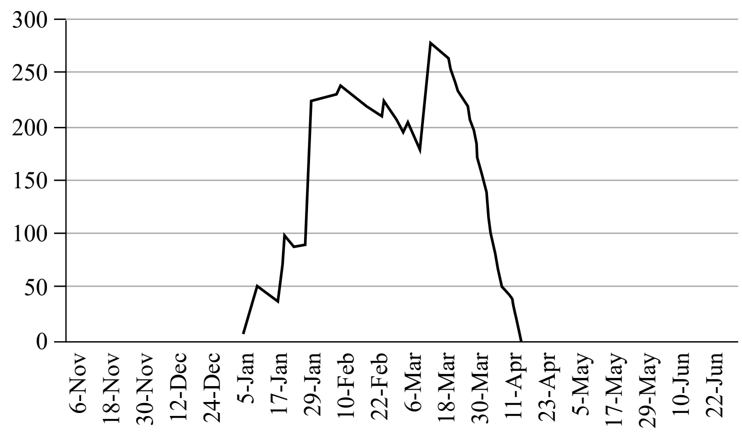


Figure 8: Mean standing snow (cm) for 2016–17 at Banihal Top (Jammu and Kashmir, India)

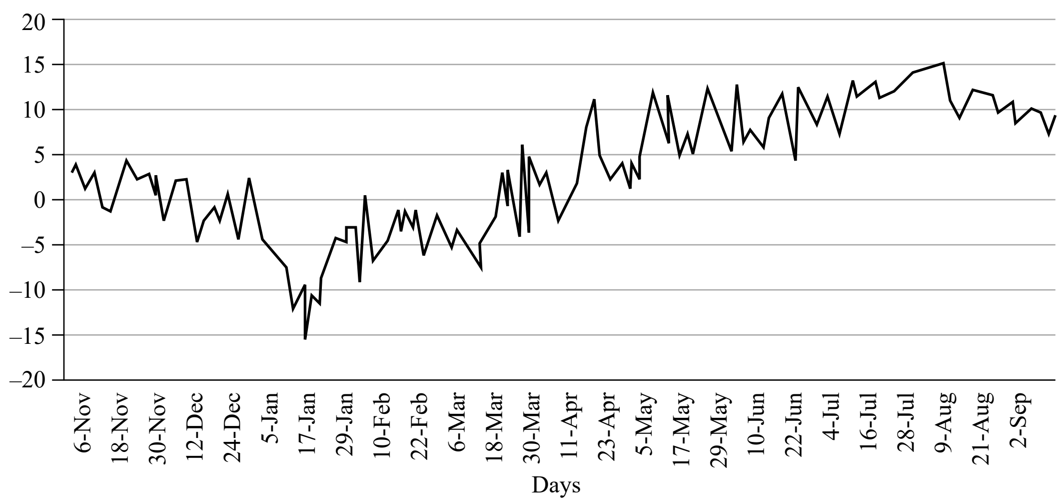


Figure 9: Mean minimum temperature for 2016–17 at Banihal Top (Jammu and Kashmir, India)

It shows that the snow season is generally November to April and maximum standing snow lies in the months of February-March. The standing snow varies with terrain feature, aspect, altitude and weather conditions of the site. These factors govern the avalanche occurrences in the region.

The shape of avalanche site is also varied near the highway and it is found that some avalanche sites are confined and some are unconfined (Table 1). Snow gallery is preferred in caseof confined avalanche site near the highway. The position of the highway on the avalanche path and snow accumulation with its frequency plays an important role in decision making for avalanche control structure. The highway NH-1A crosses the avalanche path of D-14 at three places and hence supporting structures are found more economical and feasible avalanche control schemes. Similar avalanche control measures have been planned taken consideration of all the aspects of the selection of avalanche control schemes. A combination of different avalanche control structures (snow rakes, snow bridges, snow nets) and snowdrift control structures (snow fence and jet roof) has been installed at the avalanche site D-10 (Figure 10).

Figure 10: Supporting structures installed at avalanche site D-10 (Jammu and Kashmir)

The zone planning of all the avalanche sites affecting the national highway NH-1A and NH-21 are carried out. The zone planning facilitates to visualise the avalanche hazard and its intensityby getting avalanche path, avalanche flow pattern and hazard maps. Main avalanche control structures selected for the avalanche sites affecting the national highways are given in Table 3.

Table 3: Main Avalanche Sites and their Control Structures

Affecting National Highways	Avalanche Sites	Avalanche Control Structures
National highway NH- 1A or NH-44 (Between Jammu and Srinagar)	D-7, D-8, D-10, D-12, D-14	Supporting structures (snow rake, snow bride, snow nets)
	D-1 to D-6, D-9, D-11, D-13	Snow gallery and diversion dam
	D-15	Catch dam and Mounds
National highway NH- 21 (Between Manali to Keylong (Himachal Pradesh))	MSP-1, MSP-2, MSP-4, MSP-5, MSP-6, MSP-11, MSP-12 and MNP-2, 4,5	Supporting structures (snow rake, snow bride, snow nets)
	MSP-3, MSP-7 to MSP-10 and MNP-1 MNP -3	Middle zone control structures (Snow gallery, diversion wall etc.)

The affected road length and formation zone area play a important role in deciding the avalanche control structure. The benefit-cost ratio (BCR) is one of the parameters for execution of the avalanche control measures in the region. But highways in the North West region have strategic importance and so the Indian government is working to execute the avalanche control schemes which are technically feasible and economically viable for mitigation of avalanche disasters.

Conclusion

Due to large variations in climatic, topographic features and snow precipitations, the North-western part of the Himalayas observes maximum avalanche disaster. The snow accumulation depends on altitude and other geographical parameters of the region. The unstable accumulated snow results in an avalanches which cause loss of human lives and property along with hindrance in transportation and communication. The national highways in the Border States are badly affected by avalanches and hence avalanche control schemes have been planned.

The planning of avalanche control schemes consists of identification of avalanche site, zone planning, hazard mapping and selection of suitable avalanche control measures for the avalanche sites. In this respect, avalanche control mitigation schemes have been formulated for the national highway NH-1A and NH-21 to reduce the closure period and protection from avalanches. The topographical survey is conducted for the selected area for the exact layout and material calculations of avalanche measures. The geotechnical and geological survey data are used for the planning of foundations of avalanche control measures. Integrated schemes for the diverted highway are finalised after taking into consideration of catchments area, shape and size of formation area, affecting road length, the feasibility of control measures and costs. The highway mainly crosses at the middle zone of avalanche sites and so formation and middle zone control measures have been planned. The implementation of avalanche control measuring schemes will provide safety from avalanche hazards and all weather road linkage to the north part of India.

Acknowledgements

The authors are grateful to Ashwagosha Ganju, Director SASE for his supports to write this paper. They also like to extend their thanks to the staffs of Hazard Mitigation Engineering group (SASE) who had involved in collecting the avalanche data and hazard mapping. Border Road Organisation is involved in maintaining the national highway and reducing the closure period of the road during winter. The execution work of snow avalanche control measures will be carried out by BRO and hence authors are grateful for his interest in this task.

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Parameters and Methodologies for Earthquake Early Warning System

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Abstract

The term "Earthquake Early Warning" (EEW) is used to describe real time earthquake information system that has the capacity to detect the onset of earthquake, estimate the size of earthquake and issue warning prior to the significant ground shaking. The physical basis of the earthquake early warning system is that the strong ground shaking are caused by shear-waves (secondary wave) which travel at about half the speed of the primary waves and these are very much slower than electromagnetic signals. In case of a regional EEW system, when an earthquake strikes in the seismic sensor's instrumented region, the ground motions felt by seismic sensors are streamed to the central server at the control room. Various earthquake early warning parameters namely predominant period, characteristic period parameter, low pass filtered peak displacement, squared velocity integral, log averaged period, cumulative absolute velocity, bracketed cumulative absolute velocity, windowed bracketed cumulative absolute velocity, root mean squared velocity are available and on the basis of the capacity of the EEW system these parameters are measured. Many working EEW systems like UrEDAS, Compact UrEDAS, AcCO, FREQL, ElarmS, PRESTo, and SASMEX are developed and being used by different countries around the world. Virtual Seismologist, t_C–P_d Onsite, PreSEIS, and PreSEIS Onsite are methods for EEW system. Virtual Sub Network is procedure and is being used in Taiwan EEW system. When the values of the parameters used in the above specified methods increases over the preset threshold value, earthquake warning is issued to public as well as facilities of national importance to automatic shutdown of its operations.

Keywords: Earthquake Early Warning (EEW), seismic sensors, parameters, methodology

Introduction

Natural disasters have always been very frightening and devastating to human because of their unpredictable nature. Earthquake is one of them and it has always been very disastrous to mankind. It has caused inconceivable losses and its evidences can be found in the literature.

In the last few decades economic losses due to natural disasters including earthquakes have increased many fold across the world and little effort is being made to reduce their impact on the society. In the direction of making our society disaster resilient, huge loss, due to earthquake, can be avoided if we could succeed to give alert before the occurrence of impending earthquake. For this, scientists from across the globe are giving their best efforts in the development of early warning system (Friedemann et al., 1999; Constantin et al., 2013; Alcik et al., 2009; Allen and Kanamori, 2003; Emanuel et al., 2007; Espinosa-Aranda et al., 1991, 2009; Georgia et al., 2009; Wu and Kanamori, 2005, 2008; Nakamura and Saita, 2013a, 2013b; Zollo et al., 2013).

The term "earthquake early warning" (EEW) is used to describe real-time earthquake information system that has the capability and potential to provide warning prior to significant ground shaking (Allen et al., 2009). Warning times ranges from few seconds to a little more than a minute and are primarily a function of the distance from the user to the epicenter of the earthquake. An early warning system is required mainly to issue an alarm to have a time margin for evacuating people, shutting down key facilities and not to determine exact earthquake parameters.

The concept of earthquake early warning evolved after the discovery of electricity and communication system as these two factors are the key pillar of successfulness of any earthquake early warning system, fueled by combination

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of instrumentation and expansion of seismic network with advance sensors, methodology development and awareness of increasing threat posed by earthquake. It has become the first priority of the seismological research community to reduce risk imposed by earthquake.

The physical basis of earthquake early warning is the speed of primary waves (P-wave) which is almost twice the secondary waves (destructive waves, S-wave) and speed of electromagnetic waves which are much faster than these two seismic waves. Whenever an earthquake strikes in a seismically active region, EEW system analyse initial portion of P-wave and in some case S-wave also. The analysis of these waves is done by various earthquake early warning parameters or the combination of these parameters. To get the accurate, reliable and rapid estimation of the waveform, we need to set the very specific threshold values of the EEW parameters.

High speed telecommunication and high performance computers are used to perform computational operations and EEW algorithms are used to issue warning. Warning time depends on the distance of the target city from the epicenter minus computational time at the central server and it is termed as lead time (i.e. processing time of first few seconds of P-wave after P-onset and time taken by destructive S-waves arrival to the target city).

Parameters for Earthquake Early Warning

Predominant Period (t_P): Small magnitude earthquakes are the result of the small patch of rupture over the fault and generate high frequency energy in comparison to the large rupture (large earthquake) over the fault results into radiation of low frequency energy. Therefore predominant period of the initial portion of the seismic waveform in few seconds after the P-wave arrival constrain to the magnitude. The predominant period is determined continuously in real time from the vertical component of the velocity sensor at each station and is defined with the recursive relation (Nakamura, 1988; Allen and Kanamori, 2003).

Characteristic Period Parameter (t_C): It represent the initial period of strong ground motion. Small and large events represents short and long period of initial motions respectively, therefore it can be an earthquake warning parameter. Kinematic source model (Sato and Hirasava, 1973) is the basis for t_C. To compute period parameter, first compute factor r as follows.

$$r = \left[\int_0^{t_0} u^2(t)dt\right] / \left[\int_0^{t_0} u^2(t)dt\right]$$

The period parameter t_C is computed as

$$\tau_C = 2\pi / \sqrt{r}$$

Where $\dot{u}$, u are the high pass filtered velocity and displacement of vertical component of the seismic waveform over a fixed time window t0 respectively (Kanamori, 2005, Wu and kanamori, 2005, 2008). For the earthquake early warning, if τ_c<1 sec then the ground motion has already ended or not growing Mw > 6. If τ_c>1 sec then it is likely to grow but how long it will grow can't be determined. In this case this parameter provides a threshold warning for large damaging events.

Cumulative Absolute Velocity (CAV): Kennedy and Reed (EPRI,1988) proposed new EEW parameter (cumulative absolute velocity CAV) for application nuclear power plant during a study sponsored by Electric Power Research Institute, Palo Alto, California. It is defined as integral of absolute value of ground acceleration over the seismic time history record. The velocity content present in the velocity record is associated to the energy content of the earthquake at the recording site. Therefore it is used to determine the damaged threshold of engineering structures associated with the impending earthquake (Reed and Kassawara, 1990).

Bracketed Cumulative Absolute Velocity (BCAV): CAV is not related with the arrival time of different phases of energy but it is more sensitive to low frequencies (damaging) motions than high frequencies (non-damaging) motion. Therefore, EPRI in 1991 modified the CAV calculation by removing the non-damaging acceleration's values from the records. The time histories having the maximum acceleration values greater than the predetermined acceleration value (0.025 g) within a selected time domain were considered for calculating modified CAV values and are termed as standardised CAV (Bracketed Cumulative Average Velocity-BCAV) (Alcik et al., 2009).

Windowed Bracketed Cumulative Absolute Velocity (BCAV-W): Onsite earthquake early warning systems employed in the buildings and industrial facilities require some improvements over BCAV due to some reasons. The main reasons are a) to eliminate the accumulated BCAV values due to some reasons like high noise, small earthquakes and far-field events, b) to adjust the minimum acceleration level which is proposed to the nuclear power plant to consider the lower acceleration level for building type structures, c) to identify the short time earthquake motions with very large peak ground accelerations (near field impulsive) from the long time earthquake motions with lower acceleration level (far field). BCAV-W is calculated by windowing BCAV calculation on a broader window length (W) basis. Alcik considers window length as 8 sec to perform this algorithm on his dataset. It is calculated as follows (Alcik el al., 2009):

$$\mathrm{BCAV-W} = \sum_{W=1}^{\text{win length}} \int_{t_i}^{t_i+\Delta t} |a(t)|\,dt$$

Where Δt=1 sec

Max a(t) > min acc. level

Low-Pass Filtered Peak Displacement ($\mathbf{P_d}$): Using data from Taiwan, Wu & Kanamori (2005) showed that the peak initial displacement amplitude, Pd, correlates well with the peak ground-motion velocity, *PGV*, at the same site and when Pd> 0.5 cm, the event is most likely damaging. Wu & Kanamori (2005) demonstrated that the combination of the τ_c and Pd methods can provide reliable threshold warnings within 10 s after the occurrence of a large earthquake. Wu and Zhao (2006) investigated the attenuation of Pd with the hypocentral distance R, magnitude M, and obtained the following relationships:

MPd = A + Blog(Pd) + Clog(R)

Squared Velocity Integral (IV2): It was investigated from the scaling of the early radiated energy, inferred from the square velocity integral, a new EEW parameter to the magnitude of earthquake. This new parameter considers the initial portion of P-wave and S-wave and can be formulated as:

Where the subscript c refers to the P and S phase, τ_c is the corresponding first arrival, and vc is the particle velocity measured on the seismogram. Finally Δtc is the length of the signal along with analyses is performed (Festa et al., 2008).

The Log-Averaged Period (τlog): This parameter is based on the measurement of frequency content of the initial portion of P-wave like τp and τc but has improvement over these two commonly used EEW parameters. τp and τc yield correct solution only in cases where the signal is noise free and monochromatic while τlog is calculated directly from the actual velocity spectra and therefore reflects the signal's true frequency content.

The log-average period, τlog is calculated from the spectrum of the early part of the velocity seismogram as follows:

I. A pre-specified interval is extracted, starting at the time of the P-wave arrival

II. A Hann window is applied to reduce abrupt end effects

III. The resulting signal is Fourier transformed to get the set of power spectrum coefficients Pi(wi)

IV. The set of uniformly spaced Pi is resampled to get a set that is spaced every 0.1 log unit of frequency, between 0.1 and 10 Hz, and finally

V. The log-average period, τlog is obtained through:

log(τlog)= Σ(Pi∗(wi)log (1wi⁄))iΣ(Pi∗(wi))i

where the asterisk indicates that the power spectrum is resampled according to step IV. It is emphasised that replacing Pi with Pi∗ in the above expression, and or multiplying the power spectrum coefficients by 1⁄wi instead of log(1⁄wi) would result in an average period that is biased toward the highest frequencies in the spectrum. It was noted that the switch from approximate quantities, such as τpmax and τc to the exact quantity τlog improves real-time magnitude estimates (Ziv, 2014).

Root Sum Square Cumulative Velocity (RSSCV): The RSSCV is another EEW parameter which includes the cumulative effect (amplitude and time) of ground motion duration. RSSCV is also an integral EEW parameter same as CAV and is defined as:

RSSCV= √Σvi2ni=1

where vi is the velocity vector calculated by taking integral of strong motion records for n number of samples in the selected window. RSSCV helps in enhancing the SNR and reduces the standard error in observational seismology (Bhardwaj et al., 2012, 2015).

EEW Methods Being Used in the EEW Systems Around the World

$\tau c - Pd$ Onsite

The $\tau c - Pd$ Onsite algorithm is used in on-site warning system. This type of warning approach provides quicker detection and processing of earthquake waveform but is less reliable in comparison of regional warning algorithms that are based on the processing of the multiple seismic sensor data. This algorithm was developed by Kanamori (2005). This was an extension of some earlier methods proposed by Nakamura (1988) and Allen and Kanamori (2003). This algorithm uses the period τc and amplitude Pd of initial shaking to estimate the size and forthcoming shaking due to impending earthquake (Wu et al., 2007).

PreSEIS

PreSEIS uses three two layer feed forward (TLFF) Artificial Neural Network (ANN) and each network is used for specific purpose. First TLFF uses the time differences (time difference in P-onset at first station to the P-onset on the remaining stations in the seismic instruments network) to estimate the hypocentre location, second TLFF uses the hypocentre location and CAV of each sensor to estimate the Magnitude of impending earthquake and, third TLFF uses the hypocentre location, CAV and Magnitude to estimate the rupture starting and ending location to know about the rupture.

Training of TLFF is done using some earthquake time histories whose hypocentre location, magnitude and rupture information is known to us. The main purpose of training this network is to set the weight parameters and this is done by backpropagation approach.

For warning purpose, the new parameter (ground motion parameter IM) is calculated at each timestamp using the source parameters and site conditions and can be expressed as:

$$I\hat{M}(\lambda, \theta) = f(\hat{M}^n, \hat{d}^n_{rup}, \text{site})$$

Where (λ, θ) is the location of site of interest for which warning needs to be issued, $\hat{M}^n$ is the estimated magnitude obtained from TLFF, $\hat{d}^n_{rup}$ is distance between rupture and site of interest at each timestamp and, site represents site characteristic of area of interest. Waring of impending earthquake will be issued iff $I\hat{M}(\lambda, \theta) \geq IM_{thres}$ (Böse et al., 2008).

PreSEIS Onsite

PreSEIS on-site (ANN based) approach is the further improvement over network based PreSEIS approach. This algorithm uses acceleration, velocity and displacement of three components (EW, NW, UD) sensor's seismic waveform to perform real time earthquake/noise discrimination and near/far source classification. When P-onset is detected at a sensor then this algorithm starts to estimate the moment magnitude M, epicentral distance Δ (Km), and peak ground velocity (PGV) of the impending earthquake at the site of observation at every time interval of $t0 = 0.25$ seconds and continue to update the estimations until $t0 = 10$ sec.

PreSEIS uses the acceleration, velocity and displacement waveform time series, $\ddot{u}(t)$, $\dot{u}(t)$, and $u(t)$ recorded at a single three component seismic sensor, obtained from the integration and differentiation of the recorded time series, respectively. The time series are parameterised by integration absolute amplitude on component i (i = NS, EW, UD) over the time interval between the P-onset and a given time t0. To consider the site characteristics, V_{s30} is used as an input parameter in PreSEIS (Böse et al., 2012).

Virtual Seismologist

The Virtual Seismologist (VS) method is based on the Bayesian theorem in Earthquake Early Warning (EEW) that estimates earthquake magnitude and location using observed ground motion amplitudes, predefined prior information, and envelope attenuation relationships (Cua et al. 2009;Cua and Heaton 2007). The application of Bayes theorem in EEW states that the most probable source estimate at any given time is a combination of contributions of prior information (i.e. network topology or station health status, regional hazard maps, earthquake forecasts, the Gutenberg-Richter magnitude-frequency relationship) and the real time streamed ground motion observations. VS is considered as an intelligent and smart automatic system capable enough to imitate the work of a human seismologist. Because VS based on the prior information as well as the currently available real-time waveforms makes it unique in comparison to other available EEW algorithms. This method has the capability to make quick, relatively accurate interpretation from real time earthquake waveform using the experience and the available streamed ground motion data. This method continuously updates the source estimates and predicts ground motion at each second due to change in the likelihood function as arrival of additional data.

UrEDAS

In General, the conventional early warning instruments (seismometers) issue the warning, when earthquake motion (seismic acceleration) exceeds a preset level. For example, in 1965 in Japan, Alarm seismometers were installed every 20 to 25 km along the Shinkansen railway line to issue an alarm if the acceleration of horizontal ground motion exceeds 40 Gal (= cm/sec^2) (Nakamura and Saita, 2013a). But UrEDAS, in contrast, first judge the devastating potential of impending earthquake by observing the initial portion of P-wave in terms of magnitude and location, and issue the waring if necessary. The UrEDAS estimates the magnitude and hypocenter, depth, and epicentral azimuth of earthquake immediately after the P-wave arrivals at a seismic sensor and like other seismic observation systems, does not transmit the wave form to remote processing or centralised system (Nakamura, 1988).

Compact UrEDAS

Compact UrEDAS estimates the expected destructiveness of the earthquake immediately from the earthquake motion directly, not from the earthquake parameters as UrEDAS, and then issues the alarm if needed. To estimate earthquake dangerousness, the power of the earthquake motion is calculated from the inner product of acceleration vector and velocity vector, but this value will be large. Hence Destructive Intensity (DI) is defined as the logarithm of absolute value of this inner product as DI = log |AV|. When the P wave arrives, DI increases drastically. PI value is defined as maximum DI within t seconds after P-wave detection. This value is suggested to be used for P-wave alarm. Subsequently, DI continues to increase slowly until the S-wave arrival, after which it reaches its maximum value which is called the DI value. This value relates to earthquake damage and is similar to the Instrumental Intensity scale of JMA or Modified Mercalli Intensity (MMI).

Instrumental JMA seismic intensity can be determined only after the earthquake has terminated. On the other hand, DI has a very important practical advantage, because it can be calculated in real time soon after the P-wave arrival with physical meaning. In other words, with the continuous observations of DI, an earthquake alarm can be issued efficiently and damage can be estimated precisely. In terms of JMA, intensity is expressed in term of real intensity (RI) as (Nakamura and Saita, 2013b):

$$RI = DI + 2.4$$

And

$$MMI = (11/7)\,DI + 4.27 = (11/7)RI + 0.50$$

AcCO

Acceleration collector is just a palmtop type instrument and indicates acceleration and world first real time intensity. AcCO issues an alarm with the trigger of both acceleration and intensity. AcCO indicates acceleration and intensity if the 5HzPGA (5 Hz low passed peak ground acceleration) exceeds 5 Gal. Intensity can be expressed as RI, MMI, PEIS, Philippine Earthquake Intensity Scale (Nakamura and Saita, 2013b).

FREQL

It is fast response equipment and integrates the functions of UrEDAS, Compact UrEDAS and AcCO. It estimates earthquake parameters in one second after P-wave detection faster than UrEDAS, judges the dangerousness of the earthquake motion one second after detection of P-wave faster than Compact UrEDAS, and outputs the information and alarm based on both acceleration and RI in real time in the same way as AcCO does (Nakamura and Saita, 2013b).

ElarmS

Earthquake Alarm Systems (ElarmS) is a network based Earthquake Early Warning (EEW) system. It functions on the basis of three algorithms participating in the California Integrated Seismic Network acronym as CISN ShakeAlert project. P-wave detections and subsequent parameters (frequency, amplitude based) are combined from several proximal stations to collectively characterise an event (Köhler et al., 2009). ElarmS consists of two processing modules. The Waveform Processing module (WP) runs in parallel at three locations (UC Berkeley, USGS Menlo Park, Caltech/USGS Pasadena) and receives constantly streaming waveforms from seismic sensors throughout California. The WP scans the waveforms looking for P-wave arrivals, detected by a short-term/long-term average method (Allen, 1978). When a P-wave is detected, the WP records peak amplitudes (displacement, velocity and acceleration), maximum predominant period, and signal to noise ratios every tenth of a second for 4s following the P-wave pick. Every second it sends these parameters, along with the original P-wave arrival time, to the ElarmS Event Monitor module. The Event Monitor module, or EVM, runs in a single installation at UC Berkeley. It receives the P-wave detections and parameters from the three WP modules, and identifies the imminent earthquakes in progress, by associating triggers (P-wave detections), estimating event location and estimating event magnitude. Finally the EVM sends an alert message to the ShakeAlert Decision Module if appropriate (Brown et al., 2011).

Virtual Sub Network

A continuous telemetered strong motion network is installed in Taiwan, and a Rapid Earthquake Information Release System (RTD) is implemented by the Central Weather Bureau (CWB) for monitoring earthquakes in real time since 1995(Wu et al. 1997). Till now, RTD comprises 109 telemetered seismic stations and 400+ Palert across all seismic active regions in Taiwan (Wu et al., 2013b). As soon as the RTD is triggered by an event, the system automatically extracts a subset of the RTD input signal channels and configures a VSN with a 60 Km radius centered in the event. Signals of all station within 60 Km radius are grouped together and extracted through a Multi-IO-Board to form VSN input, which will then processed in parallel through the VSN software in a dedicated computer to find out the magnitude and location of the event. 10 sec waveform data represents the optimum results (Wu et al., 2013a).

PRESTo

Earthquake Early Warning for Southern Italy applies both regional and onsite approaches to issue earthquake alarm. The Irpinia Seismic Network (ISNet) was designed in 2002 as an advanced research seismic network. Today, it consists of 33 seismic stations and each station is equipped with one strong motion accelerometer and one velocimeter. Data is continuously being fetched via Local Control Centre (LCC) to central control centre site RISSC (Emanuel Weber et al., 2007).

A software, Probabilistic and Evolutionary early warning SysTem (PRESTo) has been developed to provide a platform for EEW that integrates algorithms for real-time earthquake location, magnitude estimation, and damage assessment (Zollo et al., 2013). PRESTo continuously process the live streams of 3-components acceleration data from the stations for P-waves arrival detection and promptly performs the event detection (Allen, 1978), location (Satriano et al., 2008), magnitude estimation, damage zone assessment and peak ground motion prediction at target site. The alarm is issued through threshold based parameters T_C and P_d (Wu at el., 2007, Wu and Kanamori, 2005) after processing 3-sec P-wave data and when it is confirmed that $\tau c \geq 0.6$ s and $Pd \geq 0.2$ cm corresponds to an earthquake with predicted magnitude $M \geq 6$ and with an expected instrumental intensity IMM ≥ VII.

SASMEX

Seismic Alert System for Mexico (SASMEX) is the integration of Seismic Alert System for Mexico City (SAS) (developed in 1989 and operational since 1991) and Seismic Alert System for Oaxaca (SASO) (developed in 1999) and is in operational since 2005.

SASMEX works on the principal of Front detection and P-onset is detected much known to seismologist community, the ratio of short-term average (STA)/long-term average (LTA) (Espinosa-Aranda et al., 1991). Whenever an earthquake strikes in the region, SASMEX considers two types of range for seismic warning signals, first is Public Alert if a strong earthquake and preventive if moderate earthquake. The criteria of choosing public or preventive depend on calculated magnitude. If M>6 then public alert and in case of 5<M>6, preventive alert is issued (Espinosa-Aranda et al., 2009).

EEW System in INDIA

An earthquake early warning is developed for Uttrakhand, a state in the Republic of India. In this project 84 seismic sensors have been installed in the highly seismogenic window of about 100 Km × 40 Km in the mountainous region of Uttrakhand. These sensors transmit the ground motion data through TCP/IP to the central server in IIT Roorkee. State Wide Area Network (SWAN) and Bharat Sanchar Nigam Limited (BSNL) are two agencies which provide data connectivity facilities between sensors to server. Ground Motion data is continuously streamed from sensors to central server on 24×7 basis. Warning is issued on the basis of τc and P_d parameters for large earthquakes (Mw>6).

Conclusion

Various parameters have been researched and implemented in the operational earthquake early warning systems around the world. But it is still a challenge to scientists to overcome the problem of false and missed alarms. Therefore, further research is required to develop new warning parameters and methods.

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Parametric Study of Seismic Slope Stability for Uttarakhand Region

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Abstract

Landslide is one of the most widespread seismic hazards, which claims hundreds of lives in the Himalayan mountainous terrain of India. The problem of landslides is aggravated due to seismic shaking.

The objective of this work is to visualise earthquake induced landslide parameters and their relations with the two major earthquakes of Uttarakhand, i.e. Uttarkashi earthquake, 1991 and Chamoli earthquake, 1999. 2D dynamic modeling of seismic slope stability is applied to a landslide-prone area in Rudraprayag district of Uttarakhand. The calculations are made with models constructed from Geostudio software. Geometric and geotechnical parameters were defined on the basis of results obtained by different published papers and surveys performed in the area. Dynamic modeling of slope stability is performed with the help of SLOPE/W and QUAKE/W that is able to compute deformation. Different parameters, i.e. acceleration, velocity and displacement for both earthquakes have been calculated and assess their influence on the slope stability. These are very important parameters for the computation of Newmark displacement analysis.

This study can be used in evaluations of seismic stability of similar slopes with scenario earthquakes.

Keywords: landslide, seismic hazard, seismic slope stability

Introduction

Earthquakes are one of the main triggering factors of landslides. Largest earthquakes have capable of triggering thousands of landslides throughout areas of more than 100,000 km^2 (Keefer, 1984) and also these landslides can cause extensive damage and loss of life. Usually, their damage effects and casualties considered within the earthquakes. Conversely, it is known that earthquake induced landslides may have been destructive rather than earthquakes.

Analysis of the static and seismic stability of natural and man-made slopes is a challenging geotechnical problem. Slopes responses under seismic condition are closely related to the slope geometry, material property and the characteristics of input ground motion. Therefore, slope stability analysis becomes more challenging under seismic load than that under static condition.

For the understanding of slope stability mechanism, many researchers have attempted to analyse the stability of modeled slope under numerous conditions (Kumar, 2000; Ferentinou et al., 2006; Egeli and Pulat, 2011 and Chousianitis et al., 2016) but it is hard to genuinely analyse the response of slope under dynamic stresses of earthquake. At present, there are several methods for seismic stability analysis of slopes including widely applied pseudostatic method with its simplest applications, (Siyahi and Bilge, 1998; Biondi et al., 2002; Siad, 2003; Nouri et al., 2008 and Delgado et al., 2015). In pseudostatic method, the seismic force is considered as a constant, equivalent to a horizontal and a vertical force. The acting point of the equivalent forces is the center of gravity of the potential sliding body, and the direction of the equivalent forces is related to the unstable direction of the slope. In most cases, according to the degree of seismic damage, earthquake acceleration coefficients were determined with practical experiences.

The commonly employed limit equilibrium approach to obtain FOS cannot explain the failure mechanism of a slope in relation to the actual acceleration time history. Considering the limitation of this approach, it only evaluates the strength parameters of the slope due to the seismic coefficient Bray and Travasarou (2009). To overcome the shortcomings, certain analytical techniques have been proposed to study slope failure mechanism under dynamic stress conditions, including Newmark method (Kramer and Smith, 1997; Bray and Rathje, 1998), Khazai and Sitar, 2000; Refice and Capolongo, 2002; Ferentinou, 2006; Elayaraja et al., (2015 and Chousianitis et al., 2016). This Newmark method depends on the displacement of sliding body along the slip surface, but not the minimum factor of safety.

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Often the earthquake induced instability of slopes causes more damage to infrastructure and human lives than the actual earthquake itself. Therefore, slope stability analysis becomes essential under seismic load.

The objective of this work is to evaluate deformation of the slope by using Newmark displacement method. Then, different parameters i.e. acceleration, velocity and displacement were considered to assess their influence on the slope stability. These are very important parameters for the computation of Newmark displacement analysis.

Numerical Analysis

The stability of the soil slope is analysed under dynamic conditions using numerical simulation with the software Geostudio. Methodology and details of input parameters are discussed in the following subsection.

Methodology

Deformation of the slope is analysed by using the Newmark displacement method (Newmark, 1965). In this method, an acceleration–time history of Uttarkashi earthquake, 1991 and Chamoli earthquake, 1999 is selected, and the yield acceleration of the slope to be modeled is superimposed. The value corresponding to FOS unity gives the yield acceleration (a_y) that trigger the sliding mass. Accelerations below a_y cause no permanent displacement of the slope. Those portions of the record that exceed the critical acceleration are integrated once to obtain the velocity time history; a second integration is performed to obtain the permanent displacement time history.

QUAKE/W is used to simulate dynamic stress conditions. The variation in slope stability during earthquake shaking is analysed using calculated stresses in SLOPE/W, and to estimate the resulting permanent deformation.

Initially, a static stability analysis has been carried out in absence of seismic ground motion in order to analyse the failure mechanism of soil slope in ordinary shear strength condition, then minimum seismic stress required to trigger the slope is computed through dynamic stability analysis. Based on the dynamic stress state of the slope, the FOS of sliding mass at any moment under seismic load can be obtained within SLOPE/W. Similar procedure is adapted to calculate the amount of permanent deformation as proposed in Newmark method

Computational Condition

For the numerical simulation, heterogeneous soil slope with height 100 m and slope angle 30^0 is considered. The slope consists of two layers, i.e. a rock mass overlain by overburden material (Fig.1). However, it was observed that variation in thickness of bedrock doesn't make any significant change in the results. In the analysis, two history points have been selected, where the results will be saved for each and every time step while integrating through the earthquake record. They are A and B points shown in Figure 1.

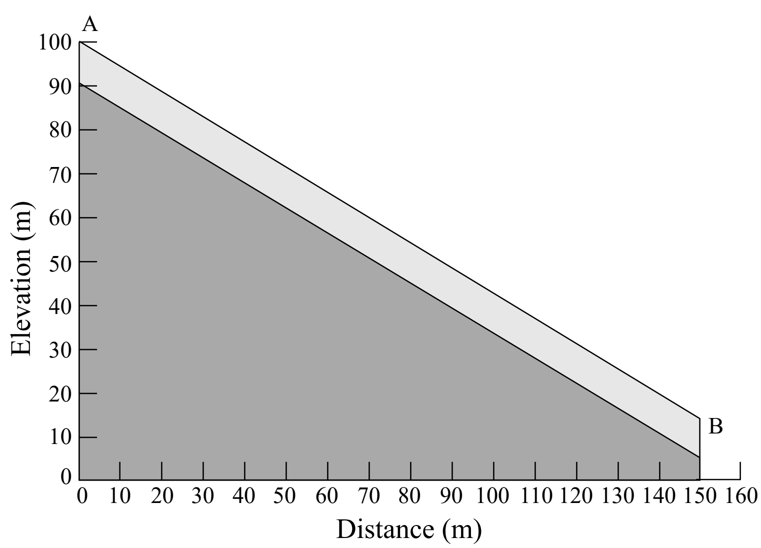

Figure 1: Slope geometry with history points

Table 1: Material Properties for Seismic Stability Analysis.

Material Type	Unit Weight γ (kN/m^3)	Cohesion c (kN/m^2)	Internal friction (^{0})
Overburden	19	30	30
Rockmass	27	100	40

Seismic Data

Seismic stability analysis is carried out using ground motion data of Uttarkashi earthquake, 1991 and Chamoli earthquake, 1999. Acceleration-time history is shown in Figure 2(a) and 2(b). It can be observed from Figure 2(a) that PGA is 0.31g and most of the peaks lie in first 10 seconds. Further Figure 2(b) indicates that the PGA is 0.19g lists the salient features of input ground motion.

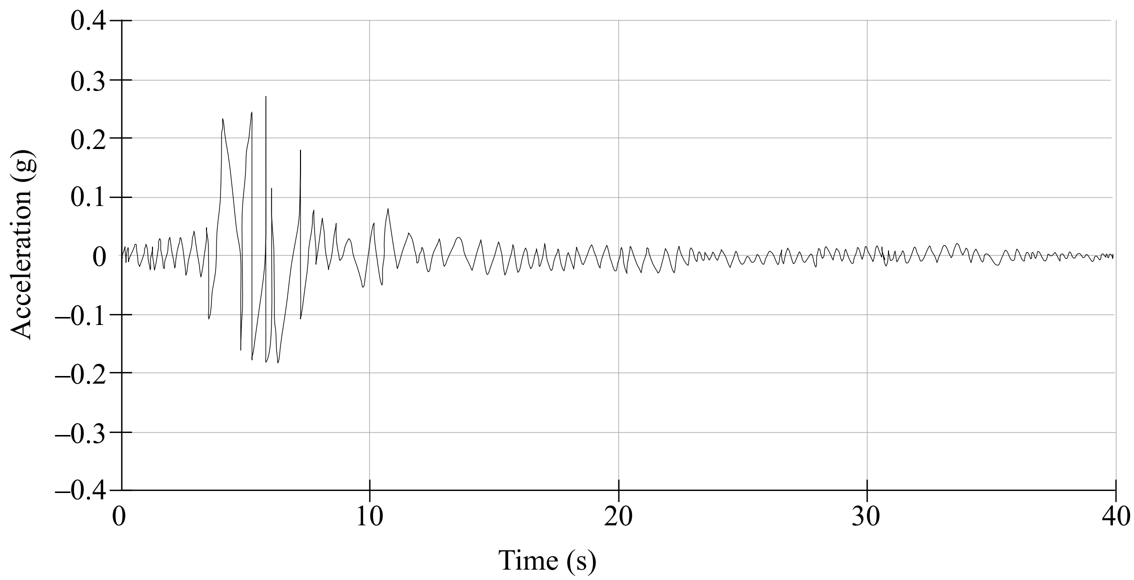

Figure 2 (a): Acceleration time history of 1991 Uttarkashi earthquake

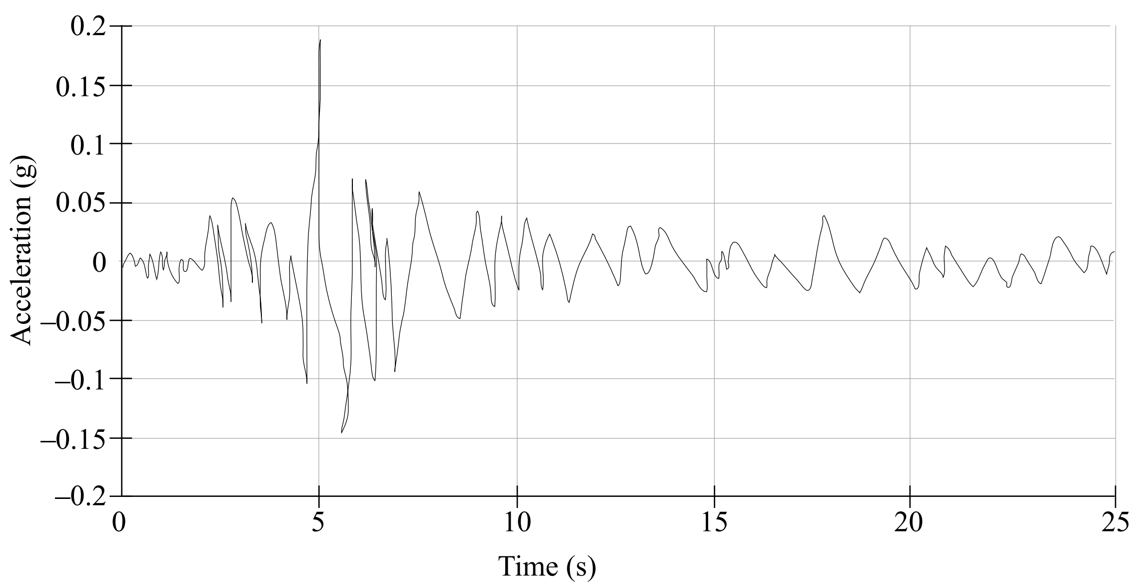

Figure 2 (b): Acceleration time history of 1999 Chamoli earthquake

Table 2: Ground Motion Data of Uttarkashi Earthquake

Earthquake Data Station	Uttarkashi Earthquake Bhatwari, India	Chamoli Earthquake Gopeshwar, India
Time of occurrence (UTC)	1991-10-19 21:23:15	1999-03-29 19:05:11
Magnitude (Ms)	7.0	6.6
Latitude	N30.78^0	N 30.40^0
Longitude	E78.77^0	E 79.33^0
PGA (g)	0.31	0.198
Selected data points	1996 (0.02 s)	1271 (0.02 s)

Deformation Analysis

For deformation analysis slope model shown in Figure 1 has been considered. In this section, deformation analysis using Newmark displacement method is presented. Time histories for average acceleration, velocity and deformation are presented.

Average Acceleration

For analysis, QUAKE/W software is used which gives, the addition of static and dynamic stresses. The dynamic mobilised shear is obtained as a result of computed dynamic stress, which is integrated along the entire slip surface of the slope. It is considered as additional shear produced by seismic loading. Dynamic stress is obtained as:

$$\sigma_{dynamic} = \sigma_{QUAKE} - \sigma_{static} \quad (1)$$

Where, σ is the stress. The average acceleration values are obtained by dividing the total mobilised shear force with a potential sliding mass of slope. The average acceleration value during the shaking of both earthquakes is plotted against the FOS for each time integration step in Figure 3(a) and 3(b).

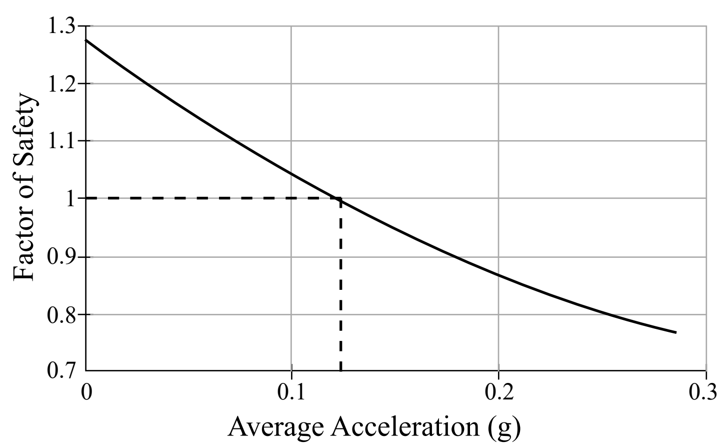

Figure 3 (a): FOS with average acceleration for Uttarkashi earthquake, 1991

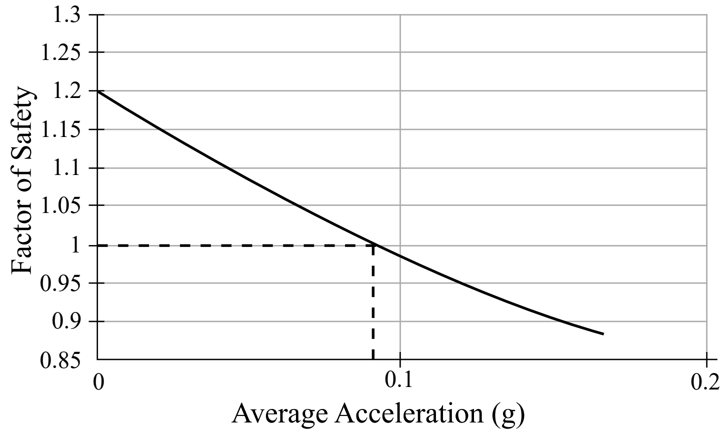

Figure 3 (b): FOS with average acceleration for Chamoli earthquake, 1999

From Figures 3(a) and (b), the value of average acceleration corresponding to FOS equal to unity can be found. This is the yield acceleration (a_y) for Uttarakashi earthquake that triggers the sliding mass. For Uttarkashi and Chamoli earthquake value of a_y is 0.12 g & 0.09 g, respectively.

The average acceleration value appeared at each integration step is plotted against time history in Figures 4(a) and (b). where the average acceleration exceeds a_y, there will be permanent displacement.

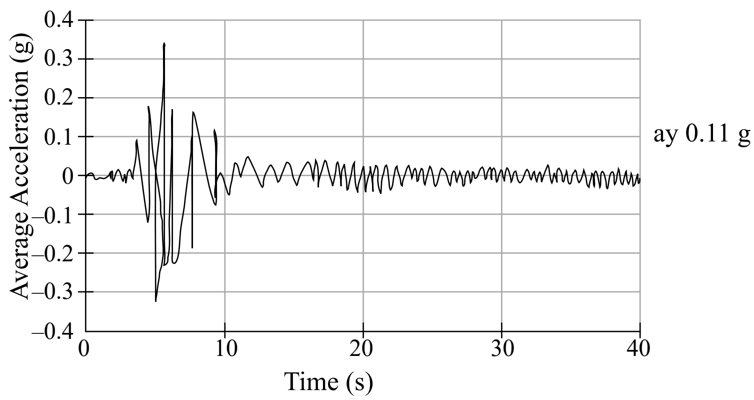

Figure 4 (a): Average acceleration time history for Uttarkashi earthquake, 1991

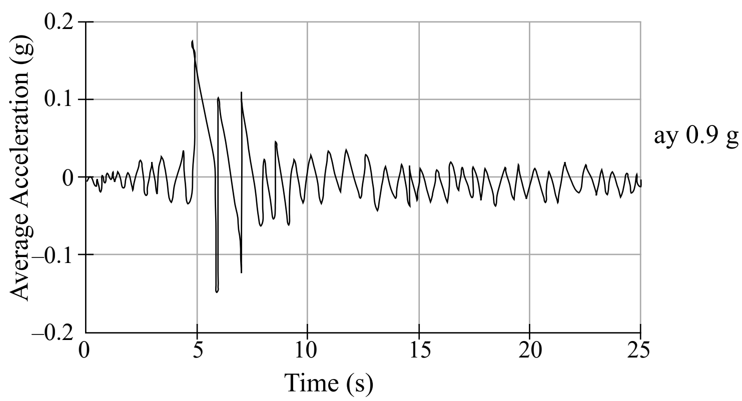

Figure 4 (b): Average acceleration time history for Chamoli earthquake, 1999

Velocity

The velocity of the sliding mass is calculated by integrating the area under average acceleration where the acceleration exceeds a_y, shown in Figures 4(a) and (b). The maximum velocity of sliding mass along the slip surface during Uttarkashi earthquake shaking is about 0.19 m/s, as shown in Figure 5(a). Similarly, Chamoli earthquake, 1999 gives 0.071 m/s velocity.

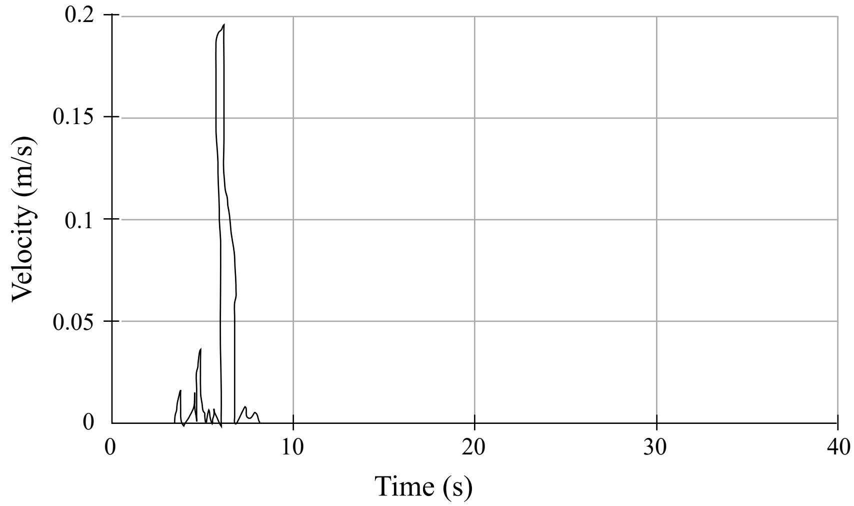

Figure 5 (a): Velocity time history due to acceleration exceeds a_y for Uttarkashi earthquake, 1991

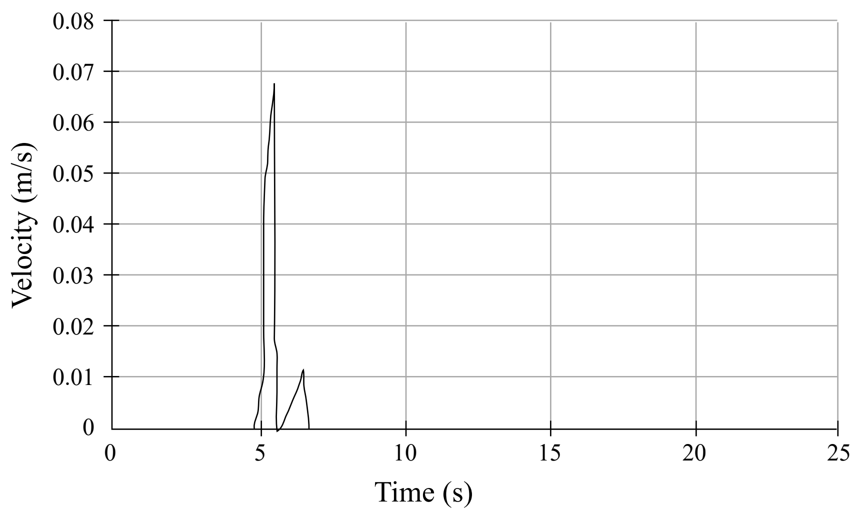

Figure 5 (b): Velocity time history due to acceleration exceeds a_y Chamoli earthquake, 1999

Displacement

The amount of permanent displacement of slope during seismic loading is estimated based on the acceleration-time history and a_y, using the procedure developed by Newmark (1965). Fig. 5 (a) shows the cumulative parallel movement of sliding mass during the Uttarkashi earthquake shaking which initiating permanent deformation of about 45 mm. Similarly, permanent displacement has been estimated as 13 mm for Chamoli earthquake shaking.

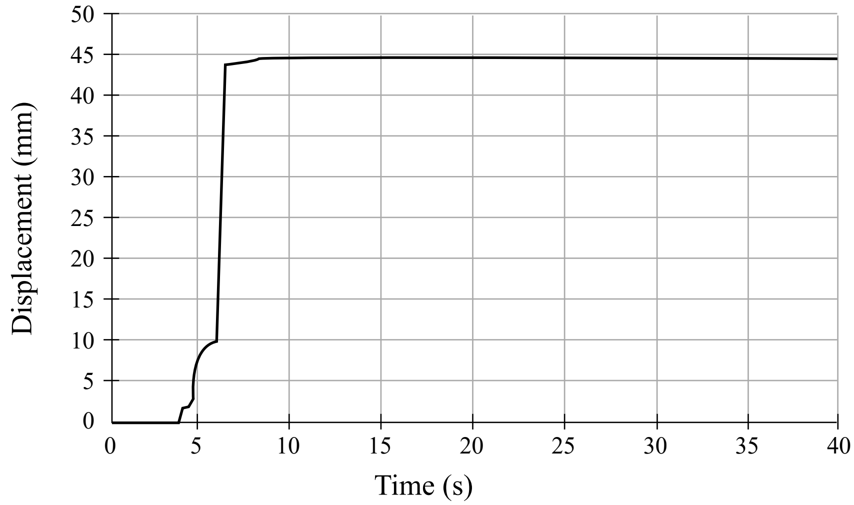

Figure 6 (a): Displacement time history due to acceleration exceeds a_y for Uttarkashi earthquake, 1991

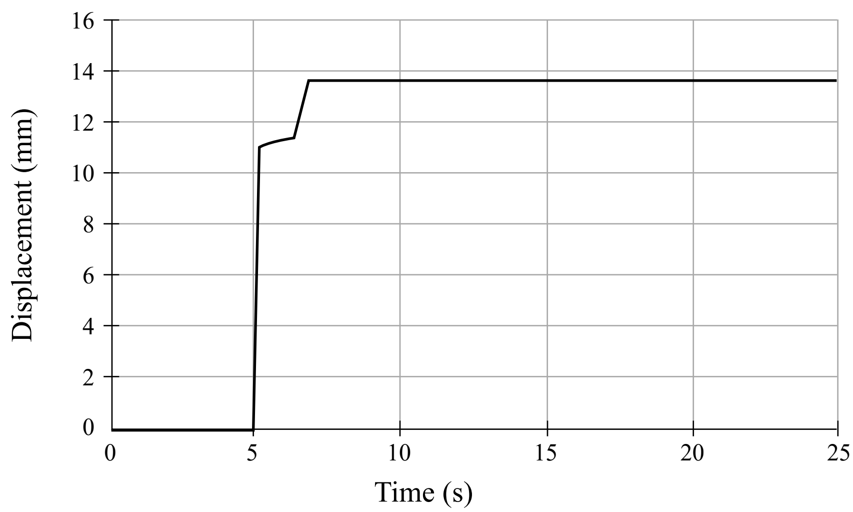

Figure 6 (b): Displacement time history due to acceleration exceeds a_y for Chamoli earthquake, 1999

Conclusion

In this study, deformation of the slope by Newmark displacement method is evaluated. Then, acceleration, velocity and permanent deformation are compared at Uttarkashi earthquake and Chamoli earthquake. The following conclusions have been made based on numerical simulation of slope,

- After comparing results obtained from Uttarkashi earthquake and Chamoli earthquake, it was found that permanent displacement of the slope is directly related to PGA and Duration of shaking.
- The result shows that there are significant variations in permanent displacements when PGA is varied. Displacement of the slope increases with the PGA and duration of shaking i.e. a higher value of PGA gives more displacement.
- It is evident from Input parameter that PGA and duration of shaking are higher for Uttarkashi earthquake. From Figures 6(a) & (b) we can see the permanent displacement of the slope is 70 per cent higher than Chamoli earthquake shaking. Change in velocity is about 62 per cent higher for Uttarkashi earthquake.

The above numerical studies have clearly provided useful insights into the slope stability analysis for seismic cases. The application of the numerical simulation could be helpful in slope failure predictions and offers a beneficial engineering tool to analyse the slope response during an earthquake.

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Andhra Pradesh Model of Lightning Early Warning and Safe Grid Management System

Col. Sanjay Srivastava[a]

Abstract

India's problems shows how the poor are most exposed to changes in the environment. It also, however, demonstrates the desperate need for economic development. ***While reducing global warming may slow the increase in lightning deaths,*** the fastest way to help these farmers is to get them off the fields. Shri Narendra Modi, Prime Minister of India referred lightning as byproduct of extremities of climate in CoP Paris 2015.

Keywords: lightening, early warning system, lightening detection system, safe grid management system

Introduction

Lightning has been the most biggest killer cumulatively as compared to all other natural disasters in India. The year 2017 has seen a substantial groth in fatalities due to lightning. As per National Crime Records Bureau (NCRB) report, at least 2000 deaths per year is attributable to lightning and it accounts for at least 10 per cent of the total deaths caused by natural disasters. It affects all hilly regions in North East, north and south and coastal states like Odisha, West Bengal, Andhra Pradesh, Chhattisgarh, Maharashtra, Jharkhand, Himachal Pradesh, Bihar, etc., considerably. However, Lightning is a state specific disaster in few states but not a national disaster by Government of India.

Lightning strikes are common along with monsoon and hailstorms, caused by cloud to cloud or cloud to land (hill) collision discharging huge uncontrolled negative energy towards earth. It causes huge loss of life and damage to property. In regions other than Coastal areas, lightning is frequent in hilly and other areas due to the prevalent geographical conditions, such as undulating hilly topography, deciduous monsoon jungles, low altitude clouds, rich mineral content, etc.

The Government of Andhra Pradesh has initiated a Lightning Warning System project by carrying out detailed analysis of this constant and steady killer called lightning and has been able to save loss of life and property. In order to address the menace of lightning, a detailed analysis of the root cause of frequent lightning in Andhra Pradesh in coordination with international and national agencies was carried out and a Lightning Warning Project has been developed which is based on early detection, timely alert/warning to target masses by available communication means, capacity building by infrastructural and non infrastructural (awareness and training) means, enhance preparedness, various prevention and mitigation measures and creation of safe shelters on a grid to minimise the losses as well as to mitigate/prevent lightning impacts.

The Government of Andhra Pradesh has implemented a Lightning Warning System project with the technical support from Indian Space Research Organisation (ISRO) in February 2017 and the state has been able to reduce the loss substantially. States like West Bengal, Karnataka and Kerala have also adopted for the similar project for next monsoon. The salient aspects of this concept of **Lightning Action Plan** are as follows:

- **Hazard, Risk, Vulnerability and Capacity (HRVC) Mapping of Lightning Prone Zones/Zone Mapping:** The lightning has varied intensity and frequency. The risk assessment and zone mapping of lightning was undertaken by Technology Institute in collaboration with International Space Agency. Based on the level and intensity of lightning counts, the state was divided in various zones in order of risk and vulnerability. The assessment of vital local assets including lightning prone infrastructures were undertaken and mapped.

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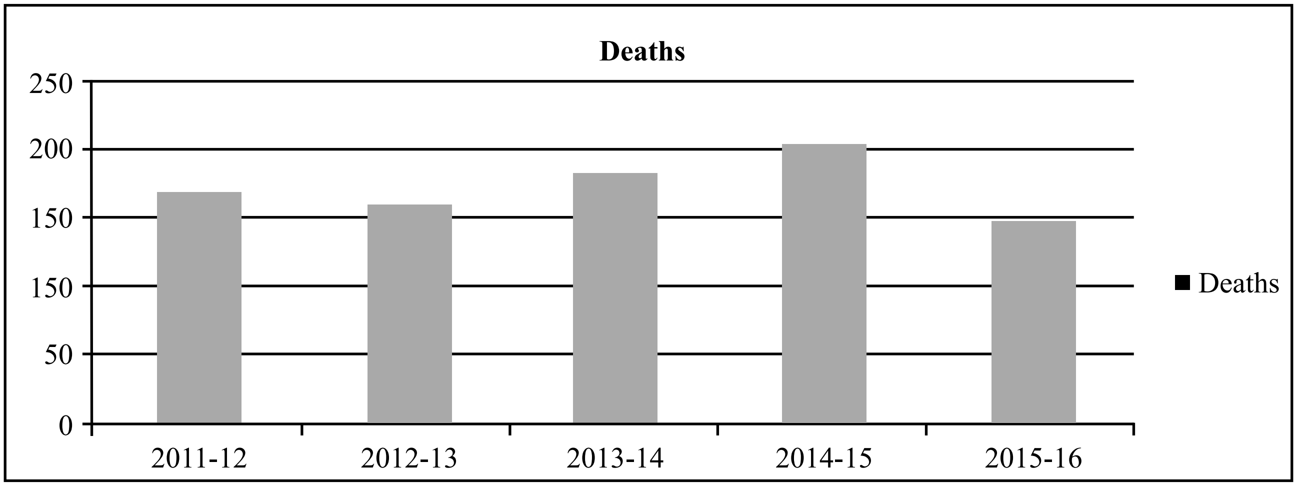
- **Lightning Detection System:** The lightning detection system is multi tiered system and the state gets inputs from mainly sensor set up by Companies and institutions from all over the world.
  Sensors from a particular company were installed and a mobile application was tried out. The sensors detected the lightning in advance and the mobile application gave 30 minutes to 03 hours advance warning. This facilitated conveying of the impending threat to target areas /people through hooter/email, whatsapp messages/ media and thereby alerting target masses to adapt to safety measures taught to them through the capacity building programme of awareness and training.
- **Alert/Warning System:** Based on the alert received through warnings on Mobile App and other means, the same is re-communicated to masses using available communication means of mobile bases SMS and Whatsapp based alerts, electronic and print media and other instruments. There is a field based hooter system also which can be installed to alert masses in an area of radius of 40 kilometers and direct them to safe grids/ shelters.
- **Enhance Preparedness:** The preparedness towards the risk of lightning was enhanced by carrying out by Impact assessment and corrective measures, checking serviceability of Lightning conductors, awareness campaign, Research and Development and continuous Monitoring and evaluation.
- **Prevention and Mitigation:** Deliberate planning was done to carry out preventive and mitigative measures and were undertaken. The important actions are Elaborate guidelines issued to government and non government organisations, State Building Bye Laws 2016 makes it mandatory for all Ground floor plus two (G+2) and above building to install lightning conductors/arresters, schools, industry, government buildings to install lightning conductors/arresters, Included in the school and college curriculum, part of Life saving skills programme, Review and monitoring etc.
- **Capacity Building Programme:** A comprehensive capacity building programme both infrastructural and non infrastructural was planned and executed. The awareness and training programmes focused on rural areas, school children, Panchayati Raj Institution (PRI) members etc was actively launched and village level Mock exercises were carried out which yielded positive results.
- **Information, Education and Communication (I.E.C.) Materials:** Effective IEC materials for children, women and villagers were developed and the same were publicised through print and electronic media, departmental programmes and awareness schemes.
- **Lightning Safe Grid:** Based on expected intensity of lightning, lightning arresters are installed in series to make the lightning safe. The lightning arresters are devices which arrest the lightning before it is formed and hence there is no sound and light. However, the same is recorded by an electronic counter. The safe grid created at Deoghar Babadham has been a testimony to the same.
- **Outcome:** With increase in acute climate activity, lightning is most frequent and more fatal wherein early warning has been most advantageous in timely preparedness and pre-regearsed response thereby saving damages. The Capacity building program of training and awareness were effective in a focused approach and based on the vulnerability, the Safe Grids were landmark success. This resulted in decrease in casualties and economic losses in Jharkhand and Andhra Pradesh due to lightning.
- **Monitoring, Review and Evaluation:** Lightning and hailstorm patterns are dynamic. Lightning zone mapping may not be sacrosanct. Due to extreme climatic activities, lightning and hailstorm pattern changes at times. Therefore, regular monitoring, evaluation and review is a must. Intensity is mostly more severe with acute climatic conditions. In fact, it has been observed that more rains bring more lightning which is most intense during initial /terminal monsoon. However, it's a regular phenomenon with hailstorms. 95 per cent fatalities are in rural areas that too with people standing under tall tree. A comprehensive sensor based forecast system with timely detection and its availability on a mobile based application is handier, user friendly and effective. Lightning arrester based Safe Grids are relatively most safe, should be promoted.



Based on above fundamentals, the Lightning action plan was implemented in Andhra Pradesh and validated and the number of deaths and loss to property has been reduced in Andhra Pradesh considerably. The exact details will be available after the impact assessment report being done by the Tata Institute of Social Sciences.

The above concept can also be applied in case of other extreme climate change activities like hailstorms, flash floods and cloud bursts also and assist in disaster risk reduction by minimising damage to life and property.

Disaster Specific Approaches: Nuclear, Biological and Chemical Disasters

Bhasker Gupta[a]

Abstract

Preparedness for modern life in the 21st century shall now mean addressing the management of Nuclear, Biological & Chemical (NBC) events, most of which will be initiated by terrorists/rogue nations/traditional enemies. Today, any NBC incident itself is alarming, since it will be a mass casualty situation, with a dangerous intent-the preparation for response is then under the assumption that it is intentional and malicious.

Within India, Armed Forces (AF) have been designated as the lead agency to tackle all such NBC/CBRN incidents and related disasters. By virtue of their presence everywhere in the country, wide reach, disciplined cadre and organisational strength, AF's are considered best suited for this task and hence mandated so, in the latest NDMP-2016, released by the PM. Within the AF, Military Engineers have been given the responsibility for NBC disasters. The target is to have a fully trained, equipped and battle worthy platoon (01 JCO and amp; 36 soldiers) at every brigade level, to tackle NBC incidents. For this, Army has also been authorised 01 NBC brick per Brigade, which consists of a list of 54 composite items/equipment needed to ward-off an NBC threat in the initial period after attack (0-24 hours).

This paper shall discuss the levels of training, preparedness, shortages and problems therein in implementing this mandate on ground, generally in the AF and specific to the Army Engineers. We also discuss individual and community NBC protection measures needed in India, where we stand today and what more needs to be done?

In conclusion the paper shall bring out recent achievements of HQ IDS in achieving synergy in counter NBC measures and formulating an SOP for managing NBC disasters. Also, it shall deliberate on the focus required towards creating CBRN defense in the country, which requires active WMD defense and passive CBRN defense and also requires planning, preparation, training and execution of physical defenses to negate the effects of CBRN elements on personnel and material.

Keywords: approaches, Nuclear, Biological and Chemical disasters (NBC), planning, preparedness, CBRN defence

PART 1: Introduction

The history of mankind has seen nuclear(nuc) weapons(wpns) being used only twice. The effects of mass destruction, caused by these wpns, have produce worldwide condemnation and ensured their non usage since the past six decades. Furthermore, the fear of "Mutually Assured Destruction"(MAD) between nuclear adversaries has prevented any adventurous war mongering between nations. However, with the emergence of a new world order post the 1990s, there has been a paradigm shift. Certain countries, who felt left out, have acquired these weapons, or are on the path of acquiring them. Non-state players have also emerged in the arena as a force to be reckoned with. Other than nuc weaponisation, strides have also been made in the delivery system, despite various control regimes.

In the 1970s, Pokhran and Chagai tests resulted in the nuclearisation of the sub-continent. Today, both of India's adversaries (on the North-eastern and Western borders) are armed with Wpns of Mass Destruction (WMD), and possess delivery means to strike targets deep within each other's country.

The minimum nuc deterrent, according to the Indian Nuc Doctrine encompasses "sufficient, survivable and operationally prepared nuc forces, a robust command and control system, effective intelligence and electronic warfare (EW)capability, comprehensive planning and training (trg) for operation (ops), in line with the strategy to employ nuc forces and wpns". On nuc forces, the doctrine talks of an effective, enduring, diverse, flexible response, in accordance with the concept of min nuc deterrence. These forces will be based on a triad of aircraft, mobile land-based missiles(msls) and sea-based assets.

Chemical wpns lie in tactical (tac) domain,whereas Biological (bio) weapons are in strategic domain; considering their effects. Also, long incubation of Bio wpns makes them a suspect to be used against field (fd) forces. Possibility

[a] Indian Army

of Radiological Dispersal Devices (RDD)/Improvised Nuclear Devices, Anthrax like substances, mustard gas etc to be used by terrorist organisations (orgs) cannot be ruled out. Thus, Chemical Biological Radiological and Nuclear (CBRN) threat in Counter Insurgency (CI) Ops/Out of Area contingency (OOAC)/UN missions will predominantly be to the Security Forces (SF).

Therefore, there is a need for us to acquire a capability (capb) to op in a such an environment (envt) in the future battle fd. CBRN wpns are WMD. Their effects are not confined to small areas or a unit. To avoid very large scale casualty (cas), it is important that persons are trained to op and take protective and defensive(def) measures in a CBRN envt. Therefore training(trg) must take the likely scenario of the future into consideration and be prepared to counter the threat accordingly. Hence trg needs, in a future scenario, must cater for the threat and capb of our adversaries.. Own forces need be prep to op in a nuc backdrop, entailing changes in tac doctrine and concepts. Also the threat of use of 'dirty bomb' by terrorist orgs being real, underlines the importance of CBRN Disaster Management (DM) trg in India in general and in Indian Army (IA) in particular.

Natural Disasters

Man-made Disasters: These are of three basic types, i.e. Chemical, Biological Nuclear & Radiologial Disasters, each of which are together known by the acronym CBRN. Each of these is explained below:

Chemical Disasters: Chemicals, being at the core of modern industrial systems, have attained a very serious concern for disaster management. Chemical disasters(CDs) may be traumatic in their impacts on human beings and will result in casualties(cas) and also damage nature and property. The elements which are at highest risks due to chemical disaster primarily include the industrial plant, its employees & workers, hazardous chemicals vehicles, residents of nearby settlements, adjacent buildings, occupants and surrounding community. CDs may arise in number of ways, such as:

- Process and safety systems failures: Human errors; Technical errors: Management errors
- Induced effect of natural calamities
- Accidents during transportation
- Hazardous waste processing/disposal
- Terrorist attack/unrest leading to sabotage

Status of Chemical Disaster Risk in India: We have witnessed the world's worst chemical (industrial) disaster "Bhopal Gas Tragedy 1984"– a devastating chemical accident, where over thousands of people died due to accidental release of toxic gas Methyl Iso Cyanate (MIC). India continued to witness a series of chemical accidents even after Bhopal had demonstrated its vulnerability. Only in last decade, 130 significant chemical accidents were reported, which resulted into 259 deaths and 563 injured. There are about 1861 Major Accident Hazard (MAH) units, spread across 301 districts and 25 states and 3 Union Territories, in all zones of country. Besides, there are thousands of registered and hazardous factories (below MAH criteria) and unorganised sectors dealing with numerous range of hazardous material posing serious and complex levels of disaster risks.

Safety Initiatives to Address Chemical Risks: A comprehensive legal/institutional framework exists in our country, with a number of regulations covering the safety in transportation, liability, insurance and compensations having been enacted. GoI has further reinforced the legal framework on chemical safety mgt of chemical accidents by enacting new rules, such as MSIHC Rules, EPPR Rules, SMPV Rules, CMV Rules, Gas Cylinder Rules, Hazardous Waste Rules, Dock Workers Rules, etc. National Disaster Management Authority (NDMA) has come out with specific guidelines on Chemical Disaster Management (CDM), prepared to provide directions to ministries/ departments/state authorities for preparation of their detailed DM plans. These guidelines call for a proactive, participatory, multi-disciplinary and multisectoral approach at various levels for CD preparedness and response. Further, NDMA has provided specific inputs to the GOM for avoidance of future CDs in the country, along with suggested amendments on existing framework. NDMA is also working on revamping of CIFs (Chief Inspectorate of Factories) to strengthen chemical safety in India. In addition, the National Action Plan on Chemical Industrial Disaster Management (NAP-CIDM, 2016), has been finalised to act as a roadmap for chemical DM in India.

Biological Disasters

These disasters are causative of process or phenomenon of organic origin or conveyed by biological vectors, including exposure to pathogenic micro-organisms, toxins and bioactive substances that may cause loss of life, injury, illness or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Examples of biological disasters include outbreaks of epidemic diseases, plant or animal contagion, insect or other animal plagues and infestation. Biological disasters may be in the form of an **Epidemic** affecting a disproportionately large number of individuals within a population, community, or region at the same time; examples are Cholera, Plague, Japanese Encephalitis; or **Pandemic** - an epidemic that spreads across a large region, that is, a continent, or even worldwide of existing, emerging or re-emerging diseases and pestilences, example being Influenza H1N1 (Swine Flu).

Radiological and Nuclear Emergencies

The growth in application of nuc science and technology in the fields of power generation, medicine, industry, agriculture, research and defence has led to an increase in the risk of occurrence of Nuc and Radiological Emergencies (NRE). India, due to its unique geo climatic conditions has traditionally been vulnerable to natural disasters. It has, of late, like other countries, become equally vulnerable to various man-made disasters. NRE can arise in a nuclear facility at plant level leading to plant/site or off-site emergency depending upon the extent of its impact on surroundings. It can also take place while using radiation sources, either at Hospitals, Industries, Agriculture or Research Institutions due to loss or misplacement/faulty handling. Other events that can lead to NRE, include; accident of a vehicle carrying radioactive material; due of an orphan source, i.e. the source which is not under regulatory control or due to usage of radioactive material in malevolent activities. Sad memories of the use of nuc wpns dropped on Hiroshima/Nagasaki, and the wide publicity given to the reactor accidents at Three Mile Island (TMI) in USA and Chernobyl in erstwhile USSR, are still fresh in our minds.

However, one must be prepared to face nuc/radiological emergencies of lower magnitudes and ensure that their impact (which, for a given magnitude, is likely to be much greater today because of higher population densities, coupled with an enhanced urban infrastructure due to economic prosperity) is kept under control. For improving life conditions, India has embarked upon a programme of using nuc energy for electricity generation. Currently India has 20 power reactors and three research reactors in operation, with five power reactors under construction and plans for setting up Thorium based reactors (to meet its ever increasing energy needs). We have made operational the first 500MW Prototype Fast Breeder Reactor (PFBR) after a prolonged experience of operation of FBTR (Fast Breeder Test Reactor). Further, we utilise radio-isotopes in a variety of applications in the non-power sector. Due to our inherent safety culture, best safety practices and standards followed in these applications as well as effective regulation by the Atomic Energy Regulatory Board, the radiation dose to which persons working in nuc facilities are exposed to, is well within permissible limits and risk of its impact on public is very low.

However, nuc emergencies can still arise due to factors beyond the control of op agencies; for example, human error, system failure, sabotage, earthquake, cyclone, flood, etc. Such failures, even though of very low probability, may lead to an on-site or off-site emergency. To combat this, a number of system upgrades are planned to mitigate/prevent them. However, we still need proper emergency preparedness plans to minimise avoidable loss of life/livelihood/property and its impact on the environment (envt).

PART II: Chemical Disasters and their Management

Background

Growth of chemical industries has led to an increase in the risk of occurrence of incidents associated with hazardous chemicals (HAZCHEM). However, industry that incorporates the best principles of safety, can largely prevent such incidents. Common causes for chemical accidents are deficiencies in safety mgt systems and human errors, or they may occur as a consequence of natural calamities or sabotage activities. These accidents result in fire, explosion or toxic release. The nature of chemical agents and their concentration during exposure ultimately decides the toxicity and damaging effects on living organisms as symptoms like irreversible pain, suffering, and death. Meteorological conditions such as wind speed, wind direction, height of inversion layer, stability class, etc., also play an important role by affecting the dispersion pattern of toxic gas clouds. The Bhopal Gas tragedy of 1984—where over 2000 people died due to the toxic gas MIC, is a live example.

A small accident occurring at the local level may be a prior warning signal for an impending disaster. CDs, though low in frequency, have the potential to cause significant immediate or long-term damage. A critical analysis of the lessons learnt from major chemical accidents exhibited various deficiencies. Laxity towards safety measures, non-conformation to techno-legal regimes and a low level of public consultation are a few such shortcomings. The scenario calls for concerted and sustained efforts for effective risk reduction strategies and capacity development to decrease the occurrence of such incidents and lessen their impact. Although efforts have been made to minimise such accidents and improve emergency preparedness at all levels, more efforts are needed to predict the occurrence of disasters, assess their damage potential, issue warnings, and to take precautionary measures towards mitigation. Another pressing need is to properly assess the potential of chemical emergencies and develop tools for emergency planning and response to reduce the damage.

Chemical accidents may originate in the manufacturing/formulation facility, or during the process ops at any stage of the product cycle, material handling, transportation and storage of HAZCHEM. Vulnerability is sometimes compounded due to the location of Major Accident Hazard (MAH) industries closer to densely populated areas. Chemical and industrial accidents generally occur due to technical failures that can be anticipated-risk associated with them can thus be predicted/reduced effectively by identification of risk areas, risk assessment and designing pre-operative measures. The occurrence of chemical accidents and probability thereof, manifesting in a disaster, remains a cause of concern.

Sources of Chemical Disasters

Chemical accidents may originate in the following:

- Manufacturing and formulation installations including during commissioning and process operations; maintenance and disposal.
- Material handling and storage in manufacturing facilities, and isolated storages; warehouses and godowns including tank farms in ports and docks and fuel depots.
- Transportation (road, rail, air, water, and pipelines).

Causative Factors Leading to Chemical Disasters

These may result from; Fire, Explosion, Toxic release, Poisoning, Combinations of these. CDs may occur due to process deviations concerning the chemistry of the process, pressure, temperature and other identified parameters with regard to the state of the substance, i.e. solid, liquid or gas, proximity to other toxic substances and the probability of a runaway reaction due to the incidental mixing of two or more HAZCHEMs with dissimilar properties. In addition, it may be due to hardware failure, resulting in large-scale spills of toxic substances (in any form) due to loss of containment, or an explosion. Further, Boiling Liquid Expanding Vapour Explosion (BLEVE) may occur due to sparks, shocks or frictional forces on chemicals during transportation. The effects can be further compounded by the micro-meteorology of the area, wind speed/direction, rate of precipitation, toxicity/quantity of chemical released, population around the release, probability of formation of lethal mixtures (fuel-air or other mixtures) and other industrial activities being performed in closer vicinity.

Any human/mechanical failure may cause large scale spills of liquids or of compressed gases like chlorine or Liquid Petroleum Gas (LPG) which can cause BLEVE and can directly affect human lives and the envt. The release of compressed gases give rise to thermal and cryogenic stresses, which may also impact the surrounding structure or building, compounding the damage.

Initiators of Chemical Accidents

Many factors, including human errors, may cause chemical accidents leading to CDs. These are:

Process and Safety System Failures

- Technical errors – design defects, fatigue, metal failure, corrosion, etc.

- Human errors – neglecting safety instructions, deviating from specified procedures.
- Lack of information – absence of emergency warning procedures, non-disclosure of line of treatment, etc.
- Org errors – poor emergency planning and coord, poor communication with public, non-compliance with mock drills/exercises, etc., which are required for ensuring a state of quick response and preparedness.

Natural Calamities

The Indian sub-continent is highly prone to natural calamities, which can also trigger CDs. Damage to phosphoric acid sludge containment during the Orissa super cyclone in 1999; release of acrylonitrile at Kandla Port, during an earthquake in 2001, are some recent examples.

Terrorist Attacks/Sabotage

Vulnerability to CDs is further compounded by likely terrorist/warfare activities, which include sabotage and attack on HAZCHEM installations and transportation vehicles, which may occur anywhere/any time.

Impact of Chemical Disasters

In addition to loss of life, the major consequences of CDs include impact on livestock, flora/fauna, the envt (air, soil, water) and losses to industry. Chemical accidents may be categorised as a major accident or a disaster depending upon the number of cas, injuries, damage to the property or envt.

Regulatory Framework and Codes of Practises

Regulatory framework on chemical safety started from the Factories Act, 1948 and chemical class-specific regulations like the Explosives Act, 1884; Insecticide Act, 1968; Petroleum Act, 1934. Later, an umbrella Act, the Environment (Protection) Act, 1986, was enacted, which also deals with chemical mgt and safety. Thereafter, a number of regulations covering safety in transportation, insurance, liability and compensations were enacted. GoI has further reinforced the legal framework on chemical safety and management of chemical accidents by enacting new rules and by way of amendments to them. Preparation of emergency plans, framing safety policies, constitution of safety committees to ensure workers' participation in safety and health mgt, notification of permissible exposure limits for harmful chemicals, and est of occupational health centres, etc., were introduced by these amendments.

Institutional Framework and Compliance

Institutional Framework

The regulations referred above provide for institutional framework for enforcement and monitoring of chemical safety and emergency mgt. It involves various central/state ministries/departments and others. The MoLE, MoEF and MoSRT & H are responsible for enacting regulations. The MoLE through its state entities; the Inspectorate of Factories/Directorate of Industrial Safety and Health (DISH); the Central Pollution Control Board (CPCB) and the MoEF with its state entities, State Pollution Control Boards (SPCBs) and Pollution Control Committees (PCCs) of UTs monitors compliance of the various regulations. MoSRT & H, through the Department of Road, Transport and Highways ensures the development and maintenance of national highways. On the other hand, State govts, through their respective state transport departments, transport commissioners and Public Works Department (PWD) are responsible for the mgt of roads and highways in the States. With respect to petroleum products and explosives, the MoC & F through Department of Chemicals and Petrochemicals and Department of Fertilizers, MoP & NG, and Ministry of Heavy Industries and Public Enterprises (MoHI & PE) through the Petroleum and Explosives Safety Organization (PESO),monitor compliance of these regulations.

The MoH & FW through various hospitals responds to medical(med) emergencies during chemical accidents. DAE and Centre for Fire, Explosive and Environment Safety (CFEES) are responsible for preparing Off-Site emergency plans. The CFEES is an authority under the MSIHC Rules for enforcement of directions and procedures in respect of laboratories, industrial establishments and isolated storages dealing with HAZCHEMs in the MoD. Similarly, the DAE is responsible for nuc installations.

Compliance

Of the 602 districts in India, 263 districts have MAH units. Of them, 170 have clusters of more than five MAH units (hazardous/industrial pockets). As on date there are 1666 MAH units in India. In addition, there are a large number of storages of hazardous substances; big warehouses including local factories/storage sites. On-Site emergency plans are in place for 1628 units. Off-Site emergency plans for 166 districts have been prepared. Twenty-six of them are based on hazard analysis studies undertaken by the MoEF. Presently, a mock drill of the On-Site plan by occupiers of MAH units every six months is a statutory requirement. However, only a few such drills have been conducted.

The MoEF has set up a **Crisis Control Room (CCR)** for rapid exchange of information and for coordination of activities during an emergency. It is also preparing a web-based accident information system for use by stakeholders concerned, with better monitoring and management of chemical disasters. Industries have also undertaken awareness programmes for communities residing in the vicinity of industrial units.

Other Technical Activities/Initiatives

Initiatives in Installations

Major Accident Hazard Control System: In addition to the efforts to strengthen the legal framework by amending the Factories Act, the MoLE through the DGFASLI and state factory inspectorates implemented a project called 'Establishment and Initial Operations of Major Accident Hazard Control System in India'. During the project period, the MAH units were identified and infrastructural facilities were augmented in the Chief Inspectorate of Factories (CIFs), Central Labour Institute (CLI), Mumbai, labour institutes of various states, and Regional Labour Institutes at Kanpur, Kolkata and Chennai.

Hazard Analysis Studies of Industrial Pockets: A sub-scheme entitled, 'Industrial Pocket-wise Hazard Analysis' has been in operation at the MoEF. Hazard analysis studies for identifying the accident potential of industrial areas/ pockets, their possible consequence and prevention strategies including rapid safety audit of MAH units have been initiated for 107 districts covering 900 MAH units. Out of these, studies of 85 districts are complete.

GIS-based Emergency Management System: In 2010, a pilot study entitled, 'GIS based Emergency Planning and Response System for Chemical Accidents in MAH Installations in Major Industrial Clusters' in four identified industrial states, namely Gujarat, Maharashtra, Tamil Nadu and Andhra Pradesh was completed. This would help existing response agencies in planning for and responding to major chemical emergencies to contain damage to a minimum. This project has been extended to Delhi, Rajasthan, Uttar Pradesh, Haryana, Karnataka, Kerala, West Bengal, Assam, Madhya Pradesh and Punjab.

Envt Risk Reporting and Information Systems (ERRIS): ERRIS was prepared by the Indian Chamber of Commerce (ICC), Kolkata for the chemical units in Haldia and Durgapur in West Bengal, developed under a project funded by the European Union with technical collaboration from Netherlands and Italy.

Emergency Response Centres (ERCs) and Poison Control Centres: Five ERCs have been established in Manali (Tamil Nadu), Bhopal (Madhya Pradesh), Mahad (Maharastra), Vishakhapatnam (Andhra Pradesh) and Hyderabad (Andhra Pradesh), which are a link between DCG and the industry during an emergency. ERCs deal with chemical emergencies in a given area and disseminate technical information relating to chemicals involved.

Capacity Development: Financial assistance has been provided for capacity development to National Fire Service College (NFSC), Nagpur; National Civil Defence College (NCDC), Nagpur; offices of the CIFs/DISH of states including Maharashtra, TN, AP, Gujarat, Rajasthan and NCT Delhi. The Confederation of Indian Industry (CII), Federation of Indian Chambers of Commerce and Industry (FICCI) and the ICC are other notable leading umbrella networks of business and industry working in these fields.

Control Room Concept: Following 5 Control Rooms have been set up in Gujarat: Emergency Control Room in Vadodara (registered as a Central Control Room); Atul Emergency Control Centre in Atul Ltd., Valsad; Vapi Emergency Control Centre in Vapi Industrial Association, Vapi; Disaster Prevention and Mgt Centre, Ankleshwar; Disaster Mgt Centre, Bharuch; Off-Site Emergency Control Room.

Emergency Operation Centres (EOCs): The national network of EOCs with links to state EOCs and other state secretariats and district EOCs at district collectorates form the main emergency communication network in the country for DM. The National Informatics Centre Network (NICNET) and the Police Network (POLNET) are other important satellite-based networks for emergency communications.

Responsible Care (RC): RC is a global voluntary initiative of chemical industry, covering all activities including research, process and product development, manufacturing and sales. It aims at an ethical and behavioural change, going away from a regulatory driven approach to a proactive approach. RC is now licensed by 52 national industry associations worldwide.

Mutual Aid Response Group (MARG): MARG, a voluntary initiative on developing 'mutual aid arrangement' for effective emergency response on a voluntary basis among neighbouring units in an industrial pocket, has emerged lately. Its a forum to help each other by sharing resources to tackle emergencies, successful in Maharashtra, where 15 MARGs presently operate. This initiative is promoted by DISH-a regulatory agency. There is a need for the expansion of MARG initiatives in other states.

Initiatives in Road Transport Sectors

- **Vulnerability and Risk Assessment of Transportation of HAZCHEM:** Risk assessment and vulnerability studies have been completed in 16 stretches of NHs in four states with a high density of hazardous material transportation. Based on identified risks, mitigation measures including preparation of DM Plans are carried out.
- **Hazardous Material (HAZMAT) Emergency Response Van:** The NSC identified and analysed the successful experience of developing and operating HAZMAT Emergency Response Vans by leading MAH units in Industrial Area of Raigad, in Maharashtra, and published a case study on it. The approach for responding to road transport emergencies represented by this case study is practical and cost-effective, hence needs to be replicated at national level.

Parallel International Efforts

- **International Labour Organization:** An ILO convention, adopted on 22 June 1993, dealing with the prevention of major industrial accidents involving hazardous substances and the limitation of the consequences of such accidents, is directly relevant for CDM in India.
- **UN International Strategy for Disaster Reduction (ISDR):** This effort is promoting chemical disaster risk reduction by educating and involving the community and civil authorities.
- **The UNEP Trans-APELL Programme**: This programme is being strengthened as a key vehicle for UNEP work, (at local level) in preventing and preparing for natural and other disasters, such as industrial disasters. To promote the APELL process further, UNEP is revising, adapting and elaborating new tools and methods to repackage it as a multi-hazard programme for disaster reduction that enables local communities to identify, assess, prevent and prepare for the impact of any type of disaster.

Strategic Approach to International Chemicals Management (SAICM)

In February 2006, over 190 countries (including India) acceded to SAICM—a voluntary agreement to ensure safe use of chemicals by 2020. This initiative of UNEP consists of an overarching policy strategy and a global plan of action, wherein 192 activities have been identified for action.

NDMA Guidelines on Chemical Disasters

A workshop on CDM was convened by NDMA in February 2006 with various ministries of GoI, regulatory agencies (DGFASLI), NSC, R&D institutes (BARC,DRDO), Indian Institute of Chemical Technology, Industrial Toxicology Research Centre, National Institute of Occupational Health, NEERI, AIIMS, professional institutions (NIDM, Delhi and DMI, Bhopal), apex industrial associations (CII, FICCI) and the DM Authority of Delhi Government, along with professionals and experts from the field. It identified priority areas for prevention, mitigation and preparedness of CDs and provided an outline of comprehensive guidelines to assist in preparation of plans by ministries/states.

It was decided to articulate the CDM guidelines through the NDMA Guidelines on CDs. The Guidelines specific for industrial installations and chemical storages, state and district-level functions, preparation of On-Site and Off-Site emergency plans, and mgt of transport accidents involving HAZCHEM hve also been prepared. They will be periodically reviewed and updated by NDMA and additional issued, if necessary.

Salient Gaps in CDM in India

Chemical accidents pose a special challenge in their management. The present status for CDM is contained in various chemical-specific and general regulations. A number of programmes and activities on preparedness, mitigation and response are underway at national, state, district and local levels. Chemical industries have also set up risk reduction measures and initiated resource sharing and other coordinated efforts. R&D activities and standards setting in CDM are also being pursued in various institutions/orgs. However, while considerable progress was made in the last two decades in development and implementation of regulations for mgt of CDs, critical gaps still exist in certain areas. Gaps identified in regulations, programmes, activities/initiatives need to be addressed on priority.

Looking Ahead

The Guidelines have been formulated as a part of an integrated national all-hazard approach for DM. The aim is to ensure that occurrence of chemical accidents and risks posed to human health, life and the envt are reduced. The chemical emergency mgt approach aims to institutionalise the implementation of initiatives and activities covering all components of the DM cycle, including prevention, mitigation, preparedness, relief, rehabilitation and recovery etc, with a view to develop a national community that is informed, resilient and prepared to face chemical emergencies, with minimal loss of life and property. Therefore, endeavour of both Central/State govts and local authorities is to ensure its implementation. To start with, existing DM plans at various levels shall be revamped to address the chemical hazards.

The guideline document provides for strengthening the chemical safety in the country on a sustainable basis. These guidelines have set modest goals and objectives to be achieved by mobilising all stakeholders, through an inclusive and participative approach. Appropriate allocation of financial and other resources, including dedicated manpower and targeted capacity building would be the key to their success. Periodic trg, tabletop exs, simulations, mock drills, etc, would further enhance the effort.

PART III: Bio Warfare (Bw) and Bio-terrorism (Bt)

History

Bio disasters are primarily of natural origin, largely the result of entry of a virulent organism into a congregation of susceptible people, living in a manner suited to the spread of infection. In crowded areas, anthrax spreads by spore dispersal in the air, small pox spreads by aerosols, typhus and plague spread through lice, fleas, rodents, etc. The average epidemic spreads locally and dies down if the contagion is localised. Disasters have occurred when envt factors were conducive, for example, Black Death occurred when conditions were favourable for increase in the number of rats, and cholera attained a pandemic form when the causative agent entered urban areas with inadequate sanitation facilities. Similarly, post WW I, move of population led to the rapid spread of Spanish Influenza virus. Short-duration infections with high mortality rates harm societies by depleting their numbers. The longer duration infections, with varying immediate mortality, nevertheless, become important when they cause large-scale morbidity,affecting the productive capacity of the population. Malaria and tuberculosis are its examples. Extension of human activity and its contact with a hitherto localised microbial envt introduces novel pathogens-spread of Nipah, Ebola, Marburg and Lassa fever viruses are its examples.

HIV, a sporadically occurring phenomenon-that of transmission of virus from chimpanzee to man-became a pandemic when it began to be sexually transmitted, and has since become the largest epidemic in history. Human conflict, resulting in large-scale population movement, breakdown of social structures and contact with alien groups has always generated a large number of infections. Until very recently, the number of cas due to infections far exceeded the losses due to wars.

As a tac manoeuvre, intro of a communicable disease in enemy camp has been ex by military cdrs from earliest times. Filth, cadavers and animal carcasses have been used to contaminate wells, reservoirs and other water sources up to the 20th century. In middle ages, military leaders used bubonic plague by catapulting infected bodies into besieged forts to spread the disease. Use of bio wpns is documented during the French & Indian wars in North America (1754–1767).

In the 20th century, use of bio-weapons became more scientific as technology for the cultivation of pathogens and vaccinology developed. During WW I, Germany developed a bio-warfare programme to use bacteria to contaminate livestock and feed. There are also accusations of German bio-attacks on Italy (cholera) and Russia (plague). After WW I, many nations undertook the development of bio-wpns. Significant research efforts were also made by both sides in WW II. Human pathogens like Bacillus anthracis, Botulinum toxin, etc., and crop pathogens like Rice Blast, Rye Stem Rust, were developed into bio-weapons. Post-WW II, the Cold War saw serious development in bio-weapons. Currently 11-17 countries are suspected to be working on bio wpns, including sponsors of terrorist activities, with even smaller groups having acquired bio-terrorist capabilities.

While bio warfare does not appear to be a global threat, use of some agents (anthrax) by terrorist groups poses a serious threat. The ease of production, packaging and delivery using existing non-military facilities are major factors helping their proliferation. These artificially induced infections would behave similar to natural infections (albeit exotic) and would be difficult to detect except by an effective disease surveillance mechanism. Bio-terrorism, thus is as great a threat as any natural epidemic causing agent.

Mitigation

The essential protection against natural and artificial outbreak of disease (bio-terrorism) includes development of mechanisms for prompt detection of incipient outbreaks, isolation of infected persons and the people they have been in contact with, and mobilisation of investigational and therapeutic counter-measures. In the case of deliberately generated outbreaks (bio-terrorism) the spectrum of possible pathogens is narrow, while natural outbreaks can have a wider range. The mechanism required however, to face both can be similar if the service provider is adequately sensitised. Response to these challenges will be coordinated by the nodal ministry-MoH&FW, with inputs from Ministry of Agriculture (MoA) for agents affecting animals and crops, and support of other ministries like Home, Defence Railways and Ministry of Labour and Employment (MoL&E). With a proper surveillance mechanism / response system in place, epidemics can be detected at initial stage of outbreak and controlled.

Normally, slowly evolving epidemics do not cause upheavals in society and will not come under the crisis mgt scenario, and will be tackled by ongoing national programmes. There may, however, be specific situations when the disaster response mechanism may be evoked, for example, an outbreak of malaria after an exceptionally wet season in a previously non-endemic region and epidemics occurring as a consequence of a bio-terrorism attack. Epidemics do not respect national borders. As international travel is easy, bio agents need to be tracked, so that they don't cross boundaries into other regions. This aspect has made international collaboration crucial for epidemic control. Organisations like WHO, Food and Agricultural Organization (FAO), Office International des Épizooties (OIE) thus have an important role to play.

NDMA Guidelines For Mgt of Bio Disasters: These are the Bible's of DM in India, post the 2005 overhaul and deal with all aspects of bio disasters.They are designed to acquaint the practioner with basics of Bio Disaster Management (BDM), in a balanced and thorough manner and give the information required by orgs to formulate SOPs at various levels. They will also be used for preparation of national, state and district biological DM plans, as part of 'all hazard' DM plans.

Background to the Guidelines

Characteristics of naturally triggered outbreaks are described and the potential for use of pathogenic organisms in strategic and tactical modes as well as potential of bio-terrorism are presented. The mass destruction capability of bio agents in context of their disaster potential is outlined. Characteristics of biological agents used or developed as wpns have been listed seperately in annexures. The matter of threat perception has been dealt with in the Indian context – tackling modern concepts on *Zoonoses* in a broad fashion as also indicating the impact of advances in molecular biology on this field. It also touches on bio-safety and bio-security and the evolution of epidemics. Clues to distinguish the two modes have been included, along with an illustrative collation. The economic aspects of epidemics, which have been well quantified in the context of deliberate action, illustrate the impact of bio agents.

Resources to Face Threat of Bio Disasters

Current Laws and Acts that deal with methods for the control of epidemics have been enumerated and the 'Biological and Toxin Weapons Convention' discussed. International agencies concerned with bio disasters and the related activities of these agencies have been given. A note by WTO on the regulation of world trade has been included. The concerns voiced at the Earth Summit held in Brazil on the disruption of natural ecosystems that could result in bio disasters, the role of Interpol in enforcing the concerned regulations and the role of NGOs has been outlined. An account of the importance of the integrated disease surveillance project in biological DM is given. Role of AF/ Railways, who have a countrywide infrastructure,to be used in such disaster situations, has been outlined.

Existing Capability to Tackle Bio Disasters

In this part, areas that have to be addressed during preparatory phase are discussed. It also gives a short description of the response to challenges that the country has faced in recent times, for example, Plague in 1994 (Beed and Surat) and 2002 (Himachal Pradesh) and the H5N1 outbreaks in poultry. The performance of responding agencies in these epidemics, though adequate, could be improved upon to meet bigger challenges.

Guidelines for Individual Stakeholders to Prepare DM Plans

These indicate the legislations that can be used, mechanics of DM and major modalities for preventing an epidemic situation and recovering from it. They also outline the community aspect and preparation necessary for satisfactory control of an epidemic threat.

Guidelines for Safety and Security of Microbial Agents

Activities of various countries for developing bio wpns have had one benefit-a clearer understanding of the hazards of handling virulent organisms. The erstwhile method of bench top style working is now considered unsafe and is not likely to be used in the 21st century. Natural pathogens from new areas or those that have demonstrated epidemic potential have to be handled in appropriately designed laboratories. These deal with the levels of pathogens and the corresponding safe handling areas. The security protocol for valuable bio materials has been presented and trg requirements and resource material given. Basic information necessary for preparing bio-safety manuals is also given.

Effects of Disasters on Animal Husbandry

Here is discussed the present state of animal husbandry in India, its vulnerability to disasters, the economic consequences of disasters and a proposed plan for dealing with such situations. The statutory and legal framework available in the country/abroad is also mentioned. Global veterinary issues and the need to interact with various international agencies and neighbouring countries have been elucidated. The intersection of public health and veterinary issues also finds a place.

Crop Diseases With Economic Ramifications

Genesis of this issue and instances of inadvertent/illicit entry of some plant species and exotic pests are discussed. The national/international regulatory mechanisms have also been described. Recent efforts to provide the infra for plant quarantine and regulation of imported agricultural products has been elaborated. Increased transnational traffic following the WTO agreements poses a challenge that the nation has to address. The steps being taken are also discussed.

How Guidelines Provide a Broad Perspective on Bio Disasters

The components for a system necessary to prepare for and respond to the threats have been set out. Time lines proposed for implementation of various activities in the Guidelines are considered both important and desirable, especially in the case of non-structural measures,for which no clearances are required from central or other agencies. Precise schedules for structural measures will, however, be evolved in the Bio DM plans that will follow at the central ministries/state level, duly taking into account the availability of financial, technical and managerial resources. If compelling circumstances warrant a change, consultation with NDMA will be done, well in advance, for adjustment on a case-to-case basis.

Milestones for implementation of the Guidelines: These are: Short-term Plan (0–3 Years) and Long Term (3-8 yrs). They provide a framework for action at all levels. The nodal ministry-MoH & FW will prepare an action plan to enable all sections of the govt and administration machinery at various levels to prepare and respond effectively to bio disasters. The sporadic occurrence of low gravity bio disasters will be managed primarily by the existing mechanism of response for medical, veterinary & agricultural services. In the current scenario, private sector is well entrenched in the primary and tertiary health care sector and is growing at a rapid rate. It would be mutually beneficial for both private sector and govt if this infra can be used for bio DM in a Public-Private Partnership (PPP) module. Also,unlike the other two agents (nuclear and chemical), bio threats can be controlled to an extent-if protective systems are in place, influx of infective agents would not have any disastrous consequences. This leads to a state of preparedness, which prevents bio disasters. If still they do occur, they will then be managed properly.

PART IV: Nuc and Radiological Disasters

Mgt of Nuc and Radiological Emergencies

Post 2005, India has seen a paradigm shift in DM. Lakhs of cases and heavy economic losses (experienced during past major disasters) have led to the realisation that development cannot be sustained unless DM activities are mainstreamed into development, as a national priority. Accordingly, GoI has adopted a proactive, multi-disciplinary and holistic approach towards DM for building disaster resilience in all infra and constructed work, to cope with both natural and man-made disasters. Enacting the DM Act,2005, formation of NDMA, with the PM as Chairperson, and similar authorities in states with CMs in Chair, were some initial steps. Next was setting up of DDMAs, with District Collectors as Chairpersons and elected representatives of local bodies as co-chairpersons.

Nuc/radiological emergencies being man-made in nature, maximum emphasis has been laid on prevention of emergencies without diluting other aspects of the disaster continuum. However, in an emergency taking place due to circumstances beyond control, the Guidelines recommend a series of actions by various stakeholders at different levels that would: (i) mitigate the accident at source; (ii) prevent deterministic health effects in individuals and limit the probability of stochastic effects in population; (iii) provide first aid and treatment of injuries; (iv) reduce psychological impact on population; and (v) protect envt and property, all under the constraint of available resources. After due consideration, these emergencies have been broadly classified into five categories:

- An accident taking place in any nuclear facility of nuclear fuel cycle including the nuclear reactor, or in a facility using radioactive sources, releasing radioactivity in the environment.
- A ‘criticality’ accident in a nuclear fuel cycle facility where an uncontrolled nuclear chain reaction takes place inadvertently, leading to bursts of neutrons and gamma radiations.
- An accident during the transportation of radioactive material.
- Malevolent use of radioactive material as a Radiological Dispersal Device by terrorists for dispersing radioactive material in the environment.
- A large-scale nuclear disaster, resulting from a nuclear weapon attack leading to mass casualties and destruction of large areas and property.

As regards vulnerability of various nuc fuel cycle facilities to terrorists attacks, these facilities have elaborate physical protection arrangements in place to ensure their security. The structural design of these facilities ensures that even in the event of a physical attack, structural barriers prevent release of any radioactivity outside the plant area itself and hence public is saved from radiation exposure. Because of their wide spread application, access to availability of radioactive sources has become easy. While their radioactive strength is in itself a deterrent to pilferage, radioactive sources can still be stolen and used in a Radiological Dispersal Device (RDD), which essentially is a conventional explosive device in which the radioactive material has been so added that, on its being exploded, there would be dispersal of radioactivity in the envt. Normally, use of a RDD by itself would not result in fatalities due to radiation.

Fatalities, if any, would primarily be due to the explosion. However, it may contaminate a reasonably large area, besides its main potential of causing panic and disruption.

There are well-established international treaties for control of fissile materials, yet there exists the possibility of it falling into the hands of terrorists. Moreover, if these treaties are violated through state-sponsored activities, access to fissile materials by terrorist groups cannot be ruled out. Accidents during transportation of radioactive materials are of low probability,due to special design features of containers in which they are transported and special safety and security measures (to take care of all possible threats/eventualities, including the threat from misguided elements).

Of all the possible types of nuc and radiological emergencies described above, it is only the nuc wpns attack by an adversary which could result in a large scale disaster. Though such a probability is low, there should be a plan in place to handle such an event, as it would have devastating consequences.

Approach to Nuc and Radiological Emergency Mgt

A four-pronged strategy is to be adopted for holistic mgt of nuc/radiological emergencies:

- The Nuc Emergency Mgt Framework -supported on prominent mainstay of strengths, such as prevention, mitigation, compliance of regulatory requirements, preparedness, capacity development, response, etc. that constitute the DM continuum.
- The existing legal framework - strengthened through various legal and regulatory means.
- The framework to be institutionalised by identifying the stakeholders at various administrative levels with their respective responsibilities in a people-centric, bottom-up approach.
- The framework to be implemented through strengthening of existing action plans, or by preparing new action plans at national/state/district levels. The Atomic Energy Regulatory Board is the nuc regulatory authority in the country, with the mandate for issuing licenses to nuc/radiological facilities and ensuring compliance with applicable standards and codes.

Present Status and Situation Analysis

Some technical and administrative issues are yet to be addressed in a holistic manner, besides analysing the present status. For responding to any nuc/radiological emergency in the public domain, Crisis Management Group of DAE activates the emergency response. It coordinates with the local authority in the affected area to provide technical inputs for effective response. Based on the severity of the radiological conditions and their likely consequences, emergencies at nuc facilities are categorised as: *emergency standby, personnel emergency, plant emergency, on-site emergency and off-site emergency*. Detailed plant-specific emergency response plans are in place at all nuc facilities for their entire lifetime. A critical emergency at a nuc plant is an off-site emergency, where public may get affected. To cope with this, detailed response plans will be put in place by the Collector, in coord with plant authorities.

A network of 18 **Emergency Response Centres** is presently est by Bhabha Atomic Research Centre (BARC) to cope with radiological emergencies in public domain, like transport accidents, handling of orphan sources, explosion of RDDs, etc. Task of these ERCs is to monitor and detect radiation sources, train the stakeholders, maintain adequate inventory of monitoring instruments and protective gear, and provide technical advice to first responders and local authorities. Further, BARC is actively involved in training personnel from various PMFs, and the NDRF and CISF.

For any major nuc accident wherein the situation is beyond civil administration, services of Armed Forces (AF) may be called for, to take over several critical functions. Civil-military coordination will thus be comprehensively developed so that the specially trained teams of AF personnel can be inducted to assist civil administration. Detailed SOPs to handle any type of nuc/radiological emergency have to be worked out initially for all cities with population of, say, 20 lakh or more and other vulnerable places in phase 1 and other cities in Phase II.This preparedness is all the more significant for the country's metros.

Prevention of Nuc/Radiological Emergencies

This deals with how nuc/radiological emergencies are prevented in nuc facilities by adopting the defence-in-depth approach, where the safety systems are in-built with adequate redundancy and diverse working principles.

Several layers of protection and multiple barriers prevent release of radioactive material into the public domain. Defence-in-depth is structured in five levels. Should one level fail, subsequent levels come into play automatically. Further, the engineered systems are inbuilt and operated by adopting the best available technologies and practices during various phases of the lifetime of the facilities. Even though such practices are already in place at all the nuc facilities in the country, there is a scope/need for further strengthening it, in the light of newer threat perceptions.

Mitigation of Nuc/Radiological Emergencies

This explains various engineered safety features and accident mgt procedures that are in place in a nuc plant as accident mitigation measures for minimising the impact of a nuc emergency by keeping the radioactivity release in the envt to minimum levels. The application of defence-in-depth concept ensures three basic safety functions, viz., controlling the power, cooling the fuel and confining the radioactive material, so that even in case of an emergency the radioactive materials do not reach the public or envt. The inbuilt safety measures, including bio shields, safety systems and interlocks, safety audits, strictly following safety procedures, etc., mitigate the consequences of accidents, if any.

Preparedness for Nuc/Radiological Emergencies

The planning and preparedness for response to nuc/radiological emergencies will be integrated in an all-hazards approach, with planning for response to all types of conventional emergencies. It is mandatory for the nuc facilities to have a comprehensive emergency preparedness plan for on- and off-site emergencies. All these activities are guided and controlled from a pre-designated ERC located outside the boundary of the nuc facility. Quality of the required emergency preparedness is ensured by periodic trg courses for on-site and off-site administrative personnel, including govt officials/other stakeholders.

A large number of agencies like police, fire and emergency services, medicos, NGOs, civil def and home guards, etc, have to be fully integrated into the nuc emergency programmes both at state/district levels. State govts will undertake actions in a proactive manner to establish formal linkages of these orgs with the nearest ERC. In the handling of any nuc/radiological emergency, foremost requirement is the availability of instruments for radiation detection and monitoring. A sufficient inventory of radiation monitoring instruments and protective gear will be built up by all State/District DM Authorities and the selected first responders will be trained in their use. Four battalions of the NDRF are trained for specialised response during nuc/radiological emergencies. In addition, four more can provide a supporting role.

Capacity Development for Nuc/Radiological Emergencies

This deals with efforts towards coping with nuc/radiological emergency situations. Capacity needs to be enhanced at all levels, which calls for requisite financial, technical, and infra supports. The confidence level in the community to handle any nuc/radiological emergency can be enhanced only through education, awareness and preparedness. Main focus is on the student community, which is the most effective segment of the society, to spread disaster awareness. Topics pertaining to radiation, effects of radiation, nuc/radiological emergencies etc are being included in the syllabi at school/college levels nationwide. In recent years, corporates have also shown willingness to support disaster relief programmes and infra building, as part of their CSR. The modalities for the type of help that they can render and are volunteering for, are worked out by the NDMA /State concerned.

Response to Nuc/Radiological Emergencies

This describes the action to be taken in nuc/radiological emergencies- and has many elements in common with the response to other man-made and natural disasters, in terms of services like medical, fire and emergency services, police, etc. However, some special features of nuc emergencies need to be taken care of additionally. The response to an emergency will always be commensurate with the level of the hazard. Timely and effective medical response is a crucial component in reducing morbidity and mortality on the one hand and alleviating fear and suffering of the affected population on the other hand. In this context, MoH&FW and health departments of concerned states will activate their respective Emergency Support Action Plans. If required, district hospitals will deploy their

Quick Reaction Medical Teams (QRMT) to assist the specialised teams of response forces at national/ state/district levels in providing necessary help in decontamination, triage, administration of de-contaminating agents, basic and advance life-support, etc.

Implementation of NDMA Guidelines

This spells out preparation of `Action Plans' by various levels of stakeholders, which indicate the detailed work plan and milestones with recommended time-frame and suitable indicators to enable monitoring and review of progress made. Like conventional DM plans, a nuc/radiological emergency plan is also to be implemented following a bottom-up approach, where the community, in association with individuals, NGOs, community based orgs, private sector, etc., will develop and implement the emergency mgt programme, tailored to their local needs.

NDMA, as the apex body, is responsible for each phase of the DM continuum with six major responsibilities viz., pre-disaster (prevention, mitigation and preparedness), during disaster (rescue and relief) and post-disaster (rehabilitation and reconstruction) scenarios. It is assisted by the National Executive Committee (NEC), which is the executive arm of NDMA. Immediate response and relief operations will be carried out by the National Crisis Management Committee(NCMC)/NEC. Preparation of action plan at macro-level will be carried out by the NCMC/ NEC, with technical assistance from DAE. District Authorities of States/Union Territories will implement the nuc/ radiological disaster risk mgt programmes in respective areas. Each state is to develop a detailed micro-level action plan in a mutually interactive supplementary mode with its district level plans.

Implementation at national/state level will be in three phases:

A **short term plan (0–3 years)** envisaging capacity development through education and awareness generation, trg and community participation, etc., est of critical infra like expansion of network of ERCs, communication systems, strengthening of regulatory framework, and emergency med preparedness including formation of QRMT, etc.

Medium term plan (0–5 years) includes further up gradation of all infra, enhancement of regulation and extension of the risk reduction framework, enhanced preparation for better response with a well-informed and trained community.

Long-term plan (0–8 years) includes, inter alia, capacity development to the optimum level with preparedness and response mechanisms fully integrated up to community level. Est of secondary and tertiary care units for treatment of radiation exposure cases is a priority area.

To conclude, the non-structural measures will be implemented in accordance with defined timelines. Wrt structural measures, their implementation schedule may be reviewed, where inescapable, at the time of formulation of plans, subject to availability of financial resources, technical manpower, etc. However, changes required, if any, will be discussed by authorities concerned with the NDMA, on a case to case basis.

Overview Of Current Cbrn Trg and Infrastructure in IA

In order to appreciate the thought process of existing CBRN trg and infrastructure, it is imperative to understand the basis of concept upon which the CBRN orgs have been evolved in IA. World over, two models are being followed:-

- **Chemical Corps Concept -** In this model, a dedicated org in the form of a Chemical Corps exists to deal with all CBRN aspects. These units are separately auth, raised, org and equipped to cater for overall def needs. USA, Russia, China and Germany follow this model.
- **Mother Corps Concept -** In this concept, all arms are responsible(resp) for CBRN def while specialist CBRN tasks are performed by the Corps of Engineers (Engrs). IA follows this concept.

CBRN Protection Policy -Directorate General of Military Operations (DGMO) has laid down CBRN protection policy for IA as under:

- Provision of minimum protection capability (capb) for max troops (tps).
- Desired CBRN protection equipment (eqpt) for approximately (approx) an Infantry (Inf) brigade (bde) and /or a Combat Command (CC) size force in a Corps to ‘fight dirty’.
- This essentially involves transiting a contaminated (contam) area in pursuance of ops or entering a contam A to evacuate (evac) tps/stores. Occupation of def/other combat ops inside a contam area would be extremely hazardous to prosecute and may, therefore, not be feasible.

CBRN Responsibility (resp) -DGMO has laid down CBRN def as an all arms resp. However, special CBRN tasks to include CBRN reconnaissance (recce), survey and marking, monitoring and decontamination (decn) is carried out by Engrs. It is, therefore, necessary that the entire spectrum of IA has an elementary knowledge of CBRN def. However, in case of a CBRN threat, there will be certain segment of tps who would be needed to op in the CBRN envt. These individuals need to have certain 'basic' knowledge on CBRN in order to enable them to op efficiently in the CBRN envt.

Present Structure of CBRN Trg

In sync with the "Mother Corps" concept, existing CBRN trg sys was evolved to meet the op reqmts of IA. To train every soldier on CBRN aspects, there is a reqmt of a well thought out and state-of-the-art infra for imparting realistic and meaningful trg at various levels, keeping in mind the op reqmts. Infra available and nature of trg being carried out a various ests is as follows:

- **Regiment(regt) Centres:** Min CBRN trg is carried out at the regt centres, since there is a shortage of instructors (instrs) and equipment (eqpt) for CBRN trg at the centres. Thus, there is a reqmt to standardise the curriculum of CBRN trg in all Regt Centres.
- **Comd and Corps CBRN Schools:** There are 11 Comd/Corps CBRN schools which have been est by pooling integral resources and are functioning on ad hoc basis. Some difficulties being experienced in imparting quality trg are:
  - **Organisation:** Org of Comd/Corps CBRN schools needs to be formalised. Presently, its on ad-hoc basis and experiences functional difficulties. No War Equipment (WE)/Peace Equipment (PE) scales exist for Comd CBRN schools. As a result, there are no standardised instructions for their functioning to achieve the desired CBRN trg output.
  - **Funding of Comd CBRN Schools:** There is no laid down procedure of funding of Comd CBRN Schools. As of now, limited trg grant/regtl funds are earmarked to run these schools. To ensure that CBRN trg eqpt is bought from such funds, our trg policy needs a review. Dedicated grants are needed for Comd CBRN schools for smooth functioning and effective trg.
  - **Infra:** In order to provide realistic op-oriented trg at various levels, there is a need for creating infra on permanent basis. Comd CBRN schools should form part of the theatre trg node and their specialisation should be brought up to impart Basic CBRN Trg.
  - **Eqpt:** There is a shortage of trg eqpt which affects quality of trg. Though every Corps has been allotted one trg brick (to facilitate battalion (bn)/Combat Group (CG) level collective trg), yet it is not sufficient for all units in the Corps Zone. In addition, trg brick eqpt which has outlived its shelf life, has not been replaced over a period of time.
  - **Instructors (instr):** Instrs for trg are pooled from units for the duration of any course. They are rotated at regular intervals, which leads to inconsistency in trg being imparted.

Inadequacies of CBRN Trg

In IA, CBRN trg has been in place for last 25 years and has come a long way. However, Number of improvements are envisaged to obtain the desired results. The need is that 100 per cent personnel must be '*Elementary CBRN'* trained. All those who will be op in a CBRN envt must be 'Basic CBRN' trained and all CBRN units, subunits and instrs at various schools/centres must be 'Advance CBRN' trained. Major inadequacies in CBRN system (sys) and the infra are as under:

- **CBRN Trg Infra:** Lack of CBRN protection and decn trg eqpt has severely affected practical aspects of CBRN trg. However, same has been ameliorated to some extent with release of CBRN Recycled Trg Equipment (RTE) issued to formations.
- **Live CBRN Trg Facilities:** Currently, no live CBRN trg facilities exist in india. It is only smoke which is presently used to depict a CBRN envt during trg/excersises. Therefore, it is, important to instil confidence in offrs and men by handling live nuc and chem agents

CBRN Trg Requirements

Our adversaries are armed with nuc wpns and possess the delivery means to strike targets deep within our nation. In the sphere of CBRN Warfare (w), a significant factor has been signing of chem wpns Convention (CWC) and Bio and Toxin Wpns Convention (BTWC) by our adversaries. However, this in no way mitigates the possibility of their use by trt orgs or precludes surreptious use. Thus trg needs must cater for threats and capb of adversaries in a future def/offensive(offn) scenario. To achieve the end state as envisaged in the "Mother Corps" concept, fwg method of CBRN trg is recommended:

Super Specialisation (01 -02 Yrs) Selected Staff Offrs and Adv Trained tps

Basic Trg. To 'Fight Dirty' (04 weeks) [@ One Inf Bde Gp & /or Comb Comd per Corps]

Adv Trg (04-05 weeks) NBC coy/pl, Comd & Staff appoinments

Elementary Trg. One week [Entire IA-1.3 million]

Proposed Methodology: CBRN Trg

In addition to levels of trg, emphasis should be given to live trg, unit trg, jt services trg and fd excersises (exs). There is also a reqmt of imparting basic CBRN trg to Artillery units, logistic installations (lgs instlns) and services units, based on threat perception, because it is reasonable to assume that initially the en is likely to employ tac nuc wpns, which will be used to contam gun As and lgs instlns to stall our offn.

CBRN Disaster Management: Lately, DM capsules as part of CBRN courses are being conducted at FNBCP and Comd CBRN schools. DM trg is thus recom to be amalgamated with the detailed conduct of CBRN trg, since AF will willy-nilly be the first responders in case of CBRN disasters. Though emphasis should be on individual (indl) protection, trg cycles should endeavour to culminate in collective trg, wherein a unit/sub-unit is trained to op effectively in a CBRN envt. If CBRN trg is separated from other training events, troops(tps) get conditioned to regard CBRN ops as a separate warfare. Integration of CBRN trg will ensure that all tps have a thorough understanding of CBRN ops and procedures.

Coord of Trg: Close coord between various types of trg is necessary to ensure that need based trg is imparted and repetitiveness in CBRN trg is avoided at various levels. This coord is achieved through; Seamless liaison between all agencies; Clear cut trg directives and instructions; Updated trg manuals, Regular practice during exs/wargames; Senior offrs study capsules; SOs familiarisation capsules (presently conducted twice a yr at FNBCP,Pune); review meetings at ARTRAC and Comd HQ levels.

Medical(med) Aspects of CBRN: Med preparedness to handle CBRN cas both during war and peace have to be addressed at the level of fd med units and static hospitals. Their preparedness has to be viewed in terms of stocking of drugs/antidotes, reqmt of special infrastructure/eqpt and trg of med pers. Towards this end, med branch needs to work out the modalities for conducting CBRN trg and laying down equipping policy for fd hospitals and QRMTs in consultation with all concerned. There is a reqmt to est 'Centre of Excellence' at Armed Forces Medical College. In addition,respective Comd Hospitals and Army Medical Corps Centre will train doctors in carrying out total decn ops and treatment of critical CBRN cas.

CBRN Courses in Foreign Countries: CBRN trg in foreign countries is essential to remain abreast with the dynamic evolution in CBRN arena. There is a need for attending courses and visit countries like UK, USA, Japan, and Czech Republic, which is being looked into on priority.

Auth of Trg Bricks to Category(cat) 'A' and 'B' Ests: A case was taken up by HQ ARTRAC to auth trg bricks(a set of items and components essential to carry out requisite trg is termed as brick) to all Cat 'A' and 'B' ests in a graduated manner. It needs to be included in the LTPP as Priority 1. All Comd CBRN schools need to be auth one CBRN trg brick and FNBCP two CBRN trg bricks.

PART VI: Road Ahead and Conclusion

Even though it's the NDRF that's presently mandated for CBRN emergencies in the country, per-force, by virtue of their strength, countrywide presence and trg, AF willy-nilly get roped in, along with the former, to tackle such emergencies and will continue to play a major role in emergency support functions. These include communication, search and rescue ops, health, med and transportation, in the aftermath of a disaster. Airlift, heli-lift and moving assistance to neighbouring countries all fall within their expertise and domain. They will also participate in trg the trainers and act DM managers, especially in CBRN aspects, heli-insertion, high-altitude rescue, waterman ship and trg of paramedics, all in concert with the NDRF. At National level, HQ IDS,with its Chief (CIDS) have been included in the NEC. Similarly, at State/District levels, local reps of AF are being made part of executive committees, ensuring closer coord and cohesion with boots on ground.

Towards combating the existing threat, DRDO has also come out with a number of next gen radiological def eqpt, all developed under the PPP mode. This range of eqpt and technology, including detectors and recce vehicles against NBC can help achieve the required deterrence, to keep both our adversaries quiet. Besides, the org has developed other eqpt like nano-technology based sensors, micro UAVs, dosimeters (which measure an individual's exposure to hazardous radiation). Also, it has developed advanced inflatable shelters-to withstand water threats and ward off solid NBC agents for at least 48 hours. However, a few aspects still remain, which are outlined in the roadmap given below.

Roadmap

- **Stakeholder Engagement:** Engage various NGOs, Corporates and individuals towards building an architecture of security. A successful system requires close working relationships between all of these and the industry.
- **Private Sector:** It plays an important role in strengthening our security system- T3 at Indira Gandhi International Airport has installed an impressive array of security eqpt, mostly procured from private manufactures.
- **Effective and Quick Response System:** Coord in case of an accident/attack is critically important. Trg and education can help in big ways. The 12 Bn strong NDRF now conducts regular training for all other PMF/CPF and SFs. Its NBC combat team is now 300 personnel strong. i.e. 75 personnel each in 4 groups.
- **Enhancing Technical Capb in Inspection/Detection of NBC Materials at Borders:** Further, est a team capb of launching NBC shelters for BGFs will be very helpful.
- **Community Preparedness by Sensitising:** Need to define role of public, private and corporate sectors for active participation during disasters/otherwise. Further, each state govt to come out with their DM Plans, to be implemented based on NDMA guidelines.

Conclusion

CBRN def trg has really evolved over the past couple of decades in India and, notwithstanding the difficulties faced by the virtually minuscule fraternity of professionals associated in this arena, the number of people trained has gradually risen to a significant number. With the proactive involvement of NDMA and other stakeholders in the field of CBRN DM, future of CBRN trg surely appears to be bright. Notably, Indian Navy has recently set up a NBC def trg facility to develop skills of its personnel in fighting such attacks and Indian Air Force is in the process of doing so. The IA has recently ordered for 1500 advanced NBC protection suits for its Armoured Personnel Carriers (APC), keeping Pak's arsenal in mind.

This optimism will surely go a long way to ensure that the first responders will respond to CBRN contingencies in a professional manner, should they arise at all. There is, however a requirement to objectively improve the trg and eqpt scenario nationally in an integrated and comprehensive manner, so to achieve the ultimate objective of a CBRN-resilient India.

Lets hope that happens, sooner than later!

Disaster Management Plan for Chemical Industries

Mukta Girdhar[a]

Abstract

Chemical disasters happens due to release, leak and explosion of chemical substances, negligence, incompetence, thus starting fires, and leading to loss of economy, human health, environment, livelihood and infrastructure for example, the Great Chicago Fire of 1871 and the 1984 Bhopal Disaster which was the worst and biggest disaster in India. A massive fire broke out at the Indian Oil Corporation depot in Sitapura Industrial Area of Jaipur on 29th October 2009, Thursday night. The impact on every aspect was huge. The Industrial Disaster Management Plan provides a framework and direction to all the stake holders to manage various such incidences and risks. The Disaster Management Plan should be a "Dynamic Document" in the sense that it should be periodically improved keeping up with the emerging global best practices and knowledge base in Disaster Management. It is in accordance with the provisions of the Disaster Management Act, 2005, the guidance given in the National Policy on Disaster Management, 2009 (NPDM), and the established national practices. Plans should incorporate substantively the approach enunciated in the Sendai Framework which will thus help the country to meet the goals set in the framework.

Keywords: chemical disasters, Industrial Disaster Management Plan, human health, environment, livelihood and infrastructure

Introduction

Disasters caused due to release, leak and explosion of chemical substances, thus starting fire, impact human health, environment, livelihood and infrastructure. Such disasters, are termed as Chemical Disasters. Chemical disasters are caused by accidents, negligence or incompetence leading to great economic loss, damage of infrastructure, injury and loss of life, livelihood and environment. For example, the Great Chicago Fire of 1871 became more severe because of presence of a heavy concentration of wood house, fuel and other chemicals in a small area. Areas close to industries come under immediate risks. The 1984 Bhopal Disaster was the worst and biggest disaster in India. At that time about 800,000 people were living in Bhopal out of which 2,000 died during the incidence and about 8,000 died later, and about 300,000 were injured. Thus, this caused about 4,000 to 20,000 deaths and several adverse effects are still continuing. A massive fire broke out at the Indian Oil Corporation depot in Sitapura Industrial Area of Jaipur on October 29, 2009, Thursday night. This led to an uncontrollable fire which engulfed 12 huge tanks. Nearly one lakh kilolitres of fuel, worth ₹ 500 crore just burn out. The flames, had thrown up huge columns of thick, black smoke which blocked sunlight. An area of 5 km radius had been marked as danger zone. More than 150 persons were admitted in various hospitals. These incidences happened because of series of mechanical and human errors. Safety equipment at the plant was not properly functioning and there were no emergency plans. People were not sensitised how to mitigate such type of emergencies and hence, the loss was huge.

The Industrial Disaster Management Plan provides a framework and direction to all the stake holders to manage various such incidences and risks. Disaster Management Plan should be a "Dynamic Document" in the sense that it should be periodically improved keeping up with the emerging global best practices and knowledge base in Disaster Management. It is in accordance with the provisions of the Disaster Management Act, 2005, the guidance given in the National Policy on Disaster Management, 2009 (NPDM), and the established national practices. Plans should incorporate substantively the approach enunciated in the Sendai Framework which will thus help the country to meet the goals set in the framework.

Emergency planning should be an integral part of any industries. It is important for effective management of an accident/incident to minimise losses to people and property, both in and around the industries.

[a] Disaster Resilient and Research Foundation

Objectives

- To control events and prevent escalation.
- To minimise the effect on human, infrastructure, economy, and the environment
- Effective rescue, first aid, medical aid and rehabilitation of the affected persons
- How to identify and manage the hazards
- How to mitigate the effects through planning and effective response

Step One

Hazard Risk and Vulnerability Analysis

Firstly we need to analyse the Hazard, Risk and Vulnerability of the Building, with respect to all types of perceived natural disasters like Earthquake, Local Flooding (due to excessive rains in short time), Lightning, Climate Change (Too hot and Too Cold) and man-made disasters Fires (in Building itself or in neighbouring buildings, affecting Building), Terrorist Related, Intrusion by Armed Terrorists firing indiscriminately, causing casualties and gaining entry in the Building, Bomb Threat/Hoax call, Human Bomb, CBRN Disasters, Micro-light aircraft with explosives crashing into the building, side, having effect inside, Stampede during evacuation, Medical Emergencies, including Epidemics. Plan should be made in two parts for any industries onsite plan and offsite plan. Onsite plan for them for incident which could affect people and the environment inside the works only and offsite pan for them for incident which could affect people and the environment outside the works as well.

Chemical industries handled Hazardous hydrocarbon Ethane, Propane, Ethylene, Propylene, Butene-1, LPG etc and heavier hydrocarbon liquids like Hexane, Cyclo-hexane, Fuel Oil, Wash Oil, etc.

Possible Emergency Scenario

Fire in Fuel Storage Tank

Flammable liquids are highly susceptible for fire As there are other establishments, such as stores are nearby, the fire from storage Tank can easily reach the stores causing extensive damage to the materials stored in and ultimately the situation will lead to disaster.

Leakage of Harmful Gas

Leakage of gas can lead a disaster. Bhopal gas leakage incident in India in 2 Dec 1984. It was Methyl Isocyanate leak from Union Carbide India Limited storage tank. Near about 3,787 death were clamed at the same day and afterward till today 16,000 death were reported. Nonfatal injuries were 5,58,125. It was considered the world's worst industrial disaster.

In the month of June 2014 gas leak incident happened in Bhilai Steel plant. This incident occurred when some repairing work was being carried out on some section of the plant. They reported some leakage and by the time rescuer reached to the spot, there was a blast in nearby pipeline. Six people died and thirty injured. On the basis of above consideration, the fire of storage fuel tank is considered as one of the credible scenario.

Fly Ash and Red Mud

By product of coal after its usage in a plant is termed as fly ash. Its technical disposal is of paramount importance from the angle of environmental pollution. The coal-ash pollutes air as well as water disposal of which causes air, land and surface water pollution also. Similarly, red mud pond mixed with caustic soda of high PH is dangerous to human, cattle etc. if exposed. Sudden breach of ash pond embankment and rupture of slurry pipeline/red mud slurry create a disaster in the near by areas.

Cyclone

Cyclones are huge revolving storms of strong winds blowing around a central area of low atmospheric pressure. They create several dangers for people living around tropical areas especially when the destructive force of a cyclone comes from fierce winds. This causes catastrophic damage to life, environment and property.

Earthquake

Earthquakes are the result of sudden release of energy in the Earth's crust that creates seismic waves. It is manifested through shaking and sometimes displacement of ground. Earthquakes are mainly caused due to rapture of geological faults. But, it can also be caused due to volcanic activity, landslides, mine blasts and nuclear tests. Earthquakes cause great damage to life and property and have a devastating impact.

Flood

It is a general and temporary condition of partial or complete inundation of normally dryland areas from overflow of inland or tidal waters from the unusual and rapid accumulation or runoff of surface waters from any source. In simpler terms, flooding is water where it is not wanted.

Onsite Incidence plan

As per the guide lines of OISD and with the approval of competent authority it has been decided to follow the siren code as written below:

- Small fire/ minor leakage/ Accident: No siren
- Large fire/ Major leakage/ Accident: A wailing siren for two minutes. It will be sounded three times for thirty seconds with an interval of fifteen seconds.
- Disaster/ Major emergency: The same type of siren as in case of two above but same will be sounded for three times at the interval of two minutes.
- Testing of siren straight run siren for two minutes.

Onsite emergency plan should rehearse in a frequency of half yearly and key personals along with other responsible member should involve. Action points are

- Rush to emergency control room.
- Cross check that key officials are in attendance as per the emergency action plan, discuss the emergency and get in touch with the respective area in-charge to know the latest situation. He will accordingly guide the team, if necessary.
- Outside emergency services like fire brigade, police are requisitioned to control and divert the traffic on adjacent road and rail, as well as to maintain law and order and also safe evacuation of the surrounding personnel.
- Nearby industries and population are informed about the mutual aid and major emergency respectively
- Advise area in-charge to exercise direct operational control on those parts of the unit which are out side the affected area
- Maintain the speculative continuous review of possible developments and assess to determine most probable forthcoming course of events.
- Direct the shut down and evacuation of plant personnel in consultation with the incident controller and key personnel.
- Liaise with chief officers of the fire, police and health centre and provide information regarding possible effects of the emergency on areas outside the plant.
- Rush to site immediately and assess the extent of emergency.
- Direct all operations to stop/remain continue within the affected area taking into consideration, the priorities for safety of personnel, minimise damage to the plant, property and environment and following departmental emergency procedure.
- Provide relevant information about the plant, process and working personnel to the fire and safety personnel, the local fire brigade and other rescue team.

- Ensure that all non-essential workers/staff of the affected areas are evacuated to the appropriate assembly points and the areas are being searched for casualties.
- Set up communication facility for assembly points, control room and incident point. He will be in touch with emergency control centre for advance action and assistance required from other dept. Or external agencies.
- Report all significant developments to the main incident controller.
- Have regard to the need to preserve the evidence, so as to facilitate any investigation into the cause and circumstances, which caused or escalated the emergency.

Offsite Incidence Plan

The Central Government has notified a set of rules entitled "Chemical Accident (Emergency Planning, Preparedness and Response) Rules, 1996, as complementary to Manufacture, Storage and Import of Hazardous Chemical Rules, 1989, under the Environment (Protection) Act 1986. This rule provides a statutory back up for setting up of crisis groups in local, districts, states and at central level for management of chemical accidents. Under this, it has been envisaged to set up functional control rooms at district, state and central level with information networking system. The district collector shall statutorily be the chairman of the District Crisis Group. This group shall persue the on-site emergency plans for the industrial installations of the district for formulation of a "District Off-Site Emer-gency Plan". Besides, petroleum products, 634 such chemicals have been notified as hazardous substances under the Manufacture, Storage and Import of Hazardous Chemical Rules 1989 (MSIHC) Rules, 1989. These hazardous substances can be a source of potential danger to the life, property and environment if not handled properly. As per the provision of the MSIHC Rules it is mandatory for every district having MAH to formulate a comprehensive plan for mitigation of such disaster and is termed as "Off-Site Emergency Plan". The local authorities are made alert to combat and contain the disaster in a pre-planned manner to meet any such eventuality. The objectives of the district off-site emergency plan is to make maximum use of the combined resources of the units and the outside services to

- initially contain and ultimately bring the incident under control.
- minimise damage to property and the environment.
- rescue the threat causalities and safeguard other people.
- trace out the fatalities and provide assistance to their relatives.
- provide authoritative information to the media.
- secure the safe rehabil- itation of affected areas.
- preserve relevant records and equipment for the subsequent enquiry into the causes and
- circumstances of the emergency.

Step Two

Resource *Mapping (within Organisation)*, for example

- Fire Fighting Equipment in-built, along with movable ones.
- Smoke detectors in each room
- Water Storage on terrace/in basement.
- Electrical auto cut off, devices, circuit breakers free of damage and all circuit boxes covered. No live wire and no live fire for cooking inside building.
- Manpower – Permanent, contractual and outsourced.

Resource Mapping (Outside)

- Hospitals: location of nearest hospital
- Nearest Police Station
- Nearest Fire Station

- Nearest NDRF Bn
- Nearest Army and Para Military Units

Step Three

Command, Control and Coordination as per Incidence Response System

- Safety Officer for the Building to be nominated who will act as Incident Commander during disaster
- Incident Control Room in Reception Area/outside
- Each floor should have Floor Coordinators
- Besides there will be two SAR Teams, and
- First Aid Teams

Step Four

Evacuation Plan

- Identification of assembly areas
- Floor-wise evacuation under floor coordinator
- Evacuation plan of various floors, which stairs to be used by which floor occupants

Step Five

Emergency Medical Plan

- Number of qualified doctors available in the building and on call. In case of on call, time taken by them to reach the building
- First aid boxes on each floor
- Employees to be trained in first aid by St. John Ambulance/ Red Cross/ Hospital
- Plan should include - Onsite first aid, triage, evacuation through ambulances and pre-hospital preparedness

Step Six

Safety and Security of Documents

- Creation of record room
- Digitisation of all important documents/files
- Regular disposal of files as per existing government guidelines
- All sections to have back-up of data in their PC/laptops

Step Seven

- Likely perceived scenarios, which should include natural disasters like, earthquake, floods and man-made disasters like fire and terrorist related disasters should be analysed and their consequent impact should be delineated.
- Suggested response for managing the perceived natural and man-made disaster should also be worked out.
- Roles and responsibilities of all key stakeholders should be delineated in detail.
- Plan for conduct of Mock Exercises to test the plan and check the state of preparedness from time to time (at least once a year) should also be made.

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Managing E-waste in Reducing Vulnerability and Enhancing Resilience: The Case of Bangladesh

N. Nabila Hoque[a]

Abstract

The purpose of this paper is to identify electronic-waste (E-waste) which is hazardous and problematic to mankind and environment; to assess practices and challenges in the matters involving overall e-waste management of third world countries like Bangladesh.

E-waste evolving out of e-goods contains hazardous substances as well as precious metal; hazardous cause damage to public health and environment if not properly managed/treated, on other hand precious metal attracts the nations for exporting/importing used or obsolete e-goods, i.e. virtually e-waste for economic benefits. Development and use of e-goods have increased the standard of people's life and brought prosperity for the nation and at the same time created waste out of e-goods directed problems at different levels. Developed countries produce huge e-waste which they mostly export to the developing countries for their economic benefit. Bangladesh has increasing usage of electrical and electronic goods/technology and generates about 03 million Mt e-wastes, which are being dumped into the open landfills, farming land and open water bodies instead of safe disposal. Though the process is very injurious and hazardous recycling and dismantling by importing obsolete e-goods is a growing business in Bangladesh. There are no any specific guidelines or regulations to e-waste management; the country has been dealing with e-waste within the purview of related environmental laws and court directives. However, Bangladesh is in the process of adopting E-waste Management and Handling Rules. Simply managing e-waste within the present position does not help in reducing economic and environmental vulnerability; it needs control on exporting/importing of used e-goods and extrapolation of advance technology to enhance resilience.

Keywords: e-waste, hazardous, recycling, management, regulation, Bangladesh

Introduction

E-waste includes all those electrical and electronic items that are unserviceable and or discarded as waste and contain hazardous substances, which can damage public health and the environment if not properly managed. Being the great user of e-goods, developed countries produce huge volume of e-wastes and taking the opportunity of fewer regulatory burdens developed counties are encouraged to export e-waste to the developing countries for their economic benefits instead of going through the process of e-waste treatment. E-goods are one of the primary drivers of economic growth and development of human living standards at the same time e-waste is also widely recognised as vulnerable to public health and environment as it contains hazardous substances like mercury, lead, cadmium, arsenic, beryllium and brominated flame retardants, and it produces toxins such as halogenated dioxins and furans[1]. Though e-waste is considered as hazardous, complex, and expensive to treat, and promotes illegal trading, yet it is viewed as a resource and income generating opportunity.

E-waste forms out of electronic devices which is mostly produced by the developing countries for their commercial benefits and are illegally exported to the developing countries every year; frequently violating the international law[2]. About 67 per cent of e-waste either undeclared or grey market are being dumped in landfills or illegally exported to the developing countries[3]. Like other waste, e-waste is also unwanted to the holder and the holder always intends to get rid of it. The global quantity of e-waste in 2014 was comprised of 1.0 metric tone (Mt) lamps, 3.0 Mt small IT goods, 6.3 Mt screens and monitors, 7.0 Mt temperature controlling equipment, 11.8 Mt large electronic equipment, and 12.8 Mt small electronic equipment[4]. This sheer volume of e-waste is globally considered as hazardous and problematic to the environment and mankind. Thus, dealing with e-waste, is a major concern for the policy makers at national and international level.

[a] Barrister-at-Law

The objectives of this paper are to: (i) have a general overview of e-waste that is usually considered globally hazardous and problem to mankind and the environment (ii) identify the e-waste problems, and legal rules/policy level initiatives of matters involving overall e-waste management particularly in Bangladesh, and (iii) make suggestions for handling and managing used e-goods to cope with the existing situation and future e-waste challenges. In order to meet the objectives attempts have been made to describe the meaning, problem, global quantity of waste, impact of e-wastes to the mankind and environment and their managing and handling situation particularly in Bangladesh with legal rules collecting information, materials related to e-waste transboundary movement and treatment practices in line with e-waste laws/policies at national and global level from various, books, articles, journals, journals, court directives and then, finalise the paper after careful analysis of data collected from the primary and secondary sources.

Meaning of E-waste

E-waste is waste but different from others due to its hazardous character. Any substance or object which is discarded after primary use is known as waste. Usually waste generates during extraction of raw materials in the production process and having consumption of finished products by the consumers. Any substance or object that can no longer be used for its original purpose, have become damaged or unsuitable for use, is leftover, unwanted, or a burden on its holder, has become contaminated with something that presents a risk and, has a low or negative economic value and is a burden on the producer is considered as waste. Few substances are always waste like production residue and substance resulting from a production process which is not, as it is, sought for subsequent use.

The electronic waste (e-waste)[5] arises out of at the end of life or any discarded item that has circuitry or electrical components with power or battery supply. The European Union Commission Directive (2002/96/EC) defined e-waste as waste of electrical or electronic equipment (EEE) including all components, sub-assemblies and consumables which are part of the product at the time of discarding. In any, EEEs become waste at the time and place when their structure and state are no more capable to provide the desired performance or may not be functional due to damage or its technology/design may no longer be state of the art or trendy[6]. Put simply, electronic products that have: (i) become really un-serviceable, non-working condition, obsolete and unwanted by the user (ii) reached to the end of their useful life (iii) lost their functional as well as face value and (iv) discarded, at some time, by the owner or user are e-waste. E-waste contains precious metal like copper, silver, gold, palladium and platinum etc. along with hazardous substance which warrants recovering for reuse or preparations for reuse following the proper treatment process without causing harm to the environment. However, e-waste generally contains the pollutants listed below[7]:

Table 1: Examples of EE Components and Associated Pollutants

Electrical and Electronic Equipment	Pollutants
Computers	Lead, Mercury, Cadmium and Beryllium
Batteries (disposable, rechargeable and lithium)	Cadmium, Cobalt, Lead, Lithium, Mercury, Nickel, Silver and Zinc
Mobile Phones	Lithium, Copper, Tin, Cobalt, Indium, Antimony, Silver, Gold and Palladium
Photocopiers	Mercury, Selenium
Circuit Boards	Silver, Lead, Copper, Cadmium, Brominated flame proofing agent, Polychlorinated Biphenyls and Arsenic
Light Emitting Diodes (LED)	Arsenic
Liquid Crystal Displays (LED)	Mercury
Cathode Ray Tubes (CRT)	Cadmium, Lead

Global Scenario of E-waste

This is the 21st century; the electronic industry is at its boom, the society is more dependent on electronics than ever. An average person every day spends 45 per cent of their time in propagation of electronics[8]. Approximately, more than 2 billion electronic devices were sold worldwide in 2014 which by 2020 is likely to be more than 7 billion[9]. The amount of smart phone users around the globe was predicted to exceed over 2 billion in 2016 increasing about 12.6 per cent from 2015[10]. The technological development has been growing in a lightning speed with diversity, improved version and more user friendly EEE items replacing the previous one. Thus, very often many EEE devices become e-waste after short termed usage[11]. The UNU ADDRESS project documents narrated that e-waste volume placed on the market since 1990 has grown from 19.5 million Mt to 57.4 million Mt in 2010 and is set to more than triple to approximately 75 million Mt by 2015[12]. Every year 20-50 million Mt e-waste is generated worldwide; USA alone generated 3.16 million Mt in 2008 among which 13.6 per cent was recycled and rest was trashed; computers and smart phones are contributing 41 million Mt to e-waste volume, which may reach to 50 Mt tonnes by 2017. The UN Environment Programme reported in May 2015 that up to 90 per cent of the world's e-waste, worth nearly $19 billion, illegally traded or dumped each year[13]. Meanwhile, the statistics has changed; United Nations University, Institute for the Advanced Study of Sustainability (UNU-IAS) presented in its report titled 'The Global E-waste Monitor-2014: Quantities, Flows and Resources' that in 2014, 41.8 million Mt e-waste was generated globally and forecasted to increase to 49.8 Mt in 2018 with an annual growth rate of 4 to 5 per cent. The highest volume of e-waste generated in Asia, however, the global picture is presented in the following Tables 2 and 3.

Table 2: Global Quantity of e-waste Generated

Year	e-waste Generation (Mt)	Population (Billion)	E-waste Generation (kg/inh.)	Remarks
2010	33.8	6.8	5.0	
2011	35.8	6.9	5.2	
2012	37.8	6.9	5.4	
2013	39.8	7.0	5.7	
2014	41.8	7.1	5.9	
2015	43.8	7.2	6.1	Projected
2016	45.7	7.3	6.3	Projected
2017	47.8	7.4	6.5	Projected
2018	49.8	7.4	6.7	Projected

Table 3: e-waste Generated in the Continents 2014

Continent	Generated E-waste (Mt)
Asia	16.0
Americas	11.7
Europe	11.6
Africa	1.9
Oceania	0.6

This huge volume of e-waste requires global awareness regarding the consequence of its impact to environment and hence, and proper treatment in a legal way to reclaim valuable materials and safe managing of toxic materials in order to protect lives, harvest and environment.

Problems of e-waste

Undoubtedly, development and use of e-goods is in the best interest of higher standard of living and increased prosperity for the nations. At the same time, in the development and usage procedure of e-goods have been creating waste as well as directed problems at different levels. e-waste contains toxic substance thus, its improper disposal harms the environment and inhabitants. Every year globally, mostly developed countries, produced 60 per cent discarded e-devices, the main source of e-waste, ends up in landfills and 40 per cent recycled but in recycle process almost 30 per cent e-material can not be recovered. Under this situation, some e-waste exports to the developing countries where it is burnt for scrap which is a toxic job and hence it creates problems for living organism and the environment[14]. e-waste is not only toxic but has economic value and demand in the market thus, dealing with e-waste also creates problem in the level of management, trading, and policy implementation. However, this problem is seen as a statement; a condition to be improved; a difficulty to be eliminated and/or a question proposed for solution or consideration. Being able to solve problems involve: (i) dealing with logic or interpretation of the problem; (ii) what rules/ways could be applied to solve the problems and; (iii) requires some abstract thinking and coming up with creative solutions.

e-waste is relatively a new extension in the waste scenario of the world which is increasing faster with growing development of technology. The major approach to treat e-waste is to reduce the concentration of the hazardous chemicals and elements through recycling or recovery. During recycling or recovery certain e-waste fractions act as secondary raw materials for recovery of valuable items which has great demand in the global market, particularly in the developing countries. The treatment process of e-waste warrants its handling, dumping, recycling, and trading; all these stages have practical problems that ultimately jeopardise human health and environment.

*Handling of e-waste. Handling is the primary/initial e-waste action which can be accomplished through either the traditional way or recycling. Scientifically controlled recycling has less risk but, un-controlled recycling has lot of risks.

However the risks associated with traditional handling and un-controlled recycling is shown in the following tables:

Table 4: Risks Associated with Traditional Handling of E-waste

End of Life Process	Occupational Risks	Environmental Risks
	-	Leakage of metals and organic compounds
Incineration	-	-Emission of various metals and organic compounds via exhaust gases -Leakage of various compounds from ashes
Collection and Dismantling	-Dust containing various compounds during dismantling activities -Dust containing Pb and Ba oxide from broken CRTs -Volatile compounds from broken compounds	Emissions of volatile compounds from broken components
Shredding	Dust containing various compounds	-
Pyrometallurgical Process	Dust and fumes of the shredded material and melting process, containing various compound	Emissions of various metals and organic compounds from the melting process
Hydrometallurgical Process	Acid fumes containing various hazardous compounds	-

Plastic Recycling	Dust and fumes of various chlorinated and brominated compounds and some metal additives	Emissions of various metals and organic compounds from the melting process

Source: Swedish Environmental Protection Agency 2011

Table 5: Risks Associated with Uncontrolled Recycling

End of life Process	Occupational Risks	Environmental Risks
Collecting and Dismantling	-Dust containing various compounds during dismantling activities from broken CRTs -Cuts from CRT glass in case of implosion Volatile compounds from broken components	Emission of dust and fumes containing various metals and organic compound to the local environment
PC-Board Heating	Exposure to fumes of various compounds from solder and PC-board components	Leakage of various compounds from dumped PC-board residues
Toner Sweeping	Exposure to toner dust including carbon black	Leakage of various compounds from emptied and dumped toner cartridges
Acid Extraction	Exposure to acid fumes containing various hazardous compound	Leakage of various metals and organic compounds from dumped residues of the extraction process
Shredding	Dust and fumes of various metals and organic compounds present in the plastics	Emissions of dust containing various plastics components to the local environment
Plastics and Waste Burning	Exposure to a wide range of metals and organic compounds via the smoke	Emissions of wide range of metals and organic compounds to the local regional global environment
Dumping of Residual Materials	-Exposure to dust and fumes containing various compounds from dumped materials -Secondary exposure via contaminated drinking water and food	Leakage of various metals and organic compounds to the ground and water reservoirs in the surroundings

Source: Swedish Environmental Protection Agency 2011

*__Dumping of e-waste__: Dumping is one of the most common methods of e-waste disposal. Being hazardous e-waste pollutes air, water, soil and it hurts the planet and all the inhabitants of it, living *organism* including crops and non-crops. Virtually, everyone and everything to the dangerous chemicals, toxic pollutants in e-waste are at risk. Dumping situation of e-waste in the developing counties like Bangladesh is at its worst. The ESDO study report presents Bangladesh generated 2.8 million Mt of e-wastes and dumped in open landfills, farming land, and in the open sources of water bodies without considering/knowing the harmful effect.

*__E-Waste Recycling__: E-waste is complex and difficult to recycle. During recycling and recovery process e-waste release (i) original constituents of equipment like lead and mercury (ii) substances that are required to be included in recovery processes like as cyanide and (iii) substances that are formed by recycling process i.e. dioxins. Such substances may pose significant human and environmental health *risk* if not properly managed. Improper recycling process in the informal sector of developing counties is a common scenario. Heavy metals even have been found in the air of developing though state-of-the-art facilities exist there. Due to recycling of e-waste, workers and local residents are exposed to toxic chemicals through inhalation, dust ingestion, dermal exposure and oral intake. Inhalation and dust ingestion impose a range of potential occupational hazards including silicosis[15]. E-waste contains mercury lead and cadmium, the source of health hazards.

Table 6: Impact of E-waste Elements

Mercury	Lead	Cadmium
*Brain disorders *Kidney, renal and neurological damage *Leading to even death	*Learning disabilities *Mental retardation *Behavioural problems *Hearing impairment	*Lung damage *Fragility of bones *High blood pressure *Nerve and brain damage *Kidney and liver disease

Source: ESDO Report on e-waste: Bangladesh Situation, 2010

e-waste constitutes a long term significant environmental and health effect involving vulnerable *group* and *generation* to come. Informal sector e-waste activities are the source of environment-to-food-chain contamination, as contaminants may accumulate in agricultural land and be available for uptake by grazing livestock. The fact is e-waste processing generates pollution which brings about toxic effects on the human body threatening the health of workers but also of present residents and future generations living in the local environment[16]. In China, rudimentary recycling techniques coupled with the amounts of e-waste processed have already resulted in adverse environmental and human health impacts including contaminated soil and surface water[17]. Common health problems are identified including diseases and problems related to skin, stomach, respiratory tract and other organs. However, the most amount of danger is for workers involved in the e-waste recycling process who suffer from tuberculosis, blood disease, anomalies in the immune system, lung cancer, damage to the nervous and blood system, malfunctioning of the kidneys and respiratory system. Their future *generation* face incidents of birth defects, infant mortality, underdevelopment of brain in children and[18]. Moreover, long–range transportation of pollutant has also been observed and atmospheric pollution due to burning and dismantling activities seems to be the cause of occupational and secondary exposure[19].

The e-waste recycling sector in developing counties like Bangladesh is largely unregulated. The practices used in developing countries often exacerbate pollution by creating hazardous chemicals and additional pollution. The workers in the recycle sector are dominated by the urban poor with very low literacy levels and thus, have very little awareness of the potential hazards. These e-waste workers are exposed to hazards leading to physical injuries and chronic ailments such as asthma, skin diseases, eye irritations and stomach disease. A particular hazard to *worker* associated with the disassembly stage and mechanical treatment methods which generate dusts from plastics, metals, ceramics and silica. The dusts and the surrounding ambient air may pose inhalation hazard along with dermal exposure hazard to workers as well as the risk of environmental contamination[20].

In Bangladesh a substantial number of children are engaged in various e-waste recycling activities; they are more vulnerable to the hazards of e-waste. According to the ESDOs study report 2010, in Bangladesh about: (i) 50.000 children are involved in the non-formal e-waste collection and recycling process (ii) 15 per cent child worker died during and after effect of e-waste recycling and (iii) 83 per cent are exposed by toxics substances become sick and live with long term illness. A substantial number of children work directly on e-waste sites or come into contact with e-waste while scavenging on various waste sites. By nature and circumstances, working with e-waste recycling is likely to harm health, safety and morals of children. Child workers are exposed to a variety of hazards e.g. falling objects, chemicals, abusive employers along with the many other social problem related to human survival in such a harsh environment; injuries and heavy metal exposure constitute two of the threats for child workers.[21]

The world seriously suffers from e-waste and thus, the existence of effective and efficient waste management policy and the application of regulatory controls are necessary to protect the environment and human health. Proper e-waste management not only protects human health and environment but also creates the opportunity to extract the re-useable precious metals like copper, silver, gold, palladium and platinum, etc. The precious metal of e-waste is valuable in black market which attracts illegal trading and organises crime groups. Hence, e-waste is an important global concern, the every nation should (i) adapt regulations and restriction to address the EEE producers, consumers and recyclers (ii) framing of laws and policies by different countries, but similar in nature, as actions guide to reduce harm from the serious consequence of e-waste (iii) export e-waste including with information on global flows from the country of origin particularly to developing countries and (iv) building capacity to better manage of e-waste. The countries of European Union adopted legislation, Directive 2012/19/EU, 4 July 2012 on EEE waste which laid down the requirements and course of action for the producers, consumers and even for the organisations involved in collection and treatment of e-waste. There is also an international treaty, popularly known as Basel Convention that came into force 1992; it has 182 signatory countries as on January 2015 and all has ratified except but USA and Haiti. The Basel Convention controls trans-boundary movements of hazardous waste including e-waste and their disposal to prevent the shipment of hazardous waste to developing countries where weak or non-existence of environmental law.

Legal Rules

The legal means connected with or created by the law. The legal rules framework provides the relevant legislation, policy and agreement under which e-waste are managed, regulated and monitored. However, the legal rules framework for e-waste is composed of international and regional conventions like The Basel Convention, EU regulations respectively along with national legislations. The Basel Convention, 1989 attempts to: (i) reduce hazardous waste generation at source; (ii) promote and ensure the environmental sound management (ESM) of hazardous waste; (iii) promote the proximity principle, advocating disposal as close to the source as possible; and (iv) regulate and monitor the remaining transboundary movements of hazardous waste. The Convention is not against the hazardous waste trading but it imposes some trade restrictions on those hazardous materials deemed to be required transboundary movement. For example, exporting waste should be state of ESM capacity or destined for recycling and recovery operations; and if these criteria are met then shipment must undergo with prior informed consent (PIC) procedure. The Convention also allows Parties to enter into bilateral, multilateral or regional *agreement* on transboundary movements of hazardous waste.

With an intension to prevent and reduce the adverse impacts on the environment and human health the EU has introduced the WEEE Directive (2002/96/EC) that came into force in 2003 to cover the wide range of issues to the management of EEE waste. The directive includes (i) prevention of e-waste generation and promotion of reuse, recycling and other any form of recovery of waste to reduce disposal (ii) to promote green design and production of electronic products based on the principle of producers responsibility (iii) to make the producer responsibility for financing take-back and management of e-waste and (iv) to create pressure for the global electrical and electronic industries to adopt EPR policies.

Bangladesh is a developing country with increasing usage of modern technology. The Environment and Social Development Organisation (ESDO) reported that, in 2010 the yearly consumption of electronic products in Bangladesh was 3.2 million and the country generated roughly 2.8 million Mt of e-waste. But safe disposal of these huge e-wastes was not being followed strictly but, without knowing the harmful effect generated e-wastes had been dumping into the open landfills, farming land and open water bodies[22]. Bangladesh is one of the signatory of the Basel Convention and also ratified in 1993. According to the Import Policy Order, importing used EE goods is prohibited in Bangladesh, but the fact is that large quantities of e-waste exits in the informal sector. EEE goods recycling and dismantling is a growing business here in Bangladesh without having any e-waste dismantling facility in the formal sector. All e-waste recycling is being carried out in the informal sector and about 120,000 urban poor are involved in the recycling trade chain of Dhaka city[23]. E-waste recycling process in Bangladesh is very injurious and hazardous for which there is no specific guideline or regulation. Presently, the country's e-waste/hazardous waste activities including production, import/export and recycling etc. are being carried out under the provision of: (i) Bangladesh Environment Conservation Act 2010, (ii) Chemical Substance Depleting Ozone Layer (Control) Policy 2004, (iii) Sound Pollution Policy 2006, (v) Bangladesh Environment Conservation Policy 2010, (iv) Hazardous Waste and Ship Breaking Waste Management Policy 2011, (vii) Bangladesh Bio-safety Rules 2012, and (viii) Import Policy Order, (ix) National Environment policy 1992, and (x) The Environmental Conservation Rules 1997, and The Environmental Court Act 2000.

The Government of Bangladesh is in the process of adopting E-waste (Management and Handling) Rules: (i) applies to producer, dealers, collection centres, refurbisher, dismantler, recyclers, auctioneers, consumers involved in manufacture, sale, purchase and processing electrical and electronic equipment or components; and define their responsibilities, (ii) describes the grant of authorisation, power to suspend or cancel an authorisation, (iii) procedure for registration, environmental clearance and renewal, (iv) procedure for transportation and storage of e-waste, (v) accident reporting and follow-up and (vi) segregation, dismantling, recycling and disposal of e-waste.

In March 1990, The High Court Division of Bangladesh Supreme Court directed the Department of Environment to shut down the operation of all ship-breaking yards operating without environmental clearance and gave ruling: (i) to ensure that no ship with hazardous wastes enter the country without being pre-cleaned at source or outside the territory of Bangladesh and (ii) the government has to confirm that ships can only broken after ensuring safe working conditions for the labourers and having in a place appropriate disposal arrangement for hazardous waste and protection of environment.

Recommendations

Managing e-waste is a multi-faceted challenge; associated recycle systems and the global aspects of illegal e-waste export is complex. The developed and the developing countries have been facing the heat of e-waste, its illegal export required to come up with measures for controlling, dealing and combating through international, regional and national regulations, rules and legislative approach. Enforcing regulations, compliance and eliminating the health and environmental hazards related to e-waste handling and illegal exporting may be considered to resolve the global challenge; it can not be a single country's task. However, the specific tasks are suggested here particularly for a developing country like Bangladesh:

- The formal sector produces significantly lower impacts and has a better e-waste recycling efficiency in compared with informal sector. So, the prevalence of formal facilities in the e-waste recycling sector needs to be ensured and strengthening.
- To upgrade recycling capacity and practices, the informal recyclers may be organised into small enterprises facilitating with development of legal framework and elaboration of applicable business structure along with proper monitoring.
- The informal sector has limited access to financial resources. So, financial incentives may be considered to allow informal sector stakeholders to formalise the financing/investment process and improve its practices.
- To improve the e-waste recycling practices, incentive package may be offered to those complying with environmental and health norms.
- Informal recycling enables large scale hazardous employment of vulnerable people and poor children who have virtually no education and are not aware of the effects of e-waste processing. So, awareness rising program and actions/activities should be considered and taken to protect their right to hazards.
- A system needs to be developed so that the producers take responsibility to reduce and eliminate hazardous substances from their products and produce long-lasting products which are simple to recycle.
- Policy effort may be initiated to manage the end-of-life of EE products focusing on mandating recycling systems, limiting the toxic content of products and seeking to control or ban illegal trading of e-waste.
- The country may develop capacity building programs/facilities for small and medium enterprises (SMEs) in the field of e-waste management practices; innovative financing for resource efficiency; and awareness programs on e-waste pollution for their citizens.
- Civil society of the country may promote green consumerism, community awareness on household waste segregation and its contribution to resource efficiency/knowledge dissemination.
- Lack of adequate legislation, insufficient enforcement and illegal activities are the common problems of the country which cannot be solved only tightening the problem thus, financial incentives and regulations may deigned in conjunction with the establishment of formal infrastructure.
- Lessons learnt from the implementation of EU Directive Bangladesh may have plan to develop regulations for handling e-waste, ensure proper monitoring the e-waste activities, and regulate importing of e-waste.

- A research system may be framed and undertaken to extrapolate suitable modern technology for managing, handling and controlling e-waste and to identify adaptation constraints and their solutions.

Conclusion

All electronic objects sold in the market will eventually become obsolete. The resulting e-waste which on the global scale is rapidly increasing contains both materials which can be recovered as secondary raw material as well as hazardous materials and substance. Thus, e-waste needs proper handling and management during recycling and development of other end-of-life treatment options. There is absence of organised e-waste recycling facilities in Bangladesh and the entire recycling exists in the informal unorganised sector. On the other hand in the name of technology up-gradation and to give people access to the awesome benefits of technology, the action of shifting burden of e-waste on developing nations like Bangladesh is clever step of some developed nations for their economic benefit. However, the enforcement of e-waste regulations hindered by the economic incentives and will continue to be hindered due to lack of proper financial support of the formal sectors. This may encourage non-compliance, and favour the illegal markets and informal sectors.

Transboundary movement, i.e. illegal export and access of e-waste in Bangladesh is a common phenomenon from developed countries. Imposing restrictions to continue on the transboundary movement of e-waste will not be a wise decision for a country like Bangladesh rather it will difficult and costly to implement; nevertheless this might destroy the potential source of cost effective raw material that need for the development of society and employment and income opportunity of the vulnerable poor who depend on e-waste related activities for their livelihood. So the matter is sensitive and requires very careful handling methods to address the e-waste which has positive threat to human environment. However, environmental degradation and hazards for the living organism have no national boundary and do not follow the policy division of nations. Therefore, the nations irrespective of their developed and developing status need to work in a common platform to identify the e-waste problem with solutions and enact of adaptation fair policy regulation dedicated to e-waste to keep the global environment safe for the inhabitants.

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Lessons Learned from Piping Failures from the Industries Affected during Earthquakes in India and Other Countries, So as to Prevent Repeating Mistakes

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Abstract

Two of the general strategies for disaster reduction are, one to learn from previous disasters so as to prevent repeating mistakes and the second to share experiences and information worldwide. In this paper the disaster being discussed is earthquakes. Many valuable lessons have been learned from the past earthquakes and global data sharing is increasing the effectiveness of mitigation efforts. Organisations, such as National Earthquake Hazard Reduction Program (NEHRP), Earthquake Engineering Research Institute (EERI), the National Science Foundation (NSF), the Earthquake Megacities Initiative (EMI), and Disaster Management Authority of India (DMAI) have played an important role in facilitating such learning opportunities.

The earthquakes witnessed in recent times in the Indian Region are Koyna, 11 Dec 1967, 6.5 M, 10 km DOF; Uttarkashi, 20 Oct 1991, 6.8 M, 12 km DOF; Latur, 29 Sep.1993, 6.3 M, 12 km DOF; Jabalpur 21 May 1997, 6 M, 35km DOF; Chamoli, 29 March 1999, 6.8 M,21 km DOF; Bhuj, 26 Jan 2001, 7.6 M, 25 km DOF: Andaman-Sumatra, 26 Dec 2004,9.1 M, 30 km DOF; Kashmir, 8 Oct 2005, 7.6 M, 15 km DOF.

Out of above, the earthquakes which were close to industries were Koyna, Jabalpur, Bhuj and Kashmir. A data on the performance of the equipment at few of industries affected by these earthquakes have been collected under a project awarded by the Board of Research in Nuclear Sciences(BRNS) to ERDA, Baroda for the collection of data from the industries around Bhuj, and to Kharad Engineering College, Kharad for the data from Koyna Hydro Power stations. The equipment performance data was collected from GEB Sikka, a Thermal Power Plant at Jamnagar; DCC, Cement Plant at Jamnagar; GSFC, Fertilizer Plant at Jamnagar, (Bhuj, 26 th January, 2001,Magnitude 7.6 M, 0.24g pga, Epicentral Distance(ED) 120 kms); IFFCO, Fertilizer Plant at Kandla; Kandla Port Trust at Kandla (Bhuj, 2001, 7.6M, 0.37g pga, 50 kms ED); GSECL, a thermal power plant, KLTPS,Panendro (Bhuj, 2001, 7.6 M, 0.22g. pga, 40 km from the fault plane, 144 kms ED); Substations of GSEDC (Bhuj, 2001, 7.6 M, 0.2g to 0.7.g pgas, 5 km to 140 km EDs); and stage I and II, Hydro Power Plants at Koyna, (Koyna, 11 th December, 1967, 6.5 M, 0.48g pga,7 Km ED, DOF); Stage I and II and Koyna Damfoot Power House (KDPH), (Koyna, 1973, 5.2 M, 5.9 km DOF, 0.15 g pga), (Koyna, 1994, 5.4 M, 10.6 km DOF, 0.25g pga) & (Koyna, 2003, 4.1 M,15 km DOF, 0.08 g pga).

Similarly, experience based data is available from industries from Kobe, (Kobe earthquake (Hanshin-Awaji earthquake), Japan, 17 Jan, 1995, 6.9 M, 10 km DOF),from Nuclear Power Plant(NPP) at Kashiwazaki-Kariwa (Kashiwazaki- Kariwa earthquake, 16 July, 2007, 6.8 M, 0.68g pga, 16 km (ED) north of the site of KashiwazakiKariwa NPP,17 km DOF & soft soil), NPP at Shika (17 Jan, 1995, 6.9 M, 0.25g pga, ED: 18 km & DOF: 11 km, hard rock), NPP at Onagawa (16 Augusr, 2005, 7.2 M, 0.225g pga, ED: 20 kms), NPP at Hamaoka (10 August, 2009, 6.4 M, 0.426g pga ED=17 km, 26 km DOF), Fukushima Daiichi & Fukushima Daiini NPPs, (11 March, 2011, 9.0 M, 0.55g pga & 0.3g respectively, ED: 154 kms & 163 kms respectively, 29 km DOF) & NPP at North Anna (23 August, 2011, 5.8 M, 0.27g pga, ED: 18 kms, 6 km DOF hard rock)

Different mechanical, electrical and instrumentation and control equipment which are used in the industry have failed by different ways during same earthquake or during different earthquakes in the world. Different equipment is designed by their specific design codes. During earthquakes the same equipment has failed by number of different ways. Industry is interested to design the equipments for such possible different failure modes/types. The only need is that the industry designers/consultants are made aware of such possible failure modes/types. In this paper, such compilations of failures to the piping systems, during Indian earthquakes, as well from other countries, lessons learned from failures and possible solutions to mitigate the damages have been made, especially with Indian industries in mind and will be useful to them. More examples of failures are given through pictures and sketches, as they explain more than words. The Indian experiences are covered in more detail.

In case of a failure to the piping system at an industry handling hazardous chemicals will lead to dual disaster of earthquake plus the chemical accident. We are well aware of the difficulties faced by government agencies during the

[a] Nuclear Power Corporation of India Ltd. Mumbai, India

Bhopal gas tragedy and the Bhuj earthquake. One can only imagine as to how to approach accident affected people who are in a poisonous gas environment, and who are also trapped under the debris, with the roads, rail lines damaged and hospitals damaged. Government agencies will have great difficulty in providing help and relief during a duel disaster with affected people spread over a huge area.

Keywords: piping failures, industries, earthquakes, lessons, mitigation

Failure of Rigid Pipelines Due to Seismic Anchor Movement (SAM)

Rigid pipelines have failed because of Seismic Anchor Movement (SAM) experienced by them during earthquake. When pipelines come from one civil structure and go to the other civil structure, due to the out of phase movement of the two structures during earthquake, the pipelines experience SAM. Similarly, the pipelines going from lower floor to higher floors also experience SAM. There is a very good example at Kandla, where out of the three fire water lines on IFFCO jetty and four separate fire water lines on four Kandla Port Trust (KPT) jetties two rigid pipelines on IFFCO jetty failed and remaining five flexible lines survived the Bhuj earthquake, for practically the same SAM experienced by the pipelines. The general layout of the IFFCO jetty and KPT jetties is given in Figure 1.

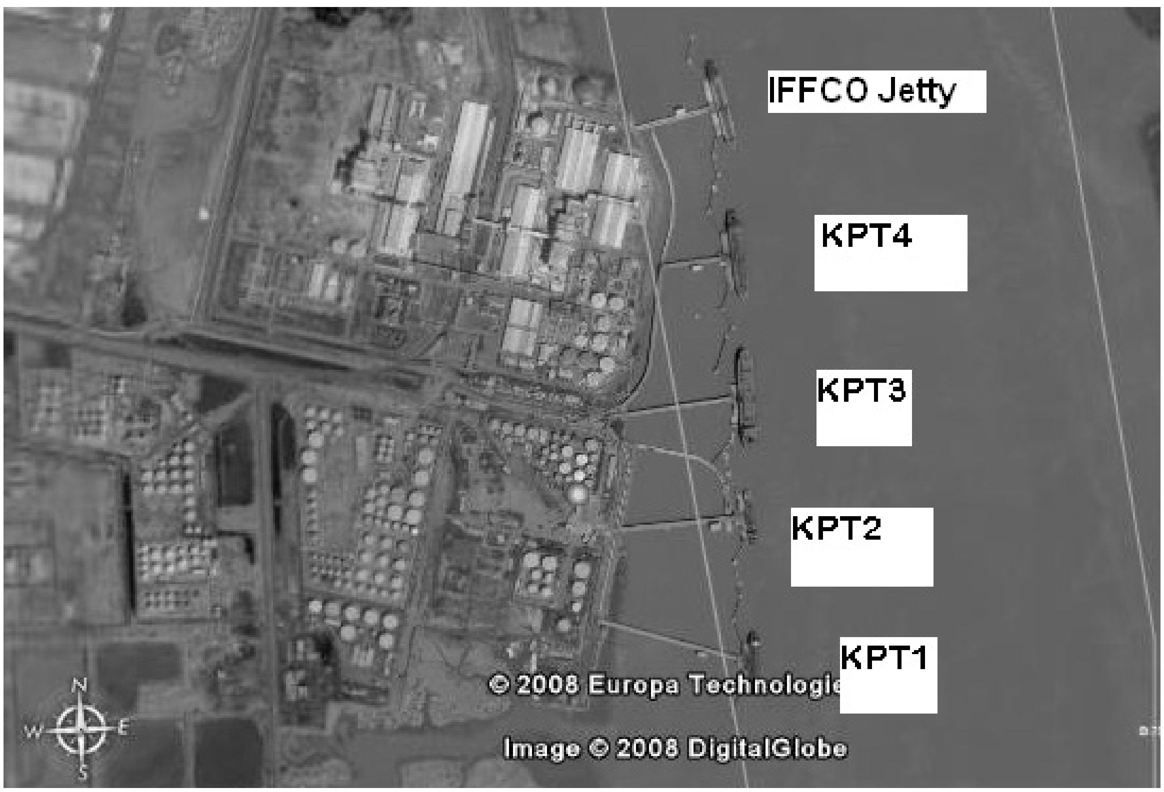


Figure 1: General layout of IFFCO jetty and kandla port trust jetties

The isometric view of the three 200 NB fire water lines near the approach jetty and the main jetty of IFFCO is shown in Figure 2. The pipelines are supported in vertical and lateral direction through U-clamp at every 2.5 metre, i.e. at every dead weight span. The pipelines are bolted by U-bolts to the ISMC 100 and these ISMC 100 supports are embedded in the concrete pedestal as shown in Figure 3. Because of these U-bolts, pipes could not move in the direction normal to the cross section of the pipe and the two pipelines failed due to SAM, Figures 4 and 5. The U-bolts over the length of 2 m on the main jetty after the bend also failed, which have not been installed after the earthquake.

There is a third line which is also running along with the two failed lines as shown in Figures 6 and 7. This pipe line did not fail as the line has sufficient flexibility provided through bends and offsets.

The seismic analysis of the pipelines have been performed and the results of the analysis are brought out below.

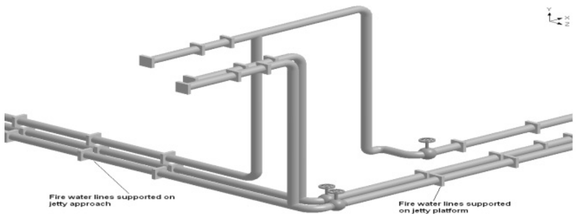


Figure 2: Isometric view of fire water piping on IFFCO Jetty

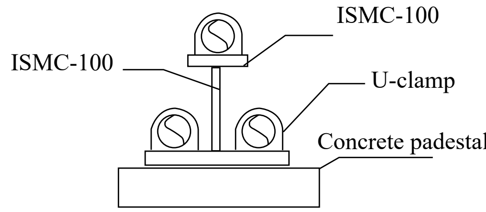


Figure 3: Details of piping support on Fire water line on IFFCO jetty

Figure 4: Two fire water lines on the IFFCO jetty experienced failure near the elbow, as well as near the flange on the vertical branch.(7.6M, January 26, 2001, 50 km epicentral distance, 0.37 g PGA estimated)

Figure 5: Two fire water lines moving on the IFFCO jetty experienced failure near the elbow as well as near the flange on the vertical branch.(7.6M, January 26, 2001, 50 km epicentral distance, 0.37 g PGA estimated)

Figure 6: Third flexible lines coming down from the structure. (No damage)(7.6M, January 26, 2001, 50 km epicentral distance, 0.37 g PGA estimated)

Figure 7: Third flexible line coming down from the structure (No damage)(7.6M, January 26, 2001, 50 km epicentral distance, 0.37 g PGA estimated)

The frequencies of the main jetty, approach jetty are 1.029Hz and 0.715Hz, respectively. The Fire Water piping frequency is 4.89Hz.

The response spectrum analysis has been carried out using the free field ground response spectrum generated by EXSIM for Kandla site as shown in Figure 8.

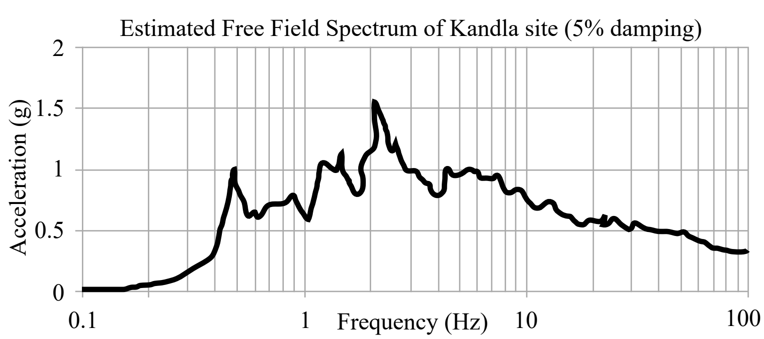


Figure 8: Estimated free field spectra of Kandla site

The displacements of the main jetty and approach jetty in east west direction are 114.14 mm and 114.26 mm respectively. The displacements of the main jetty and approach jetty in North-South direction are 110.314 mm and 160.64 mm, respectively.

The above indicates that the pipelines crossing from the jetty approach to main jetty have seen a relative out of phase displacement 27.09cm or in phase displacement of 5cm. The large SAM between the jetty approach and the jetty resulted in to the failure of the two rigid pipelines at the elbows and on the flange connection on the vertical lines.

The material of the pipe line is IS-1537 (cast iron) and its ultimate tensile strength is1500 Kg/cm^2

The stress values due to dead weight, inertial loading and seismic anchor movement in the elbows in the rigid lines which failed during the earthquake are 3062 Kg/cm^2 and 3523 kg/cm2. The stress in the elbow in the flexible line, which did not fail during the earthquake, is 174 kg/cm2. The stresses in the three pipelines on the jetties are given in Table 1.

No failure to the flexible pipelines on the four jetties of KPT. Although they experienced same Seismic Anchor Movement (SAM)

There are fire water pipelines on KPT jetties 1 to 4 (Figure 1), some of which were resting on the floor for dead weight without pedestal, some lines on pedestal without U clamp and in some cases, resting on pedestal with U clamp at more than 3 dead weight spans.

The fire water pipelines on KPT jetties 1 to 4 are shown in Figures 9 to 12. The pipelines have survived the same SAM experienced by the two nos. of rigid fire water pipelines on IFFCO jetty which failed as shown in Figure 13.The stresses in the two rigid fire water pipelines and one flexible fire water piping of IFFCO as well as the four flexible fire water pipelines on KPT jetties 1 to 4 are given in Table 1, which show that the stresses in the flexible pipelines are very low for the SAM. Whereas, the stresses in the two rigid fire water piping of IFFCO are much higher than the UTS of the cast iron material.

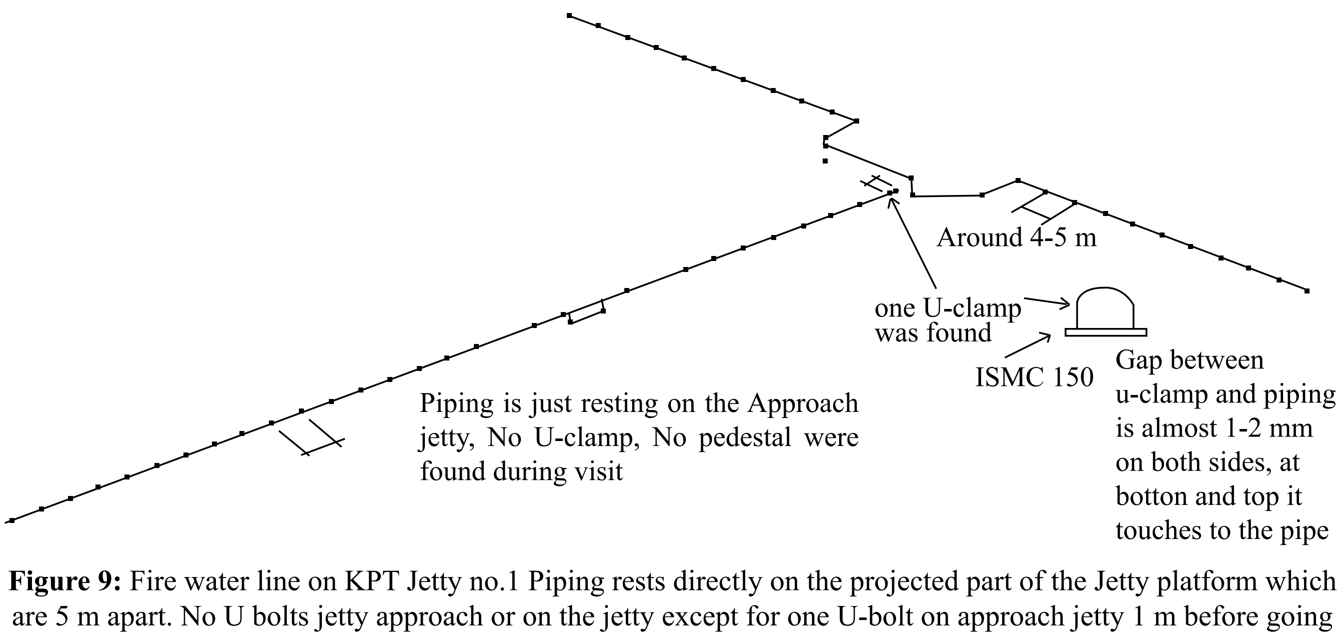


Figure 9: Fire water line on KPT Jetty no.1 Piping rests directly on the projected part of the Jetty platform which are 5 m apart. No U bolts jetty approach or on the jetty except for one U-bolt on approach jetty 1 m before going to the main jetty. No failure due to SAM or inert load Kandla, Bhuj Earthquake, 2001.7.6M, 0.37g

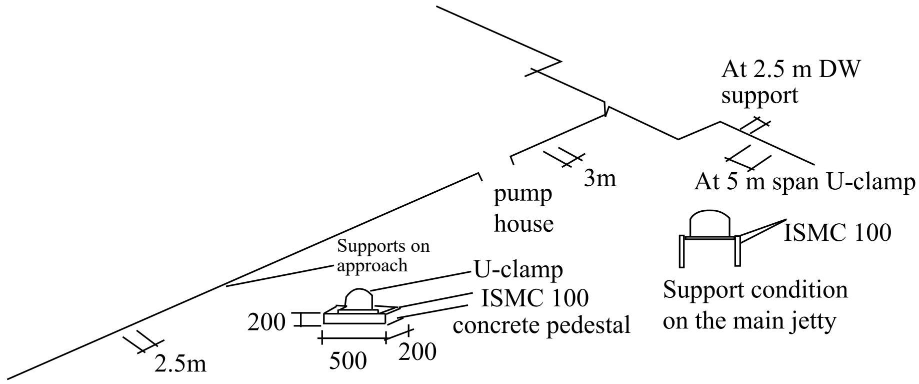


Figure 10: Fire water line on KPT Jetty no.2 DW supports at 2.5 m span (just resting). U bolts at 2 DW spans one U-bolt support at 1.5 m on approach jetty and 1st U-bolt support at 2.5 m after the turn on main jetty No failure due to SAM or inertia load Kandla, Bhuj Earthquake, 2001,7.6 M, 0.37 g

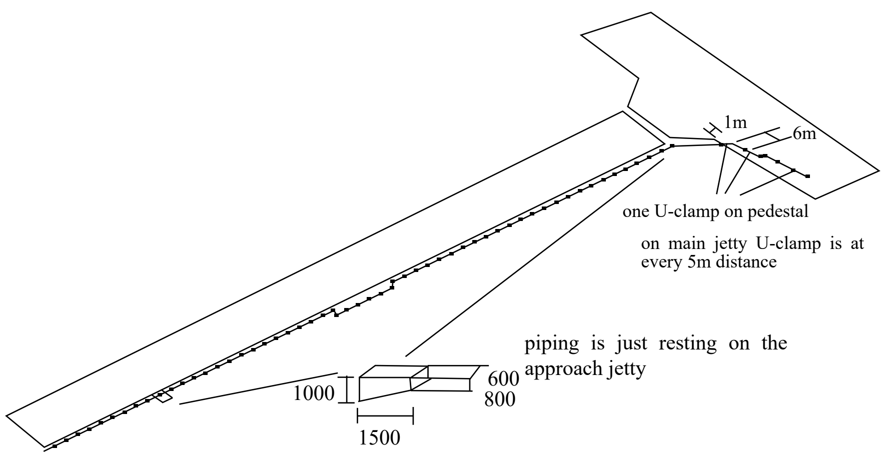


Figure 11: Fire water line on KPT Jetty no.3 DW supports at 4 meter span. No U bolt supports on jetty approach and on main jetty. One U-bolt support on approacha jetty at 1.0 m before the turn and one U-bolt support on the main jetty at 6.0 m after the turn No failure due to SAM or inertia load Kandla, Bhuj Earthquake, 2001,7.6 M, 0.37 g

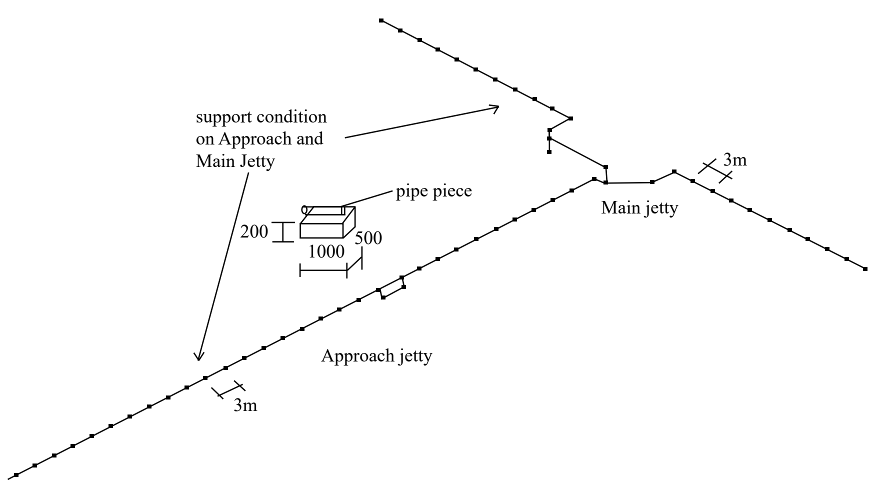


Figure 12: Fire Water line on KPT Jetty no.4 Piping rests on 1 m long pedestals (3.5, span) with 1 in pipe. No U bolt supports on jetty approach and on main jetty. No failure due to SAM or inertia load Kandla, Bhuj Earthquake, 2001,7.6 M, 0.37 g

Displacements Seen by Top Deck along with the Fire Water Piping

Jetty	X-hor. Direction (mm)	Z-hor. Direction (mm)
Approach Jetty	160.64	114.26
Main Jetty	110.314	114.14

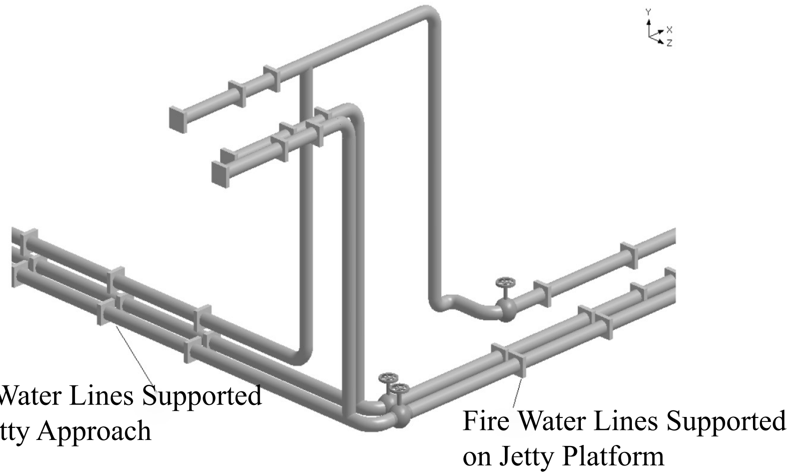


Figure 13: Displacements seen by piping on main jetty and approach jetty of IFFCO

Table 1: Stresses in the Fire Water Piping on IFFCO & KPT Jetties

FWP on various jetties and stress values in elbows

Jetty Name Dead weight support (DWSu) details Lateral support (LS) details	**Frequency (Hz)**	**Pr.+DW Kg/cm2**	**Pr.+DW+ eq Kg/cm2**	**Allow stress 1537.kg/cm2**	**Failure observe**
KPT1, DWSuon floor (no lateral support)	0.016	1259	1259	1500	No Fa
KPT2, DWSuon pedestals (no lateral support)	0.248	554.3	908.5	1500	No Fa
KPT3, DWSuon pedestals (no lateral support)	0.019	987.2	989.1	1500	No Fa
KPT4, DWSuon pedestals (no lateral support)	0.004	984.2	986.3	1500	No Fa
IFFCO Jetty, line1, DWSuon pedestals (LS at one DWS	1.608	367.9	3062	1500	Faileo
IFFCO Jetty, line2, DWSuon pedestals (LS at one DWS	1.608	386.8	3523	1500	Faileo
IFFCO Jetty, line3, DWSuon on pedestals (LS at one DWS, but the piping has a flexible loop while going from the jetty approach to the)	1.438	49.3	174	1500	No Fa

The piping has a vertical
Flexible loop

Approach to be Followed to Overcome the Pipe Line Failures Due to SAM

There is a need to make the pipelines flexible at least over the span over which the pipelines go from one civil structure to another civil structure.

To make the pipelines flexible for earthquake induced SAM, while going from one structure to an other or when they run throughout the plant, should be provided with supports at every 3 to 4 dead weight spans.

Table 2: Suggested Piping Support Spacing

Suggested Maximum Span				
Nominal Pipe Size,	**Water Service**		**Steam Service**	
NPS	**Feet**	**Metre**	**Feet**	**Metre**
1	7	2.1	9	2.7
2	10	3.0	13	4.0
3	12	3.7	15	4.6
4	14	4.3	17	5.2
6	17	5.2	21	6.4
8	19	5.8	24	7.3
12	23	7.0	30	9.1
16	27	8.2	35	10.7
20	30	9.1	39	11.9
24	32	9.8	42	12.8

The pipelines should be analysed to meet the allowable codal limit. At least 2 spans with U-bolt (not dead weight spans should be analysed with the structure or the displacement of the structure should be applied to the piping at the U-bolts.

No Failure of the Fire Water Pipe Line Due to Inertia Load

The two pipelines which have failed or the one which has not failed at the junction between the jetty approach and the jetty of IFFCO plant, run on the jetty for over 60m, on the approach jetty over 147.8 m and on the land in the plant over some 2.0 km length, which have experienced earthquake inertial load and have not failed over such 2.0 km, where as the two rigid fire water lines have failed over 2 in. of gap between the jetty approach and the jetty.

The fire water lines over the jetty approach and jetty which have not failed due to inertia load are brought out with their pictures from Figures 14 to 15. The pictures indicate their supports. These pictures show that there is no damage to the fire water piping at IFFCO jetty, although it has U-clamp supports at every dead weight span. The typical supports used for the firewater piping is given in 15.

Figure 14: Fire water on main jetty(No damage)(7.6M, 26th Jan 2001, 50 km epicentral distance, 0.37 g PGA estimated)

Figure 15: Close view of U-clamp support on fire water on main jetty(No damage)(7.6M, 26th Jan 2001, 50 km epicentral distance, 0.37 g PGA estimated)

Approach to be followed for pipe supports, as there is no damage to the pipe line because of inertia load

Irrespective of the pipe line being at cold or high temperature and irrespective of the pipe line being flexible or rigid, i.e. the piping having rod hangers, spring hangers or supports to take seismic loads at every dead weight span or at 2 or at 3 or 4 or 5 or 6 dead weight spans or small length of pipe line that has no support while going from one equipment to the other equipment have not failed because of their seismic inertia load. The pipelines include pipelines, flanges or valves on the pipeline.

As such, pipe line can be provided with rod hangers, spring hangers or supports at every dead weight span to take the dead weight and provide seismic lateral supports to take the seismic inertial load at 1 or 2 or 3 or 4 or 5 or 6 dead weight spans preferably at 3 or 4 DW spans. A small length of pipe line may not have any support, while going from one equipment to other equipment. It should be seen that a pipe line with seismic lateral supports i.e U-bolt support at every one or two dead weight spans does not experience SAM, otherwise the piping can fail because of SAM. In case Hanger rod supports are provided, provide cable bracings to resist horizontal load and arrangement to resist vertical upward load.

Failure of rigid pipe line due to large inertia forces from hanging steam generators (soil site which have large ground displacement in Active Tectonic Region (ATR) or the sites being close to a fault of a large magnitude earthquake in Stable Continental Region (SCR) Vent line connected to an economiser line in KLTPS Panendro (rigid small bore pipe line connected to a hanging steam generator.

The steam drum is hanging at a height of 55 m elevation of a steel structure by four rods at 58 m elevation. Two economiser lines of 150 NB come and join to the steam drum. One vent line of 25 NB comes from each of the two economiser lines at 52 m elevation is shown in figure 16. The photograph of the economiser lines is shown in figure 17. The vent lines have a clamp after the bends. On one vent line, the clamp is close to the elbow, about 0.5m from the elbow. On other vent line, the clamp is away from the elbow by about 1.5 m. On this line there is an additional bend before the support, which makes the pipeline flexible. Moreover, looking at the failure of the clamp, because of highly corrosive atmosphere due to sulphur and nitrogen available from the burning of lignite, the swelling of the suite in the gap due to its corrosion led to the gap between the pipe OD and the clamp getting totally clogged, forming a rigid support. The vent line which did not fail had a good gap between the pipe and the clamp and pipe could move within the clamp.

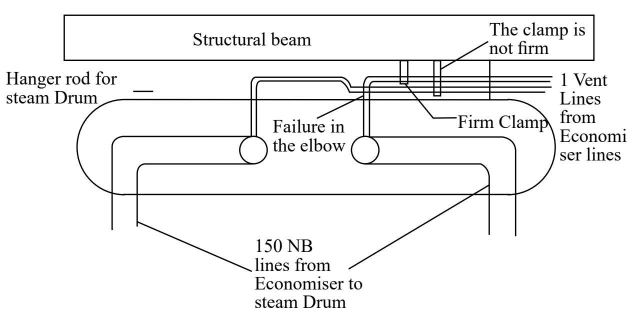


Figure 16: The schematic of the steam generator drum hanging from the ceiling by tie rods at 58 m EL. of a steel structure, two economiser lines and two vent lines. The right side vent line connected to the economiser line saw failure at the elbow due to seismic inertial load from the drum

Figure 17: The two economiser lines to the steam generator. The vent lines are connected to each of the economiser lines which are not visible in the picture (No damage to the economiser lines)(7.6M, 26th Jan 2001, 40 km from the fault plane, 0.22g)

Figure 18: Vent line connected to the Economiser line which saw failure at the elbow due to large seismic inertia load from the steam drum (7.6M, January 26, 2001, 40 km from the fault plane, 0.22g)

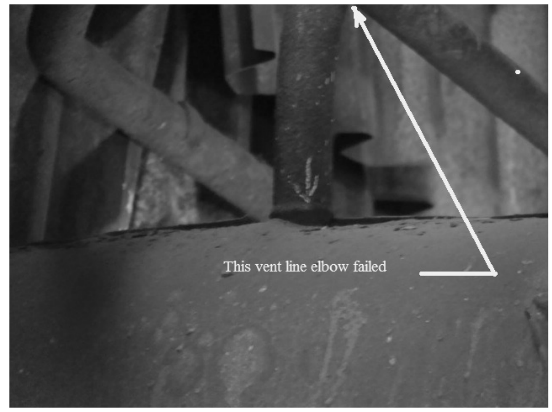


Figure 19: Vent line connected to the Economiser line which saw failure at the elbow due to large seismic inertia load from the steam drum (7.6M, January 26, 2001, 40 km from the fault plane, 0.22g)

The firm clamp on the vent line, did not allow the vent line to move. The inertia force induced by the steam drum got transferred to the economiser line and further got transferred to the vent line to be resisted by the small vent line, resulted into the failure of the vent line near the bend (Figures 18 and 19). Failure would not have occurred, if the clamp would not have become firm on the vent line. There was another vent line on the adjacent economiser line which had a small bend before the clamp support (the clamp was not firm on the pipe) and the clamp was at a longer distance from the bend, as such the second vent line being flexible did not fail.

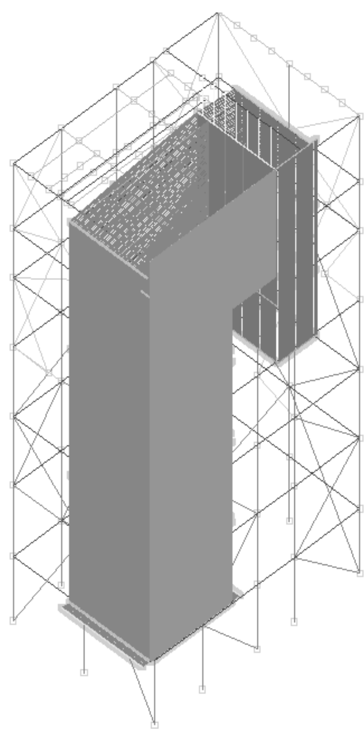


Figure 20: FE model of boiler and boiler support structure

The finite element models of the Boiler and the boiler support structure and economiser lines with vent lines at the KLTPS, Panendro, thermal power plant are shown in Figures 20 and 21.

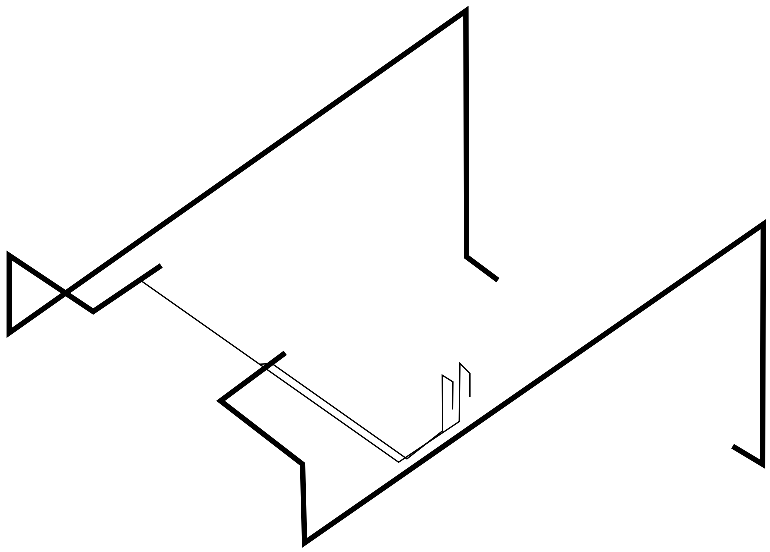


Figure 21: finite element model of vent line connected to the economiser outlet line

Approach to be followed so that failure of rigid piping does not occur due to transfer of inertial force from a heavy equipment

i) The piping being connected to heavy equipment should be flexible

A small bore piping being connected to heavy equipment like a hanging boiler drum should be flexible so that it does not fail.

ii) Heavy equipment with rod hanger or with low fundamental frequency attracts low acceleration

A rod supported steam drum connected by feeders, headers, economiser, steam line supported by spring hangers are provided with enough flexibility, do not experience large acceleration due to low frequency. However, the equipment with rod hanger will swing and generate large displacements; as such the support system of the steam drum should have bracings in three directions.

The other method is to provide snubbers on the equipment. As the steam generator is high temperature equipment the supports on such high temperature equipment are required to allow the expansion as otherwise it will generate high thermal stresses on the equipment as well on the connected pipes. Such supports which allow thermal expansion during normal operation but lock the support and offer resistance during earthquake are called as snubbers Once the steam generators or heavy equipment are provided with snubbers, the inertia forces from the heavy equipment like steam generator do not go to the connected pipelines but go to the structure supporting the heavy equipment through snubbers. Once a fixed support is provided on the S.G., the pendulum frequency of the S. G. through the snubbers with rod supports increases; this increases the attracted acceleration due to earthquake. The provided support may not be able to meet the stress requirement for the increased acceleration and one is required to increase the strength of the support.

iii) Even if the steam generator or a heavy equipment is provided with snubbers the connected piping should be flexible so that thermal stresses are low.

Failure of rigid piping connected to large un anchored tanks because of their sliding or overturning, i.e. tilting, or elephant foot bulging

Failure of connected rigid piping due to sliding of unanchored tank

Failures to the connected rigid piping due to sliding of unanchored tanks have happened in industries which witnessed large PGAs during earthquake (Figures 22 to 25).

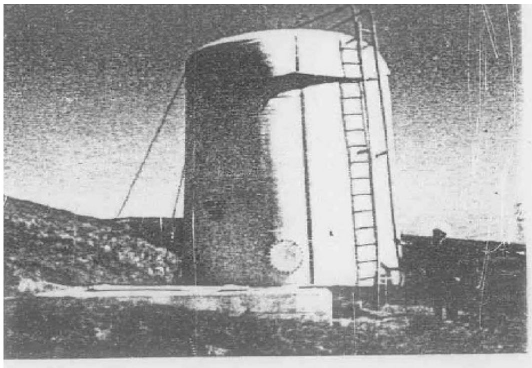


Figure 22: Tank displaced on foundation, San Fernando Earthquake, 1971, M 6.6, (Damage)

Figure 23: Unanchored holding tank slid on concrete pad, breaking fire protection piping and disabling the fire protection system in the 2010 Haiti Earthquake, M 7, (Damage). In this case, the piping was well anchored but the tank was unrestrained.

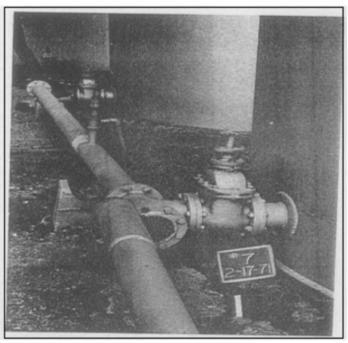


Figure 24: The pipe line has a shoe type support. Tank inlet-outlet connection broken at the flange, San Fernando earthquake, California, 1971, M=6.6 (damage)

Figure 25: Failure of Rigid Piping during Bam earthquake (Iran) (M=6.5, ED=5 km, 27 Dec, 2003) (Damage)

There are such failures of tilting of tank and failure of connected piping at Tank Yard of Friend Association at Kandla during Bhuj earthquake of 7.6 M on 26 Jan 2001, 0.37 g pga.

Failure of Connected Rigid Piping Due to Toppling of Tanks

Failures to the connected rigid piping due to toppling of tanks (Figure 26).

Figure 26: Elevated tank collapsed, kern country earthquake california, 1952, M 7.5, (Damage)

Failure of Connected Rigid Piping due to Elephant Foot Bulge (EFB) at the Tank Base

Failures to the connected rigid piping due to Elephant Foot Bulge at the tank base have happened in industries which witnessed large PGAs during earthquake (Figure 27). Under normal conditions, the thin steel-plate tank walls only resist the outward force of the fluid pressure, which a cylindrical shape does very efficiently, in tension. In an earthquake, horizontal ground motion generates alternating overturning moments on sides of the tank and large vertical compressive forces occur, which can lead to "elephant foot buckling."

Elephant foot bulges have been seen in the cylindrical bottom portion up to a height of 1 meter and bulging or protruding out radially up to 30 cm (Figure 27). Such protrusions of tank shell can give rise to the failure of rigid piping connected to the tank in the portion of the bulge. Otherwise a radial rigid pipe can make a penetration in the tank and can lead to the tank shell being ruptured. Elephant Foot Bulge are less for the anchored tanks as per the experience based data available from the world. There are no cases of elephant foot bulge in Indian experience may be the pga's seen in India by Indian industries are low.

Figure 27: Elephant foot bulging of a tank wall, 1971 san fernando earthquake, M=6.6, ECD=10 km, H/D=0.714 (Damage)

In recent times large tanks are invariably anchored to the raft. The bolts have a ductile design, which avoids the cup and cone failure of the concrete. In case of beyond design basis earthquake the bolts can have elongation and can have little vertical movement of the tank and the connected pipe. For this the connected pipe layout should be able to accommodate both horizontal and vertical movement of the tank

A damage to a rigid piping connected to the tank at higher elevation has also occurred (Figure 28). Figure shows a failure of a flange on a pipe connection to a tank. To the same tank a piping connected with a hose connection has survived.

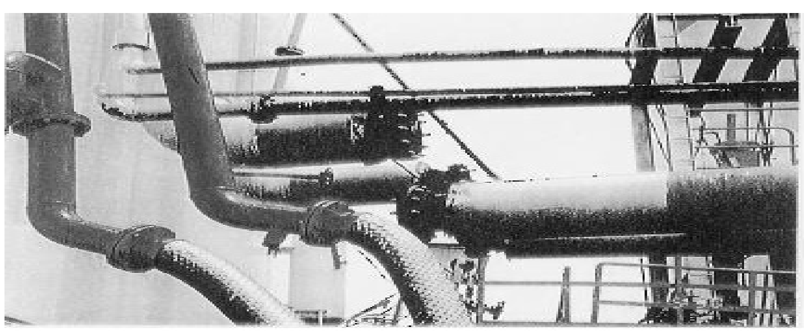


Figure 28: A rigid piping connection has failed, where as a flexible pipe with hose survived the Hanshin-Awaji Earthquake i.e. Kobe earthquake 6.9 M, 1995

Approach to Overcome the Problems Due to Unanchored Tank

i) There is need to anchor tank to the raft

ii) On soil site, the raft should be provided with pile foundation.

Approach to be Followed to Overcome the Problem due to Sliding, Uplifting and Elephant Foot Bulge in Tanks

i) The tank shell should be designed against Elephant Foot Bulge
ii) The tank should be anchored, as anchored tanks are found to have less chances of EFB during the earthquake.
iii) The connected piping to the tank should be flexible. i.e do not put a U clamp on the piping immediately near the tank. Rather put U bolts after 2 or 3 DW spans
iv) Make the pipe line flexible by providing U bend in the pipe layout so that it can accommodate vertical and horizontal movement.

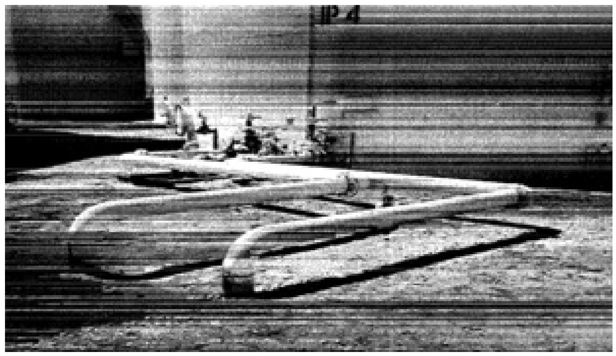


Figure 29: Inlet and outlet piping provide flexibility in both vertical and horizontal direction

v) Provide a Flexible connection viz metallic hose between the tank and the pipe line to accommodate vertical and horizontal movement

Figure 30: Flexible connection being provided at the tank outlet

Failure of Support but No Failure of Pipeline

Pipe on pipe racks on the jetty approach between the Jetty approach no. 3 and 4

The schematic and picture of the KPT jetty (Between KPT jetty 3 &4) are given in Figures 31 and 32. During Bhuj earthquake, though there was no failure (rupture)to the KPT jetty piping, but there was a failure of the supporting structure and falling of the piping between jetty no.3 & 4 from their pipe racks on to the jetty. These pipelines are supported on the steel structure made of ISMB 250 column at 10 m span and ISMB 200 beam on which the pipes rest. There are ISA 75 bracing at alternate spans.

The pipes rest on the horizontal beam of the pipe rack. The pipes are not clamped to the horizontal beam by a U-clamp and the beam does not have stopper or a long extra length beyond the pipe, so that the pipelines will not fall off the beam. As the extra length of the beam beyond the pipe was less than the ground displacement, the pipes came out of the beam end and fell down on to the jetty.

After falling down, the pipes started springing back to the original central position. During the spring back of the piping the fallen pipes damaged the support and more and more pipes kept on falling and springing back and damaging more and more pipe support racks, till the fallen pipes had rested on the jetty approach and lost their spring back energy.

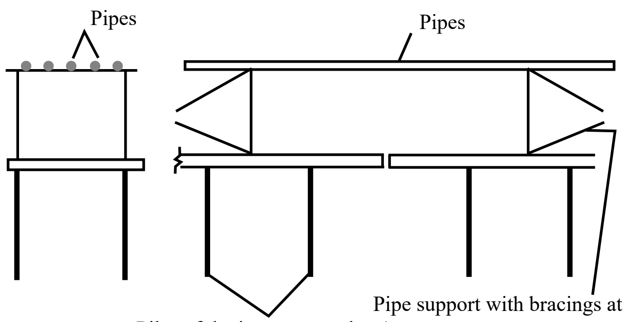


Figure 31: Schematic of the pipelines between jetty nos.3 and 4 of KPT

Figure 32: Damage to the pipe racks and pipelines falling on the KPT jetty (7.6M, January 26, 2001, 50 km epicentral distance, 0.37 g PGA)

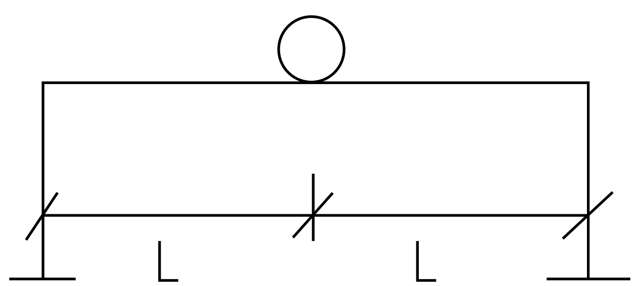
Approach to be Followed so that the Pipelines do not to Come Out of the Pipe Rack Beam

i) Provide U-clamp at 4 or 5 dead weight span to take wind load as well to take seismic horizontal load. The U-clamps at 4 or 5 dead weight spans will not allow the piping to come out of the beam of the pipe rack. The seismic support, i.e a U-clamp at 4 or 5 dead weight span will keep the piping flexible and will not lead to piping failure due to SAM

ii) Provide large extended length of the horizontal beam supporting the dead weight of the pipe beyond centre line of the pipe. The extra length should be more than the maximum ground displacement(ex: Kashiwazaki Kariwa (KK) Japan, fire water piping above ground) figures 33 & 34

placing fire piping above ground

Figure 33: A buried fire water piping ruptured at Kashiwazaki Kariwa during the 6.8 M earthquake. After the earthquake the piping was laid above the ground on the long length beam of a pipe rack



L > ground displacement + displacement of the floor on which the piping in mounted

Figure 34: Long length of beam below the pipe, so that the pipe does not fall off the beam

Large Displacement of the Pipelines can Cause the Pipe to Impact With the Adjacent Piping, or Structure or Equipment Resulting Into Denting on the Piping or Damage to the Insulation of the Pipe or to the Equipment or Structure

Long length unsupported pipelines having very low frequencies, experience large displacement resulting into impact with the adjacent pipe or equipment or structure and cause denting on the piping or damage to the insulation of the pipelines or pipe or to the equipment or structure. At industries which witnessed Bhuj earthquake there was no rupture in the pipes, may be the pga of 0.22g at KLTPS or 0.24 g at GSECL, Jamnagar were low.

The photographs of the steam lines (Figures 35 to Fig 38), feed water line (Figures 39), Boiler Auxiliary Cooling Water (BACW) (Figures 40 to 43) and Turbine Auxiliary Cooling Water (TACW) (Figures 42 and 43) showing the probable places where piping can impact with adjacent piping or adjacent equipment or structure. These photographs are from GSECL thermal power plants at Sikka, Jamnagar, Bhuj earthquake, 7.6 M, 2001,0.24g pga and KLTPS (0.22g pga). There was no damage to the pipelines or even there was no denting on the pipeline.

Figure 35: Steam line coming down from the boiler drum. (No damage).The steam line at Sikka thermal power plant (GSECL), Jamnagar. If the piping spans are large and the fundamental frequency less than 0.1 Hz, the piping may see large displacement and may swing and impact with adjacent pipe or equipment or structure. Such long spans of 20 m should be provided with cable bracings. (Bhuj earthquake, 7.6 M, 2001, 0.24g pga)

Figure 36: Supporting arrangement in Vertical steam line of Sikka thermal power plant (GSECL), Jamnagar (No damage) (Bhuj earthquake, 7.6 M, 2001, 0.24g pga)

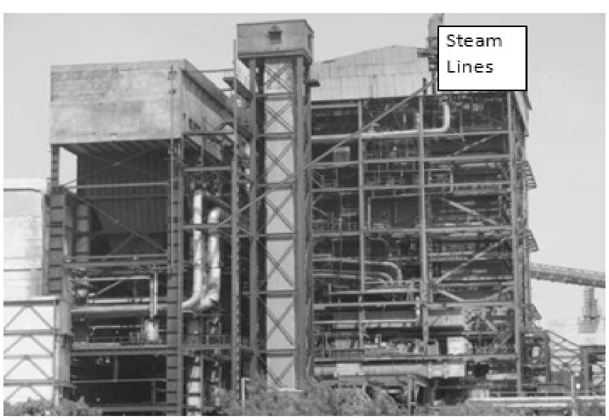


Figure 37: Steam line coming down from the boiler drum.(No damage) (Bhuj earthquake, 7.6 M, 2001, 0.24g pga)

Figure 38: Spring support for steam piping at GEB, Sikka (no damage) (Bhuj earthquake, 7.6 M, 2001, 0.24g pga)

Figure 39: Feed water header at 13m Elevation. (No damage) (Bhuj earthquake, 7.6 M, 2001, 0.24g pga)

Figure 40: BACW piping at KLTPS (No damage) (Bhuj earthquake, 7.6 M, 2001, 0.22 g pga)

Figure 41: BACW piping continue at KLTPS (No damage)(Bhuj earthquake, 7.6 M, 2001, 0.22g pga)

Figure 42: Dead weight support scheme in BACW and TACW line (No damage) (Bhuj earthquake, 7.6 M, 2001, 0.22g pga)

Figure 43: Lateral restraints in BACW and TACW line KLTPS (No damage)(Bhuj earthquake, 7.6 M, 2001, 0.22g pga)

Approach to be Followed so that the Impact Between the Adjacent Pipes or the Pipe and the Adjacent Structure does not Take Place

i) Provide U-bolts at 4 or 5 DW spans so that the pipelines will have higher frequency and the displacement will reduce and impact will not happen
ii) Provide cable bracing on the high temperature piping so that the pipelines do not impact
iii) Provide gap between the adjacent structure and the adjacent pipe, (Figure 36) to be more than the ground displacement plus the amplified displacement

Failure of the Buried Pipelines

Damage to the pipe at the bends or at coupling due to large accumulation of strains transferred from the adjacent soil which is in dynamic movement during earthquake

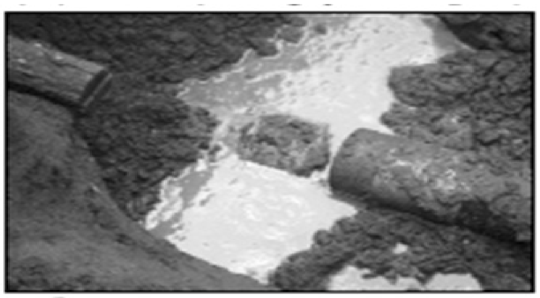


Figure 44: Failure of a coupling of the buried piping in Kashiwazaki Kariwa NPP which experienced 6.8 M earthquake at 16 km epicentral distance with a 0.68g PGA

Figure 45: Failure of a buried piping in Kashiwazaki Kariwa NPP which experienced 6.8 M earthquake at 16 km epicentral distance & 0.68g PGA

Approach to be Followed so that the Buried Pipelines do not fail During Earthquake

i) a) Run the pipe line in trenches, so that the soil does not induce strains and stresses in the pipe.

b) In the trench also provide U-clamps at 4 or 5 DW span so that the piping is flexible and does not fail due to SAM. The SAM may generate because over the long length of the piping there can be relative displacement in the soil.

ii) a) Run the piping above the ground over a pipe rack made up of a beam supported by two columns on the sides without U-clamp. The extended portion of the beam beyond the pipe centre line should be long enough, so that the length of the beam on the either side of the pipe is more than the ground displacement, so that the pipe does not fall out of the beam.(Figures 33 and 34)

b) The piping without pipe rack support should have U-clamps at 3 or 4 DW spans so the piping is flexible and will not fail by SAM (the SAM may be generated because over the long length of the piping, there can be relative displacement). There should be good gap between the pipe and the clamp so that the clamp can allow the axial movement.

iii) In case pipelines are to be buried, use steel pipes with butt welded joints and ductile-iron pipes with seismic joints

a) Steel pipes with butt welded joints and ductile-iron pipes with seismic joints performed well with no substantial leaks even in areas where extensive liquefaction-induced permanent ground displacement occurred. While old cast iron pipes broke easily even under relatively firm soil condition, see photographs in Figure 46.

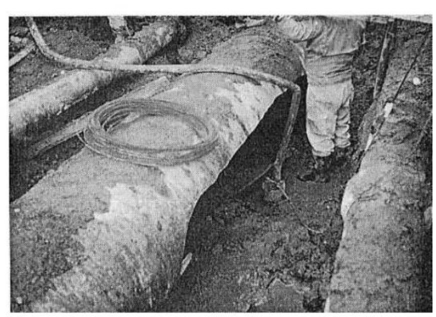


Figure 46: Buried pipelines under earthquakes - ductile iron pipes with seismic joints surviving large permanent ground deformation (left) and brittle failure of cast iron pipes (right)

Piping Failure due to Sinking of Supports/Pedestal or Building or Tank/Equipment Raft or Liquefaction or Subsidence

Sinking of Support Below the Pedestal of the Support Supporting the Pipe

Because of liquefaction of the soil below the pedestal, the U-clamp and the pedestal instead of supporting the pipe, started taking support from the pipe and as the U-Bolts were corroded, they were damaged. (Figure 47)

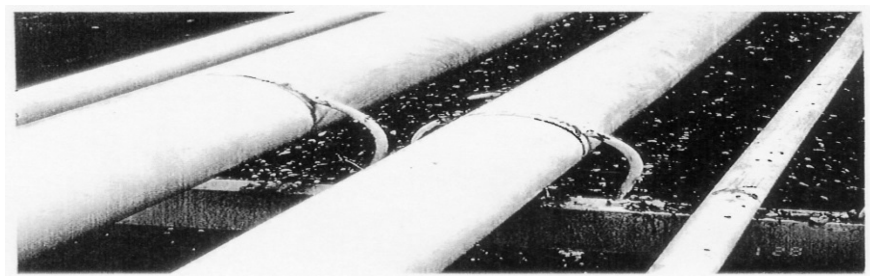


Figure 47: Damage to the corroded U bolts of pipelines due to liquefaction of the soil below the pedestal resulting in to the U-clamp and the pedestal instead of supporting the pipe, started taking support from the pipe (Kobe, 1996), 6.9 M

Subsidence of the Soil Around the Tank Foundation Raft

A drain line of a tank was provided with a U bolt with it's pedestal immediately after the tank, (Figure 48). The pedestal of the support was independent of the tank foundation and was not having it's own pile foundation. Due to ground subsidence, the soil around the tank foundation and the pipe support pedestal went down. Fortunately the soil settlement was not more than the depth of the pedestal. If otherwise, the pedestal instead of supporting the pipe would have been hanging on the pipe line through the U bolt and the weight of the concrete pedestal would have come on to the nozzle and might have caused damage to the tank nozzle.

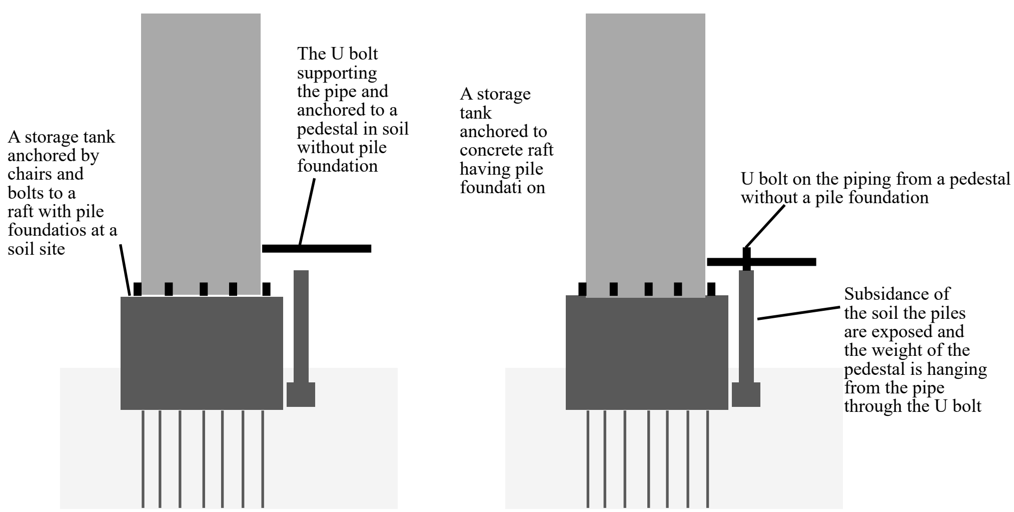


Figure 48: subsidence of the soil around the tank foundation raft and the pedestal supporting the pipe through the U bolt

Failure of the Pump Casing-Piping Nozzle Due to Uneven Settlement of the Building

The inlet pipe and pump casing were pulled apart by excessive piping external force due to uneven sinking of the building resulting in to the failure of the pump casing. (The building should have a raft with pile foundation at soil sites), at pumping facilities for sewage and drainage facility, Kobe. Soft soil) (Figure 49)

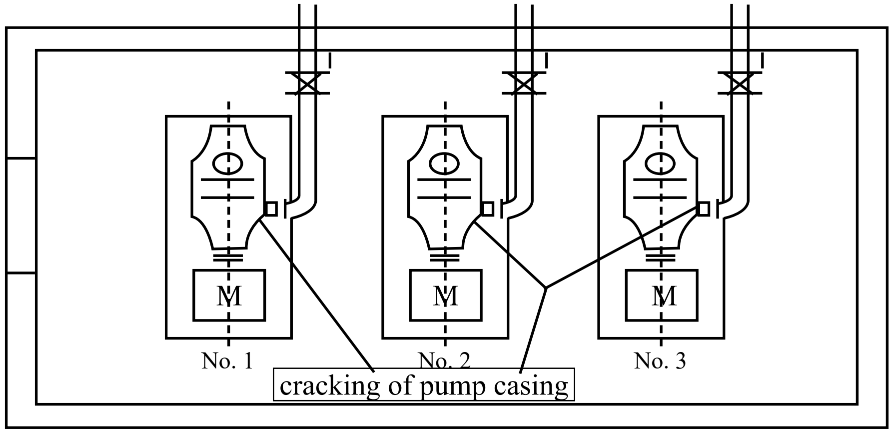


Figure 49: Cracking of the suction of the pump

In some cases, outdoor pumps have failed to operate as a result of soil failures under the concrete base mat. In Figure 50, the ground beneath the pump skid settled relative to the pipe, causing failure of flange connections.

Figure 50: Seismic ground settlement

Approach to be Followed to Avoid Pipe Failures due to Sinking of Support

i) The piping should be flexible with no U-clamp i.e piping should only rest on the support in case the support pedestal does not have a pile foundation and do not provide Shoe like support on the pipe close to the storage tank nozzle
ii) The supports of piping should have pile foundation, as well the connected equipment viz. tank, HX, pump etc should also be mounted on foundation raft with pile foundation on soil sites. The pipe and equipment foundation should be integral. The pipe and the valve on the pipe are well supported by the tank at the nozzle location. In case of a very heavy valve on the pipe line, in case a dead weight support is to be provided, provide just a dead weight support without U clamp and the pedestal should be a integral part of the raft of the tank
iii) In case U-clamps are provided, the U-clamps should be provided at a distance of 3 or 4 DW spans so that the piping is flexible and does not fail by SAM.
iv) Provide pile foundation to the pedestal and provide long length beam Figure 34 below the pipe, so that the pipe does not fall off the beam as provided at Kashiwazaki kariwa Figure 33, during the retrofit after the earthquake

Pipeline Failure due to Piping Crossing the Fault Plane

A pipe line crossing a fault is bound to fail as a guillotine rupture (Figures 51 and Figure 52).

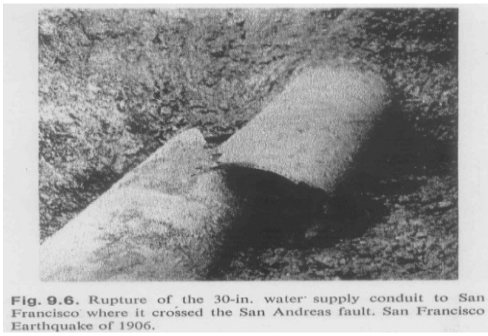


Figure 51: Failure of piping crossing the fault plant during San Francisco earthquake of 1906

Figure 52: Failure of piping crossing the fault plane or the ground rupture during 7.6M Bhuj earthquake of 2001

The pipe line should be without U-clamp so that the ground upward movement can be absorbed by the pipe line by way of piping on one side of the fault getting lifted by the ground and the ground on the other side of the fault going down with the pipe line remaining in space over some distance. In case there are a U clamp on the support, the ground on one side which is going up will get lifted with the U clamp (Figure 53), however, the U clamp and the pedestal on the other side will pull the piping along with them and will result in to SAM type of failure. This can damage the U clamp as well the pipe. On the other side of the fault where the ground is going down and the weight of the pedestal through the clamp will come to the pipe instead of the pipe being supported by the support. The piping is generally supported at every DW span for dead weight, but can withstand seismic loading even up to 5 DW span. So for the design of the pipe supports for the piping crossing the probable fault planes do not provide U clamp and provide long length horizontal beam normal to the pipe axis (Figure 34) so that the pipe does not fall down from the beam.

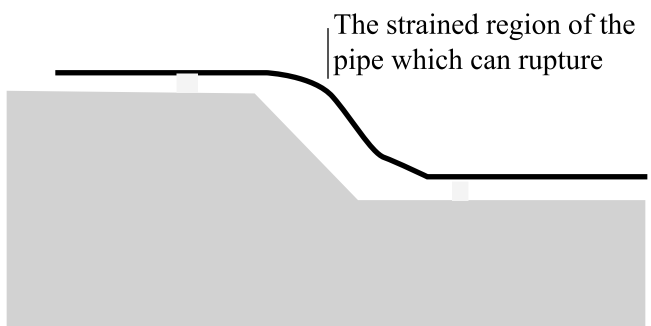


Figure 53: Failure of a pipe line crossing a fault line with firm clamps on the two sides of the fault

Approach to be Followed so that the Piping Crossing the Fault Plane does not Rupture

i) Lay the pipe above the ground on pipe rack without U bolt and long length beam as given in ii) below or provide lateral support at 4 or 5 DW spans.

ii) The piping should be very flexible for a strike slip or normal or reverse fault movement of the ground. During the earthquake, the ground should move downward below the pipe line and should not pull down the pipe along with it. The pipe line should be on long length of beam so that the pipe does not fall out of the support (Figure 34)

iii) The solution given to an oil line in Alaska is given in Figures 54 and 55

Figure 54: Zig Zag pipe line led in Alaska which is crossing the Fault line

Figure 55: Zig Zag pipe line led in Alaska which is crossing the Fault line

In November 3, 2002, the Denali Fault in central Alaska slipped approximately 5.5 meters laterally and more than 1 meter vertically beneath the Trans-Alaska Pipeline during a magnitude-7.9 earthquake without causing a single drop of oil to spill. Although no significant historic earthquakes had previously been attributed to the Denali Fault, geologists during the early 1970s, recognised the fault's earthquake potential and recommended a design along a 600-meter section to accommodate slippage up to 6 meters and 8 magnitude earthquake. The pipeline was built in a zigzag pattern to allow the pipe to expand and contract. The Alaska earthquake provided a live test of the trans Atlantic pipeline system

Failure of Pipelines due to Falling of Debris on to the Piping

Instrumentation Pipelines failed at IFFCO plant which witnessed 7.6 M earthquake, due to falling of brick walls as well as debris (Figures 56). Failure of conveyor gallery (Figure 57) resulted in to failure (the falling conveyor gallery causing guillotine rupture) in the NH3,P2O5, water pipelines passing below the conveyor gallery. The plant was closed being a public holiday. The NH3 contained in the line did leak to the environment, but the quantity of the leak was very small. It would have been a major chemical accident along with the earthquake damages to the plant, had the plant been in operation.

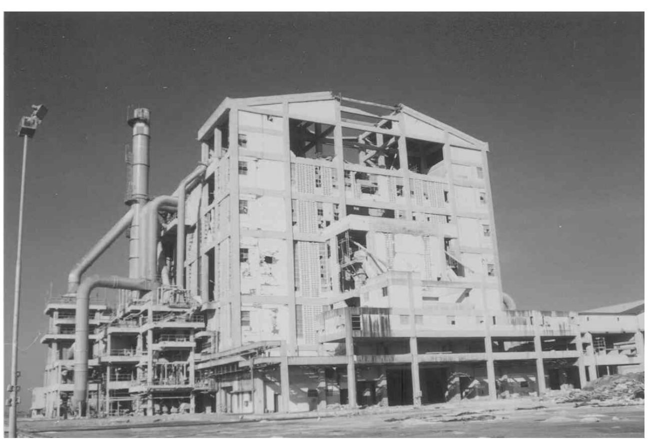


Figure 56: Brick wall falling on to the piping at IFFCO plant which witnessed 7.6 M earthquake of 26 Jan, 2001, 0.37 g pga

Figure 57: Damage to the piping due to falling of conveyor gallery on the pipelines at IFFCO plant which witnessed 7.6 M earthquake of 26 Jan 2001., 0.37 g Pga

Approach to be Followed so that Failure of Piping does not Occur due to Falling of Debris

Adjacent building walls should be made of RCC or the brick wall should be with reinforcement.

Failure in Corroded Pipeline

Corroded pipelines in many industries have ruptured during earthquake due to poor strength, Figure 58

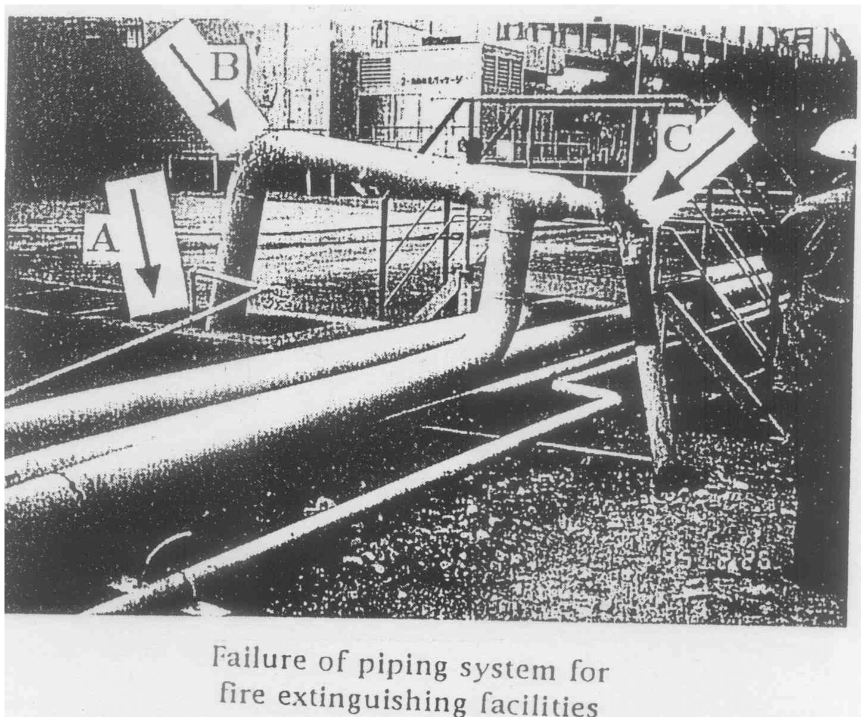


Figure 58: Failure of corroded fire water piping Locations A,B,C during 1995, Kobe earthquake, 6.9 M.

Approach to be Followed so that Corroded Piping does not fail During Earthquake

The pipelines which are known to corrode like seawater piping, pipes carrying acids etc. should be regularly inspected, every year, and pipes and pipe components viz. elbows and tees replaced when the thickness becomes less than 87.5 per cent of the design thickness.

Failure of the Piping Near The Pump or Equipment Nozzle in Case the Dead Weight of the Pipe Running Near the Ceiling is Coming Directly on to the Nozzle

Failure of pump casing -nozzle has happened when the dead weight of a long length horizontal and vertical run of the piping running close to the ceiling has come directly on to the casing of the pump (Figure 59). In Figure 60, for a similar pump, deformation is seen but there is no total failure of pump casing even though the dead weight of the piping running near the ceiling is coming directly on to the nozzle, Kobe earthquake, 1995, 6.9 M. The piping of such long length horizontal run and vertical run close to the ceiling should be supported from the floor before connecting the piping to the casing of the pump (Figure 61.1) Because of difficulty in the layout, if it is not possible to support the pipe from the floor before connecting the pipe to the nozzle of the pump or nozzle of any other equipment, at least a support should be provided as close to the vertical run, (Figure 61.3) so that maximum weight of the horizontal run of the pipe close to the ceiling is taken by the support hanger and it does not come on to the pump or as a general on the equipment nozzle.

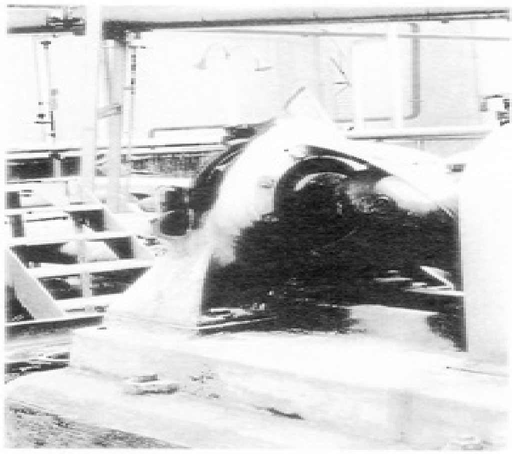


Figure 59: Failure of the piping near the pump or equipment nozzle,as the dead weight of the pipe running near the ceiling is coming directly on the nozzle, Kobe earthquake, 1995, 6.9 M

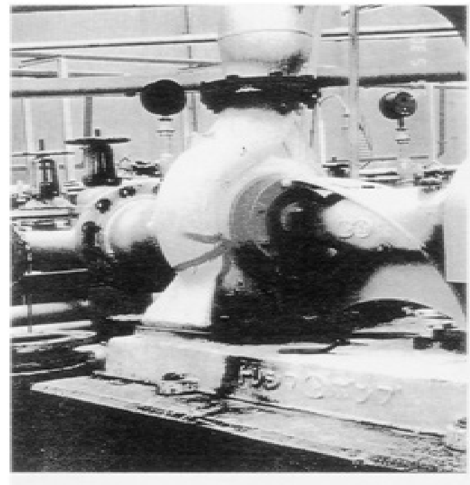


Figure 60: Deformation but no total failure of pump casing or equipment nozzle, even though the dead weight of the piping running near the ceiling is coming directly on to the nozzle, Kobe earthquake, 1995, 6.9 M

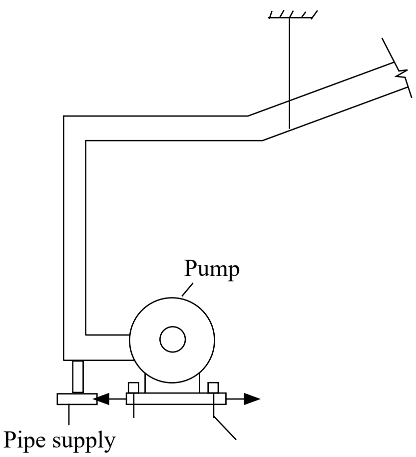


Figure 61.1: Good design, generally used in plant is to support the pipe from the floor before connecting to the nozzle

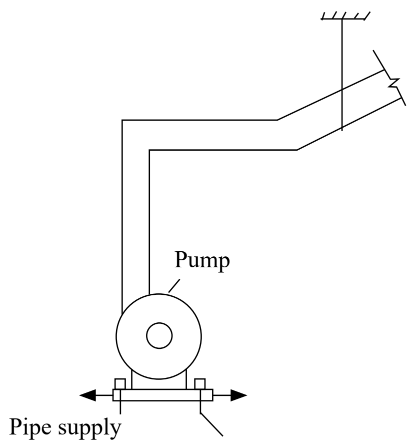


Figure 61.2: Bad installation of the connected piping to the pump, where the dead weight of the pipe running near the ceiling comes directly on the nozzle

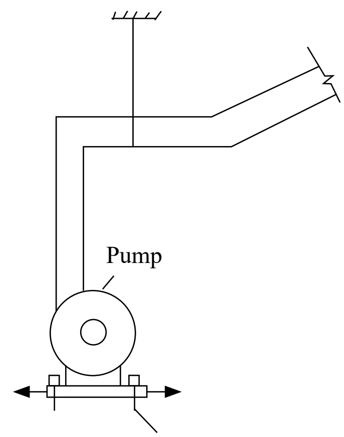


Figure 61.3: A better design, wherein at least provide a hanger rod or spring support as close to the elbow, so that the dead weight of the pipe running near the ceiling goes to the ceiling through the hanger rod or spring hanger and less load comes on the nozzle

Approach to be Followed, so as to Prevent the Failure of the Pump Casing-pipe Nozzle

i) After the routing of the piping near the ceiling before connecting the piping to the nozzle of the pump or tank or any other equipment bring the pipe close to the floor, take dead weight support from the floor before connecting the pipe to the nozzle (Figure 61.1).

ii) In case of difficulty in the layout provide a hanger rod or spring support as close to the elbow, so that the dead weight of the pipe over its run near the ceiling goes to the ceiling and does not come on the nozzle (Figure 61.3).

Failure of a Hook of the Hanger Rod

Failure of the pipe hangers, as the hanger rod has come out of the hook welded to the EP or the hole in the angle section welded to the EP or the threaded end of the hanger rod directly threaded into the ceiling by rawal plug has come out Figure 62.

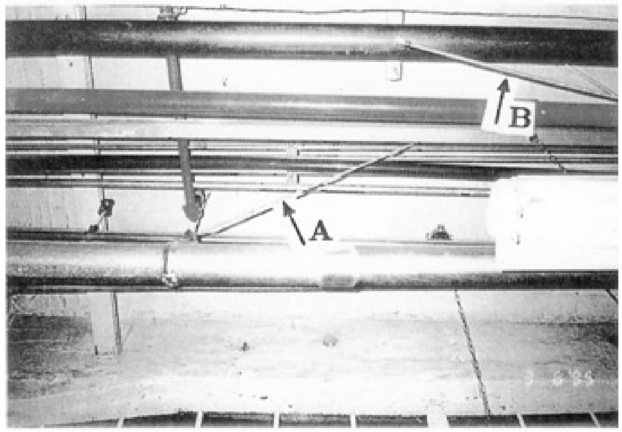


Figure 62: Failure of hanger rod supports (rods A, B) of piping system where the threaded end of the hanger rod is directly threaded into the ceiling by rawal plug has come out, Kobe earthquake, 1995, 6.9 M

Approach to be Followed to Avoid Hanger Rod Failure

i) The top and bottom ends of the rod should not be open, rather they should be closed like question mark. Furthermore, such hook type of hanger rod should not be used. The rod should have lock nut, washer and pin to avoid rod coming out of the bracket which is welded to the EP or the hole in the angle section welded to the EP. At the anchoring end of the hanger rod, there should be spherical washer, so that the top connection does not resist any movement, Figure 63. There should be a pin in the rod below the bracket so that rod does not lift upwards. The areas close to the active fault which expect large displacement cable bracings (Figure 64) or trapeze type (Figure 65) support should be provided

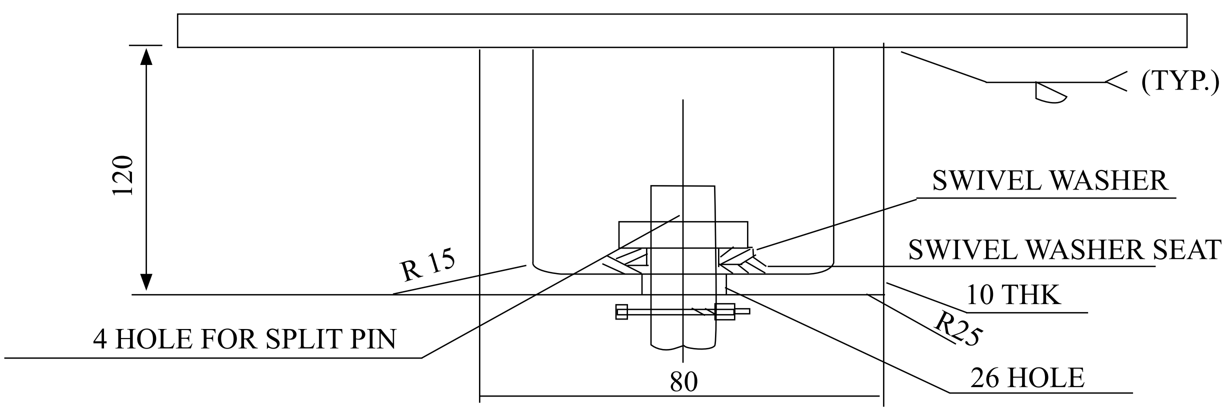


Figure 63: The arrangement of the bracket at the ceiling

Seismic Cable Restraint Systems carry tension only loads along the axis of the cable. They are used in pairs to restrain pipe, duct, electrical distribution systems or equipment in each axis. Cable restraints provide a load path between the building and the restrained component or pipe to ensure that it moves with the building. Cable restraints are required on both primary axes for all restrained systems.

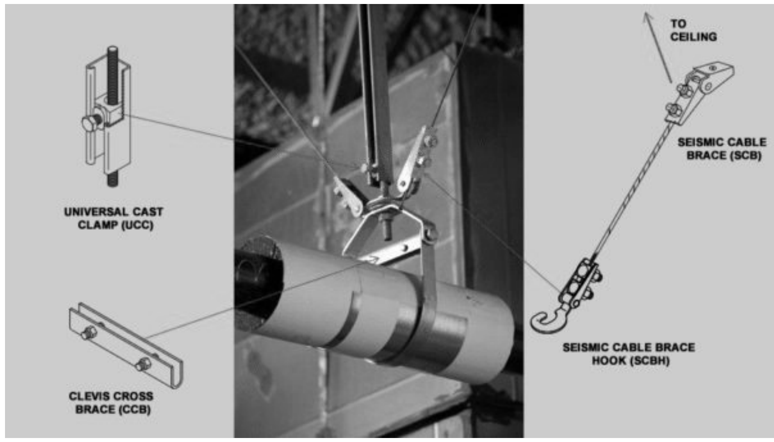


Figure 64: Cable Bracing

ii) Provide three directional trapeze type of supports, figure 65.

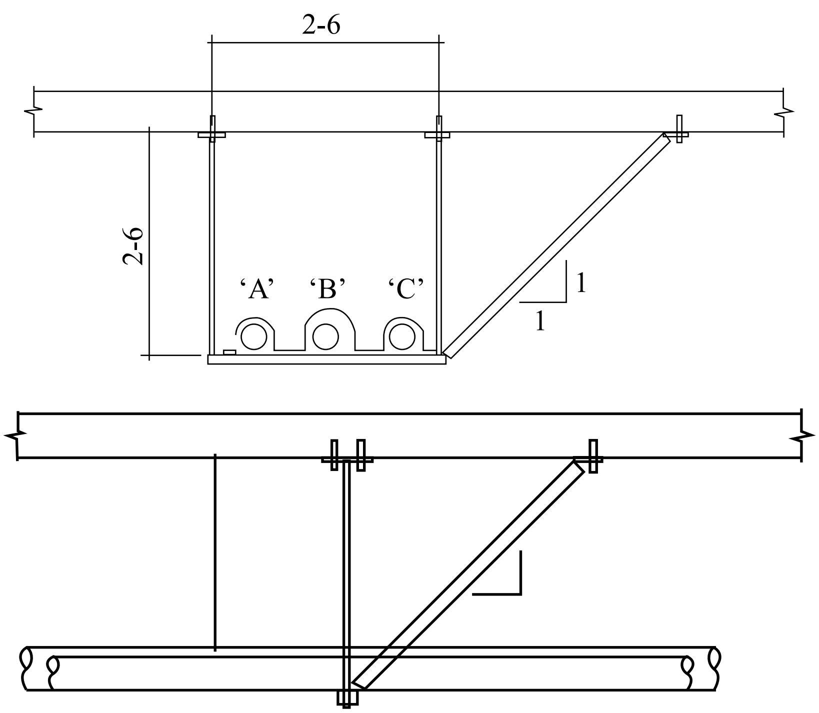


Figure 65: Trapeze support

iii) The rod with the threaded end directly anchored into the ceiling through rawal plug should not be used.

Failure in Threaded Pipes

Failures of pipes with threaded joints are observed, however, such threaded pipes are used in residential buildings and not used in the general industrial plant

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Primary Natural Hazard Risk Methodology: A Case Study of Mazar-i-Sharif City

Shabir Ahmad Kabirzad

Abstract

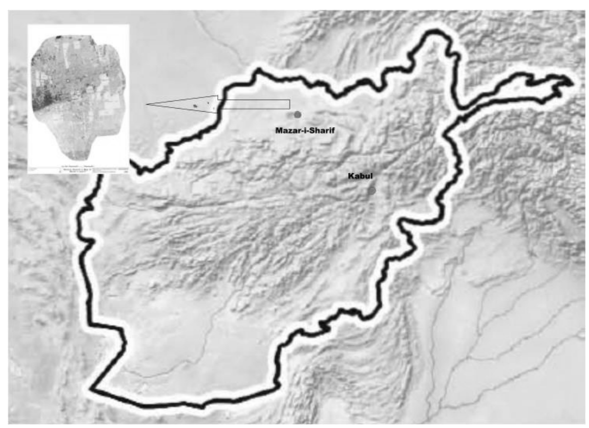
Natural hazard risk assessment is an approach and used various types of data sources in the assessment to find the natural hazard types and exposures in Mazar-i-sharif city. After collection and analysis of secondary sources such as digital images and spatial data from ASDC/iMMAP,and necessary primary data collection has been done in the city level based on four assessment criteria to find out risk types and exposure places. Types of natural hazards are flashfloods and earthquakes and has serious impact from flood and earthquake is in moderate level in the city. The assessment has targeted a few districts based on the flood risk and find out the most vulnerable areas located in district 5, 7, 10 in Mazar-i-Sharif city. The most serious are from flashflood in the two districts 5 and 10 has priority for Disaster Risk Reduction.

Keywords: flood risk, natural hazards, digital images, disaster risk

Introduction

The Primary Natural Hazard Assessment has been carried out based on the set 4 criteria (Table 1) in order to identify the exposure areas in Mazar-i-Sharif city. It is located in the northern region of country with totally 83.04 KM2 and almost 0.7 million people (State of Afghan of Cities, Report 2015).

Balkh is very historically and culturally famous province in the country and Mazar-i-Sharif is center of the Balkh province with 10 Districts/Nahia in the city. The city is also natural hazards prone area due to land use management and climate change challenges in the city. Therefore, Mazar-i-Sharif city is not resilient against natural hazards risk according to the assessment which has been supported by UN-Habitat Afghanistan Office. The assessment is started as a secondary survey in the city to find suitable approach based on stellate images then primary hazard assessment has been done. Through the assessment severe risk has been tackled after data and information collected from the city's districts. Only a few ambiguous has been founded under risk of flood and also under moderate seismic zone.



Map 1: Mazar-i-Sharif City Location in the Map

Objective

As the natural hazard assessment is a very important requirement and would find the hazards area in the Mazar-i-Sharif city. Main objective of this assessment is find exposure and the vulnerable people and also types of natural hazard in the city. At the end of this assessment we would be able to find the natural hazards types and districts suffer from disasters.

Methodology

The assessment was done through various data and sources to have objective assessment and used both primary and secondary data sources. Firstly, all images and data has been collected from the secondary sources to find the natural hazards locations with exposure boundaries then primary data has been collected from local district offices, and site teams have visited various sites in the city districts, which are considered as under the natural hazards risk. Through the assessment we collected and analysed spatial data of ASDC/iMMAP and also site data for final assessment.

The Risk Exposure has been analysed based on collected data with digital images of City and Afghanistan Spatial Data Center (ASDC) with analysis on existence of flood prone area and earthquake shake map in the districts using the digital maps. Also the types of hazards and disasters have been categorised in detail and evaluated the scale of hazards risk in each district.

The analysis was done for the major natural hazards which are observed and anticipated in the city; floods, and earthquakes. The data on Risk Exposure were mainly taken from iMMAP Afghanistan Spatial Data Center (ASDC) and interpreted the risk in district-by-district for each type of Hazards in the city.

As the accuracy of those secondary data is considered to be limited, the assessment need to carry out primary data collection through interview with Municipal District Heads and community people and the rapid analysis by site visit (ANNEX 2). Two assessment criteria were belonging to Municipal District Heads on the perception of Heads on probability of natural hazards and experiences of disasters in the area in the past few years. The same questions are asked to community people and conducted a rapid risk analysis by site visits.

Other criteria have been asked in each district, such as access to public services such as WASH, education, health facilities, transportation, bridges, riverbank and drainage system, unemployment rates and income level, and were rapidly assessed through interviewing with Municipal District Heads (M. Szoenyi, D. Nash 2016).

In addition, the status of each district, proportions of regular and irregular street layout were reviewed through UN-Habitat and Government's State of Afghan Cities report. Through assessment we have collected primary data with visual information by visiting all Mazar Municipality Districts Head, engineers and other technical staffs of municipalities and the assessment combined that primary information with multi sources of secondary digital map and statistical information from various agencies, which includes flood prone area and earthquake shake as in Maps 2 and 3.

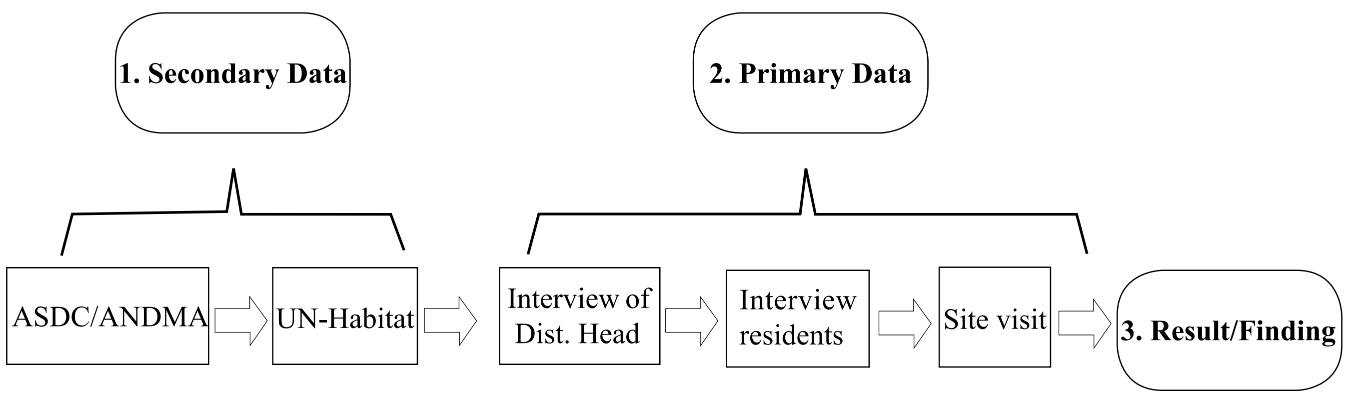


Figure 1: Primary and secondary data collection process

Together with those risk and resilience related data, Priority of the District on Resilience/Disaster Risk Reduction, willingness of Municipal District Heads for Resilience/Disaster Risk Reduction related projects and existence of on-going government/donor development projects in the District are assessed mainly through interview with District Heads. The detailed information has been shown in ANNEX 1 (Paul Arbon, 2015).

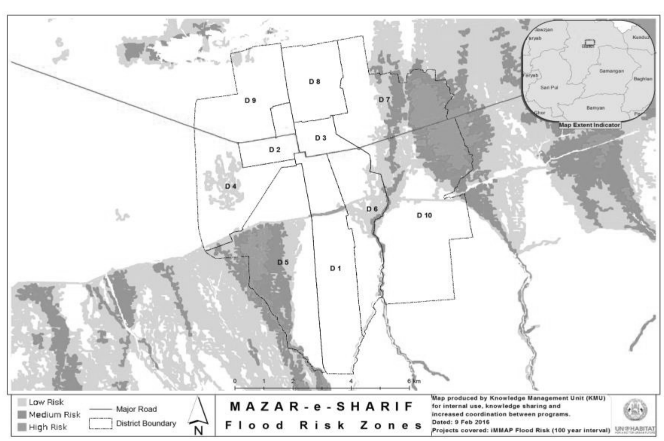
Table 1: Primary Assessment Criteria

	Assessment Criteria	Data source		Degree or Scale				
1.	Risk Exposure	Afghanistan Spatial Data Center (ASDC) Disaster Risk data by iMMAP	Earthquake	Low 1		Medium 3		High 5
			Flood	Low 1		Medium 3		High 5
2.	Probability of Natural Disaster by people's perception	Interview with District Head		None 1	Little 2	Some 3	Severe 4	Very Sever 5
		Site survey (including interview with community)		None 1	Little 2	Some 3	Severe 4	Very Sever 5
3.	Economic situation analysis	Interview with District Head		Well off 1	Relatively Well 2	Medium 3	Poor 4	Very Poor 5
4.	Status of Area: Planned / Unplanned and Regular/ Irregular	State of Afghan Cities data		Planned/ Regular 1		Partly Unplanned/ irregular 3		Totally Unplanned/ irregular 5 A Municipality
A.	Municipality Priorities/ Willingness of District Directorates for Disaster Risk Reduction Project	Interview with District Head		Least 1	Less 2	Medium 3	High 4	Very high 5
B.	Existence of on-going development project	Interview with District Head		Yes				No

Process of Analysis

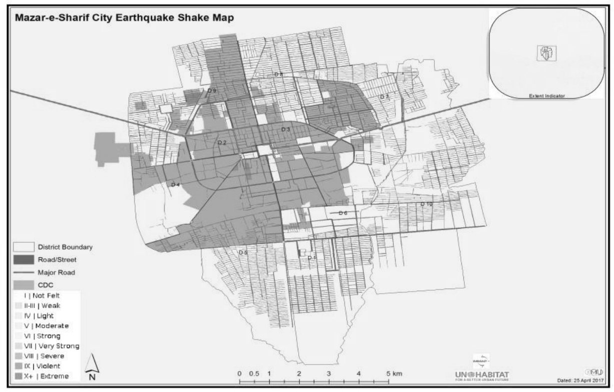
Based on the Secondary and primary assessment, a trend has been made to visualise the result of assessment. Figure 2 shows the trend of natural hazards risk presented by secondary source (ASDC/iMMAP) and primary data analysis.

Because of a lack of scientific and reliable risk data available at local level in Afghanistan, primary data have been collected from local authority through interview and the rapid site survey has been implemented by the Project team, in addition to Risk Data available from ASDC/iMMAP which is only risk information available at city district level in Afghanistan.



Map 2: Mazar-i-Sharif city flood prone area within city districts

Map 2 which is a map of the flood prone districts shows that the districts under the natural hazards risks based on the risk forecast of iMMAP, same as the high-risk areas identified by the rapid site survey. Based on the risk forecast of iMMAP, District 5, District 7, and 10, is under higher risk and the rapid site survey including interview with District Heads and community people identified District 5, and 10 is relatively high risk. This implies that our site risk assessment is the same with IMMAP prediction. The target districts is finalised after site visit to find the ground reality for clear justification for the target districts after site visit.



Map 3: Mazar-i-Sharif city earthquake shake map

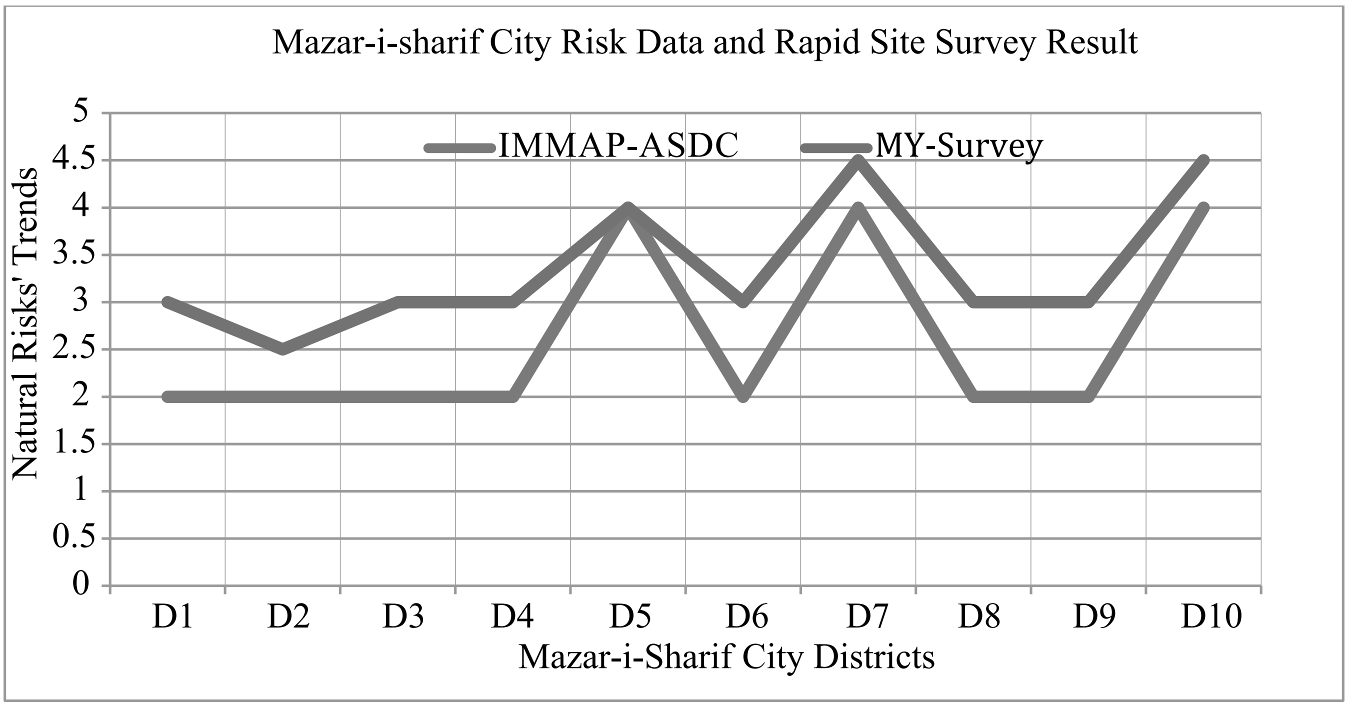


Figure 2: Comparison of spatial risk data and site survey result

Results and Findings

After all types of resource analysis it shows that there are not all types of natural hazards, only flashfloods and earthquakes natural hazard risks are available, a few locations suffer from flashflood risk and non-engineering structures with very poor traditional material increase risk of damage due to seismic impact in the structures. The most serious risk is the areas suffering from flashflood and secondly earthquake hazard with seismic condition and also structures typology (H. Volkan, 2007, B.H Panday et.el 2008). The area water infrastructure could not control water flow during rainy season and the water infrastructures do not have enough maintenance. Another concern are topographical maps because there are no topographical maps of the city when you need to specify hazards location and lack of participation information is another problem in Mazar-i-Sharif city local administration.

Conclusion

The summary of Primary Risk Assessment is shown in the Table 2 from various sources. As a result of assessment of Mazar-i-Sharif City districts, the high natural hazards risk is identified due to flashfloods and earthquakes in locations such as, District 5, 7, and 10. Among such natural hazard risk areas, District 5, and 10 are relatively poor and under serviced that could be considered as relatively vulnerable to natural disaster. Considering the Municipal District's priority and existence development condition in those high risk and vulnerable areas in the District 5,7 and 10 is identified as exposure area based on the Table 2 and detail information is in ANNEX 1.

Table 2: Mazar City Districts Natural Hazard Level and Targeted District

District	Population (SoAC 2015)	Available Natural Hazards (IMMAP)	Risk Assessment Scale (1-5)	People Economic Level (1-5)	Finalised Districts (Yes/Not)	Remarks
D1	47,333	Earthquake	Moderate	3	Not	Not high risk area
D2	29,588	Earthquake	Moderate	3	Not	Not high risk area
D3	24,705	Earthquake	Moderate	4	Not	Not high risk area
D4	51,338	Earthquake	Moderate	3	Not	Not high risk area
D5	90,345	Flashflood/ Earthquake	High	5	Yes	The Risk level is higher and people are suffering from the disasters every year
D6	40.418	Earthquake	Moderate	3	Not	Not high risk area
D7	77,873	Flashflood/ Earthquake	High	5	Yes	The Risk level is higher and people are suffering from the disasters every year
D8	74,925	Earthquake	Moderate	3	Not	Not high risk area
D9	74,925	Earthquake	Moderate	4	Not	Not high risk area
D10	72,398	Flashflood/ Earthquake	High	4	Yes	The Risk level is higher and people are suffering from the disasters every year

ANNEX 1

Mazar city Primary Hazard Assessment: Basic Risk Profile

<table>
<tr><th>Assessment Criteria</th><th colspan="2">Data source</th><th>Districts Scales</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th></tr>
<tr><td rowspan="7">Risk Exposure</td><td rowspan="6">ASDC Disaster Risk data/ UNH</td><td rowspan="3">Earthquake</td><td>H 5/M 3/ L1</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Slope area</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Flat area</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td><td>x</td></tr>
<tr><td rowspan="3">Flood</td><td>H 5/M 3/ L1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>5</td><td>1</td><td>5</td><td>1</td><td>1</td><td>5</td></tr>
<tr><td>River Flood</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Flash Flood</td><td></td><td></td><td></td><td></td><td>x</td><td></td><td>x</td><td></td><td></td><td>x</td></tr>
<tr><td colspan="3">Average of Criteria 1</td><td>2.00</td><td>2.00</td><td>2.00</td><td>2.00</td><td>4.00</td><td>2.00</td><td>4.00</td><td>2.00</td><td>2.00</td><td>4.00</td></tr>
</table>

Probability of natural disaster by people's perception	Interview with District Head	Very Severe 5, None 1	3.5	3	3.5	5	4	4.5	5	4.5	3.5	4.5
	Site survey (including interview with community)		3	2.5	3	4	4	4	4.5	3.5	4.5	4.5
	Average of Criteria 2		3.25	2.75	3.25	4.5	4	4.25	4.57	4	4	4.5
Economic situation analysis	Interview with District Head	Very Poor 5, Well off 1	3	3	4	3	5	3	5	3	4	4
Status of Area: Regular/ Irregular	State of Afghan Cities data	Irregular 5, Partially 3, Regular1	5	5	5	5	3	5	3	3	3	3
Total Score			13.25	12.75	14.25	14.50	16.00	14.25	16.25	12.00	13.00	15.50
Municipality Priorities/ Willingness of District	Interview with Nahia Head	Very High 5, Least 1	4	4	4	5	4	5	5	4	5	5
Existence of on-going development project	Interview with Nahia Head	Yes/No	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

ANNEX 2

PCR Target District Assessment Matrix (Kabul city)					**District No.**
					Name / Positions
S. No.	**Criteria**	**Means of Verification**	**Scales**	**Rate**	**Description / Answer**
1.	Probability of Severe Natural Disaster	ANDMA/ IMMAP disaster probability data	High 5, Medium 3, Low 1		
2.	Sever Natural Disasters in the past few (3-5) years (degree if damages of those disaster in the area)	Interview with Municipality and Nahia Head/ Community	Very sever 5, Sever 4, Some 3, little 2, None 1		
3.	Economic situation (access to public services, wash, education, Health facilities, roads, bridges, river bank, drainage system, unemployment rates, income level	Interview with Municipality and Nahia Head	Very poor 5, Poor 4, Medium 3, relatively well-off 2, Well off 1		
4.	Status of area: Planned/Unplanned, Regular/Irregular	Land Map/ Area Map	Unp/Irrig 5, Partially Unp/Irrig 3, Planned/ Regular 1		

A	Municipality priorities/ Willingness of District Directorate for DRR project	Interview with Municipalities	Very High 5, High 4, Medium 3, less 2, least 1		
B	Existence of on-going donor program by Gov. or development partners.	Interview with Municipality/ Nahia	Yes/No		

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Empirical Study and Analysis of Effect of Disasters on Humans and Agriculture Using Data Analytics

Disha Gupta[a] and Namrata Agrawal[b]

Abstract

Some studies in the past have tried to establish the relationship between natural disasters and macro economy. The outcomes were not unidirectional in these studies, either displaying positive or negative and even a neutral impact on the economy. Further the effects vary substantially across disaster, economy and the economic sector. Therefore, concluding the direction of impact on the economy is difficult and still lacks a clear consensus among academicians and researchers. An econometric analysis for a developing country like India, with droughts history, may generate relevant evidence to draw appropriate inferences. With this backdrop, the present empirical study examines the macro economic impact of droughts on the growth rate of Indian states using secondary data, employing panel data analysis from 1992-2015. The result shows that droughts have a significant adverse effect on States' Gross Domestic Product (SGDP).The results are consistent with the states having moderate (less than 40 percent) and less irrigation (less than 20 percent) facilities, whereas the growth impact is insignificant for the group of states having higher (over 40 percent) net irrigation. Further analysis reveals that States' Agricultural Gross Domestic Product is not significantly affected by droughts. Interestingly, the outcomes are found to be similar for states having higher, moderate and least net irrigation abilities

Keywords: natural disasters, droughts, State Gross Domestic Product

Introduction

India has been traditionally vulnerable to natural disasters on account of its unique geo-climatic conditions. The paper highlights the existing scenario of Disaster Vulnerability in India. Around 57 per cent of the land in India is vulnerable to earthquakes, of which 12 per cent is vulnerable to severe earthquakes, 12 per cent vulnerable to floods and 8 per cent vulnerable to cyclones. Apart from natural disasters, some cities in India are also vulnerable to chemical and industrial disasters and man-made disasters.

The number of climate-induced disasters has increased significantly over the last decade. Of all the natural hazards, floods, droughts and tropical storms affect the agriculture sector most depicting severe impact of climate-related disasters.

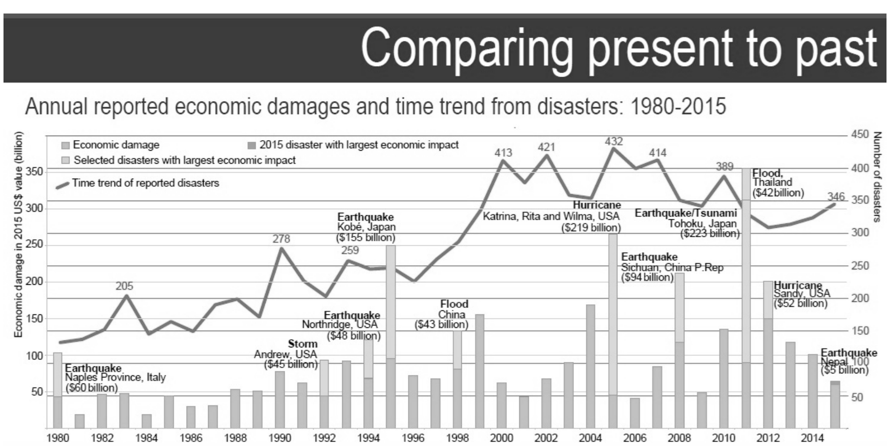

Figure 1

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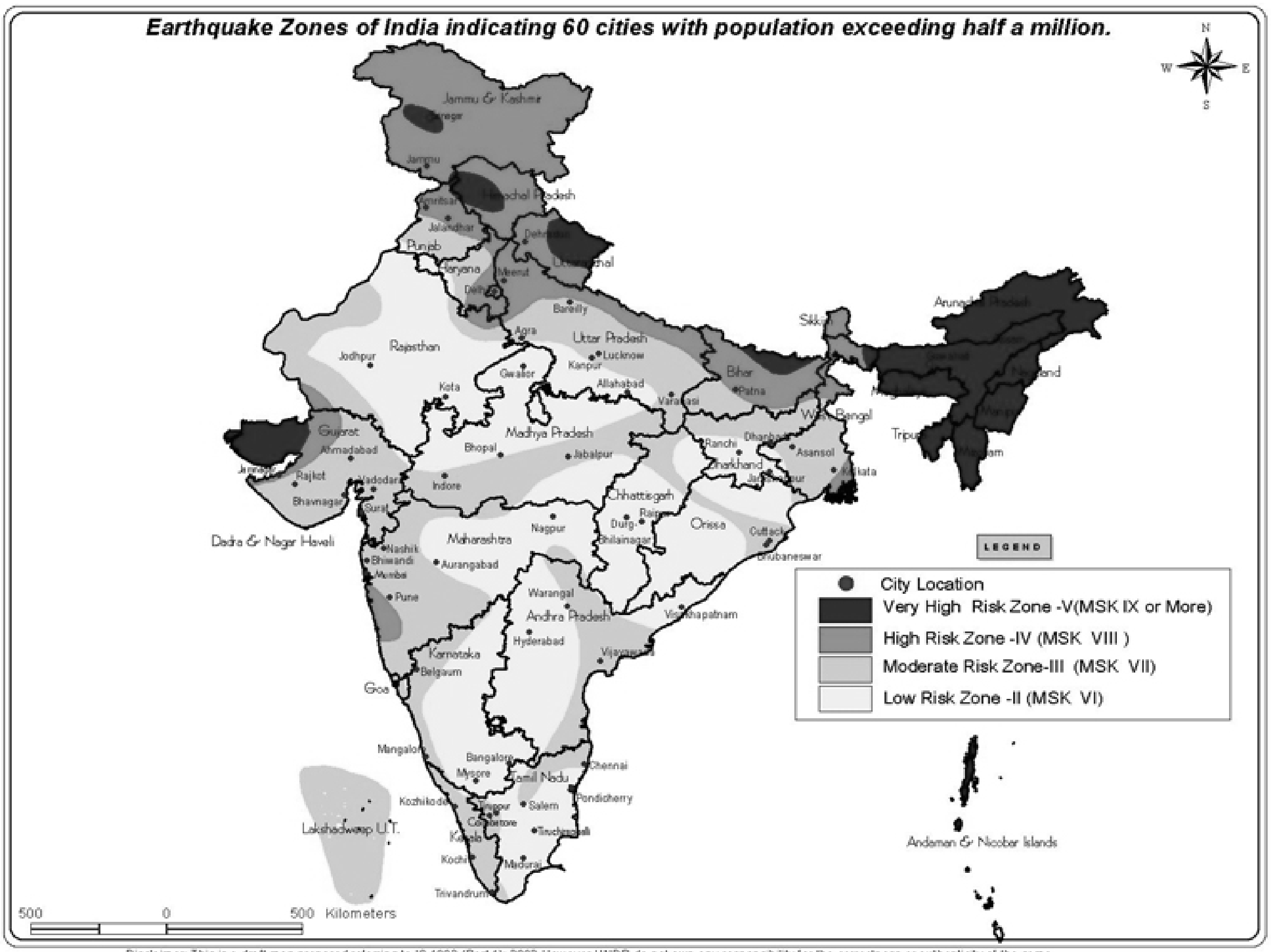
[a] Gujarat Forensic Sciences University, Gandhinagar

[b] Institute of Ministry of Finance, Government of India

- The economic cost associated with all natural disasters has increased 14 fold since 1950s.
- Deaths since the 1950s has been increasing by 50 per cent after each decade, whereas the corresponding population growth rate has been 20 per cent only.
- Worldwide, annual economic costs related to natural disasters have been estimated around $50 to 100 billion.
- By the year 2050, it is predicted that globally100, 000 lives will be lost each year due to natural disasters and the global cost could top $300 billion annually.

India has the following Nodal Agencies to manage various types of Disasters: Floods: M/o Water Resources, CWC; Cyclones: Indian Meteorological Department; Earthquakes: Indian Meteorological Department; Epidemics: M/o Health and Family Welfare; Avian Flu: M/o Health, M/o Environment, M/o Agriculture and Animal Husbandry; Chemical Disasters: M/o Environment and Forests; Industrial Disasters: M/o Labor;



Disclaimer: This is a draft map prepared referring to IS 1893 (Part 1): 2002. However UNDP do not own any responsibility for the correctness or authenticity of the same

Figure 2

Rail Accidents: M/o Railways; Air Accidents: M/o of Civil Aviation; Fire: M/o Home Affairs; Nuclear Incidents: Department of Atomic Energy; Mine Disasters: Department of Mines.

The paper calls for adopting a multi -dimensional endeavour and empirical study and analysis of the data as obtained from the Open Government Data Platform of India to understand and find the trend in last thirteen years and the critical correlation between the various vital parameters. This is essential for informed decision making and policy formulation, preparedness of the concerned Ministries, Government and the associated, CBO, SHG, NGOs.

Further, key global and Indian trends regarding damage and losses to the agriculture sector and human life is exhaustively dealt and studied. Data has been analysed to find the impact of natural disaster on agriculture, human lives,cattle lost and house damaged using data analytics software.

The trend analysis related to damage and losses has been studied and analysed for highlighting the emphatic and wider impact of disasters on the value chain, on agro-industries, national economies, livelihoods and food security, as well as the cumulative damage and losses caused by recurring disasters.

Table 1 above, depicts year-wise loss in number of lives, number of cattle, number of house damaged including the cropped area affected due to disaster in last thirteen years in India.

In this research study, data analytics tools and techniques have been systematically and exhaustively utilised to study and analyse the trend and correlation between the various vital parameters.

Research Objectives

The main objectives of the research is to analyse the following using analytical tools and techniques:

- Trend Analysis to find the trend w.r.t. damage/loss to lives in last thirteen years due to disasters in India.
- Trend Analysis to find the trend related to damage of cropped area in last thirteen years;
- To understand and analyse the crucial relationship/ correlation between various parameters as listed below:
    - Relationship between lives lost and houses damaged
    - Relationship between lives lost and cattle lost
    - Relationship between lives lost and cropped areas effected
- Assessment of wider impact of disasters on the value chain on agro-industries, national economies, livelihoods and food security.

Table 1

Year	Lives Lost (in Nos)	Cattle Lost (in Nos)	House Damaged (in Nos)	Cropped Areas Affected (in million ha)
2001-02	834	21,269	346,878	1.9
2002-03	898	3,729	462,700	2.1
2003-04	1992	25,393	682,209	3.2
2004-05	1995	12,389	1,603,300	3.3
2005-06	2698	110,997	2,120,012	3.6
2006-07	2402	455,619	1,934,680	7.1
2007-08	3764	119,218	3,527,041	8.5
2008-09	3405	53,833	1,646,905	3.6
2009-10	1677	128,452	1,359,726	4.7
2010-11	2310	48,778	1,338,619	4.6
2011-12	1600	9,126	876,168	1.9
2012-13	948	24,360	671,761	1.5

Source: data.gov.in

Methodology

For the fulfilment of the above research objectives, data has been obtained from Open Government Data Platform of India (data.gov.in). The data-set comprises year-wise loss occurred from the year 2001 to 2013 due to disasters in India. The data set thus obtained has been standardised and exhaustively analysed to assess the correlation between the various vital parameters using analytical tools. The results thus obtained has been graphically depicted for better understanding and conclusion.

The trendline analysis has been performed on the available data set of last thirteen years to arrive at pivotal results and findings.

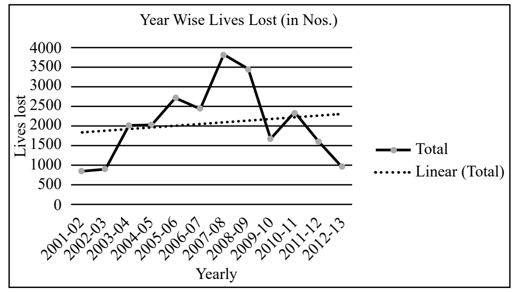


Figure-3

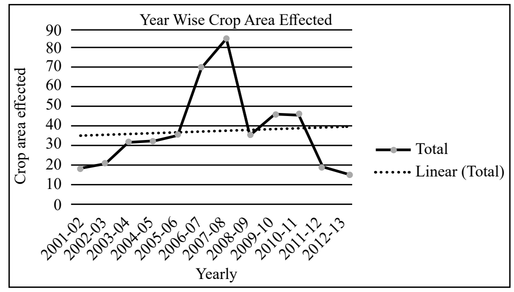


Figure-4

Data Analytics and Findings

The observations and the results as obtained after exhaustive analysis of the data as obtained from the authentic source have been elaborated as follows:

Trend Analysis w.r.t. lives lost due to disasters in last thirteen years in India

- It is evident from the Chart-1, that there has been slight increase in the number of lives lost during the year 2001–02 and 2002–03 and also during the year 2003–04 and 2004–05.
- There is a steep rise in loss of human lives between the year 2006–07 and 2007–08 due to severe disasters in India.
- There has been a steep decline in lives lost between the year 2008–09 and 2009–10.

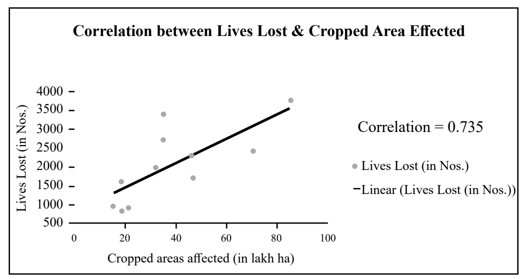


Figure-5

Trend Analysis w.r.t. cropped effected area due to disasters in last thirteen years in India

- Chart-2 depicts that there has been relatively less effect of disaster on the crops during the year 2001 till 2006.
- There has been maximum loss of cropped area between the year 2005–06 to 2007–08 due to disasters.
- There is a steep decline in adverse effect on crop area between the year 2007–2008 and 2008–09.
- The trend is relatively constant between the year 2009–10 and 2010–11 and declines in subsequent years.

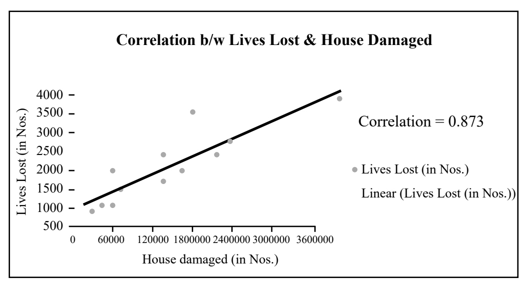


Figure-6

Crucial Relationship/correlation between vital parameters:

Relationship between Lives Lost & Cropped Areas Effected

- It is evident from the Chart-3 that there is positive correlation of 0.735 between lives lost and cropped area effected.
- This analysis is factual accurate and practical as more damage to human resource would have larger bearing on agricultural damage as well.

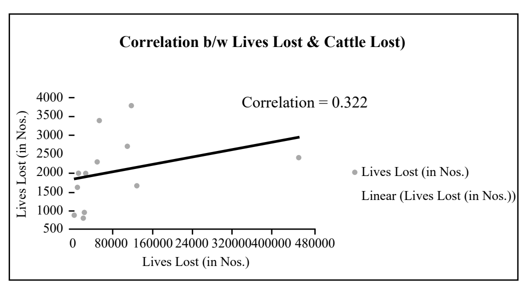


Figure-7

Relationship between Lives Lost & House Damaged

- It is observed that there is strong correlation of 0.873 between lives lost and houses damaged.
- The positive correlation indicates that with the increase in the number of house damaged, the lives lost also increases, which is empirically factual.

Relationship between Lives Lost and Cattle Lost

- It is observed that there is a relatively weak correlation of 0.322 between lives lost and cattle lost.
- This finding holds practically true.

In view of above findings and the socioeconomic conditions of urban and rural areas of the country, wherein the economic cost associated with all natural disasters has increased 14 fold since the 1950s, it is required to evolve information reporting and monitoring tools for preparedness, immediate response and damage assessment.

There should be proper guidelines for different Ministries or Departments of the Government of India for the purpose of integrating the measures for prevention of disaster or its mitigation in their development plans and projects.

Conclusion

- As natural disasters are on the rise and continue to target the world's poorest and least-developed countries, emphasis must be given on appropriate and informed investment towards disaster reduction.
- The potential of Information Technology should be effectively and accurately used. Data sets of past disasters and its critical analysis would help the decision makers in taking realistic and informed policy decisions and subsequent investments and implementations towards disaster prevention, mitigation and preparedness.
- It is also important to develop mechanisms for more efficient and effective assessment, documentation and analysis of impact of disasters on agriculture for informed and realistic remedial measures.
- Capacity building at local and regional levels for undertaking rapid-assessment surveys and investigations of the nature and extent of damage in post disaster situations should be motivated.
- To include R&D work in disaster preparedness, mitigation and prevention as a thrust area so that adequate funds are earmarked for the schemes of R&D organizations as well as the concerned Central Ministries and State Governments.
- The National Policy on Disaster Management of India may be revisited for holistic and practical implementation of prevention, mitigation and preparedness in pre-disaster phase with appropriate additional funding, along with the extant policy regarding post-disaster relief and rehabilitation under crisis management.

Recommendations

- A comprehensive assessment of impacts of natural disasters on agriculture requires a multi-sectorial and integral approach involving key organisations.
- Priority should be given to research with practical applications leading to understanding of physical and biological factors contributing to disasters.
- Programs for improving prediction methods and dissemination of warnings should be expanded and intensified. Efforts are also needed to determine the impact of disasters on natural resources.
- The size of the ICT implementation in Disaster Management in India is expected to be $10 billion in 10 years. This fact was stated in a business conclave during the 58th International Astronautically Congress held in 2007. The annual revenues of the ICT in Disaster Management/ GIS market are expected to grow from an estimated $4 billion to $150 billion in the next decade globally. With more and more government agencies, private companies and individuals using ICT (GIS) and high-resolution imagery services, the market is growing by leaps and bounds and the advantages of the same should be appropriately utilised.
- The Sendai Framework for Disaster Risk Reduction 2015–2030 was adopted by UN Member States on 18th March 2015 at the Third UN World Conference on Disaster Risk Reduction in Sendai City, Miyagi Prefecture, Japan emphasising the following priorities:
    - Understanding disaster risk
    - Strengthening disaster risk governance to manage disaster risk
    - Investing in disaster risk reduction for resilience
    - Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction.

  The Sendai Framework, the first major agreement of the post-2015 development agenda, with seven targets and the above four priorities for action may be effectively and efficiently implemented.

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RESPONDING TO DISASTERS

Food Security through Public (Food) Distribution System in a Post-disaster Situation: A Cross-Country Comparison between Bangladesh and India (West Bengal)

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Abstract

"When disasters strike, they have a direct impact on the livelihoods and food security of millions of small farmers, pastoralists, fishers and forest-dependent communities in developing countries." (Food and Agricultural Organization of the United Nations: May, 2015). Food security and livelihood in India and Bangladesh also get affected in case of disasters like cyclones and floods, which are of similar nature. Also both these areas depend heavily on agriculture for livelihood. To ensure food security, the governments of both India and Bangladesh have designed national food policies and passed acts. Because of these acts and policies, both the countries have been successful to "reduce food aid and commercial imports to insignificant shares of total supply". Nevertheless during the post disaster (flood) situation, four pillars of food security – availability, access, utilisation and stability – are violated in both West Bengal and Bangladesh. This is more so since India and Bangladesh, both being developing countries, have a substantial number of people living below the poverty line. To come out of this situation the Public Distribution System should be strengthened and utilised for guaranteeing food security. Also disaster affected people should be mentioned as the targeted group in the Targeted Public Distribution System. This paper attempts to explore the role of the Public Distribution System on a macro level by analyzing the government and non-government documents in the context of the occurrences of specific floods in West Bengal and Bangladesh.

Keywords: flood, post disaster, food security, utilisation, stability, targeted PDS system

Introduction

Natural disasters occur only when natural hazards occur in a vulnerable situation. Therefore, natural disaster = natural hazard + vulnerability. Normally the policy makers emphasise upon the first part i.e., how to reduce the risk of hazard since the policy planners have scanty knowledge in specifying the characteristics of a group those make them vulnerable to hazard. This leads to over-generalisation of a concrete disaster or post-disaster situation and the lack of social capacity building for risk governance. In common parlance vulnerability to natural hazard refers to the risk of loss of human as well as animal lives and damage of infrastructure. Wisner et al. (2004: 11) define vulnerability as: "... the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard (an extreme natural event or process). It involves a combination of factors that determine the degree to which someone's life, livelihood, property and other assets are put at risk by a discrete and identifiable event in nature and in society." There may be many factors like age, income, social network or neighbourhood characteristics, which in a post disaster situation, lead to the vulnerability. But whatever be the cause of vulnerability, that ultimately lead to the lack of three basic securities: food, shelter and livelihood. This paper is an attempt to explore to what extent the existence of a stable and operational Public Distribution Network may ensure food security, on the basis of a comparative study between Bangladesh and West Bengal (India).

Location of the Problem

"Food security exists when all people, at all times, have physical and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life." (World Food Summit, Plan of Action, 1996) "When disasters strike, they have a direct impact on the livelihoods and food security of millions of small farmers, pastoralists, fishers and forest-dependent communities in developing countries." (Food and Agricultural Organization of the United Nations, May, 2015:3)

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Food security and livelihood in India and Bangladesh, both being developing countries, get affected in case of disaster. Going by topography, Bangladesh and West Bengal, a constituent state in the eastern part of India, are akin to each other. Consequently nature of disasters those hit West Bengal is of similar nature of the disasters those hit Bangladesh. Cyclones often have a trailing route to both West Bengal and Bangladesh originating from the Bay of Bengal. Likewise due to heavy rains floods are also common in West Bengal and Bangladesh. Also both these areas depend heavily on agriculture for livelihood. According to the 'Government of West Bengal Executive Summary of State Economic Review 2013' "The importance of agriculture and allied sectors in the State's economy is reflected in its contribution of 20.34 per cent to Net State Domestic Product. The employment support from the sector is nearly 39 per cent of the total work force and about 70 per cent are dependent on agriculture for their livelihood." On the other hand, Hamid Miah and his team of subject subsector experts, wrote (which was reviewed by technical advisors and FAO core team, FAO Bangladesh) that "Although Bangladesh is on course for Middle Income Country status by 2021, agriculture remains the largest employer in the country by far; and 47.5% of the population is directly employed in agriculture and around 70% depends on agriculture in one form or another for their livelihood." On this background, this paper attempts to compare the food security on a cross country basis in a post disaster situation and its impact on livelihood in West Bengal of India and Bangladesh.

Both in West Bengal and Bangladesh monsoon floods often create havoc. According to the West Bengal Disaster Management Department since 1986 in every year (excluding the years 2008 to 2012) floods have occurred in every year, inundating huge area and affecting huge number of people. Last huge flood occurred in 2015. "The state of West Bengal is the lower most riparian state in the Ganga Basin and most of the rivers in the state originate from outside the state boundary and are of inter-state/international category. The state is quite often ravaged by destructive flood, even without any appreciable rainfall within the geographical limits of the state. Along with flood, various allied problems like bank erosion, drainage congestion and cyclonic disaster accentuate the flood situation. The state, being 42.30% of its geographical area flood prone, happens to be one of the prime flood prone states in the country" [Govt of West Bengal, *Annual Flood Report for the Year 2013,* 2014: 1].

Records of large floods in West Bengal (West Bengal Disaster Management Dept. Portal)	
02/08/00- 01/10/00	Besides flash floods triggered by incessant torrential storms, disaster is also accredited to the opening of sluice gates of dams. The fatalities counted to the tune of 1262, besides affecting millions of people.
21/06/02-28/08/02	Flooding in Jalpaiguri, Cooch Behar and Jalpaiguri in north Bengal due to monsoonal rains. Flash floods swamped 10 villages, causing four deaths and 11,000 displacements
11/06/2003-10/10/2003	Monsoonal rains caused floods affecting the regions of Darjeeling, Jalpaiguri, Malda and Murshidabad.
21/10/05-28/10/05	Heavy rains caused floods in many areas. About 3,000 coastal villages were inundated and 60,000 huts and many roads washed away
07/07/05-27/07/05	Heavy monsoon rains triggered flash floods and land slides
24/06/06– 03/08/06	The regions of Birbhum, Burdwan and Murshidabad were affected mainly from continuous monsoonal downpour. 18/09/2006
18/09/06– 05/10/06	Monsoonal rains and tropical cyclone-driven storms in the Bay of Bengal hit India and Bangladesh. West Bengal recorded 50 deaths, 300 were injured and 30,000 mud houses destroyed. Heavy rains left large parts of Kolkata city under water, subsequently 2,000 people were evacuated from the city
03/07/07– 22/09/07	The hazard affected Kolkata and several other districts. 83 deaths were reported, and millions of people were marooned in 3000 villages in coastal areas of the state.

22/09/07-08/10/07	Heavy rain from tropical depression in the Bay of Bengal caused flooding leading to 51 deaths, and affecting 3.2 million people
23/06/2008	A total of over 2.70 million people in 17 blocks of West Midnapore and 15 blocks of East Midnapore have been impacted.
23/07/2008	Sixty thousand people living in the unprotected area between the river bank and the dyke have been hit by floods in Malda district of West Bengal following rise in the water level of the Ganga and Fulhar rivers.
25/05/2009	Cyclone [Category – I] Aila hit Sundarbans regions of both West Bengal (India) along with tidal waves, with a devastating impact. As per TOI report 24,000 became homeless in Sundarbans and death toll reached 82.
16/08/09 – 26/08/09	Heavy rains since 16 August caused floods in several districts, especially Cooch Behar, Jalpaiguri, Darjeeling, Uttar Dinajpur, and most recently in Malda. Over 200,000 people were affected in the state and 12 lives were lost.
June 2011	Severe incessant rain led to a flood situation in several parts of West Bengal affecting 671,952 people across 9 districts. This resulted in 2,00,000 homeless in East and West Midnapore districts of West Bengal
23/08/13-30/08/13	Flood first affected 15 villages in Maldah on August 23. Since then the flood waters moved southwards and those worst affected area in the state were West Midnapore district, where 200 villages have been affected.
29/07/15-7/08/15	Nearly 1.06 crore people of 14 districts affected that took a toll of 125 lives.

Source: West Bengal Disaster Management Dept. (WBDMD) Portal available at: http://wbdmd.gov.in/Pages/Flood2.aspx accessed on 6.10.2016

According to *Joint Needs Assessment Report: West Bengal Floods 2015* prepared by a number of agencies in a coordinated manner "The calamity had affected 14 districts 236 blocks, 55 municipal areas and 814 gram Panchayats covering 21,885 villages. The death toll has reached 125. As many as 743,000 houses have been damaged…." Similarly Muniruzzaman ANM (2013: 54) wrote about flood situations in Bangladesh that "The 2011 monsoon floods affected over a million people and displaced some 200,000. Several areas in the south-western part of the country remained water-logged. In 2012, flash floods largely damaged the agricultural crops, habitat, water and sanitation facilities of the country. Around 1.3 million people lost their livelihood support because of this flood. At the end of June 2012 and in mid-July2012, the flood resulted in large-scale food shortages. In September 2012, the north-western region of Bangladesh was again hit by floods."

In West Bengal in 2017 "Around 152 people have died and 1.5 crore (people were) hit" [as the Chief Minister of West Bengal was cited by the NDTV] by the flood in the three districts of Uttar Dinajpur, Dakshin Dinajpur and Malda during 9 to 14 August. In the last week of July (20 – 26 July) 2017 also due to heavy rains flood occurred in 14 districts in West Bengal among which the worst hit were Howrah, Jalpaiguri, Hooghly, West Medinipur, East Medinipur, North 24 Parganas, South 24 Parganas and Burdwan, according to the PTI (01.09.17) as quoted in the *Indian Express*, 46 people died and "around 27 lakh people in 106 blocks of 14 districts of West Bengal were hit by the flood".

In Bangladesh also, UN Resident Coordinator for Bangladesh reported on 28.8.2017 that, "Monsoon rains have caused flooding across 32 districts in the northern, north eastern and central parts of the country, affecting a total of more than eight million people. An estimated total of 55,383 houses are reported to be damaged and 640,786 have been destroyed; 140 persons are known to have lost their lives due to the floods. The Ministry of Disaster Management and Relief (MoDMR) informs that 335 shelters in flood-affected areas are sheltering more than 106,000 people".

It is thus observed, that in both the countries floods occur almost regularly leaving a huge number of people as affected at different levels. In the post disaster situation the affected people face the basic problem of food security and the basic problem of the administration remains to distribute food grains in a sustainable manner especially after the first phase of crisis is over. Since most of these affected people live in rural areas and since "the main objective of the PDS is to provide food security to the poor and insulate them from rising open market price" (Dev and Suryanarayana; 1991: 2362), PDS system should be strengthened especially for the post disaster situation.

Central Argument

In India since 1993–94 although the percentage of total poor people has decreased, the absolute number of total poor people still remains 269.3 million in 2011–12 (it was 403.7 million in 1993–94), since the population has also grown. Consequently to ensure food security government of India has launched two important acts: NREGA, 2005 and National Food Security Act, 2013. Bangladesh also has designed and approved the National Food Policy (2006) and National Food Policy Plan of Action (2008–2015). Because of these acts and policies which express real concern for food security on the one hand and because of the development of agricultural technology that raised the production since nineties in a significant manner, both the countries have been successful to "reduce food aid and commercial imports to insignificant shares of total supply". (Ninno Carlo del, Dorosh Paul A. and Subbarao Kalanidhi, World Bank, 2005: ii) Nevertheless during the post disaster (flood) situation as it has been observed above, four pillars of food security – availability, access, utilisation and stability – are violated in both West Bengal and Bangladesh and studies are there on the politics of relief distribution during such situation. In case of Roanu in Bangladesh the distribution of relief, as it may be observed from the following record, was basically oriented towards crisis management.

In Bangladesh Humanitarian Assistance Programme Implementation Guidelines 2012–13 are in force for post disaster crisis management and relief distribution. Following those guidelines food and cash were distributed as part of Gratuitous Relief (GR) programme after cyclone Roanu hit Bangladesh on 22 May 2016. Around 30 lives were lost and up to half a million people were affected. After Roanu, for providing food security to the affected people the following amount of cash and food were distributed. The printed Bengali version record was collected from the Disaster Management Dept of Bangladesh, which has been translated in English here.

G.R. Rice

S. No.	Name of the District	For Roanu Allotted of G.R. Rice (Metric Tone)	No. of the Beneficiaries
1.	Chattagram	675.000	33750
2.	Cox Bazaar	325.000	16250
3.	Chandpur	217.000	10850
4.	Noakhali	300.000	15000
5.	Feni	296.000	14800
6.	Lakshmipur	50.000	2500
7.	Khulna	225.000	11250
8.	Bagerhat	75.000	3750
9.	Satkshira	50.000	2500
10.	Barisal	175.000	8750
11.	Patuakhali	200.000	10000
12.	Pirozpur	200.000	10000
13.	Bhola	500.000	25000

14.	Barguna	150.000	7500
15.	Jhalkathi	200.000	10000
		3638.000	**181900**

Source: Printed document as collected from the Ministry of Disaster Management and Relief, Dhaka

G.R. Cash

S. No.	Name of the District	For Roanu Allotted of G.R. Cash	No. of the Beneficiaries
1.	Chattagram	27,000,00	1350
2.	Cox Bazaar	14,000,00	700
3.	Chandpur	2,000,00	100
4.	Noakhali	24,000,00	1200
5.	Feni	2,000,00	100
6.	Lakshmipur	4,000,00	200
7.	Khulna	3,000,00	150
8.	Bagerhat	1,000,00	50
9.	Satkshira	3,000,00	150
10.	Barisal	8,000,00	400
11.	Patuakhali	4,000,00	200
12.	Pirozpur	28,000,00	1400
13.	Bhola	7,000,00	350
14.	Barguna	5,000,00	250
15.	Jhalkathi	27,000,00	1350
		1,34,000,00	**7950**

Source: Printed document as collected from the Ministry of Disaster Management and Relief, Dhaka on 19.10.2016

In fact Vulnerable Group Development (before 1987 it was Vulnerable Group Feeding) programme or Food Grains assistance through Gratuitous Relief justifies the continued existence of Public Food Distribution System (PFDS) in Bangladesh. There have been continuous reforms in Food Policy in Bangladesh since 1974 and especially since 1992 when Rural Rationing was abolished and Rice distribution was stopped in statutory rationing as this was found ineffective and expensive. (Shahidur Rashid et.al, 2008: 106) From 1993 wheat distribution also stopped in statutory rationing. There are specific guidelines as to how much quantity and for how much time such food grains assistance will be provided to the natural or manmade disaster affected people.

Such relief has also been disbursed by West Bengal government and many other NGOs during the floods in West Bengal, even in 2017 flood as well. But once the crisis is over such relief work stops and the affected people suffers from the insecurity regarding food. One major Bangladesh India initiative was taken by IUCN in 2014 for ‘Situation Analysis on Floods and Flood Management’ where Eklavya Prasad Nandan Mukherjee wrote (p.3) that “The initiative centres around five broad thematic areas” and the first among these areas is “food security, water productivity and poverty”. As they viewed, “The first step of dialogue and research has concentrated on creating ‘situation analyses’ on each thematic area and related issues. Each analysis set identified core issues, their significance within the India-Bangladesh geographic focus, research gaps and needs and, ultimately, priority areas for joint research." The analyses that IUCN has taken is thorough and deep probing. But the analysis has not focused on the PDS system of both the countries for ensuring food security during post flood situation. To get out of this situation this paper proposes that the Public Distribution System should be strengthened and utilised for guaranteeing food security of the disaster affected people and that should be mentioned as the targeted group in the Targeted Public Distribution System as well.

Key Writings/Reports/Laws/Judicial Decisions on the Issue

In their paper on 'Public Food Distribution System in Bangladesh: Successful Reforms and Remaining Challenges' Shahidur Rashid et.al (2008: 115) compared the food policy of India with that of Bangladesh and the benefits that Bangladesh got in procuring rice in the post 1998 flood situation. The three underlying objectives of Public Food Distribution System in Bangladesh, as they viewed, is "(1) enforcing floor and ceiling prices; (2) targeting distribution to alleviate poverty and ensure food security for the vulnerable groups; (3) managing disasters." (p.110) "Bangladesh is prone to natural disasters, such as floods and cyclones. … The PFDS is an important conduit for providing food to people affected by natural calamities and also serve to depress rising prices fuelled by speculative market behavior."

Sakshi Balani (PRS Legislative Research: December 2013: 2) wrote in *Functioning of the Public Distribution System: An Analytical Report* that in India National Food Security Act "relies on the existing Targeted Public Distribution System (TPDS) mechanism to deliver these entitlements.… Analyses of TPDS have revealed several gaps in implementation. These challenges pertain to the inaccurate identification of households and a leaking delivery system. Expert studies have shown that PDS suffers from nearly 61% error of exclusion and 25% inclusion of beneficiaries, i.e. the misclassification of the poor as non-poor and vice versa. Another challenge is the leakage of food grains during transportation to the ration shop and from the ration shop itself into the open market." In a special article in Economic and Political Weekly on 'Politics of PDS Anger in West Bengal', Dwaipayan Bhattacharyya and Kumar Rana (2008: 65) wrote that "The TPDS came under severe criticism especially from the left scholars. 'Ever since the dismantling of universal Public Distribution System of grains in 1997', observed Shakti Kak, 'the government has implemented policies which are inimical to food security' [Kak, 2007]. Madhura Swaminathan went a step further: 'Targeting food supply in PDS to a narrow section of the population is a dangerous policy, and a prelude to closing down PDS altogether'. This lacuna gets increased by the fact that the National Food Security Act (2013) does not mention the disaster hit people within the targeted groups of public distribution [Swaminathan, 2000]". Thus in case of a post disaster situation the gaps in implementation of the said Act increase and that leads to relief distribution politics as well.

This has been observed in the post flood situation in the Dakshin Dinajpur district in the north of West Bengal. Mrs Nilima Roy, a housewife, aged 44 of Dhyapa Para at Gangarampur of Dakshin Dinajpur having two daughters on September 5, 2017 narrated her plight that after the flood is over she went to Ration shop to get the due ration of her family and found that very little amount of food grains for one ration card (1 kg rice and 500 gms wheat) were only available and she could not secure that amount for another ration card of her household. Same was the experience of flood affected people Above the Poverty Line as well. Their crops like jute and rice in the farm field have been damaged by flood. With the stored rice grain, they could go for a limited days. So the APL people were also suffering from the same insecurity of food, but they were unsure whether they will get any food grains on their ration cards.

Findings and Conclusion

It is found that in Bangladesh there are certain relief programmes especially for natural calamity hit people and there are "no predetermined criteria or conditionality for participation in these programs. These are relief programs that help the poor cope by providing stop-gap consumer resources at times of natural disasters." (Shahidur Rashid et.al, 2008: 110). From this it is clear during the post reform period PFDS in Bangladesh has evolved from being relief oriented to accommodating various elements of long-term development objectives. Thus one of the central categorisation in PFDS is to lead the natural calamity hit people to long-term development orientation.

In India other than Planning Commission literature, there has been little study on the PDS although according to Indian Express (1.2.17), "The government has earmarked ₹ 145,338.60 crore for food subsidy in the next fiscal as against ₹ 135,172.96 crore in the revised estimate of this fiscal. Food subsidy bill is expected to be higher next fiscal as the National Food Security Act, under which the government provides highly subsidised food grains to over 80 crore people, has been rolled out across the country from November 2016". These subsidies mainly go through Public Distribution System where the government sells five essential items viz rice, wheat, sugar, edible oils and kerosene for daily life are supplied by the central government at a controlled price.

In India PDS has been operative since 1939, when war time rationing was introduced in Bombay and consequently to other cities in India. Since the seventies especially since the *Garibi Hatao* programme launched by Late Indira Gandhi in 1971 as anti poverty measures Public Distribution System through fare price ration shops became widely entrenched. But according to the *Tenth Five Year Plan* (Govt of India, 2002: 368), "The PDS in its original form was widely criticised for its failure to serve the below poverty line (BPL) population, its urban bias, negligible coverage in the states with the highest concentration of the rural poor and lack of transparent and accountable arrangements for delivery. Realising this, the government streamlined the system by issuing special cards to BPL families and selling food grains under PDS to them at specially subsidised prices with effect from June 1997." The Targeted Public Distribution System makes provision only for the Below the Poverty Level population for whom the allotment of food grains also increased at 50 per cent of economic cost from 1 April 2000. [*Tenth Five Year Plan,* Government of India: 368]. Later on India has passed National Food Security Act in 2013, which ensures "access to adequate quantity of quality food at affordable prices to people to live a life with dignity." The Act has detailed the TPDS as "the system for distribution of essential commodities to the ration card holders through fair price shops" and has made enough provisions for reform to deliver the food grains at the doorsteps of the priority people, to give preference to public institutions or public bodies, such as Panchayats, self-help groups, co-operatives, in licensing of fair price shops and management of fair price shops by women or their collectives and support to instituting grain banks. But the method of identification of the priority people under the TPDS has been left to the State governments and in West Bengal that is determined by the criteria of remaining below or above the poverty line.

The Programme Evaluation Organisation of the Planning Commission in its report on Performance Evaluation of Targeted Public Distribution System (TPDS) in March 2005 reported is relevant in this context. It was reported in the 'Estimates of Implementation Errors' (p.78) that in West Bengal the exclusion error of the targeted population is 31.74% of the BPL households, while inclusion error is 10.23%. However in an article published in *The Indian Express* on September 16, 2016, Jean Drèze and Souparna Maji observed that "PDS has improved in West Bengal, but it's still not up to the mark." They conducted a survey in June 2016 on the PDS in six of India's poorest states: Bihar, Chhattisgarh, Jharkhand, Madhya Pradesh, Odisha and West Bengal. On the basis of that survey, they observed that "The findings for West Bengal are tentative for two reasons. First, the survey took place just after the assembly elections, and it is possible that the PDS was at its best around that time. Second, this was a relatively small survey, involving house-to-house enquiries in six villages of two districts (Birbhum and Bankura). That applies to other states too, but for West Bengal alone, we lack other studies to corroborate the findings." Despite they concluded that PDS has improved a lot in West Bengal. According to them, "In the sample villages, 85 per cent of households had a new ration card under the National Food Security Act (NFSA). There were some exclusion errors, but not many compared with the pre-NFSA situation: Two years ago, barely half of the sample households had a ration card, and poor households were often left out. The new list of PDS cardholders is derived in a methodical manner from the socio-economic and caste census of 2011, using transparent criteria.… Another improvement is a drastic simplification in the entitlement system.… Greater transparency, simpler entitlements and other PDS reforms seem to have led to a sharp decline in leakages.… None of this means that all is well with the PDS in West Bengal. The list of eligible households is not free of exclusion errors. Also, there is a big problem of 'missing names' in the NFSA list: among households with ration cards, we found that 13 per cent of all family members were left out of the list. This matters, since PDS entitlements are proportional to family size."

In a post disaster situation, according to Food and Agricultural Organization of the United Nations, impact on food security and livelihood comes through increased household expenditure, income loss and lower purchasing power for retailers and weak social support networks for retailers, which again lead to food inflation, reduced food consumption and dietary quality and increased indebtedness. In such a situation these exclusion errors lead to the politics of relief for the ruling party. Hence, there should be specific guidelines that in a post flood situation or for that matter in any post disaster situation the PDS should be made available to all persons irrespective of their usual income position. This is understood by the central government in India. Hence as reported by the *Financial Express* the then food minister Ram Vilas Paswan called upon five flood-hit states, including Bihar, to supply PDS rice and wheat to affected people free of cost for at least six months. But such directive should be formalised in specific guidelines, so that it does not depend upon the whims of the centre nor does it lead to any flood relief anomaly. This is especially important that in the TPDS disaster hit people do not have special mentioning.

Besides TPDS always suffers from large leakages and the food grains targeted for the BPL people often go to the open market during transportation to and from fair price ration shops. This is important since India has the largest network of the PDS. The Programme Evaluation Organisation of the Planning Commission in India in their report (2005) on Performance Evaluation of Targeted Public Distribution System (TPDS) citing Tata Economic Consultancy Services, noted that 31% and 36% leakage of PDS rice and wheat at all-India level. (p. 81). So it would be better if the private operators in PDS are done away with and either cooperatives or panchayats are given the responsibility of the public distribution system, for which provision has been made in the National Food Security Act 2013.

Conclusion

The paper attempted to compare the PFDS in Bangladesh and TPDS in West Bengal (India). Going by the above exploration it is clear that in both the cases emergency distribution of food grains during and following natural calamities has been underscored although in both the countries policy of distributing food grains (in case of TPDS kerosene as well) has gone through plethora of reforms. Despite PFDS in comparison to TPDS is better suited for the purpose of food security for the disaster hit people.

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Providing Reliable Drinking Water Solutions in Times of Disaster

Vikas Shah[a]

Abstract

Natural disasters are inevitable worldwide claiming many lives while causing millions in resources damage. As per the United Nations report (2014), about 4.4 billion people have been affected by disasters worldwide since 1994 and nearly 1.3 million lives have been lost resulting in economic losses of $2 trillion. WaterHealth's revolutionary innovation, the Autonomous Transportable Operating Module (ATOM), supplies safe water to people in crisis regions. ATOM is a low-cost, fully-automated machine that fits into a 20-foot container and treats both surface and ground water. 'Rapid Action Hubs' are critical locations that will allow Water Health to deploy mobile systems across any disaster-affected state quickly. Gujarat, Himachal Pradesh, Bihar, Andhra Pradesh, and Tamil Nadu are among the states that have expressed interest in deploying a Rapid Action Hub. Despite taking precautions, calamities are unavoidable; what distinguishes us (humanity) is how we respond to them. However, it is a human predisposition to believe that it will not happen and to deal with it as and when it does (cross the bridge when one reaches it).

Keywords: disaster relief, Autonomous Transportable Operating Module (ATOM), Rapid Action Hubs (RAHs), mobile water purification system, plug and play model

Introduction

Natural disasters are inevitable worldwide claiming many lives while causing millions in resources damage. As per the United Nations report (2014)[1], about 4.4 billion people have been affected by disasters worldwide since 1994 and nearly 1.3 million lives have been lost resulting in economic losses of $2 trillion.

In the last two (2) decades (between 1995 and 2015), EM-DAT[2] recorded 7,591 natural disasters worldwide that claimed 1.40 million lives (~66,000 lives on an average each year). In addition to this, more than 210 million people were affected by natural disasters on a yearly basis. Earthquakes and tsunamis alone have caused more loss of life than all the other disasters combined. Least developed and developing nations face more losses as compared to developed nations due to the absence of proper disaster management framework in place.

On an average, India loses $9.8 billion every year due to multi-hazard disasters[3]. Various states in India (Andhra Pradesh, Assam, Bihar, Gujarat, Jammu & Kashmir, Maharashtra, Odisha, Telangana, Tamil Nadu and Uttarakhand) have been frequently affected by natural disasters since 1976. The Country is vulnerable to various types of natural disasters such as cyclones, tsunamis, floods and earthquakes[4].

Apart from creating chaos, these disasters also affect the acess to basic amenities and make the population vulnerable to various waterborne diseases like cholera, diarrhea etc. due to infrastructural damages that result in seepage of sewage and toxic materials into the water bodies due to destruction of drainage systems.

These natural disasters can be categorised into three broad categories depending on the estimated loss ($) and fatalities occurred. The categories have been listed below.

Table 1: Categorisation of Natural Disasters

S. No.	Category	Disaster	Estimated Loss ($ billion)	Fatalities Recorded
1.	Critical	Indian Ocean Earthquake	15	230,000 – 280,000
		Gujarat Earthquake	5.5	166,000

[a] WaterHealth India Pvt., Ltd

2.	Major	Kashmir Earthquake	5	1,350
		Chennai Flood	3	347
3.	Minor	Uttarakhand Flood	1.7	5,000
		Gujarat Flood	1.1	~108
		Maharashtra Flood	0.80	1,493

To overcome these disasters, the Government of India has implemented various initiatives, however, the level of preparedness was inadequate. As per the study by The Energy and Resources Institute (TERI)[5], the government had budgeted a total of ~ \$5 billion during the period 2010–2015 to prepare for disasters like mudslides in Ladakh (2010), Sikkim earthquake (2011) and Uttarakhand floods (2013), the level of preparedness was inadequate which led to high levels of mortality and displacement of people.

The developed nations implement a proactive approach to manage natural disasters which primarily consists of four major segments indicated in the section below.

1. **Disaster Prevention -** These includes activities that are designed to provide permanent protection from disasters. This primarily involves proactive approach to disaster management.
2. **Disaster Preparedness -** These initiatives are designed to minimise loss of life and damage. These are the major ways of reducing the impact of disasters.
3. **Disaster Relief -** Disaster relief activities include rescue, relocation, providing food and water, preventing disease and disability. These are responses to reduce the impact of a disaster and its long-term results.
4. **Disaster Recovery -** These activities are undertaken after the initial crisis. Since the people are still vulnerable to its after effects, i.e. initiatives like rebuilding infrastructure, health care and rehabilitation are implemented.

Currently, most of the developing nations like India have only been able to work majorly under two segments, which include disaster relief and disaster recovery primarily due to limited funds and lack of superior infrastructures/ technologies available.

Major Issues during Disaster Relief

In spite of the above laid approaches to combat the aftermath of the natural disasters, certain major challenges[6] addressed during the disaster relief programs include the following,

1. **Sanitation Infrastructure Damage -** people who live in temporary settlements during disasters often lack sanitation and hygiene facilities that leads to outbreak of diseases and in some cases, epidemics.
2. **Drinking Water Source Contamination -** disasters often destroy water, drainage infrastructure leading to spillage of raw sewage into water bodies that lead to access to unsafe water and increases vulnerability to water borne diseases.
3. **Food Source Contamination -** following natural disasters, food in affected areas may become contaminated and consequently be at risk for outbreaks of food borne disease.

Prominent Water Solutions during Disaster Relief

Obtaining reliable access to safe drinking water during disaster relief work can be difficult as existing supply options are cut-off due to damaged infrastructure. The varied options available for the provision of safe drinking water during a potent disaster include

1. **Water Bottles/Sachets -** bottled and/or sachet water is often the first option that is primarily used by government agencies to provide drinking water in disaster affected areas.
2. **Small Water Filtration Kits -** This is a comparatively small, self-contained solution; basically a water treatment plant in a suitcase. These compact water treatment contraptions are effective and easy to use and can be deployed anywhere, anytime.

3. **Mobile Purification Systems -** mobile purification systems are often adopted by relief agencies around the world to provide water to a large number of displaced people.

Introduction to WaterHealth

WaterHealth is the next generation water ‘micro-utility’, delivering a sustainable service that purifies local water sources to WHO-quality drinking water standards through Community Water Systems (CWS) to the underserved communities that have limited safe water access and/or face significant water contamination near surroundings.

In addition to this, WaterHealth also provides disaster relief by deploying a mobile water purification system that is based on a ‘plug and play’ model. Autonomous Transportable Operating Module (ATOM) is WaterHealth’s new innovation which provides safe water to the people in disaster affected regions. The model is automated, self-contained and robust and therefore allows for rapid deployment in the coverage area (disaster affected). ATOM is low-cost, fully-automated unit which is equipped inside a 20-feet container and can treat surface water as well as ground water sources. It has a capacity to provide 3,000 litres of purified water every hour, i.e. ~70,000 liters of purified water per day.

ATOM provides six (6) major benefits in comparison to traditional water purification systems.

- All necessary components housed inside a shipping container
- Easy pick-up with truck mounted crane
- Plug and play model
- Compatible with auxiliary power option
- Cleans varied raw water sources
- Installed sensors allow for remote access

Therefore, the Company has developed an adequate solution with a view of supporting India for disaster preparedness that serves as an immediate answer to a potential natural disaster by its ability to immediately deploy the mobile water purification system in areas of calamity thus, providing relief to the people.

Introduction to Autonomous Transportable Operating Module (ATOM)

Figure 1(a): Exterior view (ATOM)

Figure 1(b): Inside view (ATOM)

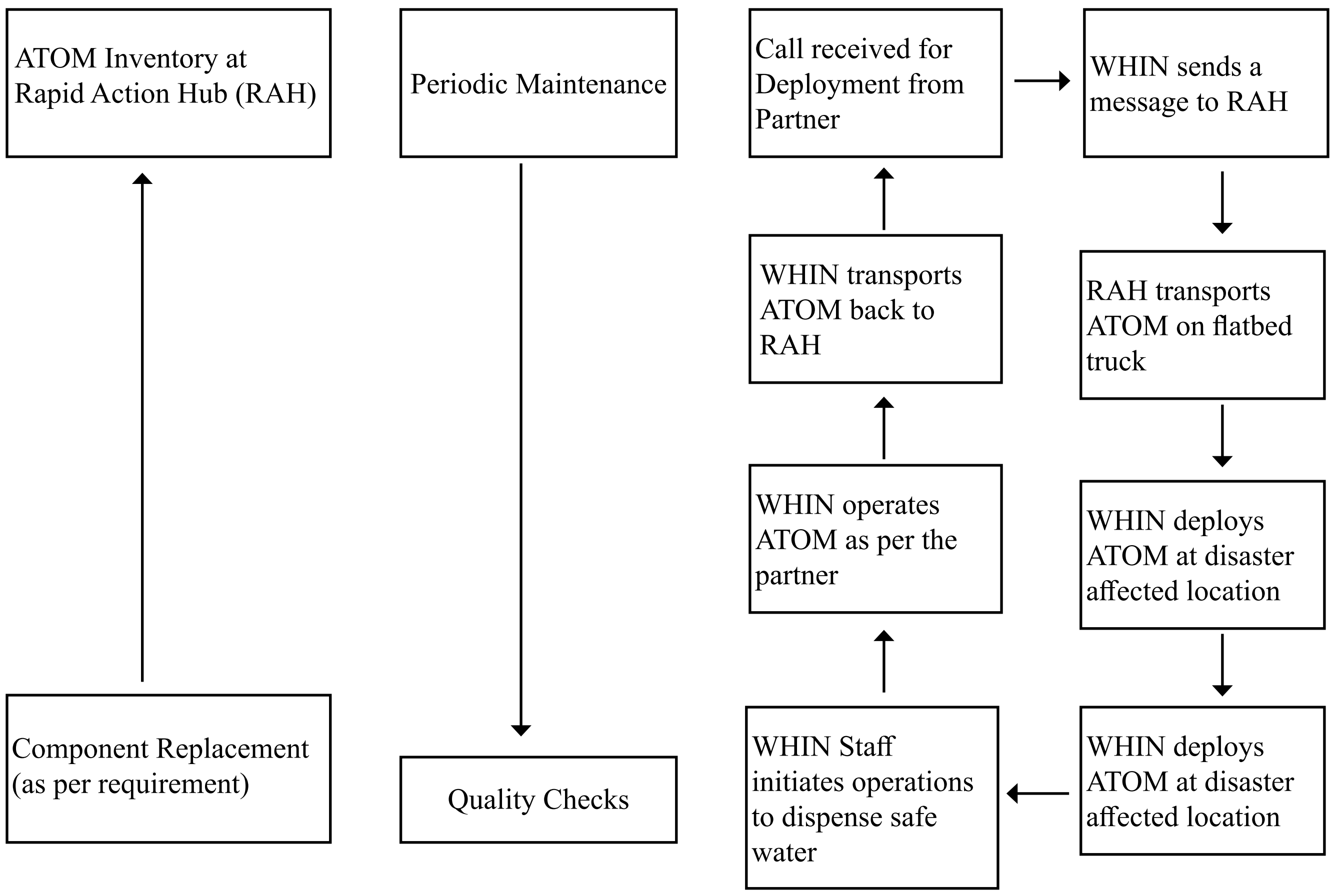
Proposed Plan – Rapid Action Hubs (RAHs)

‘Rapid Action Hubs’ (are strategic locations that) will provide WaterHealth an advantage to immediately deploy mobile system across any disaster affected state in a matter of hours/days. The states proposed for the deployment Rapid Action Hub include, Gujarat, Himachal Pradesh, Bihar, Andhra Pradesh and Tamil Nadu. During the first phase, WaterHealth will setup Rapid Action Hub across Andhra Pradesh, Gujarat and Tamil Nadu while the remaining two (2) states will be covered in next phase.

With the help of 'Rapid Action Hubs' across the Country, WaterHealth will be able to provide immediate safe drinking water access within 500 km of periphery in less than eight (8) hours. In case of an earthquake, if all roads are broken then the equipment will be immediately air lifted and sent to the disaster affected areas.

In case of emergencies, teams can be rapidly deployed to initiate operations on an immediate basis. Deployment of the ATOM can be undertaken in two modes,

Steady Mode Execution Mode



Despite taking preventive actions, disasters are inevitable, what defines us (humanity) is how we deal with such perils. Paradoxically though, it is a human tendency to believe that it will not happen and address it as and when it happens (cross the bridge when one reaches it).

Notes

1 http://www.un.org/apps/news/story.asp?NewsID=48739#.Wj9NEVWWbIU

2 http://www.emdat.be/disaster_trends/index.html

3 http://indiatoday.intoday.in/story/india-loses-$9.8-billion-disasters-united-nations/1/433641.html

4 According to National Management Disaster Authority (NDMA), more than 58% of the landmass is prone to earthquakes, over 12% of land is prone to floods and river erosion, about 76% of its coastline is prone to cyclones and tsunamis and 68% of its cultivable area is vulnerable to droughts. Available at: http://www.ndma.gov.in/en/vulnerability-profile.html

5 http://news.trust.org//item/20140630121414-xqs24

6 Of the above major three challenges, drinking water source contamination is of prime focus to WaterHealth and we have developed a new product that can provide clean and safe drinking water access to people in disaster affected regions.

Inventory Management in Humanitarian Supply Chain: A Literature Review

Priyanka Saini[a] and Rajat Agrawal[b]

Abstract

India is vulnerable, in varying degrees, to a large number of natural and manmade disasters. Disaster can be stopped but certainly their impact can be minimised by using timely relief operations. Relief operations can be very well managed and performed using principles of Supply Chain Management. Use of supply chain management for humanitarian activities is known as Humanitarian supply chain management (HSCM). Objective of HSCM is to minimise the life and economic losses due to disasters. HSCM ensures effective and efficient delivery of relief material to the affected people for their survival and to restore and rehabilitate them to their lives. HSCM improve the performance and effectiveness of the relief activities. Relief operations depend on the inventory management in humanitarian supply chain-the decision of where to preposition supplies in preparation for a disaster and how much to preposition at a location. Policy of inventory management may depend on genesis of a disaster. If supplies are located closer to the disaster, it can allow for faster delivery of supplies after the disaster. Therefore, in the aftermath of any disaster, large quantities and timely availability of supplies are needed to provide relief aid to the affected. The purpose of this paper is to review the literature to describe the current practices and research trends in inventory management in humanitarian supply chain. This paper also provides directions for future research in inventory management in humanitarian supply chain.

Keywords: inventory management, humanitarian supply chain management, natural disaster

Introduction

Now days, the increase in frequency and intensity of natural disasters has resulted in more loss of lives and property. According to United States Agency for International Development, Office of United States Foreign Disaster Assistance, United States Committee for Refugees and Immigrants, 2004, there has been a substantial increase in the loss of life, property, and material damage due to the rising occurrence of natural disasters, and complex humanitarian emergencies. Each year, about 500 natural disasters kill approximately 70,000 people and affect more than 200 million people worldwide (Duran et. al, 2011). In the aftermath of such events, large quantities of supplies are needed to provide relief aid to the affected. On the basis of literature review, with a rough estimate 70% of affected people and 50% of the lives can be saved with proper HSCM. So, we cannot reduce the magnitude of hazards but we can reduce the intensity of hazards by the reduction of vulnerable entities, proper mitigation and preparedness plan in HSCM.

As per the definition adopted by UNISDR, “Hazard is a dangerous phenomenon, substance, human activity, or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage”. The UNISDR (2009) defines disaster as: “A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.”

UNISDR considers disaster to be a result of the combination of many factors, such as the exposure to hazards, the conditions of vulnerability that are present, and insufficient capacity or measures to reduce or cope with the potential negative consequences. Disaster impacts may include loss of life, injuries, disease and other negative effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation.

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After the major disaster like, Gujarat earthquake, 2001 and Sumatra earthquake, 2004 (Indian Ocean Tsunami) caused severe damage and casualties. The Indian government decided to make a policy to manage disaster which helps to reduce the impact the effects of the disaster. In 2005, DM Act 2005 was introduced to strategise the plan of disaster mitigation and management.

The DM Act 2005 uses the following definition for disaster: "Disaster" means a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or manmade causes, or by accident or negligence, which results in substantial loss of life or human suffering or damage to, and destruction of, property, or damage to, or degradation of, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area."

The UNISDR defines disaster risk management as the systematic process of using administrative decisions, organisation, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters. This comprises of all forms of activities, including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of hazards.

The term Disaster Management defined by (DM Act 2005), "A continuous and integrated process of planning, organising, coordinating and implementing measures which are necessary or expedient" for the following: i) Prevention of danger or threat of any disaster, (ii) Mitigation or reduction of risk of any disaster or its severity or consequences, (iii) Capacity-building, (iv) Preparedness to deal with any disaster, (v) Prompt response to any threatening disaster situation or disaster, (vi) Assessing the severity or magnitude of effects of any disaster (vii) Evacuation, rescue and relief and (viii) Rehabilitation and reconstruction."

India is vulnerable, in varying degrees, to a large number of disasters. Half of the landmass of the country is under earthquake zones. Large coastal line is prone to cyclones and tsunamis. Disaster can't be stopped but it can be minimised by the use of relief operations. Relief operations can be very well performed by the use of HSCM. HSCM have the common aim to provide aid to the affected people in their survival and to restore and rehabilitate them to their lives. HSCM improve the performance and effectiveness of the relief activities.

Humanitarian Supply-Chain Management (HSCM)

The humanitarian supply-chain management (HSCM) involves managing the different factors in the system such as goods and materials, information, manpower, political authorities, available infrastructure, etc. to reduce the impact of a disaster for the people who are affected. Minear (2002) mentions that strategic planning, gathering data and managing information, mobilizing resources and assuring accountability, orchestrating a functional division of labor in the field, negotiating and with host political authorities, providing leadership maintaining a serviceable framework are highly important for the coordination of the humanitarian activities. Thomas and Kopczak (2005) defined HSCM as "The process of planning, implementing and controlling the efficient, cost-effective flow and storage of goods and materials, as well as related information, from the point of origin to the point of consumption for the purpose of alleviating the suffering of vulnerable people" from a logistical point of view.

The number of stake holders in the disaster management has increased in the last few years. This includes the local and the global humanitarian organisations, governments, military, individuals and companies to name a few. The complexity in the managing of the humanitarian activities has also increased. Moreover, due to the increase in the frequency of the occurrence of the disaster the humanitarian organisations rarely get a chance for the review of the effectiveness of their relief activities and their strategies (Besiou et al., 2011).

According to Thomas and Kopczak (2005), disaster management is an expanding area of research with the number of disasters, both natural and manmade, increasing over the years. The term disaster can be defined as "an occurrence of widespread severe damage, injury or loss of life or property with which a community cannot cope and during which the society undergoes severe disruption" (Schulz, 2008). The disasters can be classified into two categories, i.e., manmade disasters and natural disasters. The natural disasters cannot be avoided in most cases, but the impact can be reduced by proper planning and foresight into the future.

The HSCM involves managing the different factors in the system to reduce the impact for the people who are affected by the disaster. The HSCM and the commercial supply chain management (CSCM) are different in their motives and operating conditions. The main task is to mobilise the goods, finance and to administer the services to the beneficiaries. Disaster relief requires the activities in many dimensions, such as, rescue efforts, health and medical assistance, food, shelter and long-term relief activities. The success of any relief activity depends heavily on the logistical operations of the supply delivery (de la Torre et al., 2011). Even though the logistics operation was the heart of the entire relief activities, it was not until recent times the importance of the logistics was identified. Earlier it was considered as a necessary expense and hence it lacked operational knowledge and lack of investment in the communication and technology (Kovács and Spens, 2011). If we define CSC as a network that supports the flow of goods, information and finances from the source to the final customers, HSC can be defined quite similarly to this as a network for managing the flow of goods, information and finances from donors to affected persons (Ernst, 2003). The definition of the HSCM has remained ambiguous, as there has been no one definition which gives the complete meaning, issues, challenges and tasks of the HSCM. Nevertheless, various authors have tried to define HSCM under different contexts (Sheu, 2007). We have summarised a few of them in Table 1. The HSC, unlike the CSC, does not have the typical supply chain stages like those of suppliers, manufacturers, distributors, retailers and customers. Instead, the HSC consists of donors, NGOs, local bodies and the aid recipients. The Figure 1 represents a typical HSC. Figure 2 shows the actors of the supply network of the humanitarian aid.

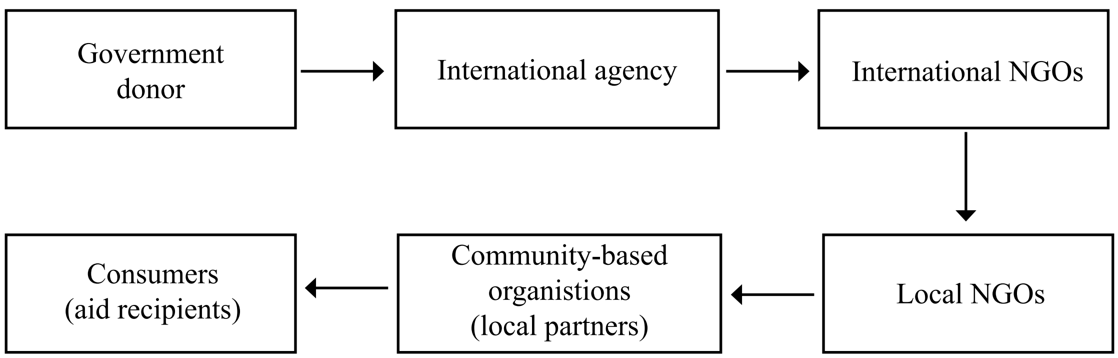

Figure 1: A typical HSC
Source: Oloruntoba and Gray (2006)

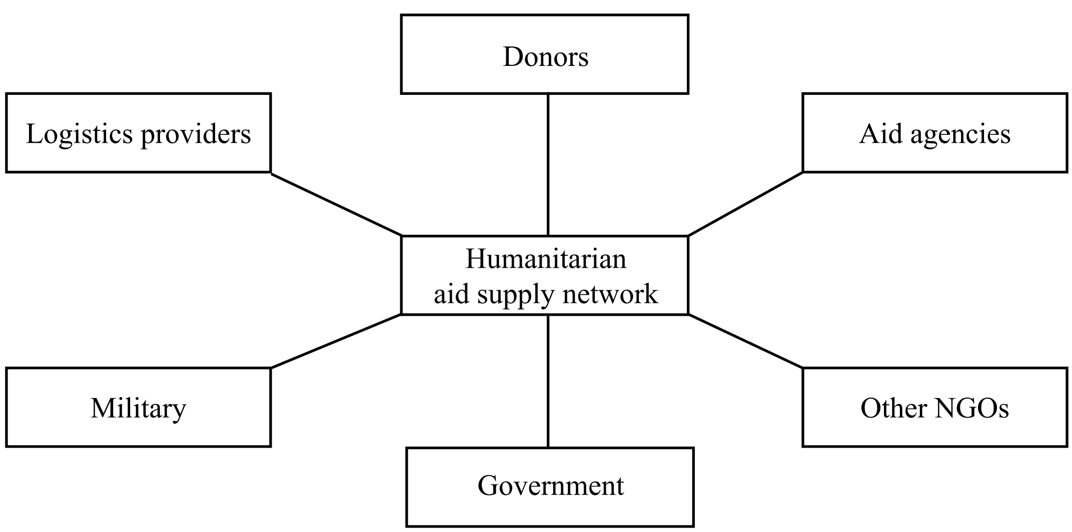

Figure 2: Actors of supply network of humanitarian aid
Source: Kovács and Spens (2007)

Table 1: Difference between CSCM and HSCM

Characteristics	Conventional SCM	Humanitarian SCM
Primary Goal	To increase supply chain surplus	To minimise the losses due to disasters
Actors	Supplier, manufacturer, distributor, retailer, customer	Donor, NGOs and aid agencies, government, military, logistics providers
Demand Behaviour	Predictable, i.e. not uncertain	Unpredictable, i.e. uncertain
Inventory Management	Minimising inventory to lower costs	Maintain sufficient inventory to have high responsiveness because of demand/supply uncertainty
Lead Time Strategy	Reduce, but not at the expanse of costs	Reduce aggressively, even if the costs are significant
Supplier Strategy	Select based on cost and quality	Select based on speed, flexibility and quality
Objective	Customer satisfaction	Recovery of the affected people

The HSCM and the commercial supply-chain management are different in their motives and the realms at which they operate. Disaster relief requires the activities in many dimensions, such as rescue efforts, health and medical assistance, food, shelter and long-term relief activities. The main objective of commercial supply chain is customer satisfaction while humanitarian supply chain have prime objective is timely recovery of the affected people.

With the expert discussion, we find out the drivers of HSCM like, in commercial supply chain management, we have all necessary drivers in HSCM also. The main drivers of HSCM will be facilities, inventory, transportation, information, and sourcing. Pricing is also an important driver in conventional supply chain management but pricing have no or less importance in HSCM because cost have no matter for save lives.

Inventory Management in HSCM

The inventory in the HSCM can be considered to be social inventory. The social inventories are those inventories which serve the social goals, but many times they have much broader perspective than just the regional or national goals (Whybark, 2007). In a typical commercial environment, to decide the right inventory policies, the managers have to consider a large number of factors in the supply chain into account. Some of them are the forecast of the customer demand which may be known in advance or might be random, the replenishment time, the number of different products, the length of the planning horizon, different costs incurred in the inventory management and the service levels at which the company wishes to operate. In the case of HSCM, the organisations have low visibility in the case of the inventory and many times, the control of the inventory is being given to the country officials which may lead to the improper planning like scarcity in some areas and surplus in other (Ergun et al., 2010). Long and Wood (1995) mentioned that the carrying cost of the inventory is much less when compared to the time value of the money. Thus, while formulating the strategies for the inventory planning, this notion is to be given a thought. The nature of complexity in which a HSCM operates necessitates the need of simpler methods for inventory management. In most of the cases, the relationships with the suppliers are built when the need arises and not on a long-term basis (Kovács and Spens, 2011). The naïve humanitarian relief model for inventory management is by far the simplest one. It places the number of replenishment orders on a set schedule and thereby reducing the complexity (Beamon and Kotleba, 2006). Prepositioning is one of the major methods adopted by the organisations working in the humanitarian field to provide fast aid to people affected by the disaster (Jahre and Haigh, 2008). International agencies are trying to locate their warehouses at strategic locations to reduce the carrying cost and response time.

Whybark (2007) highlighted that the acquisition of inventory for HSCM has two aspects; the first being the acquisition and storage of the inventory required and the second being the development of the sources for it. The second aspect is more important, since finding the supply sources for the inventory and also developing a long-term relationship with them are challenging activities. Since the inventory requirement from these sources are not as frequent as in case of a CSCM, developing a long-term relation is difficult. Moreover, in the wake of a crisis, the source may not be able to provide with the required amount of inventory. The decisions relating to the order placement is not similar to that of a CSCM, since there is no definite forecast available as of when and where the demand will occur, but a lot of parallels can be drawn from the demand prediction of medicines while formulating a model for the HSCM inventory management. The inventory management relies a great deal on the past data for the type of material required, the amount in which they were required and at what stage of operation were these aid materials required. The inventory model proposed by Taskin and Lodree (2010) helps the practitioners to determine an appropriate stock level that should be available at the beginning of the hurricane season while simultaneously determining stock levels for pre-hurricane season demand periods and it also helps them to make production/ procurement decisions which needs to be altered in the planning phases. The real-time tracking of the aid materials, inventory management and the supply chain software's tailored for the humanitarian aid programmes along with the OR-based decision support systems are very much essential for the effective management of the aid materials (de la Torre et al., 2011).

The role of inventory management is to ensure that stock is available to meet the needs of the beneficiaries as and when required for response operation. Effective response can be handled by larger and timely available inventory in HSCM. Inventory management in an emergency is more 'project based', matching supply with demand in a rapidly changing environment. This requires building a supply chain that has a high level of flexibility and adaptability, with rapid identification of need and rapid fulfillment of that need through the supply chain.

The fundamental questions of inventory management are the same for commercial and humanitarian supply chains like, how much to order, when to order, where to store. These decisions may be of concern in different disaster management phases. Pre-disaster inventory management: long-term prepositioning decisions (i.e., determining location and amount of stocks). Post-disaster inventory management: short-term pre-positioning and inventory ordering decisions, i.e. the decision of where to preposition supplies in preparation for a disaster and how much to preposition at a location. If supplies are located closer to the disaster, it can allow for faster delivery of supplies after the disaster. Therefore, in the aftermath of any disaster, large quantities and timely availability of supplies are needed to provide relief aid to the affected.

The inventory management in HSCM depends on the genesis of particular type of natural disaster. Some disasters are predictable while some are not predictable. Depending upon type of disaster, assumptions for inventory management may also be changed. Normally, it is assumed that demand in disaster is highly uncertain but to some extent disaster like, floods can be forecasted with good accuracy and therefore inventory models for dealing with flood situation may not require stochastic treatment. On the other side, inventory models to handle disaster like earthquake which are highly uncertain require stochastic treatment.

Literature Review

In this section, we provide an overview of literatures that focus on inventory management of HSCM. Our intention is not to provide an exhaustive review of all papers on this topic. We identify the common aspects of our study with the most related papers. We observe that most of the literature focus on pre-positioning, distribution (routing, transportation, resource allocation), and evacuation problems in HL/DM. We reviewed most of the studies considered different African countries or different areas of USA to provide data for models developed by them. Some Papers in HSCM by Indian authors also reviewed, they discussed various aspects of HSCM like, drivers, logistical, distribution, co-ordination issues but to best of our efforts lack in detailed study of inventory management in HSCM. Most of the studies are only for a particular type of scenario either pre-position or rapid onset inventory management. Most of the papers have only considered single item inventory management. Though they mean single item can be a single packet considering of single SKUs (Stock Keeping Units) like water bottle, biscuits, medicines but inventory management may require many other such as blankets, clothes etc. Only few studies consider the perishability terms used while this term is very important to store food and medicine in the stock to maintain inventory. Different methods are used and a variety of assumptions are made to develop disaster scenarios and associate probabilities to these scenarios; hence, even if the same raw data are used, different problem instances are generated in general. Different studies have used different methodology ranging from Linear Programming, Mixed Integer Programming, dynamic Programming, and Heuristics, etc. Figure 3 helps in understanding the application of different tools used for analysis.

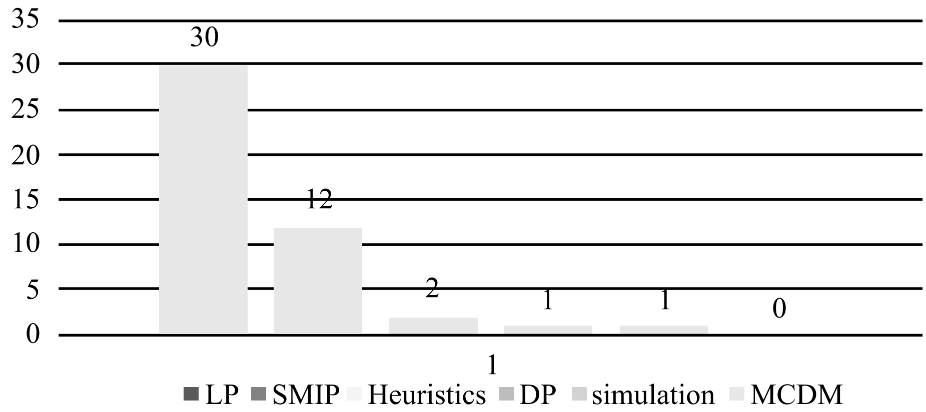

Figure 3: Types of methods used in inventory management in HSCM

Figure 3 shows that various studies which we have reviewed used Linear Programming and Mixed Integer Programming but very few studies used heuristics, dynamic programming and simulation. Papers which used LP or MIP acknowledged uncertainty of events and various parameters associated with the mathematical model. However, these models were developed based on some scenarios and the objective function was developed by summing various scenarios. Therefore, these models are only suitable for considered scenarios, which limit the wide applicability of use of LP and MIP. Linear Programming and Mixed Integer Programming generally used for making decisions under certainty, i.e. when all the courses of options available to the problem are known and the objectives of the study along with its constraints are quantified. That course of action is chosen out of all possible alternatives, which yield the optimal results. But once a problem has been properly quantified in terms of objective function and the constraint equations and the tools of Linear Programming are applied to it, it becomes very difficult to incorporate any changes in the system arising on account of any change in the decision parameter. Hence, it lacks the desired operational flexibility. But in the case of disaster, almost all the course of options like parameters, factors are uncertain and ambiguous. Parameters like exact location, undamaged infrastructure, element at risk and relief items are uncertain. So, simulation is used when uncertainty is high due to sparse data. It is used to control all of the factors making up the data and can manipulate these systematically to see directly how specific problems and assumptions affect the analysis.

In this study, we consider the relief operations of humanitarian relief organisations responding to quick-onset global disasters. The relief system involves a large number of actors and stakeholders (beneficiaries, host governments, local and international relief organisations, donors, etc.) and operates in highly unpredictable, dynamic and chaotic environments. Therefore, the disaster response activities of relief organisations vary widely and are driven by numerous factors depending on each situation's characteristics. The uncertainties and variability in the relief environment leads to most logistical decisions being made after disasters occur. So, unlike commercial supply chains, in which logistic operations are relatively established and can regularly be planned in advance of demand, most logistical decisions in the relief chain are made within shorter time frames. However, facility location and stock pre-positioning decisions in the relief chain are critical components of disaster preparedness and hence require long-term planning to achieve a high-performance disaster response. Facility location and stock pre-positioning decisions interact with other logistical decisions at different levels. In this section, we briefly describe the disaster response process and the logistical operations in the relief chain that affect and are affected by facility location and stock pre-positioning decisions.

Once a disaster occurs, demand for large amounts of a large variety of supplies occurs suddenly in massive amounts. The general flow of resources to the affected areas is shown in figure 4. This flow of resources coincides with the four main phases of disaster relief, as identified by Thomas (2002) and Beamon (2004): (1) assessment: minimal resources are required to identify what is needed, (2) deployment: resource requirements ramp up to meet the needs, (3) sustainment: operations are sustained for a period of time, and (4) reconfiguration: operations are reduced, then terminated. The length of each phase in the relief cycle varies depending on the disaster characteristics. However, the speed of relief operations during the first days of the disaster significantly affects the lives of many people threatened by the disaster. Hence, the ability of a relief organisation to mobilise its resources during the assessment and deployment phases is critical to the success of disaster response.

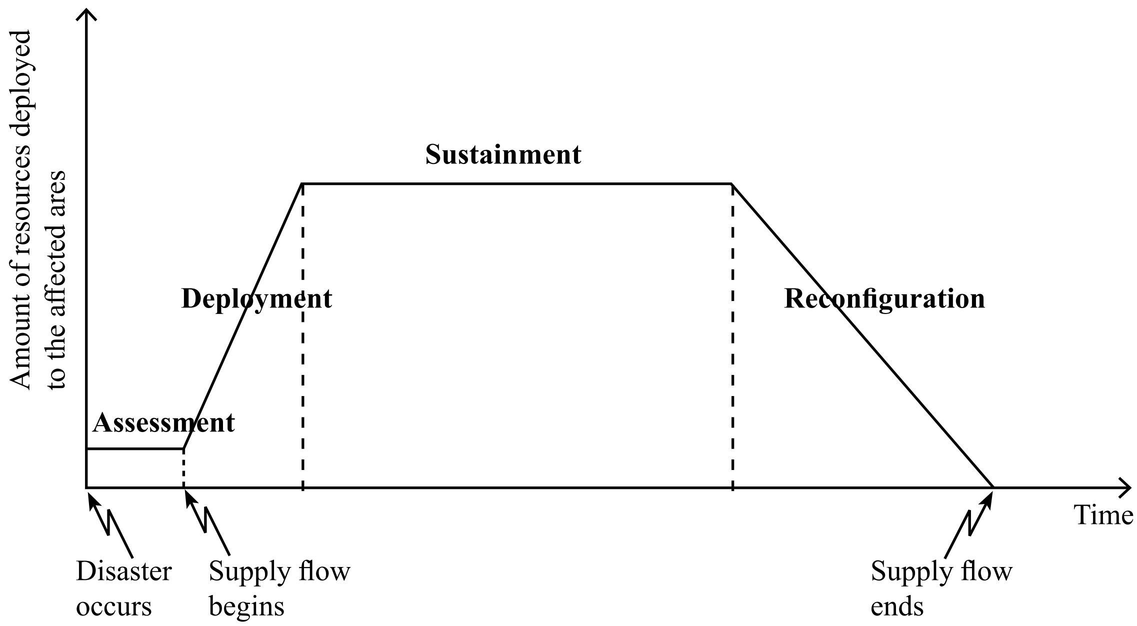

Figure 4: Relief mission life cycle
Source: modified from Beamon (2004) and Thomas (2002).

An NGO's level of involvement in a disaster relief operation, in terms of the type and scope of logistics operations deployed may vary depending on factors such as the type, location, and impact of the disaster and resource availability. However, the flow of supplies in a typical relief distribution network is depicted in Figure 5. As illustrated in Figure 5, once a disaster occurs, NGOs can acquire relief supplies from three main sources: local suppliers, international suppliers, and distribution centers (pre-positioned stocks). There are advantages and disadvantages associated with each source.

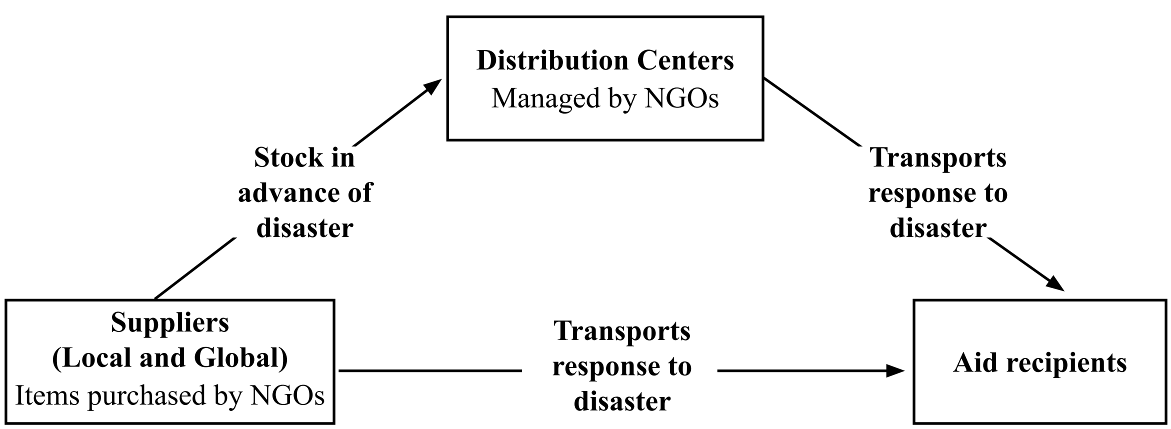

Figure 5: Relief chain overview

Now a days, the information technology has progressed a lot and provide the facilities to track the calamity anywhere on the globe so forecasting of any misfortune became possible. Some of the natural disaster like floods and cyclones can be forecasted in the period of intermediate and immediate life cycle respectively. But Earthquake and tsunamis cannot be possible to forecast cause slow onset. On the basis of genesis of disaster, Forecasting certainty will be different for all the natural disaster and inventory management will be depends on it in the manner of efficient, effective and responsive. We have summarised all in Table 2.

Table 2: Inventory Management on the Basis of Genesis of Disaster

Time	Type of Natural Disaster	Forecasting Certainty (On the Basis of Genesis of Disaster)	Inventory Management	
			Pre-disaster	Post-disaster
Slow onset	Earthquake	Not Possible	Efficient	Highly responsive (quick to respond)
	Tsunami	Not Possible, Low certainty	Efficient	Highly responsive (quick to respond)
	Flood	Intermediate Low to medium certainty	Efficient & Effective	Slight responsive
	Cyclone	Immediate Medium certainty	Efficient & Effective	Slight responsive
Sudden onset	Drought	Possible Medium to high certainty	Effective	Low responsive
	Famine	Possible Medium to high	Effective	Low responsive

On the basis of literature review and experts opinion, we find some facts about the inventory management in HSCM as discussed below.

Site Assessment

Assessing the relief demand after any disaster is the primary step in planning any of the humanitarian activity. In the initial stages, when the supply chain has to be triggered following the disaster, it is seldom that the damage assessment is done correctly. Therefore, it is based on the previous experiences and any first hand information arriving from the site that is used for the damage assessment. The needs vary from the site to site, within a site from region to region, and within a region from place to place. Under such circumstances, it becomes important to correctly assess the needs of the people and to plan the relief activities. In addition to the relief logistics, it is also important to prevent the outbreak of an epidemic at the disaster site (Granot, 1995; Darcy, 2005). The next important work to be done is to make sure that the affected communities are safe. The cleaning of the debris and attempts to use the partially destroyed houses and facilities are also important. The match between the demand for the relief (aid) items and the supply has to be achieved, for which a large amount of procurement and logistics activities has to be planned and implemented. Under these circumstances, it becomes quite difficult to assess the damage caused by the disaster and the need arising due to the disaster with high degree of correctness.

Facility Location

Facility location problems derive their importance from two factors: their direct impact on the system's operating cost and timeliness of response to the demand (Haghani, 1996). While the objective of facility location models addressing private sector problems is generally to minimise cost or maximise profit, the models addressing public and emergency services instead focus on user accessibility and response time (see ReVelle et al. (1977) and Marianov and ReVelle (1995) for a discussion and review of emergency service facility location problems). Models with coverage-type objectives are extensively used in facility location research and applications, especially when response time is the primary performance criterion (see Schilling et al., 1993 and Daskin, 1995) for a detailed discussion and review of covering models). In covering-type facility location models, a source of demand is defined as covered if it is located within a specified response distance or response time from a facility. The set covering models seek to choose facilities among a finite set of candidate sites such that all demand sources are covered with a minimum number of facilities. In disaster relief, this would mean that each potential demand point must be within a specified target response time of a facility in the relief network. However, it may not be cost-efficient or even feasible to cover the entire demand of every potential disaster scenario from distribution centers. Therefore, a maximal covering-type model that chooses facility locations to maximise the amount of covered demand subject to resource limitations is more suitable for relief chain network design.

Procurement

Acquiring supplies locally may be advantageous due to low transportation costs, prompt deliveries (no customs clearance, no delays due to congestion at the ports, etc.), and the support it provides to the local economy (PAHO 2001). Although meeting a country's emergency needs from local resources could be considered as the best procurement scenario for many reasons (including these), it may be risky to develop a response strategy that depends solely on local sources. For instance, local supplies may not always be available in the quantity and quality needed. Local procurement may also create local competition among relief organisations trying to purchase the same types of supplies, and finally may create shortages in the local market (PAHO 2001). Therefore, relief agencies procuring locally must develop contingencies for acquiring supplies from other (non-local) sources.

Using global suppliers in post-disaster procurement increases the availability of large quantities of high-quality supplies. The potential disadvantage lies in longer delivery times and higher transportation costs (PAHO 2001). NGOs commonly acquire relief items from global suppliers through a competitive bidding process. In this process, NGOs first identify potential suppliers meeting item specifications and delivery requirements. Next, qualified suppliers are invited to bid. Finally, NGOs evaluate suppliers' offers and execute contracts with the winning suppliers, after which the delivery of supplies to the affected areas begins. As a result, supplies acquired by this process may not be delivered to affected areas during the initial critical days following a disaster. Recently, some NGOs have begun to establish pre-purchasing agreements with suppliers, specifying the quality and delivery requirements for certain critical emergency items. Under framework agreements, these suppliers may hold emergency stocks for NGOs, but an NGO's evaluation of its post-disaster procurement options still depends on the situation and even in these cases, these suppliers are invited to bid (Salisbury 2007). Such framework agreements have the potential to streamline the procurement process if suppliers can be effectively integrated into the relief chain; however, such partnerships are still relatively rare in the relief sector.

Relief Logistics

Most of the studies in disaster relief logistics focus on operational logistical activities in the relief chain with the objective of optimizing the flow of supplies through existing distribution networks. Knott (1987) considers the last mile delivery of food items from a distribution center to a number of refugee camps, assuming a single mode of transportation that makes direct deliveries to camps. Haghani and Oh (1996) and Oh and Haghani (1997) determine detailed routing and scheduling plans for multiple transportation modes carrying various commodities from multiple supply points in a disaster relief operation. Barbarosoglu et al. (2002) focus on tactical and operational scheduling of helicopter activities in a disaster relief operation. They decompose the problem hierarchically into two sub-problems where tactical decisions are made in the top level, and the operational routing and loading decisions are made in the second level. Ozdamar et al. (2004) address an emergency logistics problem for distributing multiple commodities from a number of supply centers to distribution centers near the affected areas. They formulate a multi-period multi-commodity network flow model to determine pickup and delivery schedules for vehicles as well as the quantities of loads delivered on these routes, with the objective of minimizing the amount of unsatisfied demand over time. Beamon and Kotleba (2006a) develop an inventory management strategy for a warehouse supporting a long-term emergency relief operation. Their analysis is based on a case study of a single humanitarian agency operating a warehouse in Kenya, responding to the complex humanitarian emergency in south Sudan. The authors develop a multi-supplier inventory model that optimises the reorder quantity and reorder level based on the costs of reordering, holding, and back-orders.

Cost of Inventory

The funding also possesses another issue in the HSC. The time taken for the request of the funds to be transferred to the governmental and the NGOs and the time taken for the release of these funds affect the stake holder in the HSC. The stake holders who are usually worst hit by these kinds of lags are the aid recipients, since most of the distribution activities do not take place without the funds being allocated. Sometimes, the NGOs function only with the donor funding and they will be ready to operate in the country only if they are able to get a donor. Moreover, the donors also expect the organisations to function properly and this makes the donors also a customer of the relief organization (Hilhorst, 2002). The serious issues in the functioning of the HSCM are the lack of the modern technologies for the tracking and tracing of the relief goods, lack of skilled labour, and the funding constraints. The funding constraints prove to be a serious problem since it takes a lot of time and paperwork for funds transfer. Therefore, usually the HSCs function with low capitals (Tomasini and Van Wassenhove, 2009). Accurate information about the situation is a rare luxury during a disaster struck situation and moreover due to time constraints, there is very less scope for any detailed statistical analysis to find out the actual situation (Beamon and Blacik, 2008).

Stakeholders

The stakeholders in the HSCM are donors, aid receivers, NGOs, international organisations, government, local authorities, and media. The donors in the HSCM expect the media to mention their contributions, but sometimes there might be unsolicited donations from the donors, which might lead to supply chain bottle necks. In the CSC, the end customer is the only source of the income of the entire supply chain, but in case of the HSCM the end customer seldom gets into the monetary transactions with the organizations. On the other hand, the marketing and the customer service aspects of the HSCM has to concentrate on the donors to convince them that the humanitarian activities are taking place, so that they may donate (Van Wassenhove, 2006). The decision making in case of HSCM about any strategy is very difficult mainly because of the plethora of stakeholders and their potentially conflicting agendas and approaches. Tatham and Houghton (2011) stated that the decision making in humanitarian logistics as a 'wicked problem'.

Conclusion

India is vulnerable, in varying degrees, to a large number of natural and man-made disasters. Disaster can't be stopped but certainly their impact can be minimised by using timely relief operations. Relief operations can be very well managed and performed using principles of Supply Chain Management. Use of supply chain management for humanitarian activities is known as Humanitarian Supply Chain Management (HSCM). Objective of HSCM is to minimise the life and economic losses due to disasters. HSCM ensures effective and efficient delivery of relief material to the affected people for their survival and to restore and rehabilitate them to their lives. HSCM improve the performance and effectiveness of the relief activities. Relief operations depends on the inventory management in humanitarian supply chain. The decision of where to preposition supplies in preparation for a disaster and how much to preposition at a location. Policy of inventory management may depend on genesis of a disaster. Now a days, the information technology have progressed a lot and provide the facilities to track the calamity anywhere on the globe so forecasting of any misfortune became possible. Some of the natural disaster like floods and cyclones can be forecasted in the period of intermediate and immediate life cycle respectively. But earthquake and tsunamis cannot be possible to forecast cause slow onset. On the basis of genesis of disaster, forecasting certainty will be different for all the natural disaster and inventory management will be depends on it in the manner of efficient, effective and responsive. If supplies are located closer to the disaster, it can allow for faster delivery of supplies after the disaster. Therefore, in the aftermath of any disaster, large quantities and timely availability of supplies are needed to provide relief aid to the affected. In this paper, On the basis of literature review and experts opinion, we find some facts about the inventory management in HSCM, which have an important role to manage relief operations and inventory management like site assessment, facility location, procurement, relief logistics, cost of inventory, and stakeholders. The purpose of this paper is to review the literature to describe the current practices and research trends in inventory management in humanitarian supply chain. This paper also provides directions for future research in inventory management in humanitarian supply chain.

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What Makes a Humanitarian Logistician: A Competency Based Approach

Yamini Meduri[a]

Abstract

Effectiveness of humanitarian assistance often depends on the effectiveness of the resources utilised, such as predictive logic, relief partners, logistics technology and relief personnel. Analysis of the most recent yet more vulnerable disasters have pointed out that the relief workers often created a difference. Lack of appropriate access to standardised models to train the relief workers has created a need to develop a competency model which can further be validated with the relief organisations to create a standard. The current study identifies, classifies and develops a competency model of the emergency relief worker, which can be used for capacity building initiatives. Also, a measurement framework is proposed which will enable to relief organisations to monitor and evaluate the effectiveness of the relief personnel.

Keywords: competency mapping, capacity building, monitoring, disaster management, emergency relief

Introduction

Ever since the seminar work of McClelland (1973), the area of competency has been frequently researched and accepted as the 'underlying characteristic of an individual that determines the extent of performance on a given job or task' (Boyatzis, 1982; Quinn et.al, 1990; Spencer and Spencer,1993; Hoffmann, 1999; Cardy, R.L and Selvarajan, T.T, 2006). Good number of organisations also transformed themselves into competency based organisations acknowledging the fact about the importance of competent workforce. Increase number of people centric service organisations only supported this further.

However, extremely people oriented humanitarian organisations whose performance often depends on the first responders on the field are yet to explore the competency research. Ever since the Indian Ocean Tsunami in 2005, the disaster management research has increased its pace and multiple areas like logistics, supply chain of resources, preventive preparation, etc., are analysed in depth. But the research related to human resources involved in the relief operations are yet to be studied. The increasing intensity of the disasters today has involved organisations, sometimes, across borders in the relief operations. Irrespective of the size of the disaster, it is the relief worker who alters the 'tours of duty' according to the nature of the disaster site and provides relief to the vulnerable (Leavy, 2015).

Analysing the context and need for developing competent workforce, it is required that a competency based capacity building initiatives are developed and utilised (also supported by McCall and Salama (1999), Chang (2005), Kovács and Tatham (2010), Kovács et al. (2012). Also, it is found that 90% of the relief workers who participated in the study conducted by Thomas and Mizushima (2005) felt that professional training was necessary and 27% of them had no access to any such training programs. Also, the study also relieved that those who had access were trained differently as per the knowledge and convenience of the trainers.

Hence, it is imperative that there is a need to develop a standard set of skills and abilities of the relief worker so that the training can be standardised. To address challenges, such as this, competency researchers have defined a comprehensive competency mapping and modelling process so as to create a standard of expectations for a specific job (Fotis and Draganidis, 2006; Naqvi, 2009; Uddin et al. 2012). The current study attempts to define and execute a competency mapping process for the emergency relief workers who have to adapt according to the nature and complexity of the disasters yet perform to the best of their skills.

Often organisations looking forward to develop a competency model face the tough task of how to start the entire process. The initial phase of developing a competency model is defined by the competency mapping process usually

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defined as a five step process (Kandula, 2013) as illustrated in Figure 1. The current paper focuses on applying the process for emergency relief workers.

The competency mapping process often results in a competency library which defines the different competencies required for performing the job that is tested. The current study illustrates the list of such competencies required for emergency relief operations and also, presents a research agenda for the way forward. The process used for developing the competency model (Kandula, 2013) is illustrated in Figure 2. In order to implement the competency model in the regular HR process of any organization it is important that the competency model is first developed.

Research Methodology

Competencies can be collected in multiple ways and the efficiency of the complete competency model is often determined by the methodology used by the organisation in developing the model. The current study uses the content analysis methodology proposed by competency researchers for collecting the competencies required by a job (Ahmed, 2005; Kennan et al. 2009; Carliner et al. 2015). The competency is identified from 35 job advertisements using 12 independent professionals who are knowledgeable in identifying competencies from the job advertisements. Such data is put through the competency mapping process and prepared for the modeling process. The Kripendoff's alpha which confirms the reliability of the content analysis is calculated to be 0.74. Hence, as per Landis & Koch (1977) and Kripendoff (2012) standards, the reliability of the data is moderate and can be used for drawing conclusions.

Competency Mapping

Competency mapping is a term used in two different means in competency based approach in the organisations. The first utilisation is the process for identifying and collecting the competencies from the job and the second is the implementation process after the model is designed. In this study, we are considering the first means that creates a base for the competency model.

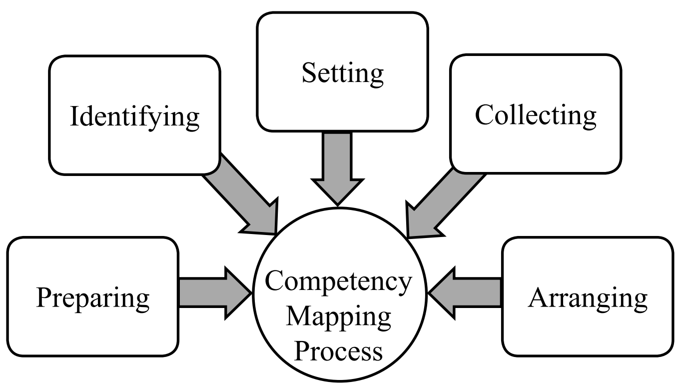

Figure 1: Competency mapping process (Kandula, 2013)

Preparing: In the preparing phase, the organisations are required to prepare themselves for the competency modeling process by understand and clarifying the objectives of the process to the people involved. Since, the current study is not associated with any particular organisation, the preparation phase identified the job advertisements that were to be put through the content analysis for identifying competencies required by the emergency relief workers.

Identifying: One of the most crucial phases of the competency mapping process is the identification of competency professionals who shall conduct the content analysis. In the current study, the independent researchers were identified through a preliminary assessment of their knowledge about competency mapping and their interest in conducting this process. The shortlisted coders were explained about the objectives of the study and the ultimate purpose of the final model that shall be developed. Also, it is in this phase that the collected job advertisements are handed over to the coders.

Setting: The setting phase is carefully omitted in the current phase as the first responders are not involved in the process. Generally, the setting phase involves explaining the job incumbents about the need and scope of the process so that they in turn understand the objective for conducting the process. Since, the current study only uses secondary data of job advertisements; the setting phase is not prominent.

Collecting: The independent coders have then identified competencies required by the first responders in emergency relief as per the job advertisements. The 12 independent coders have identified 109 competencies from the different job advertisements. However, upon further study of the competencies identified, it is found that the 109 competencies are not mutually exclusive. Hence, a further analysis of the competencies reduced the 109 to 34 independent competencies required by the emergency relief workers.

Arranging: It was also observed that not all competencies were sought by all the job advertisements. Hence, it was required to understand which of the competencies were most sought for and those which are not. The 34 competencies were then arranged as per the rate at which they were sought for. The frequency at which the competencies were identified helped us determine the important and not so important competencies required by the emergency relief worker using the relative weights method (Table 1).

Table 1: Decreasing Order of Competencies Using the Relative Weights

Skill No.	Competency	Relative Weight
19	Knowledge Related To Disaster Management	0.457
24	Multi-Cultural Sensitivity	0.362
29	Risk Evaluation	0.271
3	Analytical Thinking	0.257
33	Strategic Orientation	0.208
20	Leadership	0.195
14	Field Experience	0.181
18	Interpersonal Skills	0.178
8	Communication	0.176
31	Stakeholder Management	0.174
10	Coordination (Internal and External)	0.172
16	Information Technology	0.166
26	Personal Credibility	0.166
6	Business Process Knowledge	0.132
7	Capacity Building	0.115
27	Presentation	0.104
12	Documentation	0.092
23	Multi Tasking	0.090
21	Logistics And Supply Chain Management	0.081
15	Financial Literacy	0.080
17	Integrity	0.054

Skill No.	Competency	Relative Weight
11	Decision Making	0.046
28	Resource Management	0.040
2	Adaptability	0.037
34	Stress Management	0.033
32	Statutory Compliance	0.033
5	Attention to Detail (Accuracy)	0.030
30	Service Orientation	0.022
22	Mentoring	0.018
25	Openness	0.009
9	Conflict Management	0.008
4	Approachability	0.007
13	Empathy	0.004
1	Ability to Prevent Exploitation and Abuse	0.002

The competencies that are listed out of the competency mapping process are forwarded to the competency modeling process that results into a usable competency model. However, the current study only proposes the modeling process for further research.

Competency Modeling Process: Scope for Further Study

The competency modeling process (Figure 2) illustrates the step by step procedure required to be followed by organisations or competency researchers. A concentrated effort towards developing the competency model has achieved great results ever since the concept entered the organisational development arena. The current study proposes the competency modeling process for the emergency relief workers which can be taken up for further research.

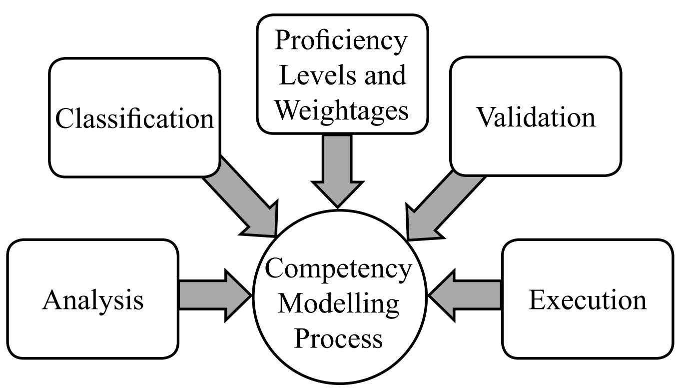

Figure 2: Competency modeling process (Kandula, 2013)

Analysis: The competencies forwarded by the competency mapping process cannot be finalised as it is based on the secondary data and the primary evidence is necessary to institutionalise the model for implementation in the organisation. Hence, it is proposed that the competencies (Table 1) are converted into a behavioural rating scale and data is collected from the first responders in disaster management. Such data should be put through in-depth analysis to identify the most required competencies from the list.

Classification: Not all competencies are job oriented. There are certain competencies which are person oriented which determine the fundamental difference between performance and superior performance of the job incumbent. Hence, it is important that the competencies that are identified from the analysis phase are classified into different clusters of competencies, which help organisations determine the training needs and the selection decision criteria. The competency listed by the mapping process can be classified as illustrated in Table 2. However, the classification needs to be tested for significance using the primary data.

Table 2: Classification of Competencies

<table>
<tr><th>Personal</th><th>Technical</th><th>Functional</th><th>Specific To The Disaster</th></tr>
<tr><td>Integrity</td><td>Financial Literacy</td><td>Statutory Compliance</td><td>Knowledge Related to Disaster Management</td></tr>
<tr><td>Communication</td><td>Analytical Thinking</td><td>Decision Making</td><td>Field Experience</td></tr>
<tr><td>Leadership</td><td>Information Technology Knowledge</td><td>Coordination (Internal and External)</td><td rowspan="12">Multi-Cultural Sensitivity</td></tr>
<tr><td>Openness</td><td>Risk Evaluation</td><td>Stakeholder Management</td></tr>
<tr><td>Interpersonal Skills</td><td>Attention to Detail (Accuracy)</td><td>Resource Management</td></tr>
<tr><td>Adaptability</td><td>Presentation</td><td>Capacity Building</td></tr>
<tr><td>Ability to Prevent Exploitation and Abuse</td><td rowspan="8">Documentation</td><td>Strategic Orientation</td></tr>
<tr><td>Service Orientation</td><td>Logistics and Supply Chain Management</td></tr>
<tr><td>Stress Management</td><td rowspan="6">Business Process Knowledge</td></tr>
<tr><td>Conflict Management</td></tr>
<tr><td>Mentoring</td></tr>
<tr><td>Multi Tasking</td></tr>
<tr><td>Personal Credibility</td></tr>
<tr><td>Approachability</td></tr>
<tr><td>Empathetic</td><td></td><td></td><td></td></tr>
</table>

Proficiency Levels and Weightages: The impact of the implementation of the competency model is determined by the accuracy of the proficiency levels defined and the weightages assigned as per the job. The proficiency is generalised for all the jobs but the weightages are assigned as per the requirement of the different jobs that the competencies are associated with. It is also suggested that the proficiencies are defined on an even scale to avoid the most possible central tendency.

Execution: Once the proficiency levels are defined and the weightages are assigned for each job, the competency model is ready for implementation. The competency models can be used for the selection process for determining the criteria that the candidates should be evaluated for. The model is the most relevant in designing and executing the training and development programs in organisations. The proficiency levels assist in evaluating the learning of the trainees from the training and also the performance of the job incumbent. The weightages help the organisations determine the basic value contributed by the job to the organisation. The competency models can help the organisations to plan the careers of emergency relief workers so as to develop and retain for different roles in the organisation.

Competency mapping and modeling process, thus, creates an platform to integrate the human resources function of the humanitarian organisations in the best possible way so as to perform better. The recent technological advancements and focused research in disaster management only increased the responsibility of the emergency relief worker to be more adaptable and quick in learning the tricks of the trade. Also, increasing intensity and vulnerability of the disasters further intensified the need for the relief worker to be better prepared for the unexpected worse. The competency based approach helps in the preparedness of the humanitarian logistician.

Conclusion

Competency Models can help organisations bring a lot of clarity in to the job role and define in detail to the job incumbent the expectation from him on the job. The highly dynamic nature of the job of an emergency relief worker requires the well-defined competency model that shall enable the organisations to be abreast with the changing landscape of disaster management. The exponential increase in research, technological advancements and cross border collaborations have mandated the role of the humanitarian logistician and a detailed competency model can help the responders to be better prepared so as to relieve the vulnerable from the pain as early as possible and hence, contributing to the performance of humanitarian logistics organisation.

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Transitional Shelters

Kankana Narayan Dev[a] and Amarendra Kumar Das[a]

Abstract

Humanitarian Aid during disasters consists of relief material, food and nutrition, emergency medical facility and Relief Shelter. There are several stages of Relief Shelter concerning humanitarian aid, but the focus of this paper is “Transitional Shelters” which is an intermediate kind of shelter in disaster management where displaced population resides for a particular (short) period till they can shift to their reconstructed habitats. Presently, disaster relief shelters functioning the role of transitional shelters are often in the form of plastic sheets, tents, prefabricated units, and public community buildings, such as leisure centres, university halls of residence, places of worship, sports venues, and private rentals. The providence of such facility is often carried out by the government administrations, NGOs, and humanitarian aid agencies. The term of residence in such facility ranges from days to years, which disrupts the normal functioning of the public institution that is used to house the displaced population especially schools and colleges. For successful disaster management the contribution of efficient transitional shelters designed and implemented with community participation is the need of the hour.

Keywords: disaster management, humanitarian, relief shelter, transitional shelter

Introduction

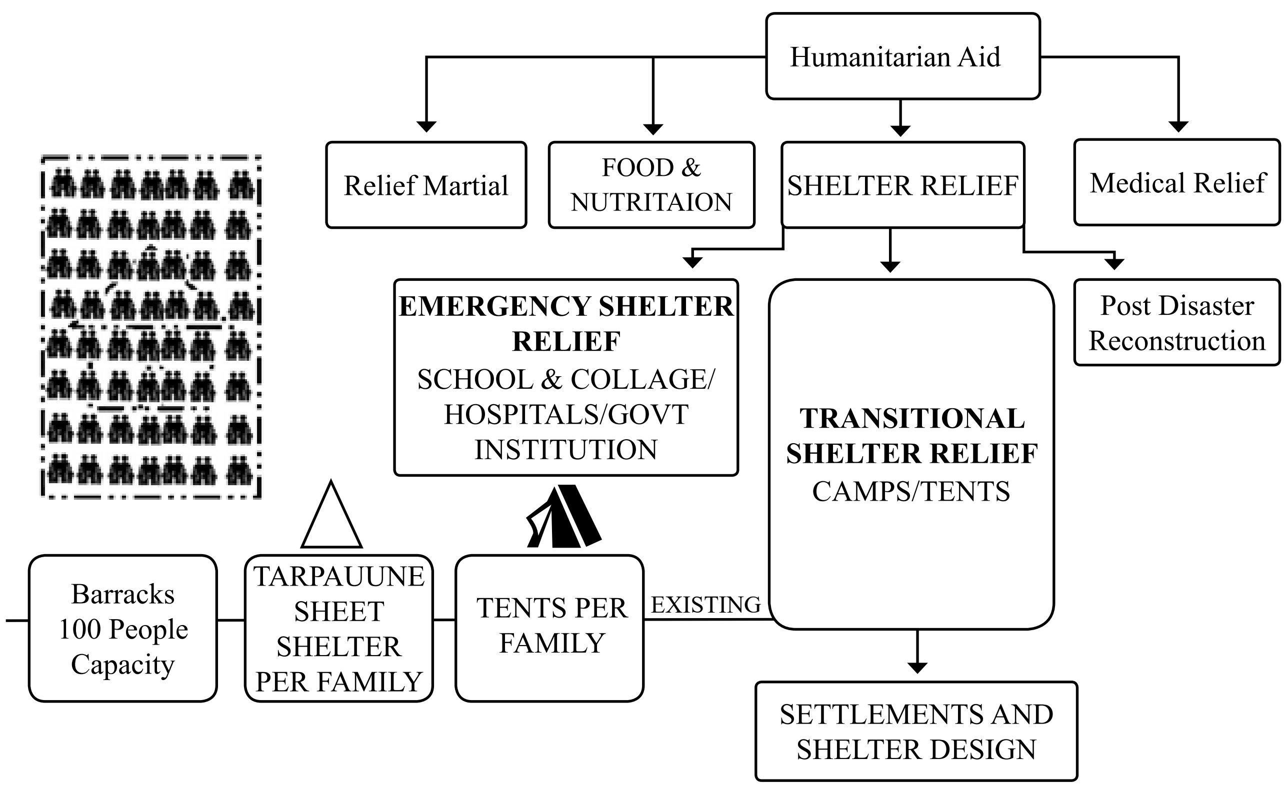

Figure 1: Current scenario of relief housing in disaster management

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The provision of relief shelters is widely accepted as a necessary component of response and recovery following disasters such as earthquakes, hurricanes, tsunamis, and floods; it is not yet clear which type of shelter is most appropriate given various circumstances that can occur in practice. As a result, the provision and performance of shelters in certain cases has been hindered by inappropriate climate, cultural differences, poorly located settings, camp-related social issues, expenses, overcrowding, poor services, and delays (Barakat, 2003, Nigg et al., 2006, Johnson et al., 2006, El-Anwar et al., 2009, Félix et al., 2013b). Also, the design of shelters may potentially overlook locally available skills and materials (Johnson, 2007b, Hadafi and Fallahi, 2010), and shelters may not provide an acceptable standard of living. Lastly, in some cases, it has also been difficult to recover shelters for future storage and re-use (Arsalan and Cosgun, 2007). Though transitional shelter as a form of accepted phenomenon is very recent, 2000 Coecellis and Vitalle presented in the SPHERE project. For the successful implementation of transitional shelter which can provide for the personal safety, climate protection, privacy, security, comfort, and resistance to disease and ill health a preparatory measure for such shelters is a must. The study of transitional shelters makes a comprehensive analysis transitional shelter property through review of literature and establishes the need of transitional shelter in disaster management using a project report study where the author was assigned to design makeshift shelters for victims of a manmade disaster.

Literature Review

Transitional shelter is an incremental process which supports the shelter of families affected by conflicts and disasters, as they seek to maintain alternative options for their recovery. Through its five characteristics, transitional shelter can be:

- Upgraded into part of a permanent house;
- Reused for another purpose;
- Relocated from a temporary site to a permanent location;
- Resold, to generate income to aid with recovery; and
- Recycled for reconstruction

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Ten Principles of Transitional Shelter

- **Access Situation:** The shelter response for transitional shelter need not be universal. Some different approaches exist for providing shelter in post-disaster or post-conflict situations, and comprehensive assessments should be undertaken to understand the potential strengths, weaknesses, opportunities, and threats of all shelter responses before selecting the most appropriate.
- **Involve Community:** the greatest effort in response is made by those affected. They are also aware of the most suitable, sustainable and rapid routes to recovery. The involvement of the community in implementation, the more efficient and cost-effective the solution is.
- **Develop Strategy:** Programmes should be used to support the appropriate groups within the affected population for a period of proper health and sanitation facility to support the entire population, both displaced and non-displaced, until durable shelter solutions are made
- **Reduce Vulnerability:** Transitional shelter programs should reduce the vulnerability of the affected population and contribute to disaster risk reduction by using site selection, site preparation, shelter design and construction

as a platform for communicating hazard resilient techniques and best practice and by building capacity within the affected population.

- **Agree Standards:** There is no standard transitional shelter design. Standards should be agreed upon, with participation from the affected population, which are appropriate for each beneficiary group.

Five Characteristics of Transitional Shelters

- **Upgradeable:** While being inhabited, a transitional shelter may be improved over time to become a permanent shelter solution.
- **Reusable:** Transitional shelter is inhabited while parallel reconstruction activities are taking place.
- Re-locatable: Relocation distinguishes transitional shelter from other shelter approaches. A relocatable shelter can be built on land where tenure is insecure or temporary.
- **Resalable:** Transitional shelter is inhabited while parallel reconstruction activities are taking place. Once reconstruction is complete, the transitional shelter may be dismantled and its materials used as a resource to sell.
- **Recyclable:** Transitional shelter is inhabited while parallel reconstruction activities are taking place. The transitional shelter may be gradually dismantled during the reconstruction process and its materials used in the construction of a durable solution.

Field Report

Transitional Shelter for the Ethnic Riot in Kokrajhar, Assam, India 2012

In the year 2012 post-ethnic clashes among Bodos and Minority Muslims more than three lakhs people lost their home in the Bodoland Territorial Council State of Assam. The administration was in an urgent need to rehabilitate the victims in a short period so that they can resume schools till then which was acting as the relief camps. A design of Bamboo Transitional Shelter using local building material bamboo in abundance was developed to meet the urgent need of rehabilitation. The prototype was tried and tested for both the communities with their acceptance.

Figure 2: Development of transitional shelter with community participation at bodoland

Source: Author

Context and Design

Building Transition Shelter

According to Sphere standards, the following steps are recommended to be followed in planning transitional shelters following a disaster to optimise the matching of needs with the availability of land and other resources.

- Rapid Assessment of relocation and resettlement issues (excerpts from Rapid Assessment on Relocation/ Resettlement Issues of Displaced Persons due to the Tsunami compiled by UNICEF by the UN Guiding Principles on Internal Displacement).
- Analysis of data obtained to determine size type and form of the transitional shelters and settlements.
- Developing layout plans – criteria Compiled by Centre for Housing Planning & Building (CHPB), Red-R and Practical Action South Asia.
- Designing transitional shelters – criteria compiled by Centre for Housing Planning & Building (CHPB) and Practical Action South Asia.

Rapid Assessment of Relocation and Resettlement Issues

A rapid assessment (preferably carried out within ten days) is necessary to support and facilitate decisions and incorporate the wishes of the displaced persons regarding possible relocation options.

The objectives of the assessment would be to find out:

- Opinions of displaced person (living in camps and with host families)
- Socio-economic profiles of camp inhabitants.
- Experiences and needs of the families who are hosting the affected communities.
- Assessment of the knowledge and access to information among the displaced persons to relocation/resettlement issues.

Analysis of data obtained to determine size type and form of the transitional shelters and settlements. The data obtained from the above assessment should be analysed regarding political, socio-cultural, economic, technological and numerical terms so that the size, type, and form of the settlement and transitional shelters can be determined.

Analysis of Transition Shelter to Conventional Disaster Relief Shelters

Options	Pros	Cons
Bamboo structure with tarpaulin sheets	- Temporary in nature indicating that its only makeshift - Easy procurement in large quantities- most economical - Possible to distribute the ready material kits and let people take responsibility to erect - Easy to erect	Not very comfortable climatically
Bamboo transition shelter	Temporary in nature indicating that its only makeshift - Possible to distribute the ready material kits and let people take responsibility to erect - Climatically more comfortable	- Procurement may be more difficult as specifications, costs and available quantities may vary. - Not so quick to erect but quicker than third option. - Costlier than first option

Bamboo structure with CGI sheet roof	Conventionally executed	Long lasting solution may encourage continuation in camp. Possible to distribute but difficult to be erected by people themselves. Will take more time to deliver if required in large quantities CGI sheets are difficult to be reused if once nailed. Costly option
Bamboo structure with CGI sheet roof (community shed)	Conventionally executed	Lack of privacy for women, feeding mothers, old women need to be built and delivered Not so quick to be delivered costlier than option 1 and 2 Risk of longer continuation

Figure 3: Comparative analysis of the transitional shelter with other models

From the comparative study, the developed transitional shelter had the following properties:

- Comfortable shelter with privacy for humanitarian aid.
- Low cost (it was found that the cost of shelter per family comes down to 60 % less if the bamboo shelter is offered in place of the PWD barracks in the riots of Kokajhar year 2012)
- Innovative use of split bamboo (as per structural physics semi-circular section of structural members here the beams and diagonal bracings, purlins etc. Is much better in tensile stress than round sections of bamboo.)The use of split bamboos makes the total required bamboo (*jati*) to 10 number.
- Introduction of bamboo mats (*dharis*) as a potential building material and innovative make of the "HDPE sheet and Bamboo mat sandwiched roofing."
- The development of the transitional using locally available material and skill helps in empowering the community in Disaster Management.

Conclusion

The project of the Bamboo Transition Shelter is a suitable type of shelter used for humanitarian emergencies in the North East India and also further becoming an enterprise in providing such housing to the whole of India and the world. The structural properties of the shelter are suitable for its easy assembly and mobility within a short span of time. It is of great importance that aid agencies worldwide consider the advantages of transition shelter and indeed the concept. Every year more than a lakh people need shelter during emergencies, such as floods, landslides, earthquakes, riots, etc. The existing models of relief shelter which are usually in the form of emergency housing in schools, hospitals, and public institution are not successful in providing enough support to the victims till they can rebuild their homes. Also, the barrack-like accommodation by the administration in such situations where 100 people stay in a row have been found to be very unhygienic, uncomfortable climatically and lack of privacy. Therefore, a designed transition shelter is environment-friendly and less costly as learned from the field experience of shelter design developed in situ at Kokrajhar for the riot victims in the year 2012.

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ISRO's Capabilities in Disaster Management

Kriti Khatri[a], Bindia Kumari[a] and K Shahana[a]

Abstract

This paper presents the capabilities of ISRO's Space Program in dealing with Disaster Response and Recovery efforts, associated with pre- and post-disaster event and help in restoration of affected areas back to normalcy. Disasters, natural or manmade, result in loss of life and property. Disaster Management aims to lower, or eradicate, the probable losses from hazards, indemnify fast and apportion support to victims to attain swift and efficacious recovery. Satellite based telecommunication, remote sensing for earth observation and navigation systems contribute to more effective disaster risk management and emergency response.

ISRO's prime objective is to enable India plus its neighbouring countries to use space-based information in all stages of disaster management including prevention, preparedness, early warning, response and reconstruction. This paper highlights the efforts taken by ISRO during the recent disasters to support the common people. The existing as well as upcoming ISRO's space programmes are being proposed so as to have better future scenario prediction, detection of disasters and providing timely location based help for India as well as its neighbouring countries.

Keywords: Distress alert transmitter (DAT), disaster management support (DMS), disaster warning dissemination system (DWDS), geographic information system (GIS), national database emergency management (NDEM), virtual private communication network (VPN)

Introduction

Disaster caused by natural or man-made perils has adverse effects not only to its occurring environment alone, but also cause loss of lives and properties as well. Over the last few decades, both natural and man-made disaster have been increasing worldwide, with the highest number of occurrences, damages and casualties in Asia. According to the 2016 World Disaster Reports, the top five most common disasters occur due to floods, earthquakes, storms, heat wave and drought. In 2016, there were 574 natural disasters reported worldwide, affecting 117 countries, 41.8% disasters occurred in Asia. In India 3,666 people were reported killed while 16, 561, 182 were affected by these natural disasters. Figure 1 shows the geographical distribution of India over a number of major natural hazards, such as floods, cyclone, droughts, etc. Consequently, if these natural disasters are not examined and managed properly, they will have adverse effects on the environment, socio economic activities and destructions of lives and assets of host community.

Since inception, ISRO's space program have been helping not only the people of India but also the people worldwide in one form or the other by providing services as well as timely information for relief and restoration at the time of disasters. ISRO's co Remote Sensing Satellite constellation regularly helps in crop Inventory, Groundwater Prospects Mapping and drought assessment; Landslides and Earthquakes monitoring; Forest fires, Monitoring of Glacial Lakes/Water Bodies and Satellite Aided Search and Rescue. Also continuous research and development keeps on taking place for improvement of the early warning systems and decision support tools.

The disaster management cycle illustrated in Figure 2, is an ongoing process by which plans are made so that the impact of disasters is reduced, response during and instantly following a disaster is speeded up, and steps to recover after a disaster has occurred can be taken up accordingly. Appropriate actions by governments, businesses, and civil society at all points in the cycle helps in greater preparation, better warnings, reduced susceptibility/preclusion of disasters during the next iteration of the cycle.

[a] Delhi Earth Station, Space Applications Centre, ISRO

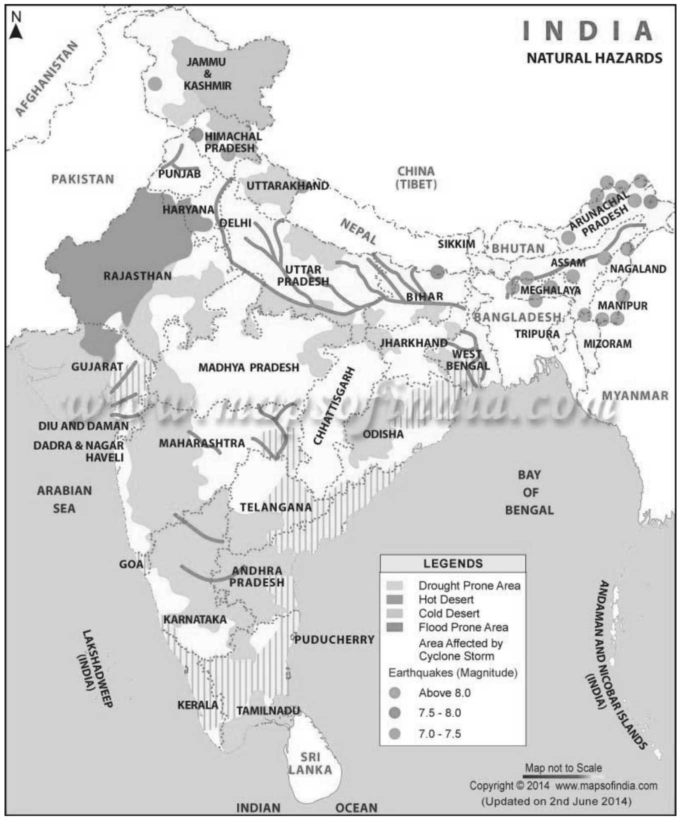

Figure 1: India climatic disaster risk map

Contributions from space technology have reduced the lead time during preparedness, response and recovery Phases of Disaster management. Under the Disaster Management Support (DMS) programme, the services stemming from space infrastructure, setup by ISRO, are optimally created to provide data and information required for effective management of natural disasters in the nation. The Geostationary (GEO) satellites (Communication, Navigation and Meteorological), Low Earth Orbiting (LEO) Earth Observation satellites, aerial investigation systems along with ground setup form the core element of the surveillance Systems for disaster management. In order to strengthen the disaster management activities, these space based information is continuously provided by the DMS programme to the state and central government departments.

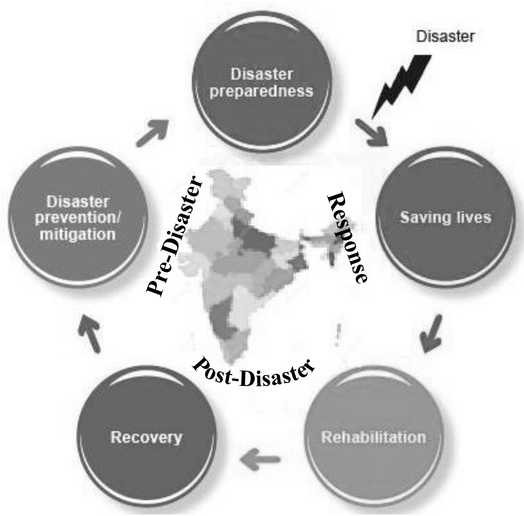

Figure 2: Disaster management cycle

Telecommunication Support for Disaster Management

When any disaster strikes, the terrestrial-based communications get affected the most. Communication is vital and at high demand during disasters as it's the need of the hour for the decision makers, administrators involved in the relief operations and the public affected by the disaster. With this background, ISRO has implemented broadband satellite based virtual private communication network (VPN) for Disaster Management Support (DMS), at national level, in India.

It has been possible to connect remote and inaccessible rural areas/off shore islands with the help of INSAT series of satellites. During disasters, this ensures fail-safe communication, which in turn helps in providing relief measures. ISRO has set up satellite based VPN network in order to establish emergency communication during DMS activities. These facilitate secure data access through a dedicated network connecting information providers as well as users at different levels. The National Emergency Operation Centre (NEOC), Cabinet Secretariat, NDMA, PMO; other key data providing agencies (IMD, CWC, GSI, SOI, INCOIS, NIDM); and the 20 multi-hazard prone State Emergency Operation Centres (SEOCs) are connected to the Decision Support Centre (DSC) of NRSC / ISRO.

For a fail-safe communication during emergency, ISRO has developed INSAT Type-D terminals (portable satellite phones with solar chargeable battery packs) for deployment by various States during disasters. Distress Alert Transmitter (DAT) is a low cost satellite transmitter developed for emergency communication of alert messages from fishing boats. These terminals are distributed to fishermen through the Indian Coast Guard to disseminate of Disaster warnings directly to the potential victim using DTH based Disaster Warning Dissemination System (DWDS) - a custom-made set-top box. In this warning system, siren warning followed by voice message can be sent to individual or group of DTH receivers. In association with India Meteorological Department (IMD) and Doordarshan, 500 DWDS is being established at different locations The various terminals/systems developed by ISRO/DOS can be seen in Figure 3.

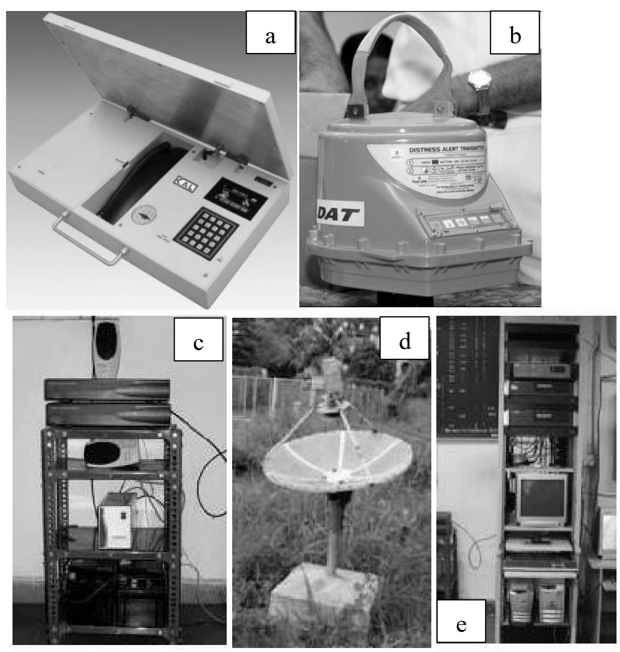

Figure 3: Different terminals developed by ISRO/DOS for Communication during disaster.

a) INSAT Type-D terminals (portable satellite phones with solar chargeable battery packs).
b) Distress Alert Transmitter (DAT) for emergency communication of alert messages from fishing boats.
c) DTH based DWDS indoor transmit equipment
d) DWDS outdoor receiving antenna
e) DWDS S-band Receiver

Remote Sensing Support for Disaster Management

The Indian Remote Sensing (IRS) satellites observe the planet Earth from space and provide periodic synoptic and systematic information relevant to land, ocean and atmosphere and several aspects of environment. For different user requirements in the country and for international usage, a variety of instruments have been flown onboard the IRS satellites to provide necessary data in a diversified temporal, spectral and spatial resolutions. This information is helpful in a number of ways to the state and central governments – for understanding weather and climate, supporting environment and eco-system, monitoring and management of natural resources, planning/monitoring/ supporting activities during disaster events. A GIS (Geographic Information System) based repository named NDEM (National Database emergency management) Portal has come up in order to support disaster/ emergency management for the country.

The National Remote Sensing Centre's (NRSC) Decision Support Centre is involved in monitoring natural disasters, such as cyclones, floods, landslides, earthquakes, agricultural drought and forest fires at operational level. The information generated (in near real time) from aerial systems are distributed to the concerned for aiding in decision making. The value added products generated using satellite imagery helps in addressing the information needed to cover all the phases of disaster management such as, preparedness, early warning, response, relief, rehabilitation, recovery and mitigation.

Floods

Satellite images are the best tool to assess the extent of flood affected areas. The satellite is programmed to collect the required data (optical or microwave) for the demarcation of flooded areas. The flooded and non-flooded areas marked in different colours on a map along with the affected villages and the transport network are circulated to the concerned Central State agencies immediately. Also flood plain mapping is being carried out using airborne LiDAR / LFDC data for flood inundation modelling and flood depth assessment. The pre-flood and post-flood images by RADARSAT-2 SAR of Kaziranga National Park, Assam can be seen in Figure 4.

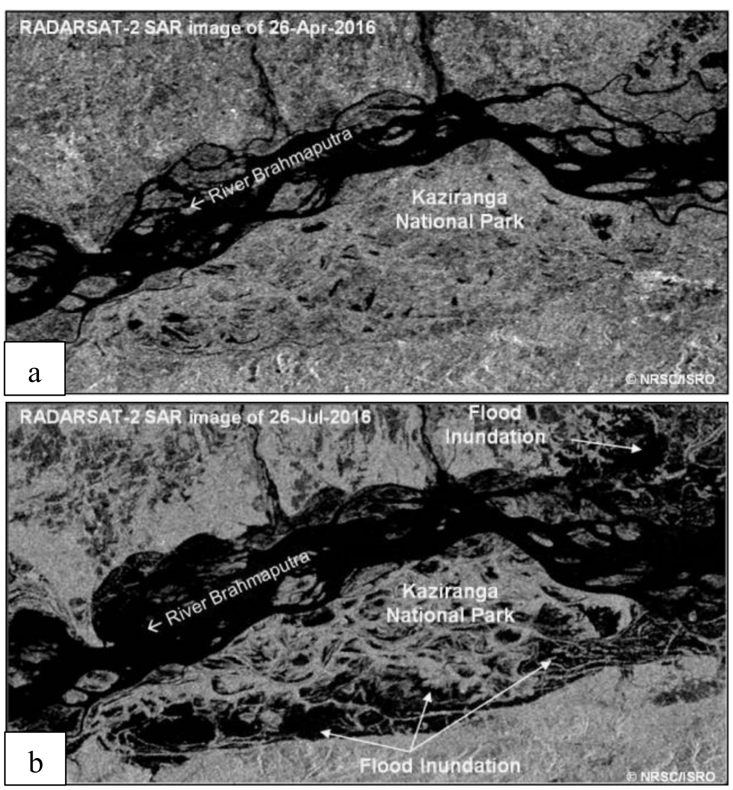

Figure 4: Flooding in kaziranga national park, assam as observed from satellite image. a) Radarsat-2 sar image of 26 april 2016 (pre). b) Radarsat-2 sar image of 26 july 2016 (post)

In 2015, after monitoring flood in 10 different states, more than 105 flood maps were disseminated to the concerned State and Central officers and were made available to users on the web through Bhuvan and NDEM web portals.

Also a model developed by ISRO, for heavy rainfall or cloud burst alerts, is being used for Uttarakhand and Himachal Pradesh regions. This information is made available on ISRO's MOSDAC (Meteorological & Oceanographic Satellite Data Archival Centre) website. Figure 5 shows the images obtained by Resourcesat-2 AWiFS Image in June 2013. This suggests that there would have been heavy rainfall in lower areas, including the Kedar valley and other part of Uttarakhand, leading to the floods.

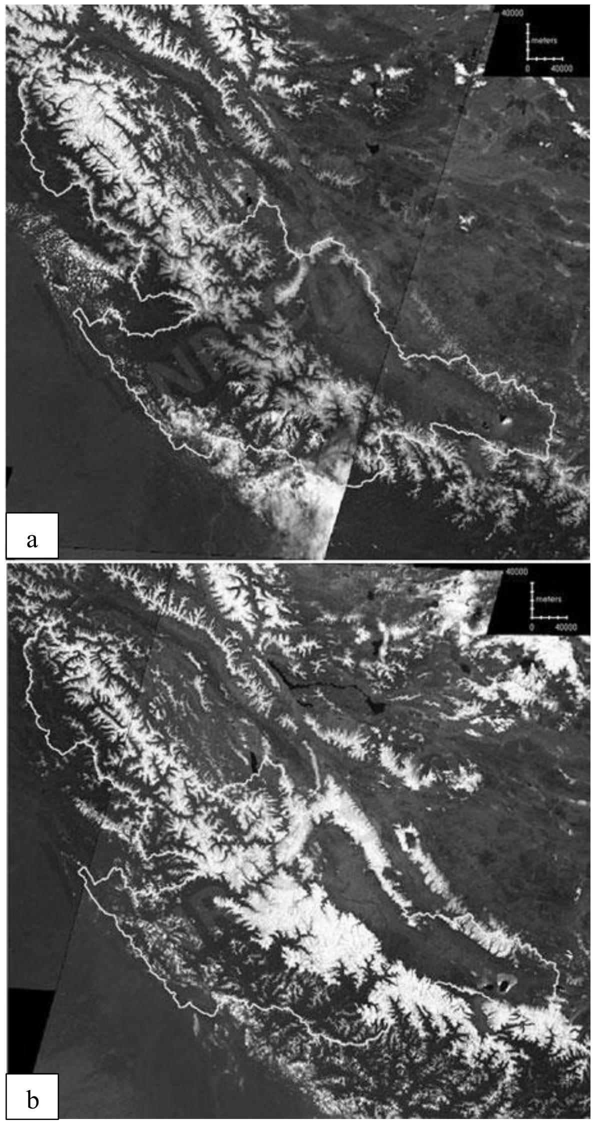

Figure 5: Cloud burst in Kedarnath Sector. a) Resourcesat-2 AWiFS Image of June 1, 2013 shows some snow covered areas in the upper reaches of himalaya. this was well before the rains hit (pre). b) resourcesat-2 awifs image of june 21, 2013, which was acquired after the event, clearly shows that the area under snow has increased substantially (post).

The percentage of success of the early warnings was about 87% in 2016. During 2016, near real-time monitoring was done for major floods in 11 states and disseminated through Flood Early Warning System (FLEWS). Using predominantly microwave data from RISAT-1 and Radarsat-2 satellites, more than 110 flood inundation maps were disseminated to the concerned government agencies.

Cyclone

Meteorological Department predicts the tropical cyclone track, intensity and landfall. Mathematical models, developed at Space Application Centre, ISRO are regularly used to forecast the upcoming tracks of the cyclone. These experimental track predictions are regularly posted on departmental web portal (http://www.mosdac.gov.in/) as part of information dissemination.

The data from INSAT-VHRR, NOAA-AVHRR and METEOSAT are used for identifying cloud systems over the oceans, and also for tracking cyclone and prediction of storm surges. The wind pattern generated by the Oceansat-2 Scatterometer data is being used to forecast the formation of a cyclone beforehand the depression turns into a cyclone. Such cyclogenesis forecasts are done for all the global cyclones and uploaded to the portal. Figure 6 depicts the Oceansat-2 derived wind vectors during the Phyan Cyclone of 2009.

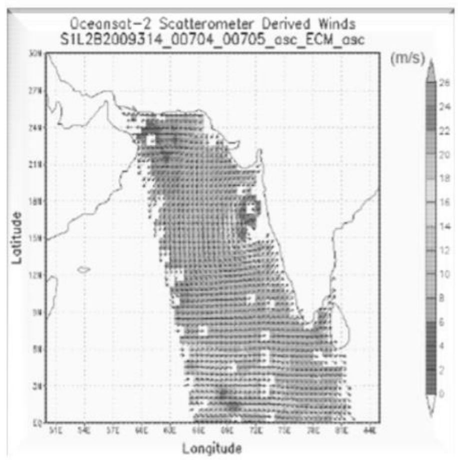

Figure 6: Oceansat-2 derived wind vectors during Phyan Cyclone 10 November 2009.

The early warning system was useful in early evacuation and saving many lives, during the recent cyclone Phaillin that hit the state of Orissa in India, in October 2013. Almost 1 million people were successfully evacuated from the state of Orissa and Andhra Pradesh following the warning of the cyclone by disaster management authorities. Thus, space based technologies, through timely provision of reliable data can help in minimizing the economic losses and damages.

At present, Kalpana-1 (VHRR, DRT), INSAT-3A (VHRR, DRT, CCD) and INSAT-3D (Imager, Sounder, DRT) satellites carrying meteorological payloads are supporting weather forecasting services. The performance of the system during the current year has been maintained to the level of 98% operation efficiency (24x365 bases). The output generated by the system is used for efficient and successful forecasting the major weather events, particularly major cyclones in 2015.

During the Tropical Cyclone Vardah that made landfall near Chennai city in December 2016, with peak intensity of 130 km/h, maps showing vulnerable areas with respect to nearby streams were derived from satellite data and provided to Govt of Tamil Nadu in advance for preparatory activities.

Forest Fire

Forests play an important part in maintaining ecological balance of the earth. Every year, around 55% of the forest cover gets affected by the fires resulting in losses of the ecological balance as well as causing an economic loss of over 440 crores of rupees. The Forest Survey of India (FSI) has estimated that 1.45 mha of forest is affected by fire annually with 6.17% of forests susceptible to severe fire damage. Forest fires (hotspot) can be assessed on a global scale with the help of observations based on satellite data. They can be detected by combining the data from various sensors like AVHRR, ATSR, TRMM VIRS, MODIS. Under the DMS program of ISRO, active forest fire have been observed using satellite data since 2006. The observed satellite images and interpreted information is uploaded daily to the Indian Forest Fire Response and Assessment System (INFFRAS) website. INFFRAS is designed to meet the requirements of the forest department at Pre fire, during fire and Post fire time. Recent Forest fire in Almora district of Uttarakhand state is shown in Figure 7 a).

Within half an hour of satellite overpass, email and SMS (short message service) are used to disseminate information to the FSI and State Forest Departments regarding active forest fire location. The information is also published in BHUVAN. IRS Resourse SAT 1 & 2 satellite's AWiF sensors are used to assess the Post-fire burned area of the forest. Figure 7 (b) and (c) depicts the Spatial and temporal distribution of forest fire in Uttrakhand.

In the 2016 fire season, many fire detections were done using satellite data and disseminated through Bhuvan. Also during the nearly 1600 active forest fire detections in Uttarakhand, these were also studied in detail by using wind and other meteorological parameters at 10-km spatial resolution, simulated WRF models, to quantify and track the dispersion of pollutants etc. These were then provided to the Ministry of Environment, Forests and Climate Change.

Landslide

Every year, landslide in mountainous areas, is one of the major natural disasters that causes widespread damage and loss of life. On an average, about 0.412million km, i.e. 12.6% of the Indian sub-continent is prone to landslides. In areas that are inaccessible like the mountain terrains, satellite remote sensing plays a pivotal role for collecting information on landslide. Predictive modeling in GIS using terrain parameters (e.g. topography, geomorphology, lithology, land use, etc.) and known landslide occurrences can be done to prepare 'Future landslide susceptibility' maps. The damages caused due to landslides, can be mapped by very high resolution satellite data, such as Cartosat-2 (ground resolution: 1 m).

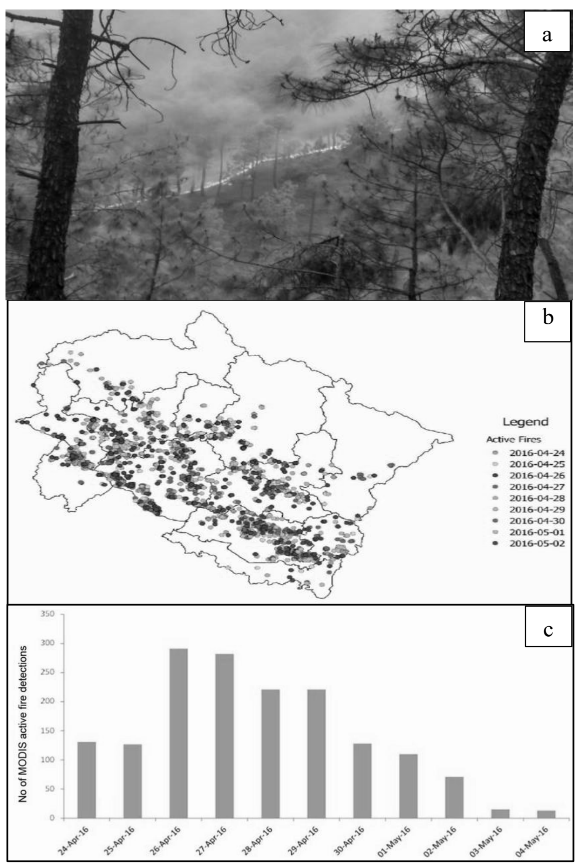

Figure 7: a). Forest fire in almora district of uttarakhand state. b). Spatial distribution of aggregate forest fires locations in uttarakhand, india (24/4/2016 - 2/5/2016) [26]. c). Temporal distribution of forest fires in uttarakhand (20/4/2016- 4/5/2016).

Landslide Hazard Zonation maps (LHZ) and early warning system along pilgrim/tourist routes of Himachal Pradesh and Uttaranchal, Himalayas and in Shillong-Silchar-Aizwal sector are prepared by the Department of Space (DOS). Damage estimations (caused to roads, built-up land, agricultural land, etc.) are being monitored under DMS activities. Figure 8 shows the Bhuvan disaster services on landslides. The early warning system is generated based on the spatial (terrain, morphological and geological factors) and temporal (triggering factors) controls of slope failure.

During Feb-May, 2015 CARTOSAT was used to monitor the landslide on Phuktal river (Zanskar region), Kargil District, J&K. This included regular updates on impoundment area, volume of water and possible scenario due to breach and was provided to NDMA. The inputs were used by NDMA to assess the threat and clear the blockade. Also continuous monitoring of the status of Lhonak Lake in Sikkim and Pareechu Lake in Tibet was carried using CARTOSAT data.

Figure 8: Bhuvan disaster services on landslides generated for the pilgrimage route corridors leading to kedarnath sector in uttarakhand.

The early warning system for rainfall triggered landslides, developed by ISRO, for use along the pilgrimage route corridors leading to Gangotri, Badrinath and Kedarnath as well as along the Pithoragarh-Malpa route in Uttarakhand was operational in 2016. The forewarning is generated based on the statistical relation between the terrain (geological, morphological) and temporal (primarily long-term rainfall events) factors.

Earthquakes

Remote sensing along with GIS can be linked with other topographical and geological database to arrive at hazard map that provides a database from which the evidences left behind by disaster can be recorded. The earthquake prone areas are generally large, but they are constrained to well-known areas (plate contacts). Satellite data gives an overall outline of the area affected by the disaster along with the terrain information. These data are then used for carrying out disaster assessment and relief measures under the DMS program.

During the Nepal earthquake in April 2015, quick satellite coverage for acquisition by Indian Earth Observation (EO) satellite data was used for damage assessment in the urban areas like Kathmandu valley and rapid inventory of earthquake induced landslides was done. High-resolution satellite images (Cartosat-1/2, Resourcesat LISS IV) were used to map co-seismic landslides triggered during the earthquake under the pre- and post-disaster DMS activities. This can be seen in Figure 9. Also Total Electron Content (TEC) data obtained from several CORS / International

GNSS Stations was studied by ISRO, prior to the occurrence of the Nepal Earthquake. More than 5000 landslides have been mapped in this attempt. Many landslide-dammed lakes have also been mapped.

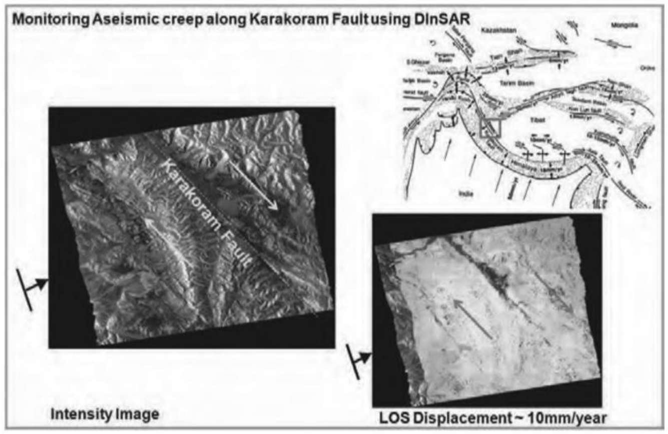

Figure 9: Monitoring aseismic creep along karakoram fault using dinsar.

Navigation Satellite Support for Disaster Management

Recently ISRO completed the constellation of Indian Regional Navigation Satellite System (IRNSS) commonly called NAVIC (Navigation by Indian Constellation) by Prime Minister Narendra Modi.

IRNSS is an all-weather satellite based navigation and positioning system. It is a constellation made up of a combination of geostationary earth orbit (GEO) and geosynchronous orbit (GSO) over the Indian region. It consists of seven satellites - three in GEO orbit (at 34º E, 83º E and 131.5º E) and four in GSO orbit inclined at 29 degrees to the equatorial plane with their longitude crossings at 55º E and 111.5º E (two in each plane) as shown in Figure 10. All the satellites are continuously visible in the Indian region for 24 hours a day. IRNSS provides position information at high accuracy level (mm level) to a normal level (a few meter levels) over India and a region extending outside the landmass to about 1,500 kilometers. The system provides two types of services, a Standard Positioning Service (SPS), and a Restricted Service (RS). Both of these services are provided in L5 band and S-band. India is now proudly among five nations in the world which have their own satellite navigation system.

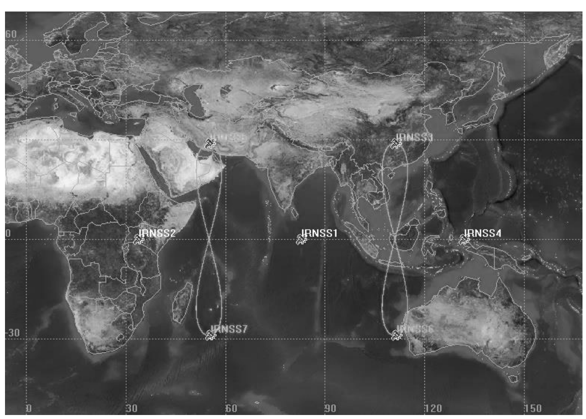

Figure 10: Irnss constellation

At the time of emergency, real-time or, at least, near-real-time imagery response (with Remote Sensing and GIS Tools) for natural and man-made disaster creates a need for rapid comprehensive and reliable information. The use of NAVIC satellites, in disaster management is a natural fit because almost every aspect of a disaster is referenced by location. NAVIC can be used at every stage of a disaster event, right from the pre-disaster, during disaster and post-disaster events. It will thus aid in the DMS support. NAVIC will allow for easy integration with other geospatial technologies that aid in disaster management. Along with these geospatial tools that will be helpful in monitoring, assessing, detecting or manage disaster and thus will be helpful for management as well as mitigation during disasters as shown in Figure 11.

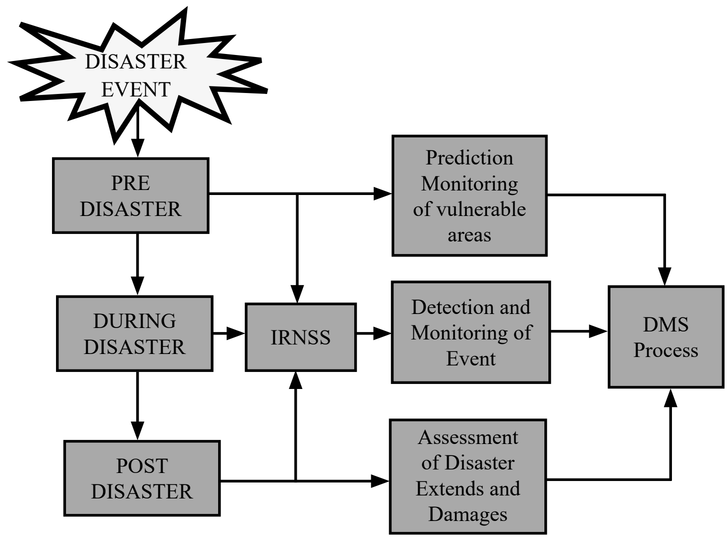

Figure 11: Irnss based dms

Support to International Community

ISRO makes active participation in the international front by sharing experiences, exchanging information and best practices towards global disaster management. With the recent launch of South Asia Satellite also known as GSAT-9 satellite in Ku-band with coverage over South Asian nations - Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, Sri Lanka and India, ISRO has a goal to provide the people of the region with better communication, weather forecasting, tele-medicine and response to disaster management.

DMS program of ISRO is responding well to the International Charter on “Space and Major Disasters”, the initiatives of UNOOSA (United Nations Office for Outer Space Affairs), UNESCAP (United Nations Economic and Social Commission for Asia),“Sentinel Asia project” for supporting disaster management activities in the Asia-Pacific region, BIMSTEC (Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation) and Economic and Social Commission for Asia and the Pacific (ESCAP).

The Indian geo-stationary satellite, INSAT, without fail, provide area specific Cyclone Warning service to Bangladesh even when there is a failure of conventional communication channels.

The Regional Specialized Meteorological Centre (RSMC) in New Delhi, India is one of the five centres recognised by the World Meteorological Organization (WMO) under a global system for monitoring tropical cyclones. The satellite imagery from INSAT is used to keep a constant watch on the tropical cyclones of Arabian Sea and the Bay of Bengal.

The Satellite Aided Search and Rescue (SAS&R) system of India provides services to seven neighbouring countries. In 2015-2016, it supported rescue of 2072 lives in 103 SAR incidents and 51 lives out of 7 incidents. Online Beacon registration system has been upgraded based on user requirements to respond to these activities. About 815 new radio beacons were added in Indian database (most of them for Aviation applications) in 2016.

ISRO has carried out the Lead Role in International Charter Operations during April-October 2015. During 2015, satellite data support was provided for 10 emergency requests from Vietnam, Pakistan, Indonesia, Bangladesh, Japan, Myanmar, Nepal and Taiwan for floods, oil spill, landslides and Typhoon disasters. ISRO supported 23 disaster events in 10 countries by providing 42 data sets from IRS satellites in 2016.

Future Satellites for Disaster Management Applications

To reach the masses and educate them on national disaster management, ISRO has made its disaster management platform NDEM more user friendly in 2017. To improve the weather monitoring and monsoon studies, ISRO in association with IMD, has taken up establishment of five indigenous Doppler Weather Radars at Cherrapunji, Thiruvananthapuram, Gopalpur (Odisha), Kochi and Sriharikota.

India's future Earth Observation (EO) program will ensure the continuity of the thematic series of satellites -Cartosat, Resourcesat, Oceansat and RISAT for land, water and ocean applications. Also, INSAT series will continue to provide support in the area of atmosphere and meteorology related studies. It is also envisaged to realise Geo Imaging Satellite (GISAT) in geostationary orbit to enable near real time imaging.

In this regard, INSAT-3DR in the INSAT series for meteorological applications; Scatsat-1 in the Oceansat series; Resourcesat-2A in the Resourcesat series have already been launched in 2016. Also Cartosat 2D with Panchromatic and Multispectra camera was recently launched in February 2017. It is planned to design, develop and launch with enhanced technological capacities (in terms of sensors and payloads), Cartosat-2E and Cartosat-3 in the Cartosat series of satellites, Oceansat-3 in the Oceansat series, and Resourcesat-3 in the Resourcesat series in the coming years.

ISRO and NASA have collaborated to launch a satellite to study earthquakes. NASA-ISRO Synthetic Aperture Radar, or NISAR has been designed to observe and take measurements of ecosystem instabilities, ice-sheet collapse, and natural hazards such as earthquakes, tsunamis, volcanoes and landslides. The satellite is planned to be launched by 2020-21. NISAR is shown in Figure 12.

Also work on dual frequency L&S band airborne SAR is being taken up to contribute significantly to the advancement of science. This primarily aims at utilizing L&S band airborne SAR data for various applications such as management of natural resources, weather and hydrological forecasting, land geo-physical parameter retrieval, coastal area monitoring, early warning of natural disaster etc.

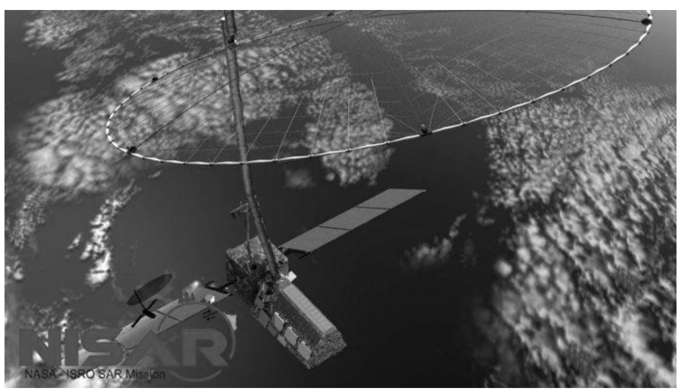

Figure 12: NASA-ISRO synthetic aperture radar mission (NISAR)

Conclusion

Natural disasters cause significant damages to not only life but also property. The increase in population is resulting in increased pressure on earth resources, imbalance in the green house equilibrium, etc., and thereby resulting in the increased vulnerability of life and infrastructure. ISRO since its inception has been working with the aim of applying the advanced technologies to the real problems of man and society.

In this paper, India's/ISRO's space capabilities to deal with disasters have been discussed. ISRO's has been using the space based technology not only for India but also its neighbours. ISRO programs were helpful in the recent 2013 Uttarakhand disaster, 2014 Srinagar floods and the 2015 Nepal Earth quake. On international front in 2015 and 2016, SAS&R services were provided to seven neighbouring countries, satellite support was provided for 10 emergency requests from neighboring countries. The recently launched as well as upcoming ISRO's space programs are being proposed keeping in mind so as to have better future detection, prediction, timely warning and help for disaster hit areas. With the recent launch of South Asian Satellite, ISRO has continued its efforts of being a helpful neighbour at the time of emergency.

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Role Definition of Armed Forces in Disaster Relief and Response in India

A. Shajahan[a]

Abstract

Rapid urbanisation, climate change induced increase in hydro-meteorological disasters have resulted in loss of life and property in India in the past two decades. Indian armed forces have been traditionally part of the government response mechanism for disaster relief during natural disasters. Armed forces are called upon to assist the state/local governments when their handling capacity is overwhelmed. Their participation was on the basis of 'Last to enter – First to exit' principle. However, in practice there is over-reliance on armed forces. Govt of India enacted the DM Act 2005 which created institutions like the NDMA, NDRF, etc., for a holistic approach to DM. However, the dependence on armed forces has shown no appreciable downward trend. This is due to the increasing ferocity and frequency of natural disasters, such as cyclones floods and civil capacity build-up being in transition. In the post-2005 (DM Act Enactment) framework, with the specialised response forces, such as NDRF and its equivalent SDRFs, there is a need to evaluate the role of armed forces. Is there a need to define/redefine? What are the terms of their engagement and disengagement? What exactly does this role definition entail? This paper attempts to find answers to these questions by a mixed methodology of qualitative and quantitative data collection methods by an inductive approach.

Keywords: DM Act 2005, disaster response, role definition for armed forces

Introduction

India's Disaster Profile and Armed Forces in Disaster Response

India is one of the 10 most disaster-prone countries in the world (NIDM, 2015). In recent times, floods during peak monsoons in 2013 ravaged Uttarakhand and J&K in 2014. These calamities have had a debilitating effect on the economy, social structure and people of the affected regions. The national annual figures for the average affected people is 49,087,940 and the economic damage is 1,550,446,000 USD (SAARC DISASTER REPORT, 2011). India is vulnerable in varying degrees to a large number of natural as well as man-made disasters. Over 40 million hectares (12 %) is prone o floods and river erosion. Around 58.6 % of the landmass is prone to earthquakes of moderate to high intensity. Of the 7,516 km long coastline, close to 5,700 km is prone to cyclones and tsunamis. Around 68 % of the cultivable area is vulnerable to drought and hilly areas are at risk from landslides and avalanches (Satyendra, 2014). One of the most important functions to be performed in times of disaster/after-disaster is identification, mobilisation and deployment of relief in the impacted area and evacuation of stranded population. Post-disaster relief is extremely complex and demands smart strategies and innovative employment of the national Air Power for seamless resource mobilisation and evacuation of affected populace between theatres. As per Oslo guidelines, the category of asset that contributing countries reported most frequently deploying, and in the greatest volume, was air transport.(SIPRI, 1994) Armed forces globally and in the Indian context have always been among the first responders to any calamitous event triggered by natural disasters (SIPRI, 1994). Indian Air Force (IAF) has been a vital component of this military Humanitarian Assistance and Disaster Relief- HA/DR operations.

Objectives

The present paper aims to analyse the current legal and institutional framework to evaluate the mode and manner of participation of armed forces. The paper aims to bring out the adequacy or otherwise of the current framework for armed forces participation in disaster response/relief.

[a] Indian Air Force

Methodology

Mixed methodology of qualitative and quantitative data collection methods by an inductive approach has been adopted for this paper. Desk Research of international and national reports, MoD dispatches of various disasters, case studies on the intervention of armed forces in various disasters sourced from newspapers, archives of armed forces have been analysed for arriving at findings for evaluation of role of armed forces across both statutory (DM Act, 2005) and other non-statutory policies and plans. The larger question is to attempt a study on adequacy of current legal and institutional framework for supporting armed forces participation in disaster response.

Defining 'Disasters' and Phases involved

Disaster

DM Act, 2005, defines disaster as a calamity, catastrophe, detrimental damage, mishap and a grievous occurrence, which is beyond the controlling potentiality of the victims.

Phases of DM

A typical Disaster Management continuum as shown below, comprising six elements (Refer Figure 1) (NDMA, 2013):

(a) **Pre-Disaster Phase**
- (i) Prevention
- (ii) Mitigation
- (iii) Preparedness

(b) **Post-Disaster Phase**
- (i) Response
- (ii) Rehabilitation
- (iii) Reconstruction

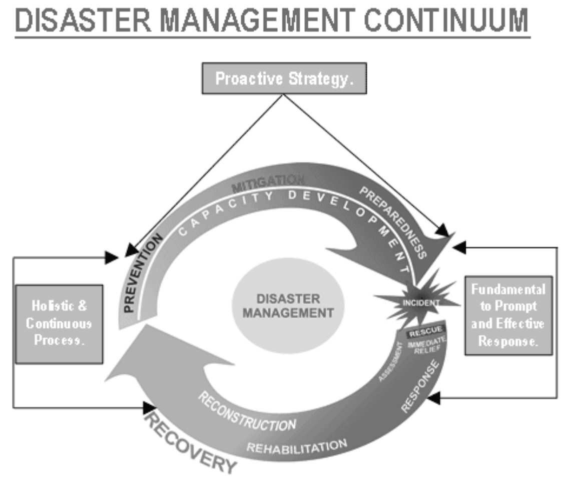

Figure 1: Disaster management cycle

Armed forces have been traditionally part of the post-disaster phase especially during the immediate response and in some cases of geographically inaccessible areas, they have continued well into rehabilitation and reconstruction phase too.

Positing DM in the Indian Constitution

'Disaster Management' as a subject does not find mention in any of the three lists of the seventh schedule of Indian Constitution. Article 21 of the Constitution relates to the protection of life and personal liberty. This can be considered as the basic constitutional provision(Goel, 2013) for DM as disasters threaten the basic life and liberty of affected population.DM Act of 2005 was enacted by invoking entry no. 23 in the concurrent list, namely 'social security and social insurance, employment and unemployment'. Second ARC[1] of 2005, HPC on DM under JC Pant (1999) and NCRWC (2000) have recommended that the subject of DM be included in the concurrent list. However, by practice and convention, the primary responsibility for managing disasters rests with the state governments[2].

DM Frameworks in India

Evolution of Global DM Framework

The above initiatives were characterised by a focus on legislation, policy and institutional arrangements as being vital for a holistic approach to DM. The HFA which has been succeeded by the Sendai Declaration (Para 10.3 d &e above) identified- "legislation as a critical aspect in forging a comprehensive approach to disaster risk reduction." As can be seen starting from the 1990s, there has been continuity at the global level in legislative framework for DM. From IDNDR[3] to Sendai declaration, the focus has been on disaster risk reduction. The IDNDR (1990-99) & ISDR (2000 onwards) played an important role in accelerating the process of enactment of DM legislations (ISDR report 2011)[4]. As of 2011, 48 countries (including India) reported substantial achievements in developing national policy and legislation on DM. As per UNDP (UN Development Programme) study, the development of DM legislation is often triggered and sustained by factors, such as major disasters, political shifts, engagement of particularly dynamic individuals, and well- educated and participating communities (Llosa, Irina et al. 2011). A legal framework establishes "legal authority for programs & organizations that relate to hazards, risk and risk management" (Mattingly, 2002). "without a comprehensive and binding legal directive that obliges actors and agencies to take action, the natural inertia of bureaucracies means that non-specified essential tasks are unlikely to be undertaken" (Britton, 2006). Laws and regulations provide for the basis for promotion and enforcing certain rights and reciprocal obligations. They also create structures of incentives, penalties, rewards and punishments (Pelling and Holloway, 2006). Thus, the need for a basic legislation on DM that is comprehensive cannot be over-emphasised. This realisation marked the global approach to disasters in the 1990s.

Historical Evolution at National Level

In India, the focus on DM was mainly centred on famine and to an extent on floods during the British rule. Hence, the early legal framework introduced during late 1870s was the Famine Codes by the Famine Commission. This was followed by preparation of 'Relief Manuals' by the states before and after independence. In 1970s, a comprehensive programme on Drought Mitigation was taken up through DPAP- Drought Prone Areas Programme. Independent India faced the problem of food scarcity and a formal first attempt at ministerial framework emerged with the establishment of a Scarcity Relief Division in the Ministry of Agriculture. This division subsequently was assigned work related to various other natural calamities. The nomenclature of Scarcity Relief Division was later changed to Natural Disaster Division and the Ministry of Agriculture became the nodal agency for DM at the national level. DM was, at this stage, still focussed on relief and rehabilitation and there hardly was any focus on prevention and mitigation. However, global initiatives like IDNDR, HFA etc pushed the GOI- Government of India to focus on prevention & mitigation aspects to evolve a holistic approach to DM. This was further accelerated by India's experience of major natural disasters like the Latur earthquake in 1993. GOI constituted a HPC- High Powered Committee under JC Pant in 1999 to review "existing arrangements for preparedness and mitigation of natural disasters and recommend measures for strengthening the organisational structure". The HPC submitted its final report in 2001. The report recommended "Constitutional & Legal framework, Organisational structures & Institutional mechanisms" towards a vision of "Disaster-free India by adhering to a culture of preparedness, quick response, strategic thinking and prevention". The Gujarat earthquake of 2001 led to the constitution of an 'All-party national Committee' headed by the Prime Minister. The HPC of 1999 was further converted into a Working Group of the National Committee and submitted its report to the Prime Minister in 2003. The main recommendation of the Working Group was for the adoption by GoI (Government off India), a National DM Policy. Further, GoI set up the 2nd ARC- Administrative Reforms Commission under Shri Verappa Moily in 2005 to prepare a blueprint for revamp of the "Public Administrative System". The ARC submitted its third report titled "Crisis Management: from Despair to Hope" in 2006 by which time the GoI enacted the DM Act 2005.

Historical Evolution of DM Laws in States of India and Other Legislations

The 2001 Gujarat earthquake jolted the central government to convert the HPC into a Working Group. While the HPC/Working Group recommended "enactment of a central legislation on DM". The GOI at this stage took the view[5] that "disasters being a state concern, the states be advised to enact their own respective legislations". However, the Tsunami of 2004 jolted the GOI and the DM Act 2005 followed (Mishra, 2013). Even as the DM Act of 2005 as a central legislation was underway, some Indian states passed their own DM laws, namely The Gujarat DM Act 2003, the Bihar DM Act 2004, the Uttar Pradesh DM Act 2005 and the Uttaranchal Disaster Mitigation, Management and Prevention Act 2005. The Gujarat DM Act was the country's first DM Act and was very comprehensive and inspired many states especially the UP DM Act. At the national level evolution of DM framework was the result of global initiatives of the 1990s, major disasters experienced and recommendations of various committees set up by the government on the subject. While major disasters like 1999 Super Cyclone of Orissa and the 2001 Gujarat earthquake provided impetus to a central legislation on DM, it was the Tsunami of 2004 that was the final trigger for enactment of the DM Act 2005 (Mishra, 2013).

Current Legal and Institutional Framework for DM in India

Legal Framework for DM (Pre-2005)

The Union Ministry of Home Affairs[6] is the nodal ministry for disaster management. The National Crisis Management Committee (NCMC), headed by the Cabinet Secretary and constituted under the Ministry of Home, oversees the various disaster related activities in the country. It functions as a decision-making body and gives directions to the Crisis Management Group (CMG). Further, for execution of polices formulated in the ministry, the Central Relief Commissioner (CRC) is designated as the nodal officer for coordination of relief operation.

DM Act, 2005

The act was a watershed in disaster management in our country; it established **NDMA**-National Disaster Management Authority as the nodal body for policy formulation and for coordinating all capacity building and capability accretion programmes in the field of DM. It also established **NDRF**-National Disaster Relief Force, the largest single standalone specialised disaster force in the world. It also created **NEC**-National Executive Committee, envisioned as the main executing arm of the NDMA for evolving a multi-sectoral holistic mechanism for DM in India. The act also lays down the framework and structure of DM framework at state and district levels in the form of SDMAs and DDMAs-State Disaster Management Authority and District Disaster Management Authority. Disaster Management Act 2005 is an important instrument to rationalise the role and functions of various establishments and a tool to bring in a sense of accountability and responsibility. However, when it comes to armed forces, the Act, merely includes the mention of "deployment of naval, military and air forces, other armed forces of the Union or any other civilian personnel as may be required for the purposes of this Act" under the heading "Measures by the Government for Disaster Management." (Sec-11 & 37). There is no amplification or mention of the role of the armed forces with a view to offer legal support and backup. The Act is surprisingly silent on the aspect of assigning defined role and responsibilities to the armed forces (Manekshaw papers, 2008). The Indian Armed forces need to be given a charter, an institutionalised role for managing disasters in the country (CLAWS, 2014)

Legal Framework for DM (Post-2005)

Enactment of DM Act, 2005 was a landmark event as it established for the first time a comprehensive law on DM at the national level. Prior to 2005, there existed sectoral laws on environment, forests, mines, etc. Post enactment of the DM Act 2005, both the old and new institutions continue to be part of the DM institutional framework. The National Crisis Management Committee (NCMC) in MHA, a pre-2005 institutional arrangement is still functional and takes over the functions of NEC (a post-2005 body) during major disasters.

Armed Forces Pre- and Post-2005

Prior to enactment of DM Act 2005, Armed forces formed core of the response mechanism of the government. It was to address this dependence and build-strengthen government capacities at national, state and local levels that the GOI enacted the DM Act. Post -2005, the number of stakeholders has substantially increased, namely NDRF, SDRF, Civil Defence, NGOs, Volunteers, etc., and the armed forces continue to be called for assistance during calamities. Presently, the response scenario thus represents a complex maze of stakeholders who bring overlapping capacities and diverging command and control structure and different philosophy of operating and information sharing.

Legal Framework for Armed Forces in Disaster Management

The armed forces under the Ministry of Defence (MoD) are called out to assist civil authorities. The armed forces respond to disasters as a part of their mandate to **aid civil authorities**[7] **or ACA** as specified in the Instructions on Aid to the Civil Authorities by the Armed Forces, 1970. The armed forces render disaster relief under the duty listed as 'ACA' – Aid to Civil Authority[8]. The term "aid to civil authorities" (ACA)[9] is a British imperial usage (Brigadier PK Mallick, 2007) referring to the process by which local authorities can request the central government to lend assistance in times of emergency. Armed Forces may be called upon to help the civil authorities in any of these duties, viz.

(a) Maintenance of law and order,
(b) Maintenance of essential services,
(c) Assistance during natural calamities, such as earthquakes and floods and
(d) Any other type of assistance, which may be needed by the civil authorities.

The enactment of DM Act, 2005 created a specialised disaster response force- NDRF and an apex Disaster management centric organisation-NDMA. Prior to the enactment of DM Act of 2005, the armed forces undertook HA/DR missions under the ACA. They still continue to do so, even after 2005. While other key stakeholders-NDMA, NDRF, Police, SDRF, etc., draw guidance and legal authority from DM Act 2005 for their role in disaster response, armed forces continue to draw legal authority and guidance from ACA. This places one of the key stakeholders (armed forces) outside the framework as it exists today.

Institutional Framework for Armed Forces in Disaster Management provided by the DM ACT

The only institutional arrangement for engagement of armed forces is the National Executive Committee[10] (NEC) of the NDMA of which the CISC -Chief of Integrated Defence Staff to the Chairman Chiefs of Staff Committee is a member. The National Crisis Management Committee (NCMC) in MHA, a pre-2005 institutional arrangement is still functional and takes over the functions of NEC (a post-2005 body) during major disasters. There is no institutional role for armed forces in the NCMC. However, The Task Force for Review of DM Act constituted under Dr PK Mishra opined that NEC has been ineffective[11] and recommended the rescinding of NEC and incorporation of NCMC (a pre-2005 institutional arrangement in the MHA) as the premier agency for DM. There is no institutionalised representation of the Armed Forces in the NCMC.

At the national level, other than the NDMA, each ministry has a Crisis Management Group. In the Ministry of Defence, the Defence Crisis Management Group comprises the heads of operational directorates of the three Services, the Intelligence Directorate and representatives of other Ministries like Ministry of External Affairs, Ministry of Home Affairs and an associated Ministry depending upon the nature of the crisis. The armed forces are to be requisitioned through the Ministry of Defence. However, in extreme cases the state authorities can seek armed forces assistance directly. The National Disaster Management Policy approved by the Union Cabinet on October 22, 2009 acknowledges the role of the armed forces in disaster management and states that the armed forces are called only when the coping capability of the civil administration is exhausted. It, however, admits that in practice (as has been in the past) the armed forces are deployed immediately and they have responded promptly. Though the armed forces have been part of virtually all disaster related operations, pre-2005 and post-2005[12], there is no defined and regulated role for the armed forces in the legal and institutional framework as defined by the DM Act 2005.

Institutional Framework for Armed Forces in Disaster Management provided by ACA

The Defence Crisis Management Group(Alhuwalia PS, 2014) functions from Integrated Defence Staff (IDS) Operations Room (Ops Room), which is also known as Interim National Command Post. The IDS Ops Room is always in direct communication with the Army, Navy, Air and Coast Guard Ops rooms. This is the place from where all disasters whether it was the Tsunami, floods or the recent earthquake were tackled. The basic document governing the assistance rendered by the Armed Forces to civil bodies is a publication issued by the Ministry of Defence called, 'Instructions on Aid to Civil Authorities by the Armed Forces' 1970. Further amplification on this as to how the three services should respond is contained in the 'Tri Services Emergency Response Plan' of June 2002. This plan has been examined and evaluated in detail by the Chiefs of the three Services, approved by the Chiefs of Staff Committee and has been promulgated to all field formations.

Thus, the armed forces though being part of the GOI's core response mechanism continue to remain outside the DM Act 2005 which did not specify or define their role especially when creating a 'Disaster-response specific' force -NDRF. Armed forces formulate their plans and procedures derived from the envisaged role as given in the ACA. This has impacted their effectiveness in disaster response as they are not part of the NDMA-NDRF-NCMC- institutional framework. They simply bring upon their combat equipment, training and command and control structure into the disaster zone when called upon to do so by the 'Civil-Authority'. This invariably leads to duplicity of effort due to multiple stakeholders present. An institutional role will go a long way in integrating the special capabilities of armed forces into the disaster response mechanism shortening response timeliness and saving lives and valuable funds/costs.

Evaluating the Role of Various Stakeholders in DM in India

Role of Armed Forces as per DM Act 2005

As per the letter and spirit of the DM Act 2005, the Armed Forces are to be called upon to assist the civil administration only when the situation is beyond the coping capability of the state governments. In practice, however, the Armed Forces form an important part of the Government's response capacity and are immediate responders in all serious disaster situations. On account of their vast potential to meet any adverse challenge, speed of operational response and the resources and capabilities at their disposal, the Armed Forces have historically played a major role in emergency support functions (National Disaster Management Policy, 2009). The Disaster Management Act 2005 is surprisingly silent on the aspect of assigning a well -defined role and responsibilities to the armed forces. There may have not been an explicit articulation in the Act but the military will continue to form part of the "Core Group" for immediate response (Dagur, 2008). The Raksha Mantri in his inaugural address (Manekshaw papers 2008) delivered during a seminar on the subject in December 2005, in the backdrop of many disasters to include the tsunami, avalanche and snow storm, followed by the earthquake in Jammu and Kashmir (J&K) had stated," *The world over, without exception, all governments have involved the armed forces whenever a disaster strikes. They are invariably the first to respond and quickest to reach the affected area. As has been increasingly observed in recent cases across the world, the men in uniform have played a stellar role in mitigating and alleviating the suffering caused by disasters. We need to, therefore, strengthen their hands in executing this onerous task by giving them all the support needed in this direction".* The role recognition and role definition of armed forces did not emerge in the post 2005 DM framework. However, in practice, neither the employment philosophy nor the engagement mechanism has been qualitatively altered and the armed forces continue to be involved in Disaster Response operations as before.

Role of Armed Forces as per Other Non-statutory Provisions

As per **National Disaster Management Policy** (approved by the Union cabinet in October 2009), the armed forces are called upon to assist the civil administration only when the situation is beyond their coping capability. In practice, however, the armed forces form an important part of the government's response capacity and are immediate responders for all serious disaster situations. On account of their vast potential to meet any adverse challenge, speed of operational response and the resources and capabilities at their disposal, the Armed Forces have historically played a major role in **Emergency Support Functions**. At the National level, the Chief of the Integrated Defence Staff to the Chairman Chiefs of Staff Committee has already been included in the NEC. **Similarly, at the State and District levels, the local representatives of the armed forces may be included in their executive committees to ensure closer coordination and cohesion**.

The National Disaster Management Plan (NDMP) 2016 was released by GOI as per the mandate of Section 11 of the DM Act 2005 that mandates a NDMP for whole of India. Sec-37 of the Act, further specifies "every ministry and department of the Government of India, including the hazard-specific nodal ministries, shall prepare comprehensive DM plans detailing how each of them will contribute to the national efforts in the domains of disaster prevention, preparedness, response, and recovery (NDMA, 2016). **Many ministries including the Ministry of Defence under which the armed forces operate have not yet completed this task of comprehensive disaster plans**. The plan defines "Response" as measures those are taken immediately after receiving early warning, anticipating an impending disaster, or post-disaster in cases where an event occurs without warning. It further amplifies that the primary goal of response to a disaster is **saving lives, protecting property, environment, and meeting basic needs of human and other living beings after the disaster**. The immediate focus will be on search and rescue of those affected and to evacuate those likely to be affected by the disaster or secondary disaster that is likely to happen. **In the section on response, roles, function and responsibilities of ministries and agencies that have a key role to play are described**. Some of the other key features of the plan are:

(a) The NDMA will be coordinating with relevant nodal ministry and the disaster-specific nodal ministry will liaison with the state government where the disaster has occurred and coordination among various relevant ministries and departments to provide quick and efficient response.

(b) The state government will activate the Incident Response Teams (IRT) at state, district, or the block level as required. The IRTs will coordinate with the state EOC. The SDMA[13] (or its equivalent) will provide technical support to the response.
(c) Different central ministries and departments will provide **emergency support** to the response effort as per request from the State Government. It may be noted that the SDMA, Department of Revenue or Commissioner of Relief (as applicable) is the nodal agency for coordination of disaster response. The various agencies whose responsibilities are defined in detailed DM plans for the state and district will be responsible for specific response measures.
(d) DDMA[14] is the nodal agency for coordination of response at district level supported by other district level agencies. The department wise specific activities at central ministries and state government are summarised in matrix providing clarity to the roles and responsibilities of various agencies.

The NDMP provides a framework with role clarity for rapid mobilisation of resources and effective disaster management by the central and state governments in India. While it focuses primarily on the needs of the government agencies, it envisages all those involved in disaster management including communities and non-government agencies as potential users. The NDMP provides a well-defined framework for disaster management covering scope of work and roles of relevant agencies along with their responsibilities and accountability necessary to ensure effective mitigation, develop preparedness, and mobilise adequate response. **However, in keeping with the underlying spirit of the DM Act Viz, not entrenching the role of armed forces in the DM matrix so civil capacities develop, the plan too contains no explicit enunciation for armed forces even as the plan elucidates role of all government agencies in the response role**.

Emergency Support Function (ESF) of Armed forces- Some of ESF as specified by NDM Policy 2009 are listed below:

(a) Communication
(b) Search and rescue operations
(c) Health and medical facilities
(d) Transportation, especially in the immediate aftermath of a disaster
(e) Airlift, heli-lift and movement of assistance to neighbouring countries
(f) Imparting training to trainers and DM managers, especially in CBRN aspects, heli-insertion, high-altitude rescue, water-manship and training of paramedics

NDRF and Armed Forces

NDRF with a current strength of 12 battalions is the 'specialist response' provider under the new DM framework. However, the enormity of the disasters in recent times especially the Uttarakhand Floods (2013) and the J&K floods (2014) have exposed the constraints of NDRF as a responder (Vivek Chadha, 2014) current strength of 12 battalions, NDRF cannot match up the 'boots on ground' that the armed forces are capable of putting up in the affected area. **Hence, for the foreseeable future, armed forces will remain a part of rescue and response operations**. Some of the limitations in terms of capability of NDRF (Vivek Chadha, 2014):

(a) NDRF is unlikely to be the first responder as the armed forces are located at remote areas, which are vulnerable to disasters. Though equipped with specialised stores and equipment, NDRF cannot match the armed forces capacity and capability for large scale mobility and evacuation. The armed forces possess larger fleet of vehicles, boats, helicopters and aircrafts. The trained pool of manpower the armed forces possess with an efficient and robust command and control structure will always be relevant in large scale disasters and sudden onset disasters. Vivek Chadha, an IDSA analyst further comments that, *"Given the de facto responsibility of the armed forces in disaster relief, it would serve them better if this can be formalised, with sector specific stores allocated for disaster relief. This could also include periodic interaction with the civil administration to coordinate requirement of supplies and their location. Disaster management exercises can further be conducted to rehearse all elements of the state to ensure better response."*

(b) NDRF as a Specialised Disaster Relief Force: The DM Act 2005 envisages NDRF as a specialised force and it has since emerged as the world's largest standalone disaster specific force. As mandated by the Act, it has been equipped with world class equipment and hence can perform certain core specialised functions that the armed forces may not be able to undertake due lack of specialised equipment and disaster-specific training. These may include iron and concrete cutting techniques especially needed during earthquakes, establishment of relief camps, evacuation of population in the pre-disaster phase to safe locations, etc.

ACA and Armed Forces

The inadequacy and antiquity of armed forces undertaking complex DM operations under the British legacy provision of ACA- Aid to Civil Authority clause has been commented upon by many military experts. The term "aid to civil authorities" (ACA) is a British imperial usage referring to the process by which local authorities can request the central government to lend assistance in times of emergency. Before independence, dealing with internal security was an important task of the army. The colonial rulers made no distinction between using the army for internal and external security duties (Brigadier Mallick, 2007). The primary issue concerns decision-making because the centre and states on the one hand and civil society and state government, on the other, are not on the same page. In fact, successful disaster mitigation strategies require a combination of knowledge, technology, and expertise. The key players are the state and civil society, but it is the nation's armed forces that take control in every disaster. Owing to their training and field experience, the armed forces become an inalienable part of any disaster team (Kumar, 2008). The primary role of armed forces is to preserve national interest by safeguarding the territorial integrity of the nation against external threats. Their secondary role is to assist the civil authorities in handling internal threats, maintaining of essential services and also assist central or state governments during calamities (Mammen, 2004). Internationally, the question of armed forces involvement in disaster relief/response led to the formulation of OSLO guidelines or Guidelines on the Use of Military and Civil Defence Assets in Disaster Relief in 1994.[15]

(a) Report of Task Force for review of DM Act 2005: The GOI constituted a Task force under Dr. PK Mishra in December 2011 for review of (performance) DM Act 2005. The task force submitted its report in March 2013. The report opined that there is a need to redesign the NDMA's structure, ensuring greater objectivity and transparency in selecting Members. It also listed that the NEC, which has been assigned crucial, and multifarious, activities under the Act, has failed to deliver.

(b) Role of Civil defence, State police and others: police, civil defence and other response agencies do not have capacities to be effective during major disasters and at best if coordinated well shape up as viable ground-level liaison units for NDRF/Armed forces during the response and relief operations.

Evaluating the Consequence(s) Arising Due to Non-enunciation of Role of Armed Forces in DM Act and Other Non-statutory Policies

The armed forces are important constituents of the government's capacity to respond to disasters. The lack of role definition of the armed forces has impacted the capacity building, training and effective utilisation of the unique capabilities of the armed forces for optimal disaster response. Some of the salient aspects of this impact are: -

(a) Lack of Civil-Military Jointness in DM Training and Capacity Building While within the government organs, departments and institutions, a fair degree of liaison, coordination and cooperation has been achieved after the enactment of DM act, 2005, there has been virtually no effort in joint training of DM professionals, NDRF, CD, Home guards, Volunteers, etc. Some of the NDRF special battalions have received training at defence training establishments, yet, in terms of mock drills, training at ground level, there is simply zero jointness. Increasing complexities of post disaster recue and relief methods have necessitated specialised training like search and rescue in collapsed structures, damaged structures, burning trains, apartments, CBRN protection and decontamination etc. NDRF created by the act has been in the forefront of acquiring these specialist skills and has acquitted itself well[16]. **However, the armed forces have remained divested of these training initiatives. Similarly, there has been no qualitative change in the training or preparation of armed forces for disaster relief post-2005**. In one of the state level DM coordination meeting[17] that this author was part of, it emerged that the NDRF which has an inventory of very specialised disaster-specific equipment **has never had a single exercise with the IAF for validating air transportation of such costly equipment**.

(b) Lack of Civil Military Liaison- During non-disaster period, there is hardly any meaningful liaison between the civil government machinery and the military. At the state level, the liaison apparatus is rudimentary and restricted to meetings on land-encroachment, exchange or top dignitary visits, security issues, etc.

(c) MoD & DM: MoD, which exercises control over the armed forces, is not assigned any primary or secondary role in any of the recognised major disasters. The only institutional arrangement for MoD participation under the DM Act, 2005 is in the NEC[18] where Defence Secretary is a member. This effectively has contributed to very few institutional linkages between the armed forces and the state/district administrations.

(d) Specialist Equipment: Armed forces in spite of being first responders in most cases do not have specialist equipment (unlike NDRF) and make do with their military hardware available in the affected area or that flown in. post-disaster operations are complex and demand smart and specialist equipment like thermal imagers, radiation meters, etc.

(e) Local Capacity Development: When government sponsored or NGO driven capacity building programmes are undertaken targeted at the local community to build resilience, the armed forces even if deployed in the area are not a part of such exercises. This again is due to absence of institutional linkages as explained in Para (a) and (c) above.

(f) Lack of Inter-service Jointmanship[19]: One of the recommendations to bring more jointmanship between the armed forces was the creation of the IDS-Integrated Defence Staff as a functional entity where all issues of joint planning and training and operations are handled. Within the MoD- Armed forces framework, it is the IDS[20] that deals with DM issues. However, due to lack of higher direction from the newly established DM framework and the consequent absence of armed forces as stakeholders inter-service jointmanship, so essential for effective disaster response has not really fructified or taken shape. The level of jointness achieved is far from satisfactory and inevitably results in duplication, time delays and sub-optimal utilisation of both human and material capacity during DM operations.

(g) Lack of DM Database Access: The Indian armed forces handle disasters without any database of the resources, skills and services essential for effective response at short notice. The DM act and the progress thereafter has led to focus on early warning, IDRN[21]- India Disaster Resource Network, integration of state and district level information, etc. NDRF and other stakeholders have seamless access to these databases, while due to armed forces being outside the existing framework, lack access and often operate in isolation or with last minute partial information during crisis situations.

(h) Induction of New Hardware and Platforms: As a part of capacity enhancement for their primary role of defending the borders, Armed forces induct new weapons, hardware, platforms etc. India is the world's largest military equipment importer. Significant inductions in recent times are C-130s and C-17s transport aircraft that have special capabilities that can be effectively employed during disaster situations[22]. The Navy inducted INS Jalashwa (Ex-USS Trenton) that has capability of doubling up as a field hospital. Due to the armed forces being outside the framework, these inductions and their capabilities are not in the domain of DM agencies and District administrators who are the last mile executors of all policies, plans, and capabilities. The capabilities and limitations data of these new platforms can enable sharper plans and efficient execution of Disaster Response operations.

(i) Command and Control Systems for Disaster Response: NDRF has adopted ICS/IRS- Incident Command/ Response System from the US agencies for disaster rescue and relief operations. Armed forces which operate in larger numbers and over greater geographical spread have their own traditional command and control system. No joint training or mock drill to test compatibility of the two systems of command and control has been ever done. This invariably brings coordination, information sharing and other operational issues during crucial phases where every available capability needs to be focused on saving lives and rescuing affected people. The incident commander under the ICS system is responsible for all tactical actions related to the incident (Disaster Event). In the same area, armed forces operate within their own strict command and control- (C&C) systems. The inter-operability and compatibility of these two CC systems has not been tested or validated.

(j) Absence of Armed Forces from 'Stakeholders Meetings and Similar Fora for Policy and Planning: The DM Act has triggered evolution and establishment of many government and non-government initiatives/fora for policy, plans and capacity building. The lack of a clear role definition of the armed forces and the consequent isolation has kept them outside of such platforms and institutional arrangements, as they do not figure in the list of 'so called stakeholders'. Some of the examples of such isolation are absence of armed forces from IDRN-Integrated Disaster Resource Network, IDKN-Integrated Disaster Knowledge Network, and many such common capacity building platforms NPDRR- a GoI constituted multi stakeholder national platform for Disaster Risk Reduction (NPDRR[23]). Des spite being a multi stakeholder platform-NPDRR does not have any representation of the armed forces.

Conclusion

Given the geographical diversity and the increasing frequency and ferocity of natural disasters, armed forces will always be relevant and needed for disaster relief.

(a) The institutions established by DM Act are in a state of transit with both the pre-2005 and post-2005 institutions involved. (Misra, 2013).

(b) No matter what capacities and capabilities NDRF develops, due to cost and specialised nature of air operations, the IAF as a responder during disasters will always be a relevant stakeholder. Similarly, the 'boots on ground' that army brings forth in the disaster area as was seen during Uttarakhand (2013) when nearly 80,000 personnel of various army formations were involved as against approximately 8000 NDRF personnel. Similarly, the specialised skills that armed forces possess remain largely unmatched by civil agencies and hence, armed forces as disciplined and well trained manpower source of the government will always remain relevant.

(c) One of the best trained and most capable stakeholders in the DM calculus-the Armed Forces are uniquely placed to render complex and strenuous disaster response operations.

(d) In spite of creation of specialised DM agency and standalone response force, namely the NDMA and NDRF, respectively, the scale and frequency of the engagement of armed forces has not abated.

(e) In the foreseeable future too, their involvement will continue. Within this special capability, to bring the unique capabilities of Air power to bear upon the disaster response requirements has too shown an upward trend. With potent and highly flexible platforms in the form of advanced aircrafts, helicopters and UAVs being added to the IAF inventory, there is a need for deliberate doctrinal and operational appreciation of their employment in disaster response. Also, the approach to DM response operations needs a review due to the increasing complexities and inter-play of multiple stakeholders in light of the new framework established post-2005 after the enactment of the DM Act.

Notes

1 ARC-Administrative Reforms Commission & HPC-High Powered Committee & NCRWC- National Commission for Review of Working of Constitution

2 National Policy on DM. Approved by Union cabinet in Oct 2009." Institutional & Legal arrangements/State governments"/p.25.

3 IDNDR-An International Decade for Natural Disaster Reduction, beginning on 1 January 1990, was launched by the United Nations, following the adoption of Resolution 44/236 (22 December 1989).

4 The Global assessment Report on Disaster Risk reduction of the ISDR-2011.

5 As per GoI communication by Deputy PM to all CMs dated 23 July 2003.

6 The nodal agency for DM was Min of Agriculture till 2002, post which MHA was designated as the nodal agency. However, for drought, Ministry of Agriculture continues be to a nodal agency.

7 The Union War Book of India lists,'Aid to Civil Authorities.' as an duty of all three armed forces-IAF, Army and IN.

8 As mandated by the Union War Book.

9 'Role of Armed Forces in Internal Security: Time for Review'. Brigadier PK Mallick. *CLAWS Journal*. Winter 2007. p.68.

10 A post 2005 institutional arrangement created by the DM Act of 2005 with Home Secretary as its ex-officio chairperson.

11 4.5.2.1 of the Task force Report March 2013. p.52.

[12] Enactment of DM Act 2005 and the subsequent formation of NDRF.

[13] SDMA-State Disaster Management Authority established as per the DM Act2005 with Chief Minister as the Chairman to handle all aspects of DM.

[14] DDMA-District DM Authority is the 3rd tier of the framework established by DM Act 2005 and is the nodal agency at district level.

[15] Argentina, Austria, Belgium, Germany, Indonesia, Italy, Japan, Kenya, the Netherlands, Norway, Russia, Switzerland, the UK and the USA were among 45†states and 25†organizations that participated in the conference.

[16] 46 member team of the National Disaster Response Force (NDRF) reached Japan on March 28, 2011 to provide disaster relief and rescue assistance in the tsunami struck town of Onagawa. The team was equipped with the latest state-of-the art gear for radiation monitoring, detection and personal safety equipments and were self contained in terms of nuclear, biological and chemical (NBC) suits, emergency rations and essential medicines. The NDRF team also carried Collapsed Structure Search and Rescue (CSSR) equipment and relief material like portable shelters, tents, blankets, medicines, water bottles etc.

[17] The IAF- Govt of Karnataka DM Coordination meeting at HQs Training Command (Bangalore) on 23 Jun 2017.

[18] For the effectiveness or otherwise of NEC, please refer to para 6.2(d) (i & ii) of this paper.

[19] Lack of jointmanship was highlighted as one of the reasons for 'kargil war' of 1999 by the Kargil Review Committee headed by noted defence strategist and analyst- Dr K Subhramanyam.

[20] Headed by a 3-Star general or equivalent officer in rotation from the three services. HQs at Kashmir House, New Delhi.

[21] IDRN is a nation-wide electronic inventory of resources that enlists equipment and human resources, collated from districts, states and national level line departments and agencies.

[22] Already seen action during Maldives water crisis in 2014 and Nepal earthquake in 2015.

[23] Vide Government's Resolution No.47-31/2012-DM-III dated February 26, 2013. The National Platform aims to bring together the whole range of India's disaster risk community from Government, Parliamentarians, Mayors, Media, International Organisations, NGOs, local community representatives, scientific and academic institutions and corporate businesses, etc. It will help in sharing of experiences, views and ideas, present findings of research and action and explore opportunities for mutual cooperation in the field of Disaster Risk Reduction. The output from the National Platform will offer a strategic direction and a road map for the formulation of our future national action plans on DRR.

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Capabilities and Expertise of the Indian Navy in Management of Disasters

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Successful emergency [disaster] management relies upon experience and expertise.
- Leo Bosner, 2008[1]

Abstract

The Indian Navy (IN) has accumulated expertise and experience importance in dealing with disaster relief and response over the last two decades. This capability has been recognised not only by the Indian authorities, but also by many developed countries. After the tsunami, IN was invited to form a "core group" of countries consisting of the United States, Japan and Australia to carry out relief efforts at the IOR. India's image is, a developing country that can support both itself and its neighbours (IOR) and remote assistance (beyond the IOR) that requiresfrom poor countries looking for aid funding. IN has played an important role in all these episodes of post-disaster management. Human Assistance and Disaster Relief (HADR) is a supplementary role for the military, but IN spends considerable time and effort responding to national needs, especially in disaster situations. This paper is intended to highlight the function of Indian Navy in dealing with different types of disasters. The Indian Navy is building expertise on the foundation of real-time disasters, and the components of the are different exercises performed at different levels, including Triservices' involvement in the involvement of multiple institutions. The goal is also to elicit details for both real-time operations and knowledge building exercises performed by Indian Navy .

Keywords: Indian Navy, post-disaster, disaster response, disaster relief, capabilities, expertise

Introduction

Indian Navy (*IN*) has gained significant expertise and experience in dealing with the disaster relief and response in past two decades. This skill has not only been acknowledged by the Indian agencies but also by many developed nations. In the aftermath of Tsunami, *IN* was invited to form a 'core group' of nations comprising US, Japan and Australia to undertake relief operations in IOR. The image of India over the years has changed from a poor nation, in quest of relief fund, to a developing nation capable of supporting self and neighbours, both near (IOR) and far (beyond IOR), in need of relief. *IN* has played a significant role in all these episodes of post-disaster management. Even though Human Assistance and Disaster Relief (HADR) forms the supplement role of an armed force[2], *IN* spends sizable time and effort to keep abreast of the nation's need especially in disaster situations.

Paper Overview

This paper aims to bring out the capability of *IN* in dealing with various kinds of the disasters. The *IN* has built the expertise on the substratum of real time disasters with building blocks being the various exercises conducted on various levels including tri- service participation to multi-agency participation. The aim would also be to bring out the details of both real-time operations and exercises conducted by *IN* to build expertise.

Defining Disaster to Obtain Capability

Disasters come in all shapes and sizes and have origins that range from natural to artificial. However, definition allows a clear understanding to a professional engaged in operations about the task and purpose of the assigned

[a] Eastern Naval Command
[b] Indian Navy
[c] Headquarters, Eastern Fleet, Visakhapatnam

mission, more so in the case of a uniformed service like *IN*. Disaster has been defined by various world agencies in different manner. The most in use definitions to explain the disaster world over are as follows:

"A disaster is a serious disruption occurring over a relatively short time, of the functioning of a community or a society involving widespread human, material, economic or environmental loss and impacts, which exceeds the ability of the affected community or society to cope using its own resources"[3,4]

"A situation or event [which] overwhelms the local capacity, necessitating a request to a national and international level for external assistance; unforeseen and often sudden event that causes great damage, destruction and human suffering"[5]

The *IN* uses the undermentioned definition for disaster, as approved by the Parliament of India under the Disaster Management Act, 2005:

"Disaster means a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man-made cause, or by accident or negligence, which results in substantial loss of life or human suffering or damage to, and destruction or property, or damage to, or degradation of environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area."[6]

The definitions used by International agencies/organisations are broad in sense and leaves lot to the imagination of the user in classifying an event as a disaster or otherwise. In contrast, the definition provided under DM Act, 2005 is specific and provides little leeway for the user in classifying an event as a disaster. The definition may seem inconsequential to a layman, the professionals understand that data collection, survey records, fund allocation and stocking items for specific purpose are dependent on definition accepted by the government of the day.

Understanding India and IOR with Respect to Disasters

India and its neighbouring region are one of the most unstable in the world in terms of frequency and occurrences of disasters. The undermentioned facts would do justice in understanding why in-lays, such emphasis on disaster management and consequent planning and exercises:

(a) The developing countries account for 95% disaster related deaths worldwide, with India accounting for majority of deaths, placed at second place.[7]

(b) India's National Policy of Disaster Management has classified 75% (5600 out of approx. 7517 kms) of Indian coastline susceptible to cyclones and tsunamis.[8]

(c) The coastline of India's east coast and many South East IOR nations is inhabited by the economically weaker sections of the society. It has been established through various research that there exists a strong link between income and mortality rates from disaster events (Figure 1[9]).

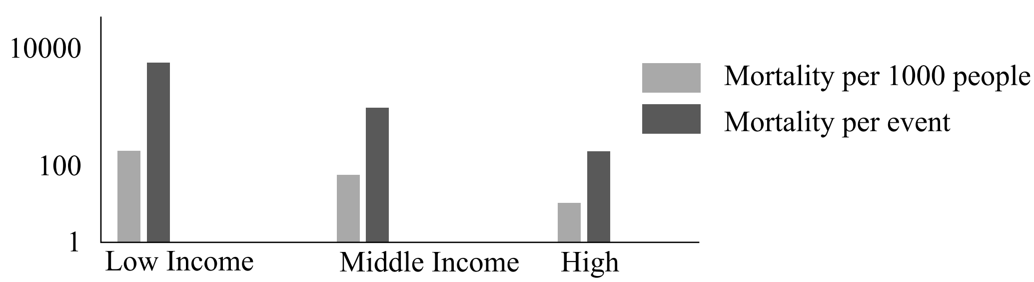

Figure 1: Disaster mortality vs. economic development

(d) India and its neighbouring region, both on land and sea (IOR), are the most populated regions of the world with yet expanding population. It is acknowledged world over that excessive population leads to failure of disaster management policies and hence, the extensive deaths.

(e) Distances in India and IOR, coupled with overloaded and yet developing inland or nonexistent infrastructure, compound the problem in speedy supply of disaster relief material to the needy, in times of disaster. The maritime distances are huge across maritime neighbours in IOR which leads to delayed arrival of relief in times of disaster.

Disaster Management – Government vis-a-vis Indian Navy

Shri Narendra Modi[10], post Gujarat Earthquake of 2001, said that "Disasters cannot be totally prevented but their impact can be reduced". However, as a matter of fact, the disaster management is not listed in any of the three lists in the seventh schedule of the Indian constitution, which specifies all subjects under the central government and state governments. Accordingly, it did not find mention in the written doctrine of the *IN*. India continued to approach the disaster relief with a reactive approach and formulated various programs to deal with floods and droughts leaving aside major disasters like flash floods, cyclones, earthquakes and tsunamis. India also launched various programs like Drought Prone Area Program (DPAP), Desert Development Plan (DDP), National Watershed Development Project for Rain fed Areas (NWDPRA) and Integrated Watershed Development Project (IWDP).[11]

The major disasters like Orissa Super Cyclone, Gujarat Earthquake, Tsunami and Mumbai floods at the turn of twenty-first century brought forth the government attention towards disaster management. Even though, the *IN* played major disaster relief role in all these catastrophes, the government had not made any national policy on disaster management and accordingly, was not included in the officially listed roles of Indian Navy. The passing of Disaster Management Act, 2005 proved to be a watershed moment for India, which set in motion the country's policy making in disaster management. The *IN*, since, has included HADR operations as a role in its maritime doctrine. National Disaster Management Institutional Mechanism includes Indian Armed Forces in its scheme of things (Figure 2[12]).

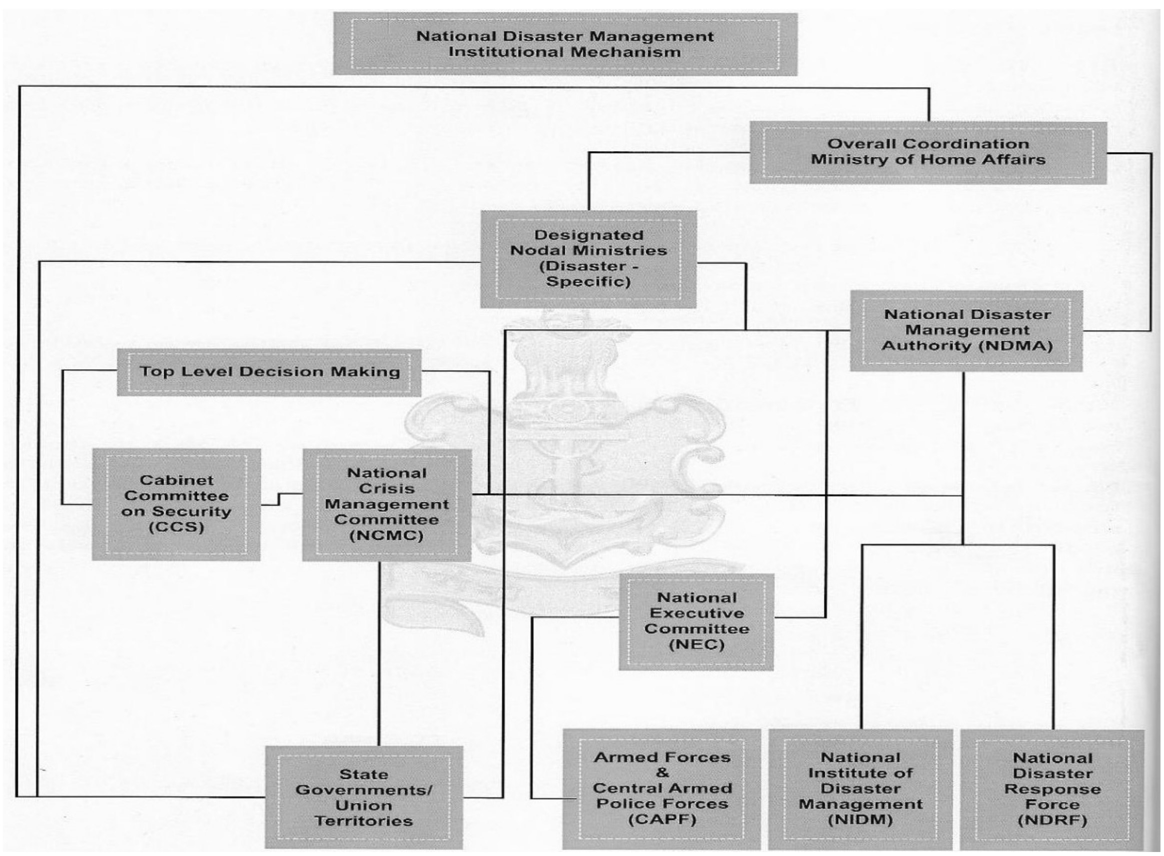

Figure 2: National level disaster management –basic institutional framework*

* It does not represent command and control or hierarchy for disaster relief operations.

Capabilities of the Indian Navy

As discussed, the Indian Navy gives impetus to its HADR role in India as well as across IOR nations. The succeeding paragraphs would aim to lay down certain capabilities, which reside within the *IN,* which helps it in responding to a disaster in an apt manner. However, it must be remembered that the *IN* sees itself as an emergency responder only, for an 'out of [civil administration] capacity' situation, and not as a long-term solution to the crisis.[13] Hence, other agencies should develop and maintain the requisite expertise and resilience for disaster relief operations.

Indian Navy is a multi dimensional force operating platform through sea, air and land medium. Hence, it can deal with a range of natural and human-made disasters. However, the *IN* is more suited to undertake HADR missions in some specific natural disasters as marked in Figure 3[14]. Although, the most disasters which the *IN* can deal effectively fall in the category of hydro-meteorological disasters, the *IN* may render support for other disaster management issues especially if the second or third order effect of other disasters are going to cause some hydro-meteorological disaster like local flooding, fire, etc.

Natural Disaster Categories, Types and Subtypes

		Hydrometeorological	
Biological	**Geophysical**	**Hydrological**	**Meteorological**
Epidemic	Earthquake	Flood	Storm
■ Viral infectious disease	Volcano	■ General flood	■ Tropical cyclone
■ Bacterial infectious disease	Mass movement (dry)	■ Storm surge/coastal flood	■ Extra-tropical cyclone
■ Parasitic infectious disease	■ Rockfall	Mass movement (wet)	■ Local storm
■ Fungal infectious disease	■ Landslide	■ Rockfall	**Climatological**
■ Prion infectious disease	■ Avalanche	■ Landslide	Extreme temperature
Insect infestation	■ Subsidence	■ Avalanche	■ Heat wave
Animal stampede		■ Subsidence	■ Cold wave
			■ Extreme winter condition
			Drought/wildfire
			■ Forest fire
			■ Land fire

Figure 3: Natural Disaster Categories, Types and Sub-types

Scalable, Tailorable and Flexible Organisation. The *IN* has been organised in a manner that it can respond to a disaster in a scalable, tailorable and flexible manner. Each ship and aircraft in the *IN*, leaving aside few exceptions, can perform multiple tasks (**flexibility**) in addition or in lieu of its primary mission. Eg. For example, a deployed for overseas deployment can easily be tasked to detour and undertake HADR mission as was done during Op Sukoon[15]. The number and type of units (ships, aircrafts, helicopter and manpower) deployed is purely dependent on the size and type of the disaster. The size and type of the deployed force can be quickly increased or decreased based on the ground situation (**scalable and tailorable**). For example, Tsunami saw the deployment of 40 ships in disaster relief operations whereas Mumbai floods primarily saw the deployment of only aircrafts and diving teams.

Self-Contained and Self-Reliant: A Indian Navy ship or establishment is self-contained and self-reliant organisation in terms of manpower and equipment esp. when deployed for disaster relief operations. Hence, each organisation pressed into disaster relief would accompany its own resources for surviving and would not rely on civil administration truly forming a support of civil administration.

Mobility: The naval forces are mobile in nature and can transit hundreds of miles every 24 hours. This provides an inherent capability, wherein the ships can be set in motion for a forecasted disaster from thousands of miles away. This mobility with readiness has established the *IN* as one of the first responder for many disasters in the IOR in past two decades. This has projected India's soft power strategically in our neighbourhood reiterating the fact that '*partners are temporary, but neighbours are permanent*'.

Surveillance: The Indian Navy has various resources which can undertake surveillance of the affected area for damage assessment and planning of the relief operations over a distance. The *IN's* maritime reconnaissance aircrafts can cover full coastline and internal lands of coastal states of India without involving external agencies.

Facilitation of Command and Control/ Communications: Mr Jone Holf[16] has said in various forums that, "In an emergency, information is as important a commodity as the more traditional and tangible commodities like food, water and shelter". Natural disasters result in breakdown of communication between various government agencies and the affected zone causing panic amongst the affected populace and administration both. The *IN* ships are equipped with various equipment from basic portable handsets to space based communication and specialised manpower to operate them. Hence, ships are suitably placed to establish central command post for relief operations. All commands of the *IN* maintain a communication ready brick consisting of basic equipment at all times which can be supplied onboard ships (preparing for deployment to support a disaster situation) within few hours of notice. The space based telecommunication esp. via INMARSAT (International Maritime Satellite) can be utilised to undertake telemedicine for emergency care, until arrival of the specialised medical teams under civil agencies.

Provisioning of Basic Relief Material: A human in distress requires the basic tenets of life viz. food, clothing and shelter to survive the stress and shock of the event. *IN* maintains a ready stock of these necessities at all times to sustain disaster struck people. These include:

(a) Emergency ration to sustain the relief operations for few days
(b) Emergency medical supplies
(c) Running a community kitchen for the people
(d) Clothing of people of various genders
(e) Equipment for diving, search and rescue and communication

Restoration\Maintenance of Essential Services: The Indian Navy ships have trained manpower of various specialisations who can undertake basic repair work on the essential supplies to either restore or maintain operability. The primary of these include restoration of electricity utilising in-house personnel and may be material, basic repairs involving wielding, and cutting trees, and provisioning water supply for the people via ship's Reverse Osmosis (RO) plants, which can generate tonnes of pure fresh water on daily basis. Indian Navy supported Maldivian Capital, Male, in its water crisis by supplying more than 1000 tonnes of water within 24 hours of seeking assistance by deploying Indian Navy Ships Deepak and Sukanya. These ships delivered packaged drinking water and augmented the supply with onboard RO plants.

Naval Shipping as Means of Transportation: Some *IN* ships have large load, both men carrying capacity designed primarily for amphibious operations like LPDs.[17] These ships can be utilised to undertake following missions in support of disaster management missions:

(a) Transportation of army engineers, equipment and associated material to undertake road and bridge repair. The equipment carried can include bulldozers, cranes, boats, etc.
(b) Transportation of personnel and material from other disaster relief organisations like National Disaster Relief Force (NDRF).
(c) Embarkation and transportation of personnel, who are marooned in isolated places along the coast line or islands, to safer places.
(d) Transportation of relief medical teams with relief medical vehicles, which can be offloaded at a beach, if one exists and still usable.

Diving Assistance: The Indian Navy, being a water-borne service, maintains a considerable strength of divers, specialised in various tasks, for day to day diving requirements of the ships. The *IN* also maintains a standing diving team at various places during the monsoon period for aid to civil authorities, when requisitioned. The naval divers can be used for various purposes as mentioned below:

(a) Undertake salvage operations up to 150 tons weight from 30 meters of depth
(b) Operate inflatable crafts for rescue personnel in hinterland and urban environment both
(c) Rescue of drowning people
(d) Rescue of underwater dead bodies to minimise post-disaster disease spread
(e) Undertake underwater wielding or cutting operation, if essential for managing disaster.

Water Crisis/Draught Relief: All major *IN* ships are integrally capable of generating fresh water from sea utilising RO plants fitted onboard. A minor quantity of the water produced is consumed in running of essential machinery onboard and domestic chores of the crew. In times of crisis, *IN* ships can supply water ashore by minimising own consumption. It must be remembered, ships require deep waters[18] for sustained RO plant operation. Hence, the ship would sail to deeper depths for generation of adequate water and not remain alongside supplying water at all times.

Hence, the civil administration should accordingly manage a storing capacity ashore, which can store maximum water from the ships which would allow their further re-deployment for mission at the shortest possible time-frame.

Power Supply: The Indian Navy ships are in possession of portable gensets, which can be landed ashore and utilised for restoring supply to essential services like medical services, telephone exchanges etc. Large gensets can also be carried by LPDs, if necessitated and provided for by NDRF, as NDRF being the primary supplier for disaster relief stores as mandated by DM Act, 2005[19].

Survey Assistance. During coastal disasters, sea ports become the major logistic hub for receiving the local and international aid. However, the big ships carrying relief material are suspicious of the navigational safety of water within and around the port. Hence, it is beneficial to undertake check survey (a abridged version of full hydrographical survey) and declare harbour fit for navigation. Amongst IOR nations, *IN* is the largest navy with integral hydrographic service. The IOR nations rely on *IN* as the natural choice for performing this task as soon as assistance for disaster management is asked.

Assistance in Sanitization Efforts: The prevention of spread of disease is one of the biggest concern in the post disaster environment. The *IN* has limited trained manpower who undertake the task of hygiene management onboard. These personnel are utilised to maintain high standards of hygiene amongst the community kitchen and disaster relief camps run by the *IN*.

Security of HADR Mission: All relief materials are generally distributed in a rationed scale to facilitate distribution to as many affected people as possible. There are chances of rioting and loot of relief material, especially from thin manned forward deployed parties. The *IN* can safeguard it's HADR items and personnel from such incident as it is trained and equipped for that mandate. However, this is achieved by way deterrence, planning and effective communication with the populace rather than use of force, which can further aggravate the situation.

Handling Human-made Disasters

Human-made disasters present as large a threat to humanity as the natural disasters. The *IN* is capable of handling human-made disasters as efficiently as a natural disaster. The majority tasks which fall under the ambit of human-made disasters, especially at sea, are the primary responsibility of the Indian Coast Guard. However, IN being the larger force with more means contribute significantly to these missions as well. The various missions which the *IN* is capable of undertaking under the umbrella of human-made disasters are mentioned below:-

(a) **Search and Rescue (SAR) Operations**. The Indian Coast Guard maintains close liaison with Indian Navy in the Search and Rescue operations. India is the regional SAR coordinator for south IOR. Indian Navy has carried out numerous SAR operations since its inceptions, both over sea and coastal areas. Indian Navy is capable of mounting large scale SAR operation within hours of the crisis.

(b) **Firefighting**. The Indian Navy is one of the most worked up organisation in firefighting. The *IN* is capable of organising and performing firefighting efforts against all classes of fire. The *IN* ships, on several occasions, have rendered aid to civil authorities in dealing with fire onboard shipping and even ashore. For example, on June 22, 2012, navy firefighters rescued people stuck inside Maharashtra Government Mantralaya, Mumbai donning Aluminised Fire Proximity Suits (AFPS) and use of thermal imaging cameras.

(c) **Ecological Disasters**: Oil spills from shipping at sea can cause major ecological disaster. It not only destroys the marine life but also spoils the livelihood of the fisherman and becomes a health hazard for the coastal community once the waste washes ashore. The Indian Navy per se does not specialise in managing the ecological disasters at sea. However, *IN* does undertake certain activities which contribute to prevention of these disasters. These activities include, but not limited to, the following:
   (i) Maintain the record of the ships entering and leaving ports of India and operating in Indian EEZ.
   (ii) Document inspection of various ships, drills operating in various oilfields of India.
   (iii) Maintain surveillance over the Exclusive Economic Zones of India.

(d) **Non- Combatant Evacuation Operations (NEO)**: NEO operations involve rescuing the civilians of Indian and other nationalities, as directed by Government of India trapped in a foreign land due to deteriorating civil law and order situation, which may lead to the loss of life and property. The Indian Navy has rescued thousands of Indians and people of other nationalities from foreign lands in last two decades.

Support in Hinterland: The *IN* would seldom come to mind when disasters occur in the hinterlands of India. However, the *IN* possess certain capability like specially trained divers, boats, etc., which can be utilised anywhere across nation to assist in the relief operations.

Miscellaneous Capabilities in Disaster Management

Media Management: Erik Qualman[20] explains today's social media that "we don't have a choice whether we do social media, the question is how well we do it". The Indian Navy runs its own twitter handle, facebook page and an Indian Navy app. As already brought out earllier, the *IN* ships have robust communication equipment which would allow navy to update the ground situation through various social media platforms in real time. The real-time updates help to calm the nerves of both, the national leadership and the local populace, in the times of crisis. In addition, the social media platform allows navy to suitably disseminate information like location of medical camp, relief camp to the affected populace. The media which cannot arrive on scene for coverage owing to damaged connecting routes can be provided video clips and pictures of the situation by the Indian Navy for further telecast. This helps in preventing the spread of rumours regarding the extent of relief efforts under progress.

Liaise for International Relief: Sea is a global common which connects 75% of the world. During peace time, the Indian Navy undertakes several multi-lateral exercises and flag showing missions across the globe. These missions allow the *IN* to maintain with liaison with several nations on working level. In times of disaster, if help to a foreign country is being extended or vice versa, the Indian Navy would lead the country in the coordination efforts especially liasioning purpose.

Multilingual Community: Maintaining effective communication between various agencies involved in disaster management and the affected populace is a pre-cursor for smooth operations. The ships are the melting pot of Indian society, being served by personnel from across India. Hence, the *IN* ships in all scenarios would be able to communicate with the local populace in their local language ensuring better understanding of the situation. Other outside agencies, may or may not have these advantages and can utilise this capability of the Indian Navy.

Expertise of Indian Navy in Disaster Management

Indian Navy has gained considerable expertise in dealing with multitude of disasters over the period of last few decades. It has dealt with missions as small as providing water supply to 100 people to relief mission in the aftermath of tsunami. The various missions and exercises which have been undertaken or practiced by Indian Navy towards preparation of disaster relief missions has been detailed in succeeding paragraphs.

Floods: The Indian Navy constantly deploys in support of flood relief operations within India and abroad. Every year it undertakes many such missions which helps to build expertise both at execution and planners level. One would seldom find a mid or senior ranking Officer in the sea-going branch of the *IN* who has not performed or planned one such mission. This is a big repository of talent, residing within the country. The *IN* has participated in several flood relief operations even in the landlocked places by flying- in the diving relief teams. As brought out earlier, the *IN* maintains a standing team of divers and boats which can be pressed into relief operations within hours of notice. The significant flood relief operations undertaken by the Indian Navy are as follows:

(a) Chennai floods, 2015
(b) Mumbai floods, 2006
(c) Uttrakhand floods, 2013
(d) Mudslide in Philippines, 2006
(e) Srilanka floods, 2017
(f) Bangaldesh floods, 2017
(g) Kashmir floods, 2014

Cyclones: The Indian Navy has performed several real-time missions in HADR role to relief the populace in times of cyclone. The *IN* has its own meteorological department which constantly monitors weather in the IOR utilising satellite picture made available by Indian Meteorological Department (IMD). The forecast of any disturbance over sea which is susceptible of converting into a cyclone is updated to all concerned personnel every few hours. This is navy's in-house mechanism to forewarn the ships and aircraft squadron of the impending danger and be prepared to tackle the disaster. The significant disaster relief missions undertaken by navy in recent past are as follows:-

(a) Cyclone Nargis, Myanmar.
(b) Cyclone Hud-Hud, India.
(c) Cyclone Phalin, India.

Tsunami: The Indian Navy was one of the leading organisation which undertook disaster management post tsunami, both at home and away. It pressed into service close to 40 ships in relief operations. It undertook all the tasks required in such situations viz. provisioning relief material, medical aid, communication restoration, SAR at sea, supplying essential supplies ashore. Indian efforts were well appreciated across the World by affected nations like Sri Lanka, Indonesia and the nations engaged in relief operations like US, Japan and Australia. The lessons learnt from this experience have been well documented and incorporated in various Standard Operating Procedures of the *IN*.

Firefighting: As covered earlier, the Indian Navy has a robust firefighting and training organisation in place. It runs a dedicated school for teaching various aspects of firefighting. Every major station of the navy has a mock built up designed to learn firefighting. Every *IN* personnel compulsorily attends one or the other training facility. Indian Navy also maintains a pool of officers and sailors who are specialised and trained in firefighting. The recent instances of the *IN* rendering assistance to civil authorities for firefighting are as follows:

(a) Maharashtra Mantralaya Fire, Mumbai, 2012
(b) MSC Daniela at Sri Lanka, 2017.
(c) MV Amsterdam at Mumbai, 2013

Survey Operations: Indian Navy is the largest hydro-surveyor in the IOR. India maintains a sizeable number of survey vessels of various classes. The Indian Navy not only undertakes survey across India, it helps various other nations in survey of their ports. These nations include African nations, islands in Indian Ocean, Sri Lanka, etc. The Indian Navy also trains officers from various nations at the Hydrographic School, Goa. Hence, the navy has enough expertise and experience in assisting the crisis which demands harbour to be surveyed for speedy dissemination of disaster relief material.

SAR Coordinator: The World has been divided into many areas over sea to assist in SAR operations. Each area has its coordinator whose charter of duty includes coordinating SAR operations within the region. In India, Indian Coast Guard manages this organisation under various Maritime Rescue Coordination Center. The *IN* with more assets and long logistical legs assists in all search and rescue efforts at sea. The *IN* rendered assistance in SAR efforts for doomed MH 370 flight in cooperation with other nations.

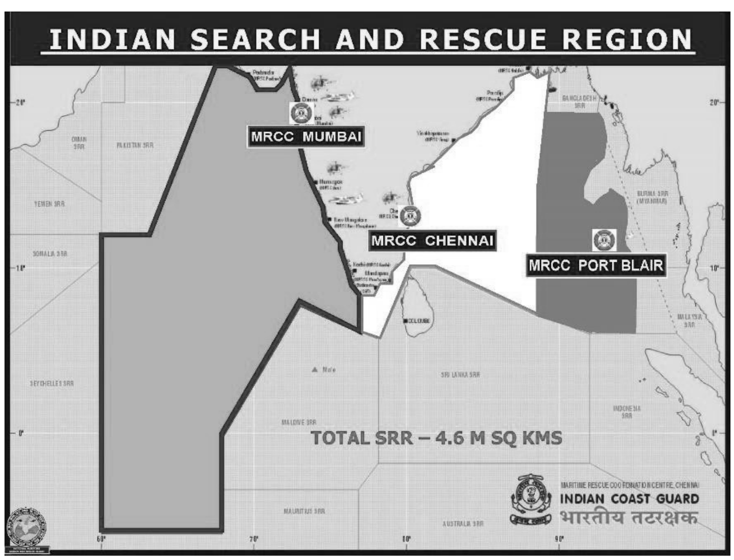

Figure 4: Various MRCCs under ICG

HADR Exercises: The Indian Navy participates in a number of table top and mock drill exercises to streamline and rehearse various procedures of HADR missions. These exercises are held on various levels from multi-agency to multinational exercise. These exercises have provided an expert pool that can render service in various HADR missions. The noteworthy exercises undertaken by the *IN* are as follows:

(a) Table Top Exercise with Malaysia
(b) RIMPAC, USA
(c) ASEAN regional forum disaster relief exercise
(d) Exchange of ideas during exercises Malabar (with US, Japan) and Varuna (with France)
(e) Exercise Parkampana – The first ever exercise involving all stake holders (both military and civil) of disaster management was conducted by Indian Navy in 2016

International Liaison: The Indian Navy has close liaison with other navies of IOR through 35-member Indian Ocean Naval Symposium. This is one of its kind voluntary organisation which seeks cooperation from member nations in the fields of common interest in IOR. India's soft power clubbed with equal-status approach towards partners gives India an edge over other nations trying to forge similar organisations. During Cyclone Nargis, the military rulers of Myanmar refused USS Essex to assist in relief operations. It was India which could dispatch two *IN* ships through rough weather viz. INS Rana and Kirpan to provide relief. Post that, India convinced Myanmar government to accept international aid. This indicates the Indian Navy's growing influence in the region.

Non-combatant Evacuation Operations (NEO): The Indian Navy has been part of many NEO operations which could have turn into catastrophes, if not assisted in a time bound manner. Indian Navy has even assisted developed nations like European Union and US citizens. US specifically asked its citizens to approach the *IN* for rescue in Yemen in 2015. The largest NEO missions undertaken by Indian Navy[21] are as follows:

(a) Operation Rahat, Yemen – rescued more than 4,000 civilians from 26 nationalities.
(b) Operation Sukoon, Libya – rescued more than 2,000 civilians of five nationalities.
(c) Operation Safe Homecoming – rescued more than 15,000 civilians within two weeks.

Recommendations

The HADR mission is not the primary role of an Armed Force of a state. However, it is included in one of the roles of the Indian Navy. Hence, the Indian Navy lays enough emphasis to building capability and expertise for HADR missions. The following are few recommendations which would go long way in successful conduct of HADR missions and minimise human loss.

- **Duration of Assistance**: The Indian Navy would be responder in emergency beyond the capacity of civil administration and would maintain in the relief zone until civil administration comes in charge of the activity. Hence, the Indian Navy should not be approached as a matter of routine and only in grave situation. The *IN* envisages that, in most scenarios, it would not be required to maintain in a disaster affected zone for a timeframe longer than seven days within which rehabilitation efforts would be stabilised.[22] However, if required, the *IN* would maintain in the area, as was done during Tsunami, 2004.
- **Notice for Assistance**: Time plays a key role in any disaster situation. As detailed earlier, the Indian Navy maintains various readiness efforts to deal with any eventuality even at short notice. However, the Indian Navy would prefer a close coordination with other agencies involved in similar task to provide a notice as early as feasible to allow more robust preparation and equip effectively according to requirements specific to the disaster.
- **Joint Exercises**: Training is important key ingredient in handling disasters. Indian Navy undertakes several exercises on command headquarters level to multi-national exercises. Indian Navy would urge various govt. agencies to join these exercises in better preparation for future disaster relief operations.
- **Sharing of Various Directives**: The civil administration receives various directives from government of the day concerning the disaster management. It would be beneficial for the government if details of latest government directives to civil administration with respect to disaster management are shared with nearest military installations to allow them equip and organise as per need.
- **Preparation for Nuclear Disaster**: India has aspired to generate 63000 MW of electricity through Nuclear technology by 2032.[23] However, Tsunami in Japan, 2011 which led to nuclear radiation leak from Fukushima nuclear power plant brought to the fore a different kind of mission i.e. a natural disaster causing a graver human-made disaster than natural disaster itself. India is a developing nation and would not be able to back track from

planned nuclear power capacity building. **Hence, it would be prudent that various organisations involved in the disaster management undertake paradigm shift and start equipping and training themselves for this kind of mission**.

Conclusion

Researchers have been studying disasters for long time. They believe that all disasters including natural disasters are human-made. They reason that human actions before the strike of the hazard can prevent it developing into a disaster. All disasters are hence the result of human failure to introduce appropriate disaster management measures.[24] National Disaster Management Authority (NDMA) in its annual report, 2015 said that India is not ready to face natural disasters.[25] A statement of this nature from the nodal agency of disaster management in India is a reminder for all stake holders to prepare more robustly for the tasks ahead. *IN* dedicates considerable efforts in disaster relief preparation and operations but has limited role and hence, capability in pre-disaster management missions. The proactive and cohesive approach of all government and non-government agencies in disaster management can go long way in ensuring minimal loss of life in future disasters.

Notes

1 Leo Bosner served in US Federal Emergency Management Agency for 29 years prior retiring from top post in 2008.

2 Indian Maritime Doctrine, 2009.

3 International Federation of Red Cross and Red Crescent Societies (www.irfc.org), accessed on 20 July 2017.

4 United Nations International Strategy for Disaster Reduction, (www.unisdr.org), accessed on 20 July 2017.

5 CRED, Centre for Research on the Epidemiology of Disaster, www.housingreconstruction.org, accessed on 21 July 2017

6 p. 3, Indian Navy. Indian Navy Disaster Management Policy 2017.

7 p. 228, SA Tabish, Syed Nabil, Disaster Preparedness: Current Trends and Future Directions. International Journal of Science and Research

8 Parmar Capt. Rahul, HADR in the IOR and the Indian Navy, Indian Ocean Naval Symposium.

9 CRED CRED, Centre for Research on the Epidemiology of Disaster, www.housingreconstruction.org, accessed on 21 Jul 2017

10 Shri Narendra Modi is the 14th Prime Minister of India.

11 Planning Commission, 2002.

12 p.6, Indian Navy Disaster Management Plan 2017.

13 p.17-18, Indian Navy Disaster Management Plan 2017.

14 CRED, Centre for Research on the Epidemiology of Disaster, www.housingreconstruction.org, accessed on 21 Jul 17

15 Operation Sukoon saw the deployment of IN Ships Mumbai, Brahamaputra, Betwa and Shakti to rescue Indians stuck in Lebanon in 2006.

16 Mr Jone Holf was the Deputy Secretary of Department of Homeland Security, United States of America and his seen many crisis situations in his career.

17 Ibid.

18 Deep water is not of a fixed depth. It depends on many factors like draught of the ship, position of intake pipe iro hull, water quality inside harbour or anchorage. Sometimes water in harbour is clear of debris. In such scenarios, the ships may run their RO plants in harbour itself providing continuous water supply ashore.

19 pp 30, Indian Navy Disaster Management Plan 2017.

20 **Erik Qualman** is an American author of *Socialnomics*, which according to WorldCat, is held in 1090 libraries

21 www.indiannavy.nic.in

[22] Indian Naval Disaster Management Plan – 2017.

[23] Available at: http://economictimes.indiatimes.com/industry/energy/power/india-eyeing-63000-mw-nuclear-power-capacity-by-2032-npcil/articleshow/6730724.cms, accessed on 22 July 2017.

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[25] p. 234, SA Tabish, Syed Nabil, Disaster Preparedness: Current Trends and Future Directions. International Journal of Science and Research

Multi-dimensional Role of Border Security Force in Disaster Management

Ravindra Kumar Thapliyal[a]

Life on earth is at the ever-increasing risk of being wiped out by a disaster, such as sudden global nuclear war, a genetically engineered virus or other dangers we have not yet thought of.

–Stephen Hawking

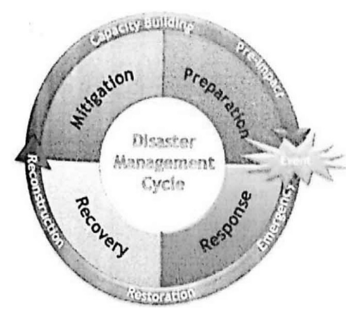
Abstract

The increasing incidence of disaster across the globe is creating a devastating impact on the lives, property and livelihoods of people. India is prone to natural and man-made disasters and the number has been increasing every year because of mixture of various factors such as adverse weather, population growth, urbanisation and industrialisation. The security forces like Border Security Force and others, as resources of the country, represents organisational strength, high sense of discipline and logistic capabilities that can be mobilised on a short notice in a self contained, self sufficient to support lifesaving relief efforts.

Hence the purpose of this paper is an attempt to present the role of Border Security Force in Disaster management as about ninety percent of troops deployed at border as a "First Line of Defense" and at such far flung area of the country where government machinery is minimal. This paper also highlights the specific training capabilities of BSF own disaster management training center in capacity building through imparting specialised, specific and need based training to various organisations. This review is set out to identify the achievements and new challenges of the force related to training, capacity building, and response at force level to any calamity.

Keywords: disaster management, BSF, BIDR training capabilities, Prahari Prayash in capacity building, rescue and relief operations of BSF

Introduction



The United Nations defines a disaster as a 'serious disruption of the of a community or a society. Disaster involves widespread human, material, economic or environment impacts which exceed the ability of the affected community or society to cope using its own recourses'. ***Disaster management*** is the process of forming common objectives and common values in order to encourage participants to plan for and deal with potential and actual disasters. It involves preparedness, response and recovery in order to lessen the impact of disasters. Disaster management can be defined as the organisation and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, in particular preparedness, response and recovery in order to lessen the impact of disasters. The process that helps us to face disaster effectively is commonly known as disaster preparedness. Hence, the individual as a part of community should prepare adequately to prevent face and respond to disasters. History has shown that where communities have prepared themselves to confront disasters losses to life and property have been less and environment could be protected.

Concept of Disaster Management

As per Disaster Management Act, 2005, "Disaster management" means a continuous and integrated process of planning, organising, coordinating and implementing measures which are necessary or expedient for:

[a] BIDR, BSF Academy Tekanpur

(i) Prevention of danger or threat of any disaster
(ii) Mitigation or reduction of risk of any disaster or its severity or consequences;

Risk is a measure of the potential to cause damage. Risk may be defined as the frequency of an event happening and its impact. High vulnerability and high hazard are associated with high disaster risk, whereas hazard is a physical or human-made event that can potentially trigger a disaster. In parlance of DM Capacities are the qualities and resources of community (or individual) to anticipate, cope with, resist and recover from the impact of hazards and in other hand Vulnerability is 'Susceptibility to harm' of those at risk. Conventionally risk is expressed by the following equation.

$$Risk = \frac{\text{Hazard} \times \text{Vulnerability}}{\text{Capacity}}$$

Hence, all agencies involved in disaster management operations must fully cooperate with each other. The forces have always been expected to be in the front in the front in providing relief during different disaster. BSF being physical presence in remote areas they are well placed to assist the government in relief endeavour.

Border Security Force: Role and Task

The Border security Force popularly known as First Line of Defense came into existence on December 1, 1965. The Force grew from 25 battalions in the 1965 and is presently the largest Border Guarding Force in the world. The Border Security Force is An Armed Force of the Republic of India, with the basic role of guarding the Borders of India with Pakistan and Bangladesh and matters connected therewith.

The force draws its uniqueness from the fact that it is the only CAPF with its own Air Wing, Water Wing, dedicated Artillery, own cavalry, camel wing, canine wing and its breeding/training centre and dedicated R & D institutions. Till date 1733 brave hearts have made the supreme sacrifice on the altar of duty and attained martyrdom. The supreme sacrifice of the Bordermen has been duly recognised by the Government of India by awarding Mahavir Chakra-01, Kirti Chakra-04, Veer Chakra-11, Shaurya Chakra-12, President Police Medal for Gallantry-231, and Police Medal for Gallantry-864 (Roll of Honour, @Bsf.nic.in).

For the last several decades the BSF has been deployed all over the country and abroad for maintenance of law and order, internal security duties, counter insurgency operations, anti-naxal operations, election duties and disaster relief. Due to its unique capability to quickly adapt to various situational requirements and to work in Perfect harmony with other agencies such tasks are always are assign to this unique force of the union.

Role and Tasked Performed by BSF

Specific tasks/role and duties performed by the BSF are broadly listed below (www.bsf.nic.in):

- Promote a sense of Security among the people living in the border areas
- Prevent trans-border crimes, unauthorised entry into or exit from the territory of India
- Prevent smuggling and any other illegal activity on the border

Three battalions of the BSF, located at Kolkata, Guwahati and Patna, are designated as the National Disaster Response Force Units and play an important role in Disaster relief work in complete north east region, Eastern UP, West Bengal, Bihar, Odisha and other states with its jurisdiction. The battalions are equipped and trained with for all natural disasters including CBRN emergencies.

BSF Institute of Disaster Response: Role in National Level Training

In the year 2003 MHA earmarked BSF Institute of Disaster Response at BSF Academy Tekanpur as one of the National level Nodal Training Institution for Disaster Response for conducting courses on Disaster management specialised field like MFR/CSSR and CBRN Emergencies, with aim to train personnel of NDRF/SDRF Bns, BSF personnel and other organisations in the subject field

The vision of the institute is

- *to grow as a premier institute of excellence for training in disaster risk mitigation and management and to be recognised as one of the leading institute at the national level in the field.*
- *to strive relentlessly towards promoting awareness, capacity building in the field by providing quality training and promoting a culture of prevention and preparedness at all level.*

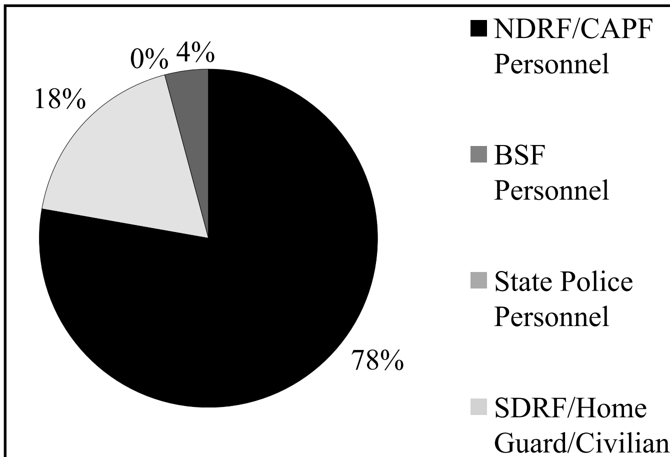
Training Orbit of the Institute

As per the mandate of the institute BSF Institute of Disaster Response imparted quality training to the large number of trainees of different organisation in the specialised field of disaster management and the largest chunk is of NDRF, i.e. more than 4000 personnel. Hence the contribution of BIDR to train the NDRF personnel is unmatchable especially when initially selected lot of NDRF trained as instructors to strengthen the new raising force. Now it is decided by FHQ BSF Trg. Dte., that it is equally important to trained the own BSF personnel in disaster response as it is a part of daily affairs to deal with such situations and since year 2015-16 special courses are being organised for BSF all ranks.

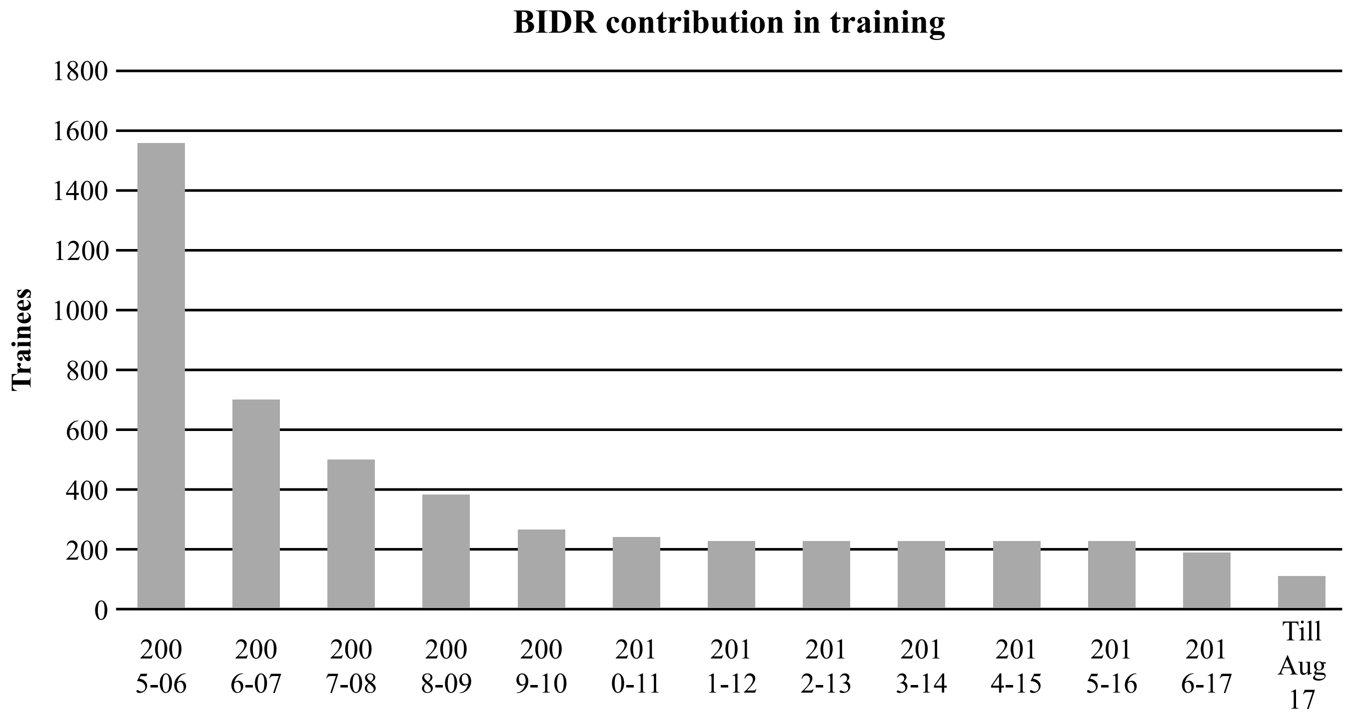
Apart from that the NDMA sponsored courses are integral part of training programme of the institute. The endeavor of BIDR is to impart formal training to the state disaster response force personnel, NCC, youths of Nehru Yuva Sangathan, Civil defense and other volunteer organisation as per the direction of NDMA and FHQ BSF. As far as training expertise is concerned, BIDR was instrumental in rising of Madhya Pradesh SDRF by providing training to their work force in large at first.

Table 1: Data on organisation wise personnel trained by BIDR up to August 2017

Organisation wise personnel trained	Strength
NDRF/CAPF Personnel	4114
BSF Personnel	950
State Police Personnel	23
SDRF/Home Guard/Civilian	238
Total	**5325**



Pie Chart: Organisation wise personnel trained

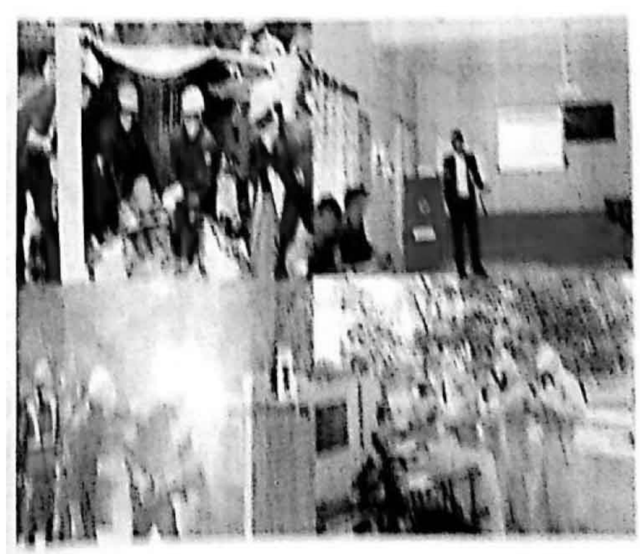


Number of Trainees	1531	707	533	412	269	281	243	226	267	269	249	221	117

Figure 1: Graphical representation of number of trainees trained in specialised disaster management field since inception of BIDR

Specialised Courses at BIDR

All the courses conducted by BIDR on disaster management are approved by the Trg. Die HSF, NDMA and according to training regime of NDRF Trg, Die. Both basic and advanced courses are being organised for various stakeholders and are as under.



- ***Faculty of MFR and CSSR (Basic and TOT Courses):*** Courses on MFR/CSSR are conducted as per the guideline given by programmer for Enhance of Emergency Response (PBBR) and NEP PEER was a five year regional training program (2003-08) of the U Agency in International Development, Office of US Foreign Disaster Assistance (USAIDOFDA) in MFR modle trainees me exponential to volume skills like victim assessment, stabilising the Vitim proper transportation. life saving skills like cardio pulmonary resuscitation, FBAO, respiratory distress and childbirth emergencies, in collapsed structure search and rescue (CSSR) module trainees get exposure of simulated situation with the help of CSSR props. In this course trainees are given skill oriented knowledge about, how to carry out search and rescue operation where multiagency involved and at same time learning new techniques about breaching and stabilising the structure.

- ***CBRN Emergencies Training Wing (Basic, TOT and MOT Courses):*** Chemical, Biological, Radiological and Nuclear emergencies are the latest threat of disaster and also known as weapon of mass destruction. BIDR organises all basic and advance courses on the subject with having well trained faculty. The important factors while dealing with such kind of emergencies are timely detection of the source, proper decontamination of rescuer/victim/area and proper medical management of the victims by effective triage method. DRDE Gwalior provides effective support to the institute in the form of lecture on the subject by the scientist as well as visit of premier installation.

Year wise summarised details of trainees of different organisation, trained by BIDR in different specialisation field of disaster management is given below in Table 3.

Table 3: Details of Trainees Trained by BIDR in Specialised Field

Training Year	Basic DM course (MFR&CSSR)	CBRN Emergencies	Other courses	Total
2005-06	1511	20	-	1531
2006-07	604	103	-	707
2007-08	533	-	-	533
2008-09	355	32	25	412
2009-10	248	21	-	269
2010-11	254	27	-	281
2011-12	138	74	31	243
2012-13	115	69	42	226
2013-14	139	67	61	267
2014-15	165	89	15	269
2015-16	212	24	13	249
2016-17	148	57	16	221
Till Aug 2017	58	59	-	117
TOTAL	**4480**	**642**	**203**	**5325**

**Other courses- Integrated course on security management emergency response, security management courses for tribal youths and other courses.*

Factors Affecting Trainees Outcome

Based on Feedback Received from the Participants

The participants come for training at BIDR, especially trainees of basic courses usually not having significant knowledge or idea about the subject field. Participants especially from state forces as a part of SDRF are even not willing to do the course but being detailed by their respective department, have to complete the course. Significant positive changes in attitude and changes in general outlook can be seen. The disaster management training at BIDR is basically based on three important components of learning:

- ***Knowledge***
- ***Skills***
- ***Attitude***

Highly positive feedback of the trainees shows the instructional capabilities of the faculty available with, who all are putting their heart and soul in learning process both in classroom teaching as well as practical skills and which is very important in mentor mentee relationship. As quoted by Dr A P J Abdul Kalam "*Excellence is a continuous process and not an accident.*"

Community Awareness Programme: Unique Initiative of BSF Academy

The goal of any disaster management initiative is to build a disaster resistant/resilient community, equipped with safer living and sustainable livelihoods to serve its own development purposes. The community is also the first responder in any disaster situation, thereby emphasising the need for community level initiatives in managing disasters. Within the vulnerable community, there exist groups that are more vulnerable like women and children aged and infirm and physically challenged people who need special care and attention especially during disaster situations.

"Prahari Prayash": A Step Towards Well-being of Society

"Prahari Prayash" an initiative of BSF academy Tekanpur with aim to aware the people of surroundings of Gwalior and Tekanpur on different environmental and social especially to school children and college students. Such group of the society may be considered as a target population for maximum impact and results. BIDR focused on organizing workshop/campaign for College students, NCC/NSS cadets on disaster management skills. It is observed that youths are always keen to learn new knowledge and associate themselves in all the activities organised for them by the BSF institute.

Since January 2017 to August 2017 total 75 such programmes conducted different organisations and civilians with support of district administration Gwalior District Education Department and SDRF Gwalior Team.

Table 4: Community Awareness Programme on DM Organised by BIDR

Year wise	Total Programme Organised by BIDR	Organisations				
		Municipality Representatives/ Villagers and Other Civilians	Students of College/Schools	Teachers	NCC/NSS/ Scouts and Guide Camps	Total
Jan-14 to Dec-14	35	1021	759	82	3058	4920
Jan-15 to Dec-15	16	765	380	20	975	2140
Jan-l6 to Dec-16	17	42	1378	108	–	1528
Jan-17 to Aug-17	07	–	1606	51	–	1657
Total 75 such awareness programmes						**10,245**

The vision of BIDR is to train maximum people with aim of capacity building of the society in effective disaster response and should not be limited to professionals and personnel involved in, but should also be focus on building the knowledge, attitude and skills of the community to cope with the effects of disasters. At present identification and training of volunteers from the community towards first response measures as well as mitigation measures is an urgent imperative.

BSF in Disaster Rescue and Relief Operation at Various Frontiers

The Indian sub continent is prone to multiple disasters and India on account of its geo-climatic condition is highly vulnerable to natural disaster. Flood, drought, cyclone and even earthquake are recurrent phenomenon. Due to repeated natural and man-made disaster India has suffered enormous loss in terms of lives, livelihoods and damage to both public and private property.

The motto of BSF is ***"Jeevan Prayant Kartavya"*** and BSF always stands on these pillars idealistically. BSF is serving the nation, not only in role of 'First wall of Defense' of the country but also in service of humanity. Border-men dedicated themselves to serve the nation in multidimensional role and during disaster always stand to save the precious life. BSF is deployed in entire flood prone area in north east region and West Bengal state along the International Border with Bangladesh and all the frontiers of BSF are leaving no stone unturned to help the flood affected border population. This year monsoon badly hit Gujarat state and north Bengal region and here BSF troops despite of all odds and difficulties did commendable job in rescue and relief operation.

Flood situation during July-Aug 2017

Gujarat Frontier: All units of Gandhinagar Sector i.e. 94/142/37/154/1066 Arty and WW Bhuj carried out several operations in flood affected areas. Ftr Gujarat has deployed 300 personnel in many teams to assisted civil administration in regulation of traffic and shifting of villagers from lower areas to upper ground areas one team laid sand bags on the bank of SIPU dam to protect the banks of dam. BSF troops have played very vital role in saving of precious lives and during this period BSF rescued 2233 civilians from flood affected areas and helping them to reach at safer places. BSF has distributed 60,850 food packets, 10180 water bottles and 35 bundles of clothes.

A mega relief and medical camp at highly flood effected village Nalodar, Wav (Taluka), Dist-Banaskantha was also organised under directions/supervision of Sh A K Tomar, IPS, IG Guj Ftr. Approx 600 civilians were benefited and daily need items of worth approx Rs 12 Lac were also distributed to floods victims in the presence of Sh Vijay Bhai Rupanl, Hon'ble Chief Minister of Gujarat and Sh Shankar Bhai Chaudhary, Minister of health & family welfare, Government of Gujarat.

Similarly one more relief and medical camp was organised in village Meghpura, where 200 civilian were given medicare and daily need items worth ₹ 05 Lac also distributed. Hon'ble Chief Minister of Gujarat appreciated the efforts and humanitarian role played by BSF during flood in entire north Gujarat i.e Deesa, Patan, Banaskantha etc. (Info source: Ops/G branch Ftr. HQ Gujarat BSF)

DATE – 28.07.17 PLACE – KAMALPURA AREA

RESUCUED 100 PEOPLE, DISTRIBUTED 1000 FOOD PACKETS AND 1500 WATER POUCHES AND DISTRIBUTED MEDICINES TO THE PEOPLE OF KAMALPURA.

DATE – 31.07.17 PLACE – KAMALPURA AREA

DISTRIBUTED RATION BAGS-55, WATER BOTTLE – 1000 IN VILLAGE TELENA, CHHANIDHAR, KOLAPURA AND RAMESHWAR AND ALSO CROSSED 150 PEOPLE TO BOTH SIDE OF VILLAGE IN GENERAL AREA KAMALPURA

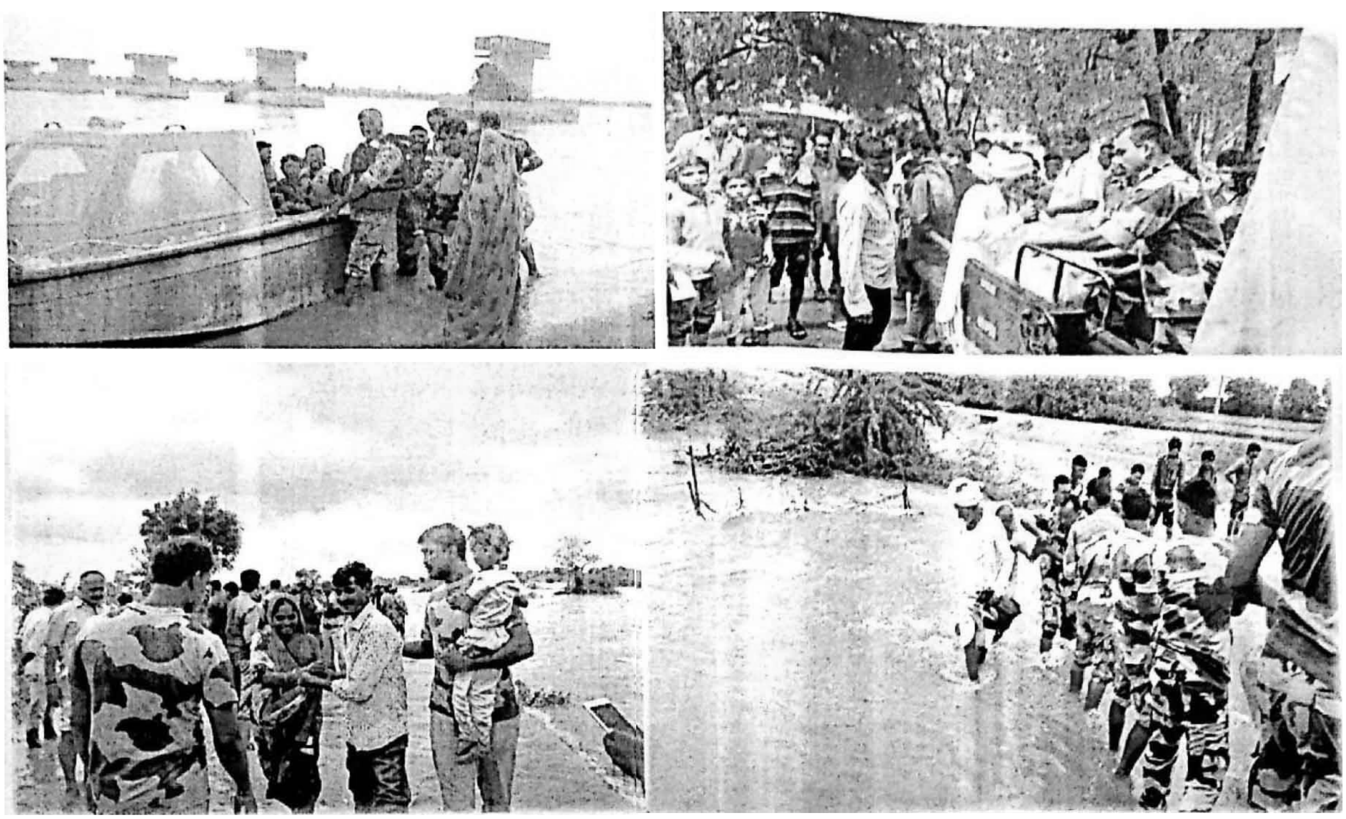


Figure 1: Pics of Gujarat flood relief ops carried out by BSF troops in July-Aug 2017

North Bengal Frontier: In Rescue and Relief Operation

In North Bengal area due to recent flood, border areas under sector Raiganj, Kishanganj and Jalpaiguri under Dakshin Dinajpur, Uttar Dinajpur, Jalpaigun and Coochbehar districts were worst affected. Most of the villages in the bordering area were submerged in the water for about a week due to flood. Border population in these areas experienced scarcity of food material, drinking water and remained cut off from all sides. About 25 BOPs of SHQ Raiganj and Kishanganj were severely affected and flood water up to 3 to 4 feet was logged inside the BOPs and around border fencing. Four of the BOPs had to be shifted temporarily to safer places

Immediate Evacuation and Relief Work

Many villages in the border area were submerged in flood water and were cut off from all sides. BSF troops immediately came into action and evacuated old and sick people and also provided them food, drinking water and shelter. Even in flood relief work BSF families did commendable job by providing valuable support. Each BSF Family of Frontier HQ as well as Sector HQr and Units prepared minimum 02 food packets daily for 05 days and distributed to flood victims under aegis of BWWA. (*Info source: Ops/G branch Fir..HQ North Bengal BSF*)

Figure 2: Pics and media coverage of BSF rescue and relief operation in North Bengal during July-Aug 2017

Conclusion

Disaster has been with us as long as recorded history and presumably even longer. Generations have had to withstand disaster, we can only minimise losses to both human and property but prevent them. Disaster management is relatively a new discipline in our country and in fact a few decades ago, the government machinery in India had no clear concept of disaster management. But now things are moving speedy in a right direction especially after National Disaster Management Act, 2005. It is need of the day that in such awareness programme on how to face disaster effectively must be involve maximum population and for that purpose training plays an important role. For various stakeholders training needs may be listed as:

- Disaster management training: Training for executives or policy makers.
- Skill Training: For those who may required to undergo duties and of rescue and relief operation, such as force personnel and other volunteer groups as first responder
- Coordination training: Training for coordination in disaster management cycle. Various government departments, who are directly or indirectly involved in the process and NGOs may be the key actor.

The Border Security Force can be consider us a national resources in disaster management map of the country as its disaster training institute being a national premier centre providing meaningful and quality training to the various organisation and thus strengthening the preparedness phase at national level, whereas at the same time whenever required bordermen are effectively responding during occurrence of any crisis with aim to serve humanity.

A Borderman's Pledge

I will not Disgrace the Borderman's Arms,
nor Abandon the Comrade,
who stands at my side.
Whether alone or with my many,
I will defend everything that my country holds sacred.

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Police as the First Responder: A Global Perspective

Parvez Hayat[a]

No community or city can be certain that it will not face a disaster. The unexpected is a fact; it can come anytime, anywhere. Role of police will vary in different disaster situations–mentally physically and psychologically.

- (Leonard, 1938)

Abstract

Conceptual role of police has been largely ignored in public discourse and literature. It was only in early 90s after Super Cyclone 1999 in Odisha and Katrina in New Orleans 2005 that it caught the attention of Disaster research scholars, experts and academia to think in terms of broadening the role of police by adding additional coping capacities to deal with disaster situation and other emergencies effectively. They also suggested the inclusion of police managers in pre –disaster plan so that police contribute along with other Emergency Management Services (EMS), community and other stakeholders in Disaster Risk Reduction.

Police are more prepared trained, disciplined since training makes them mentally and physically tough, supposed to deal with unexpected situations. It may be emergency or disasters. The practical experiences having dealt with different disaster situations, shown that, at times, police have to share many responsibilities, which is technically beyond the preview of their prescribed duties, or mandate. Over a period, police have become a formal and disciplined uniformed force regarded by the people as most effective managers in their role in managing disasters (V A Leonard, Thomas).[1] Police has already proven its proficiency in solving professional crimes, keeping community safe, regulating traffic, public safety and maintenance of law and order. Recently, it has been witnessed that police have proven their skill in successfully conducting mega sporting events like Olympic and Commonwealth games. Hence, police can also play a crucial role in effectively dealing with both natural and man-made disasters. In order to effectively manage disasters, the government should capacitate the existing local police force apart from creating new specialised forces.

Keywords: disaster management, police response, second victimisation

Police is a Uniformed Civilian Disciplined, Trained to Deal with Unexpected Exigencies

Police organisation has to see itself as a major player in disaster management. Purpose of the Disaster Management Act, 2005 was to create resilience and augment preparedness to deal with the disasters effectively and the same is difficult to achieve unless we have hundreds of thousands trained citizens, dedicated, equipped and trained response forces, empowered and accountable civil and Police leaders and a willing state to ensure availability of resources both for response and capacity building. It is the management during golden hours that we must strive to achieve to reduce the loss of precious human lives.

It has to adopt disaster management function as a primary one and not a side work thrust upon it. State & district level authorities cannot afford to wait for response of specialist forces such as NDRF, and armed forces all the time. Moreover, on many occasions, it might not be advisable nor feasible to obtain/ deploy armed forces and NDRF. Hence, state police must be prepared as response force. Given the not so good future prognosis in view of climate change and other factors with respect to disasters, sooner it is done, better it is. In addition to capacity building, State governments have to bring about changes in law to empower the police and the supporting organisations such as home guards and civil defence. Hence the local police must be trained, equipped and empowered so that they find themselves capable to support the victims in the 'golden hour'. Subsequently they can play supporting role to the specialist forces if and when they come in bigger emergency cases. On many occasions specialist forces are not required based on typology of disasters and the local police may retain the primary role to help the victims.

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The outside forces are also handicapped in operating in unknown area, among unknown people and at times there is a language problems too and here are the key to critical role of police.[2]

Local police have advantage over others in terms of their proximity to an incident, organisational capability and authority to command people and resources. Police with a well-developed communication system could respond within no time, whereas specialised out-station forces 345 have costs in terms of time lag which may be critical many a time. Police being closest to society reach the disaster site at the earliest to start Search and Rescue (SAR) work.[6]

Police prevent second victimisation, the very fact that during devastating Katrina hurricanes in New Orleans, Police Chief had to withdraw a contingent of police force from SAR and dispatch them to control looting the victims of disasters even people like criminals who find disaster situations as opportunity to commit crime(Quarantelie1993,1905). Looters were even stealing valuables from dead bodies and it's the police which stop second victimisation. We find similarities in kosi disaster in 2008 Bihar how looter and robbers were active in stealing property of those who left their houses un protected when kosi floods gushed in and people left most of their properties to save their lives.

Police provide public safety and maintain 'law and order' Firefighters control the spread of existing or potential fires and paramedics provide medical assistance. In reality, their roles are quite varied and obviously invaluable. Role of police in a disaster situation primarily is crowd control, law and order at disaster site, traffic control and cordoning of road or and clear the way for other EMS like firefighters and paramedics to enter the site, besides search and rescue, coordination with government and non- government agencies as well as with specialised forces like Armed Forces, National Disaster Response Force (NDRF).

Therefore, there is a need on part of governments to invest more in local police a portion of their Modernisation Funds for capacity building and procuring modern life saving and other modern SAR rescue equipment.

Hence there is need to statutorily define the role of police in DM Act, 2005 by making required amendment, State Police manuals and State Disaster Plans to make the police accountable by legal mandate in effectively dealing with disasters.

The United Nations (UN) defines a disaster as a serious disruption of the functioning of a community or a society. Disasters involve widespread human, material, economic historical and cultural losses that may be incalculable, irreparable, and very likely to affect Industry, tourism economy or environmental impacts, which exceed the ability of the affected community or society to cope using its own resources (UNISDR, 2009).

The Red Cross and Red Crescent societies define disaster management as the organisation and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, in particular preparedness, response and recovery in order to lessen the impact of disasters (ifrc.org, accessed on 12.06.17).

National Disaster Management Act (NDMA) 2005 section 2(d)- defines disasters as a catastrophe, mishap, calamity, a grave occurrence in any area arising out of natural or man-made causes, or by accidents or negligence which reflects a substantial loss of life or human suffering or damage or degradation of environment and is beyond the coping capacity of the community which are necessary and is of beyond a coping capacity of the community, which are necessary for prevention of damage, mitigation of risk reduction, evacuation, rescue and relief, rehabilitation and reconstruction.

Table 1: World's Ten Deadliest Disasters

S.No.	Name of Event	Year	Country and Region	Fatalities
1.	Earthquake	1556	China, Shaanxi	830,000
2.	Earthquake	1731	China	100,000
3.	Cyclone	1737	Calcutta, India	300000
4.	Yellow River Flood	1887	China	900,000–2,000,000
5.	Messina Earthquake	1908	Italy	123000

6.	Earthquake	1920	China, Gansu	235000
7.	Great Kanto Earthquake	1923	Japan	142,000
8.	Great Chinese Famine	1958-1961	China	15,000,000–43,000,000
9.	Bhola Cyclone	1970	West Bengal, India & East Pakistan (now Bangladesh)	500,000
10.	Tangshan Earthquake	1976	China	242,419

Source: Disaster Management in India, MHA, Government of India, 2011

Similarly, some of the major disasters, which took place in the last century since 1900 are captured in the Table 2

Table 2

S. No.	Name of Event	Year	Country and Region	Fatalities
1.	China Floods	1931	China	1,000,000–2,500,000
2.	Floods	1954	China	40,000
3.	Cyclone	1970	Bangladesh, Chittagong Khulna	300,000
4.	Bangladesh Cyclone	1991	Bangladesh	139,000
5.	Earthquake	1999	Turkey	17,000
6.	Tsunami	2004	Indonesia, Sri Lanka, India, Malaysia, Somalia, Bangladesh, Thailand	230,210
7.	Hurricane Katrina	2005	United States of America	1,836
8.	Sichuan Earthquake	2008	China	87,476 deaths including missing
9.	Cyclone Nargis	2008	Myanmar	More than 138,000 deaths
10.	Haiti Earthquake	2010	Haiti	316,000

Source: Disaster Management in India, MHA 2011

India is prone to extreme climatic events and related disasters due to its unique geo-climatic condition. However, climate change has been looked at as an environmental problem, and therefore featur under the domain of a different institutional setup (NATCOM, 2004, 2012; Patwardhan, 2007, Oxfam, 2011). Till 90s of last century, it was the Agriculture Ministry which used to look after the Disaster management, which subsequently got transferred to the Ministry of Home Affairs in 2002 as nodal ministry to coordinate with other ministries, following the Bhuj Earthquake on 26 January 2001. A legal framework was created through Disaster Management Act, 2005, for addressing the different management activities of DRR (Disaster Risk Reduction) at the national and sub-national levels with institutional framework and budget for response, capacity development and a special force was conceived for response during disaster.

The Act provides for creation of authorities at National, State and District level called National Disaster Management Authority/or Agency (NDMA) in some states, State Disaster Management Authority (SDMA) and District Disaster Management Authority (DDMA), respectively for formulating the plan and policy. It further creates a framework for response, preparedness, mitigation, etc., at the National, State, and District level and at Local level/Panchayat level through National Executive Committee (NEC), the State Executive Committee (SEC), and District Level

Executive Committee (DLEC), respectively, which are the main body responsible for managing the DRR activities. The Act makes provision for setting up of a National Disaster Response Force (NDRF) for response during disasters and National Institute of Disaster Management (NIDM), a kind of think tank and research body of NDMA for the capacity development at national level at Delhi under Ministry of Home Affairs. The management of different kind of disasters originating from different triggers and sources are done by different Ministries of the Government of India as given in the following Table 3.

Table 3: Convener-Nodal Ministry and Department for Management of Different Kinds of Disasters

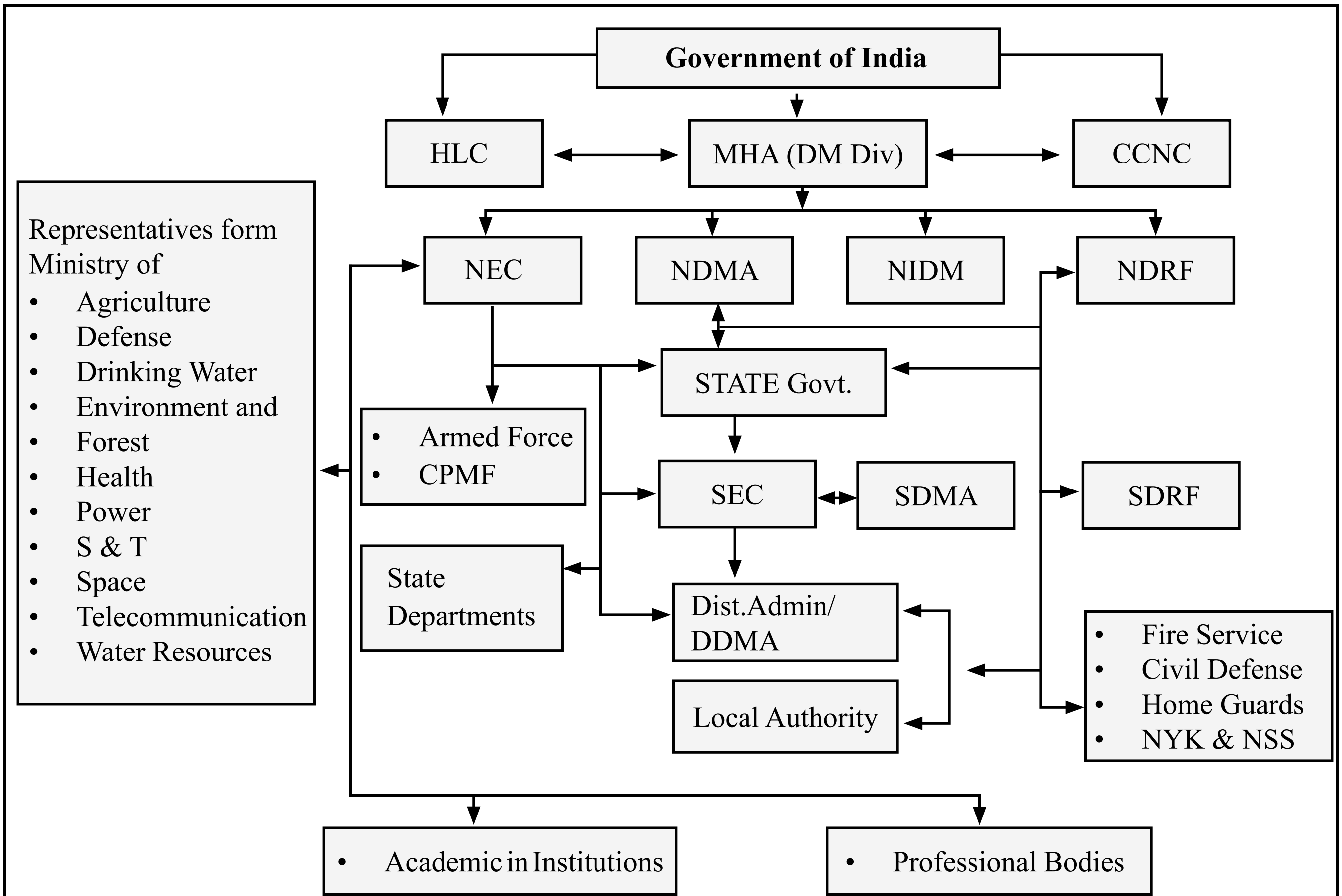
Disaster	Disaster Management by	Mitigation efforts by	Member Ministries on Mitigation Plan Committee(MPC)
Earthquake	Ministry of Home Affairs (MHA)	Ministry of Earth Sciences	Ministries of Science and Technology, Urban Development, Rural Development, HRD, Health and Family Welfare, Panchayati Raj, Youth Affairs & Sports, Women nad Child Development, IT & Telecommunication, I&B and Space.
Flood	MHA	Ministry of Water Resources(WR)	Space; Telecommunication
Drought, Hailstorm and Pest Attack	Agriculture & Cooperation (A&C)	Department of Agriculture and Cooperation, Ministry of Agriculture	-
Landslide	MHA	Ministry of Mines	Road Transport and Highways and Shipping
Avalanche	MHA	Ministry of Defence	Road Transport and Highways and Shipping
Forest Fire	E&F	Ministry of Environment, Forests and Climate Change (MoEFCC)	-
Nuclear Disaster	MHA/Atomic Energy (AE)	Department of Atomic Energy	Defence; Health and Family Welfare
Industrial and Chemical Disasters	E&F	Ministry of Environment, Forest and Climate Change	-
Biological Disaster	Health &Family Welfare (H&FW)	Ministry of Health and Family Welfare	Defence, Environment and Forest, Agriculture and Cooperation, Animal Husbandry, Dairying and Fisheries and Chemical Fertilizers.
Rail Accident	Railway	Ministry of Railways	-

Source: Disaster Management in India, MHA 2011, Srivastava R.K.

As institutional structure of disaster management in India has evolved following the enactments of the Disaster Management Act, 2005, the new setup created under the DM Act however co-exist with the existing structure, somehowhave not totally subsumed with the new structure. The structure hierarchical in making, have four levels, Centre, State, District, and Local, which may be seen from the following Table 4

Table 4: Institutional Structure of Disaster Management in India

Levels of Institutional Arrangements as under Disaster Management Act, 2005



Note

HLC	- High Level Committee	NIDM	- National Institute of Disaster Management
MHA	- Ministry of Home Affairs	NDRF	- National Disaster Response Force
CCNC	- Cabinet Committee on National Calamities	SEC	- State Executive Committee
NEC	- National Executive Committee	SDMA	- State Disaster Management Authority
NDMA	- National Disaster Management Authority	SDRF	- State Disaster Response Force
DDMA	- District Disaster Management Authority	NYK	- Nehru Yuva Kendra

Source: Disaster Management in India by R.K. Srivastava (2016)]

Table 5: Disaster-wise Nodal Agencies for Forecast

Disasters	Agencies
Cyclone	Indian Meteorological Department
Tsunami	Indian National Centre for Oceanic Information Services
Floods	Central Water Commission
Landslides	Geological Survey of India
Avalanches	Snow and Avalanche Study Establishment
Heat and Cold Waves	Indian Meteorological Department

Source: Disaster Management in India by R.K. Srivastava (2016)

During and after occurrence of disaster different Emergency Management Services including local police work in coordination with other civic agencies and local authorities to minimise the impact of disaster on life and livelihood of the people, Police department also play an important role not only during disaster but also after disaster and also at recovery and rehabilitation stag as well.

Police Department are government-sanctioned authority to deploy police for maintaining law and order within community, Police are also part of emergency management services (EMS) at the local level at disaster affected sites as one of first responder to designated places, assisting rehabilitation and relief distribution, security at Relief distribution centers, etc. Police perform disaster scene security, cordoning the way to facilitate other EMS services like fire- fighters, paramedics to enter, security of critical structure, Search and rescue, crime fighting to help victims from second victimisation, crowd control, laming the chaos, traffic regulation, bomb removal, and disposal, victims identification and disposal of dead, Transporting victims, dead. They as first amongst the first responders-, paramedics, firefighters, community, civil defence, etc. Welfare and health agencies, utility companies and the many other organisations that can be involved in responding to an emergency work closely with local and central government organisations, other emergency services (Damon P. Coppola 2015).

However, after Katrina in New Orleans, USA 9/11, Super cyclone in Orissa, and Bhuj, role of police as first responder came into public discourse. There is a need to broaden the role and enhance the capacities of police personal in view of management of disaster for achieving larger community resilience.

Disasters hit the poorest the hardest. They often live in areas that are prone to recurring hazards, tsunami, gale, storm surges, floods or famine, earthquake, etc. They are also the ones who are bound to loose their homes, jobs and farmland when fleeing from scene of disasters often losing life, property and home and at times become subject of second victimisation by criminals, looters, who even rob, snatch valuables from even dead, money from dead, burgle the affected houses, theft in relief, looting relief materials there only during disasters and afterwards Role of Police becomes very crucial in protecting affected people from second victimisation.

"Traditional police responsibilities have expanded tremendously since Disaster in Hurricane Katrina touched down in New Orleans in USA on August 29, 2005. Katrina and 9/11 in 2001, in World Trade Centre in USA, not only highlighted the need for officials all over world to enhance preparedness and coordination efforts, but also emphasised the need for local police to broaden their roles during a crisis (Available at: http://www.mdchhs.com/category/blogs/).

Typical police training focuses on keeping communities safe through prevention and detection of crime, traffic regulations, investigative techniques, security and maintenance of law and order. Self-defense tactics and firearms training are also required for officers to meet government regulations and maintain minimum safety standards. However, after Katrina and similar natural disasters, police executives have been forced to incorporate additional training designed specifically for responding to catastrophic disasters" (Herron, 2015**).**

The principal roles of the police in an emergency are maintaining law and order, protecting life and property, public safety, assisting the movement of rescue, medical, fire and other essential services, assisting and coordinating movement control over land and undertaking inland search and rescue. The aftermath of any disaster often goes on for months, even sometimes years. Police continue supporting agencies throughout the recovery, starting right from onset of disasters.

Police being first line of defence of the responders and work as the core member for safety of community and recovery of the affected community from the disastrous situation. However, it has been noticed that the conceptual role of police in both pre-disaster planning, during the disaster and post-disaster responses has been largely ignored in the Literature and academic discourse. Role of police has not been even statutorily recognised rather mired by its failure or criticism by public and even in certain judgments of Hon'ble Supreme Court and High Court in handling serious disasters.

The professionalisation of policing apparently has been largely achieved in the area of their traditional duties like dealing with fighting crime, criminal investigations and maintaining public order. For the first time in history, many in both the practitioner and academic communities began to believe that the police really could reduce crime through the adoption of research-based strategies. The manifestation and institutionalisation of this belief are evidenced by the adoption of phrases like "evidenced based policing" that have begun in public discourse to dominate the policing landscape.

The policing literature has given very little attention to the role of police in disaster events. Many leading college-level policing textbooks (Gaines and Kappeler, 2010), discuss the issue in general terms and often only in the context of examples of police failures. While there is a growing body of research in recent years addressing the role of police in large-scale planned events such as major sporting events like the Olympics and common wealth games, and tackling political agitations and E- crimes, relatively not much attention has been given to the role of police to natural or man-made disasters. They are given the difficult talk of "creating calm out of chaos" (Punch & Markham, 2000 as cited by Varano in his article: policing Disasters pp. 83-86).

Analysing the Role of Police in Broader Aspect: Theoretical Construct

After some recent large scale natural disasters like Super Cyclone Orissa 1999, Bhuj Disaster in Gujarat 2001, Great Tsunami at Chennai, in 2004, Hurricane Katrina in New Orleans USA August 29, 2005 and 9/11 in 2001, in world Trade Centre in USA. There is tremendous expansion in traditional role of police not only highlighted the need for officials all over world and nationwide in India as well to enhance preparedness and coordination efforts, but also emphasised the need for local police to broaden their roles beyond typical policing during a crisis includes disasters, emergency management and keeping communities safe through prevention and detection of crime, traffic regulations, investigative techniques and arrests are typical content of training of police.

After 1999–2001 over a decade year of substantial attention to problems associated with responses to natural and man-made disasters, significant barriers remain in the level of communication and coordination among first responders includes police as core first defence out of three first responder's EMS (Emergency Management Services) like Police, Fire Fighters and Paramedics. These barriers are best understood as physical and often cultural barriers of coordination amongst multi-cultural agencies more importantly police, fire and other civic agencies, tasked with public safety and not technical in nature. Bhuj, Great Tsunami, Super cyclone in Orissa, Hurricanes Katrina and Rita further emphasised that the "lessons learned" in the aftermath of the 9/11 attacks as well as the infusion of federal and state resources to help address the systemic problems identified after 9/11 were largely ineffectual. Communication infrastructure was so devastated during Hurricane Katrina and Bhuj, for example, that many first responders had to rely on paper communications and face-to-face contacts.

After nearly few years of "lessons learned" discussions, few could have imagined a more effective response to unexpected events. Disaster management is highly complex issue. While the present response system is handled by our well-developed administrative machinery, the same has number of difficulties. Some of them can be overcome by ensuring availability of locally trained responders. Here comes the role of the police. Policemen posted in police stations are closest to the society and are the first responder after the community. People understand that they are the first agency whom to approach in any disaster/emergency.

The policemen are the most visible face of the government and people too identify police as saviours in distress. Police with its organisational strength, resource capability and training is expected to protect/help people in difficult times. They do play prominent role in all phases of emergency management, i.e. rescue, relief and recovery in disaster situation.

But are they adequately prepared for this? No, certainly not. The Governments are creating specialised forces like National Disaster Response Force (NDRF), Odisha Disaster Response Force (ODRF), Bihar Disaster Response Force (BDRF), etc., to respond to emergencies. But such forces also have their inherent limitations, such as less in number, located at fewer locations in a state and, therefore, they at times they may not be able to reach at disaster site in critical hours which a may be critical and significant in the context of distance of unit from the site, availability of the unit, accessibility of the area and availability of transport, etc. Inadequate or absence of response during 'golden hour' may have far reaching implications in terms of loss of life and damage to property. On the other hand, the local police has host of advantages like quickest to rush to site of disaster in golden hours of crises.

Typologies of Disasters

When considering police responses to disasters, it is first important to develop typologies of events to which police and other public and private entities may be required to respond. This conceptual approach is important because different types of disasters not only present various practical and political challenges but they constrain the capacity of communities to respond and shape the public's reactions.

At the conceptual level, Quarantelli (1988, 1993) distinguishes between non-community crises, consensus—type community crises, and conflict—type community crises. Non-community crises are those which largely affect a relatively isolated physical location and gusually include examples such as transportation accidents, railways accidents, aviation accidents where there may be no role of community as first responders as there may not be communities living near bye, no nearby hospital, no communication and police shall be only first responders in Golden Hours and first line of defence till specialist forces like NDRF, Army can be requisitioned and deployed for disaster mitigation.

Community type crises are those that cause large- scale community-wide destruction and which usually entail a large-scale mobilisation of people and resources to address damage by shifting affected people to safer places like super cyclone in Odhisha, tsunami, etc. From this conceptual standpoint, the magnitude of the physical damage as well as the scope of the physical damage are important dimensions of the distinction between local crises and disasters. Based on this framework, consensus types are those events caused by "natural or technological agents" which denote traditional notions of "disasters." Consensus events generally occur suddenly infested areas, creating "widespread public consensus and a focus on terminating the crisis at the earliest possible and restoring public order and peace. These forms of crises result in a consensus-building approach that results in a shared resolve to collectively "fix" the problem. Whereas, conflict-type crises are those resulting from "wars, civil disturbances, riots, or terrorist activities, communal disturbances, 9/11in USA, 26/11attacks in Mumbai (Quarantelli, 1988, p. 373). Therefore, terrorist attacks in Mumbai and other places includes naxal attacks in naxal infested areas are example of consensus type.

Challenges Faced by Police

Experience, however, demonstrates that police are ill prepared for the challenges associated with large-scale disasters such as major hurricanes and major terrorist attacks. The September 11th terrorist attacks, for example, shed light on a reality that was long known within the larger emergency planning arena, police and other segments of the first-responding community lack sufficient training, experience, and technological infrastructure to effectively respond to disasters when the occur. The lack of preparation is so fundamental in many ways that even in the most local (as opposed to statewide or regional) first responder communities lack the capacity for the most basic forms of communication. At the time of the September 11th attacks, 26/11 in Mumbai, communication problems were well known throughout the emergency planning community. Similar but smaller scale problems were well documented during the 1993 World Trade Center bombing,). Even Gujarat Bhuj, Kosi floods in Bihar not well documented. There seems to be a tendency, however, for the problem of interoperability and other problems with disaster planning to be "rediscovered" in in the event of the next major disaster. Real questions remain about what must be done to ensure that police and other first responders can be better prepared to collectively respond to disasters when they occur in well-coordinated manner.

Steps for Mainstreaming Role of Police in Disaster Management

Consideration of police responses to disaster events can be organised around three main issues as follows:

(a) Law enforcement agencies are presumably part of a broader discussion regarding how government, social service agencies, and other entities will plan, train, equip, and prepare for various natural and man-made disasters. This might involve a variety of meetings, training sessions, policy formulation, and the creation of mutual aid agreements, memoranda of understanding, and similar articulations.
(b) Agencies play a role in working with other emergency service providers to deal with the immediate response to save lives and, when possible, preserve property. Police personnel assist with myriad activities of relevance to the disaster event at hand, such as rescue efforts, rendering medical care, controlling and directing traffic, and communicating information.
(c) Agencies are central aspects of disaster recovery when a critical event has a more entrenched impact. As communities deal with the physical, economic, and social effects of disaster, law enforcement plays a key role in addressing ongoing safety and crime concerns in affected areas.

Involvement of Police during Various Phases

The nature of law and order is the basic function of the police still mentally, physically and psychologically, the police are more prepared and equipped to deal with abnormal and unexpected situations. Over a period of time based on tackling various disasters, situations lead to enhancement of their skill and experience to deal with disasters situations. The police have to share many other responsibilities, which are actually the job of other agencies. Over the period, the police have become a formal and disciplined government agency regarded by the people as one of the most effective managers. The role of police can be divided into two parts based on disaster situations- primary and secondary.

Pre-disaster Role

Superintendent of Police of a district is ex-officio member of District Disaster Management Authority (DDMA) and in this capacity, he could play important role in prevention and preparedness phase.

- **Emergency Traffic Plan:** Being familiar with the local terrain, local resources Police should prepare emergency traffic plan including detail mapping with focus on strategic points, which may have used at the time of evacuation.
- **Detailed Communication Plan:** Police has a robust and effective Communication system that is also for non-police functions. It can also be used to propagate Information and warning of threatening disaster. Thus, police can develop communication protocol for responding during disasters e.g. designate separate channel for rescue, relief.
- **Resource Mapping:** It is important to locate essential resources at very beginning of search and rescue works. It has been experienced during the Kosi flood 2008 that in rescue and relief works even small and tiny elements become very important. So local police could identify, locate and document general essential elements useful for different kind of disasters.
- **Capacity Building:** Men in uniform (Police) are most visible and reliable government agency who receive basic and advance pre designed training under different verticals at various levels leading to discipline and mental and physical toughness capable to deal effectively with different unexpected exigencies.
- **Primary Role:** The primary role is evident during management of actual disaster situations, which includes the following:
  - Search- Police in Disaster role are required to keep equipment, first aid kits, sprints, drugs to stop blood. Police besides their other duties, once they arrive, look for victim at disaster site, at times depending on magnitude of disaster, police assist and coordinate other civic agencies and Special Forces in search operations as and when they arrive.
  - Rescue- once the victim is located after the search; next step is rescuing them to safer places for further evacuation.
  - Evacuation- Victims are evacuated to a safer place close to the site of disaster.
  - Provision of life support system- Facilities for quick evacuation and provision for quick medical aid, water, and identification of dead if any, is the important task.
  - Mobilisation and deployment of resources-Effectiveness of any agency depends as to how quickly the resources are mobilised and deployed at the disaster site; the exact nature of deployment will vary from disaster to disaster. Most important resource mobilisation is to make available adequate infrastructure for disaster managers and the affected civilians who are in distress.
  - Restoration of communication system/liasoning with rescue teams: Ensuring effective communication network system is a key to any successful operation in a disaster. The basic objective is restoration of normalcy as quickly as possible. Overall security of area, maintaining public order and public safety emerges in modern literature and academic discourse as most important role of police. Telephonic communication breaks down since the telephone towers/offices get destroyed with the result that as it happened during Bhuj Earthquake (Mishra, 2001). Wireless communication might be the only means left for information dessimination. During floods or any other disaster most of the rescue teams operate in unknown territories under adverse conditions where landmarks are either washed away or destroyed. Kosi floods of 2008 had

another unusual experience, few NDRF and Army boats got lost to a wrong direction since frequency of their wireless sets were not synchronised with that of District. Police sets, with the results local police sent teams in boats to locate them and therefore police role as coordinator and support to outside agencies become significant.

- Prevention of commission of cognizable offences including all offences against property, human body and second victimisation. During disaster situation people abandon their houses with or without belongings. The safety and security of such houses and belonging is at risk. During such period, people are without jobs hence incidence of crime generally increases. Police can provide safety to such persons and houses by active patrolling and take other preventive measures during and after disasters to protect looters as it happened in Katrina in New Orleans 2003 and Kosi 2008 Police had to be deployed to apprehend looters and thus protect victims from incidence of second victimisation.
- Co-ordination with various agencies: During disaster various agencies are like Army, NDRF, CRPF, BSF, these external agencies are not informed about physical terrain, route chart, etc. Police can function as a link with external agencies. The coordination between police and other agencies needs to be standardised.
- Maintaining law and order, public safety and, security aspects are important task police have to perform.
- Cordoning of the affected area– Disaster site, technically speaking, is a scene of crime too; cordoning is essential to keep the spectators away from the victims. Katrina in USA, Bhuj in Gujarat, Kosi floods in Bihar are examples.

Cleaning the area at disaster sites like train accidents, presence of police to regulate milling emotionally charged passengers, a gathering of crowd is detrimental to life and property of victims. Local police only achieves the same since it is possible a train falls or a plane falls at desolated place too distant from community and only nearest police station can reach site earliest with availability of multi level communication network inform other EMS services includes specialised services like NDRF, etc.

During Hudhud cyclone in Vishakhapatnam, AP 2014 which killed 46 persons hit 22 lakh families colossal economic loss it was experienced that Industrial town several industries were too affected and management were obstructing relief and rescue team to avoid government get correct assessment of loss of life and persons injured as they have to give more compensation if actual figures comes out. It was local police who help rescue, search and relief team to get ingress into those factories.

Management of VIP security as every disaster site is visited by VVIPs and VIPs. Providing adequate security cover and clear passage for the movement of important persons visiting the disaster site is a too important.

Media management and their proper channelisation at the disaster site again assumes importance and adds to the role of the local police on the site. Effective coordination can support police to achieve success in any disaster operation only by creating understanding with various other agencies and NGOs involved in the management of a disaster situation. Legal formalities are one of the most important functions of the police is to deal with the damage to life and property at the disaster site as per the established local laws in this regard.

Post-disaster Role

After every disaster, certain compensation and payments are announced by various governmental agencies and NGOs. The police have a very important role to play in curbing fraudulent claims from being cleared. Other than this, the police have to investigate further damages and losses in assistance with concerned agencies. They also play an active role in rehabilitation phases like providing security at rehabilitation camps, safe houses, etc. In fact their role continue till recovery stage. Many disasters like Bhopal gas leak disaster, coal mines disasters in Jharkhand, includes flooding due to river changing the course leaving some pre occupied area and water capturing in a newer area create conflict situation at time leading to litigations where police may hade to intervene.

Secondary Role

Secondary role of police mainly captures the pre-disaster scenario. It is here that a gap exists in theoretical formulation of disaster management and practical implementation on the ground. In any disaster management plan there is a need to incorporate police at the beginning. This role eventually refers to the preparatory stage of disaster management exercise. Any planning for disaster management with prior signals must take stock of police resources and the role they can play in contingency planning pre-disaster.

A law enforcement role may quickly evolve into a search and rescue role as the immediate or surrounding location of a disaster is largely secured. In the immediate aftermath of a disaster, the police will likely be focused on public safety and to some extent, protection of property and evidence. Officers would be expected to assist with evacuating citizens from affected areas, dissemination of information to the public to scotch rumour mongering's, calming the chaos, assisting in transportation of victims and medical care, assisting with search and rescue efforts. This may involve established plans, procedures, and arrangements besides inventing strategies in response to situations of unanticipated nature and magnitude. When disasters are man-made, law enforcement actors try to ensure harm has been mitigated. Police at times have to make extra efforts to ensure marginalised and the poor do not get left out in rescue and more importantly from relief as those who are influential often try to polish off big share of relief from administration and poor lower classes in case of India Dalit, etc., suffer second victimisation as has been witnessed in Kosi disasters in 2008**.**

Camp Management

Security of camp inmates, officials and state officials, block officers particularly includes volunteers engaged in running of camps including paramedics is core function. During Kosi disaster over 400 relief camps had people from many villages with different religious, political and caste backgrounds and thus had potential for friction. This entails deployment for law and order maintenance.

Security during Relief Distribution/Relief Management

Security of relief distribution centres in terms of cash and kind, distribution centres are chosen at strategic and convenient location. Like wise security of grains, local bank branches. Relief distribution centres usually are chosen by administration in safe zones with clear access and with adequate police security to ensure and protect weaker and marginalised sections from second jeopardy. There are instances like during Tsunami in Orissa, relief material were first to arrive from West Bengal in proximity and on the way some influential people unruly stopped them and it was police which escorted the relief to pre-destined destination.

Causality Information, Identification of Dead and Disposal of Dead

The identification of people killed and involved in accidents /emergencies is police responsibility Police through their modernised FSL (Forensic Science Laboratory) now uses DNS tests so that large no of dead get identified in shorter span of time to fix parentage. All enquiries could be handled by police station staffs. Disposal of dead bodies and documentation of dead and the missing for the benefit of next of kin to claim the compensation and ex-gratia.

Restoration of Critical Infrastructure

Disaster usually affect infrastructure such as road, telecommunication, health centres, school, electricity supply. Police can provide protection to the agencies who are involved in the restoration of such infrastructure.

Feedback/Assessment: Media Management

Since the police is the key factor in managing the disaster, their feedback assessment is very important in updating the plan for the future and also in developing contingency plan. Accurate reporting of a news as well as clarifications, scotching unverified rumours, police do it using their multi layered communication network and their easy outreach to people in vicinity by personal contacts as police tend to be well situated to take a lead in communicating with public about disaster related information (Verano2007)

Deployment of policeman on the boat playing in floods helps prevent over crowding of boat and prevent capsizing. Such boats are provided with hand held wireless sets to keep tracking its movement and providing help in disasters and to provide security to resources from unscrupulous elements e.g. during Kosi flood 2008 state government boats were captured by local goons.

Role of Police in Long-term Recovery

Some disaster events are of a brief nature and have a confined physical and geographical impact. Other incidents will result in widespread damage and destruction to residences, critical infrastructure, and other aspects of communities. These situations can create appreciable challenges for law enforcement. For example, in the aftermath of Hurricane Katrina law enforcement personnel throughout the affected area had to work very long hours for days on end providing security and control, assisting search, rescue, and recovery efforts, preventing looting and other criminal acts, and ensuring public safety. The officers working to secure the areas affected by Hurricane Katrina and Bhuj in Gujarat had to work harder for a very long hours with their need as individuals to tend to their own families and deal with damage to their own property, all the while dealing with the grief, stress, and other emotions.

Agencies can also find themselves affected emotionally by large-scale events. Vehicles and facilities can be damaged, communication and utility infrastructures can be lost, and unforeseen challenges can arise. All of this had to be done under extreme conditions, with disrupted communication and infrastructure. Moreover, their role was constantly shifting from public safety and security, to search and rescue, and back to security since the apparent threat landscape too kept changing. This all occurred within the broader context of need and uncertainly for many first responders themselves. During Orissa super cyclone of l999, the collector's office at Cuttack was flooded by mud. Men of the police force only rescued the collector on their shoulders.

Conclusion

Police since long has been dealing with disasters, unexpected calamity as they are the ones who are trained, remain in uniform as semblance of discipline which command respect and public faith and manifest legal authority of state. Their training leads to mental and physical toughness and therefore they can deal with unexpected calamity includes man-made and natural disasters. Besides they are the one organ of state that have domain knowledge of local area, know local people, reach first on incident site besides community and they have the responsibility of maintaining law and order, public safety and calming the chaos.

Related to this is the need for police to pursue integrated response strategies thorough partnership with other emergency responders and also those who might play a role in incident recovery.

Local volunteers and community level action is important depending on the situation and typology of disaster so as to effectively deal with all kinds of disasters preparation and response. Though citizens are in most of disasters are first responders, police form a first line of defence and they have greater chance of saving life in Golden Hours certainly police along with community can serve to diminish some of suffering and losses that occurs during and after disasters and protect victims from second victimisation.

They have to ensure that local voices are heard, local language recognised and response and recovery and rebuilding process belong to the front line of disaster responders' community and local police as well as SDRF created under NDMA Act 2005, so far 23 states have created SDRF mostly out of local civilian and armed police who receive special training from NDRF and other training institutes located in the country. Odisha has created ODRF very well trained force largely out of local police itself and ODRF at present is rated the best model, which also trains the community wherever deployed.

Similarly, Civil defence personnel, Red Cross officials, available members of civil society groups, and spirited public individuals, all play a significant role as 'first responders' till arrival of specialised agencies. In recent Kashmir flash floods since police being a civilian and their families too suffered like others in community their houses flooded, their uniforms got washed away or sunk into water than NDRF planes they had to work without uniform to protect others lives, distribute food packets dropped by Army planes since people perceive police only in uniform police was even criticised to be invisible by media who came from outside not realising that police too suffered and were at duty day and night ignoring their families They have to continue to supplement the efforts and activities of other responders. Factually major disaster situations bring in armed forces in the aid of civil authority, and Army and Air Force have played a stellar role but local police have to come on front to coordinate and assist the Armed forces even in reaching relief at right places. Police personnel deployed for such relief operations could prevent commission of cognizable offences to preclude second victimisation. Arguably, there may certain instances of disasters where assistance of specialised forces may not be required.

MFR (Medical First Response Training) for Police Personnel includes CPR (Cardiopulmonary Resuscitation) as well as coordination for providing smooth work includes Local Police, NDRF, Civil Defence, and other stakeholders. State Disasters Response Forces, which has been battalions cut out of largely local police and ex-army in several states, which are trained in CBRN (Comical Biological Radiological & Nuclear Disasters) play important role in disaster management.

Since law and order becomes a major problem after disasters, local police should receive specialised training to learn ways and methods to lessen the law & order related problems in during and after disaster scenario in the vulnerable community. Looting, violence particularly gender based violence; human trafficking even snatching valuables from dead, all are related to second victimisation are common problems that rear their head after a disaster strikes. The community and police can think of new ways to join hands together for dealing with such issues in case of a disaster.

The police invariably get involved in Search, Rescue operations; regulate transportation of victims, and relief work, medical assistance, assistance in distribution of supplies of foods and providing security at affected places to protect them from second victimisation. Local police so trained and deployed in disaster prone areas can in turn train local community in preventive measures in event of disasters particularly in natural disasters.

The police multilevel communication system more importantly wireless communication both HF (High Frequency and VHF (Very High Frequency) is made available for transmission and receipt of messages in connection with disasters. Recently in Kashmir flash floods when all kinds of communication failed only Police wireless communication network was available as lifeline for transmitting messages.

Police stations located in disaster areas should preferably have a stronger multilevel network includes HF, VHF, Tetra, Satellite phones, wireless set, besides land line network. Police officers & SHOs and other supervisory officers CUG Plans (Close User Group) mobile phones besides their landline and other such important phones should be published in media for information for general public.

The police also supposed to possess basic equipment based on disaster specific locations like sniffer dogs, gas cutter, tree cutters, anti-sabotage teams, search lights, lifesaving jackets, First Aid boxes, boots, portable generators, reflector batons and jackets, boomer lights, etc. Like what ODRF in Odisha are provided. Besides police man in each police station should be provided with the basic medical training so that at least two policemen in each police station can provide first aid to victims in event of disasters, victims may also be provided with lifesaving medicines, basic first aids and treatment in the Golden Hours by police stations as in many advanced countries, before transporting and referring victims to nearby hospital, it will definitely minimise the loss of life after disaster events.

Mock drill with other EMS includes local civic agencies should be a regular feature in vulnerable areas. The Master Trainers of NDRF, who regularly receive specialised training by specialists from Switzerland other country should conduct periodical training of trainers (ToT) of local police as well statewide, on rotation basis so that a fixed percentage of policeman receive basic training.

There are differing thoughts at present in India going around at top level in NDMA (National Disaster Management Authority) and other expert planners on the subject as to whether NDRF should have their own cadre as so much spent on their training and later after deputation period is over they go back to their routine duties in the respective Paramilitary Forces they come from on deputation. Factually, planners and experts in NDMA have a different view despite Supreme Court Order to create a separate cadre for NDRF to grow as elite specialist services.

Whereas planners and experts in NDMA giving logic that during No Emergency situations, NDRF will have no work and hence government will only incur hefty expenditure. A mixed model 30-70 or 40-60 will be preferable so that officers in NDRF with core competency remain in 30-40% and rest 60-70% come on deputation.

Moreover NDRF during lean period do mock exercises besides giving training as per designated calendar and SDRF and local police.

Besides,SDRF and local local police need to receive similar training from ‘Sea Explorer’ Institute’ from Kolkata in area of Relief, Rescue and Under Water Diving, NISSA, Hyderabad, NCDC Nagpur in fire fighting and MFR (Medical First Response Training) includes CPR (Cardiopulmonary Resuscitation) Training Institute located in Bangalore.

Their training needs to be upgraded disaster specific in view of local hazards of area of deployment. All the police stations are required to be strengthened with trained personal in view of basic first aid and necessary equipment support.

Surprisingly World Conference on Disaster Risk Reduction on 18-22 January 2005 at Hyogo, Japan which adopted Hyogo framework 2005-15 and Sendai framework 2015-30 too did not mention police as one of first responders agency besides NDMA Act 2005 which specify role the of Army and NDRF in Disasters but not specifying role to Police as first responder.

It, therefore, requires amendment in the said NDMA Act 2005 and similarly as recommended in proposed Model Police Act 2011(updated 2015) by BPR&D (Bureau of Police Research & Development) submitted to MHA for approval, recommending Police be given statutory role in dealing disasters by making provision in State Police Manual and involving police high officials while states prepare Disaster Plan.

It, is, therefore, recommended that certain amendments to be made in the NDMA Act, 2005 and States' Police Manual so as to redefine the role of police in disasters.

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Disaster Grievances Registering System for Increased Resilience during Emergencies Using ArcGIS

Hasmitha Rayasam[a], Sarthak Tewari[a] and Shreedatri Dey[b]

Abstract

The increase in the use of social media and other online channels for raising concerns and highlighting problems is a direct result of the ease of availability of these platforms. In case of emergencies, especially during the event of a disaster, the most accessible platforms for seeking help are social media channels like Twitter, Facebook, etc. Introduction of a Disaster Grievance Registering System would result in a multi-platform application that includes desktop configurations, mobile and web applications and services published from ArcGIS software for creating, managing, and sharing geospatial content. Creating a web application to help the citizen report emergency situations would generate a Disaster Service Request Form using which the location and the grievance can be logged into the records to be immediately addressed. Reports from social media channels from Twitter can also be imported using GeoEvent extension for ArcGIS to give a more comprehensive, spatially distributed report, which also shows the disaster hot spots or the most affected areas. Private organisations, military or government agencies involved in disaster rescue and relief operations can use Grievances Registering Systems to optimise fieldwork, execute efficient rescue missions and respond quickly to any kind of emergencies location-wise using these spatially distributed reports.

Keywords: disaster grievances, social media, GIS application, rescue missions, resilience

Introduction

Disasters strike without warning in most cases and cause devastating effects across the world. These disasters could be man-induced or natural but are unbiased in the destruction they amass on people, animals, building, structures and nature alike. With the progress in technology, certain disasters like urban flooding and hurricanes can be predicted and the suffering alleviated to some extent. But most of the disaster response and mitigation is limited to government personnel. With the advent of the Internet, citizens can take part in addressing and aiding in emergencies using social media to increase the efficiency of disaster response.

Social Media and GIS

While GIS was evolving to make this world an easier place to understand, another medium was making ground breaking changes in the field of human interaction, The social media, a tool as strong as any other. It did not take long for people from governments to common citizens to realise its strength, benefits, applications and related implications. Twitter, Facebook, YouTube, Google+ and LinkedIn individually have billions of users, which are constantly increasing. They influence our lives, both online and offline. New technologies have been added to existing ones like GeoEvent to ArcGIS that make the clubbing of social media and GIS an extremely feasible option.

Objectives

Proposing a framework to enable disaster mitigation using social media and GIS which in turn would:

- increase efficiency of disaster response and mitigation teams.
- aid in easy sharing of pre-disaster preparedness, safety and awareness advisories with public.
- enable citizens to submit disaster grievances, calls for help from mobile devices.
- optimise field work, communication with citizens, etc.

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Literature Review

The GIS industry, in recent times, has gone beyond just map making, datasets and models on individual desktops (ESRI's ArcMap). With time ESRI has come up with a more advanced concept of ArcGIS Server. ArcGIS Server enables we to distribute maps, models, and tools to others within any organisation and in a way that fits well into their workflows.

ArcGIS Server is a comprehensive software making GIS data of a user available to potentially everyone else in the workplace for better work flow between teams. This is done through web services that allow a server computer to process requests made for access by other devices in the network. With the advent of ArcGIS, Geographical Information Systems can now be accessed by mobile phones, tablets, desktop computers and any other device that is able to connect to web services. Maps made available to the ArcGIS Server are called services.

ArcGIS Server

Components

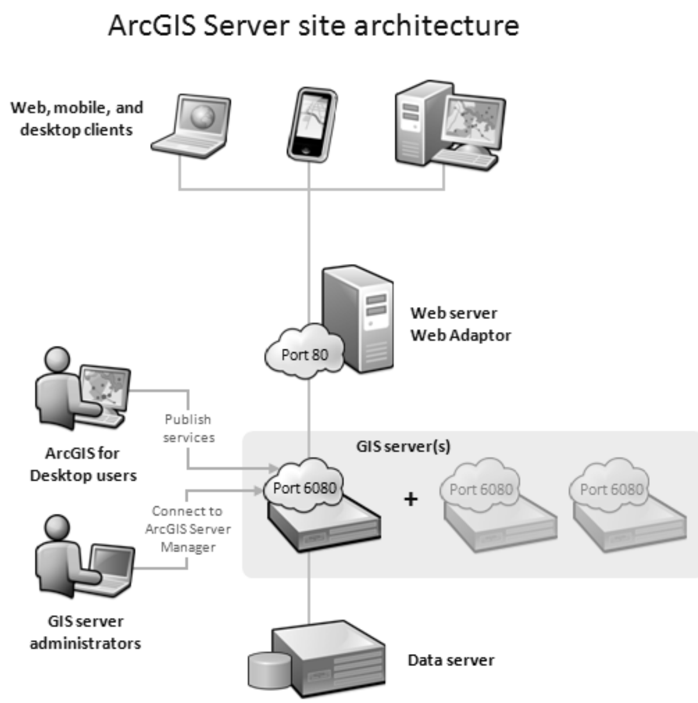


Figure 1

When ArcGIS Server is installed, a set of web services is immediately available for use in apps. ArcGIS Servers can be organised in groups, called clusters. Each cluster runs a dedicated subset of services, as configured by the server administrator.

- Web Adaptor: The Web Adaptor receives web service requests through a common URL (on a port and site name you choose) and sends them to the various ArcGIS Server machines in the site. Other types of Web Gateway technologies like HTTP load balancer network router, etc can be used to expose the site to.
- Web Server**:** A web server can host web applications and provide optional security and load balancing benefits to your ArcGIS Server site. If you just need basic hosting of GIS services, you can use the site that you create after installing ArcGIS Server. If you need to go beyond simple hosting of services, or if you want to use your organisation's existing web server, you can install the Web Adaptor.
- Data Server: Data can directly be placed on each GIS server, or accessed from a central data repository, such as a shared network folder or an enterprise geodatabase.

Table 1

	Editions		
GIS Service Capabilities	**Basic**	**Standard**	**Advanced**
Support for Spatially Enabled Databases[1]	Included	Included	Included
Geodatabase Management[2]	Included	Included	Included
Create and manage GIS Web Services	Included	Included	Included
Support for web mapping Apps	Included	Included	Included
Support for smartphone and tablet Apps	Included	Included	Included
Hosting/managing map-centric content (aka. Portal for ArcGIS)	–	Included	Included
Image processing and analysis	–	Included	Included
Web Editing	–	Included	Included
Visualizing 3D spatial content[3]	–	Included	Included
Geoprocessing	–	Included	Included
Advanced Geoprocessing with Extensions	–	With Analyst Extensions[1]	Included
Real-Time Data Processing and Monitoring	–	With ArcGIS GeoEvent™ Extension for Server	With ArcGIS GeoEvent Extension for Server

Selecting Appropriate ArcGIS for Server Edition and Level Functionality

ArcGIS for Server is offered in three editions. Each edition offers greater functionality:

- Basic
- Standard
- Advanced
- Capacity: The ArcGIS for Server editions described in the previous section are available at two levels, scaled according to capacity: Workgroup and Enterprise.

Table 2

	Capacity Level	
GIS Service Capabilities	**Workgroup**	**Enterprise**
Simultaneous connections to multiuser geodatabase	10	Unlimited
Multiuser geodatabase storage capacity	Included	Unlimited
Maximum number licensable cores	Included	Unlimited
Maximum number of Portal for ArcGIS named users	Included	Unlimited
Distributed deployment of ArcGIS for Server components	Not supported[2]	Supported

The People Component

To run an ArcGIS Server site, different people are required ranging from authors to end users.

- ArcGIS Server Site Administrators: To install softwares, configure web applications and tune the site for best performance.
- ArcGIS for Desktop Content Authors and Publishers: Resources like maps, attributes and databases that are published on the site are created by content authors using ArcMap, ArcCatalog, etc.
- Application Developers: They take services available from an ArcGIS Server site and make them available across devices like phones and desktop computers through applications dedicated to this purpose.
- Client Application Users: A thorough knowledge of the number of end users accessing an ArcGIS Server site, as well as their usage patterns, can be valuable to you when planning the size and scope of project deployment.
- Others: Many other people may use or directly influence the ArcGIS Server site. These include IT administrators who coordinate the setup and architecture of a site, GIS managers who set requirements of a site, GIS technicians who create the data, etc.

Deployment

An ArcGIS Server is designed to be scalable and can accommodate both small and large deployments.

- Single Machine Deployment: In its most basic configuration, an ArcGIS Server site can run on a single GIS server machine without needing any additional components. The deployment scenario described below is straightforward to set up, maintain, and upgrade. It can support a sandbox environment for development and testing, but it is also a valid (and in some cases ideal) configuration for some production environments.

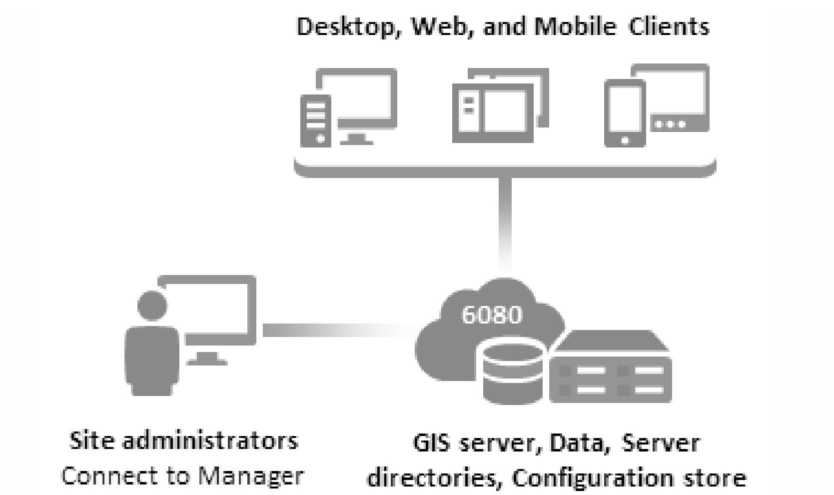


Figure 2

Advantages

- Straightforward to install, maintain, and upgrade.
- High performance because local paths are used to access resources

Disadvantages

- May not fit security requirements, since ArcGIS Server Manager and ArcGIS Server Administrator Directory are exposed through the same port (6080) that everyone else uses to access the services. Overcome this by specifying that only certain IP addresses can access the server in the Administrator Directory.
- Web tier authentication is not available without ArcGIS Web Adaptor. If web tier authentication is needed, ArcGIS Web Adaptor has to be included.
- Not highly available; the GIS server is a single point of failure if it goes offline.

- Multi Machine Deployment: ArcGIS Server supports the configuration of multiple-machine sites. In a multiple-machine site, two or more GIS servers can be administered and used as a single logical unit, providing ArcGIS Server administrators with great flexibility to easily adjust the computing power of the site by adding or removing GIS servers. Multiple-machine sites also simplify the process of publishing and updating services across multiple GIS servers.

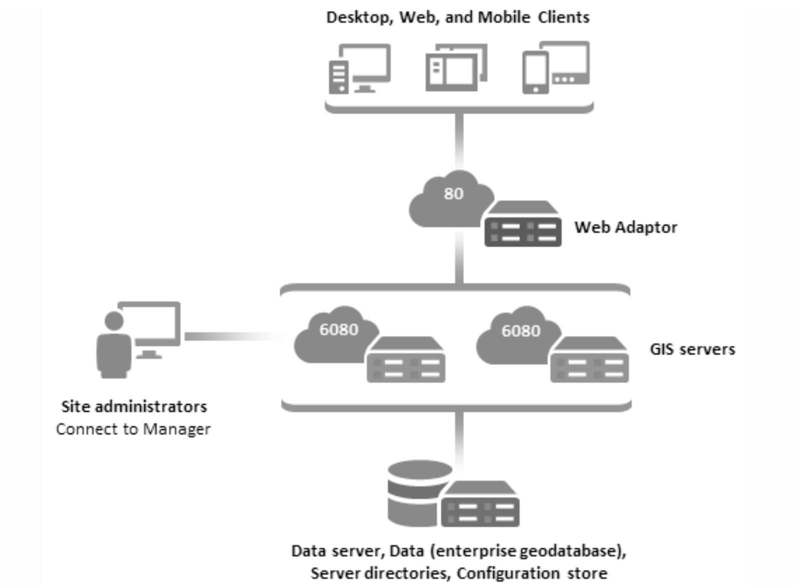


Figure 3

Advantages
- A single ArcGIS Server site provides the means to easily administer ArcGIS Server and it services across a number of machines.
- Easy to adjust the capacity of your site by adding and removing ArcGIS Server machines.
- Load-balancing is handled among ArcGIS Servers.
- Integrate standard organisation authentication by using web-tier authentication through ArcGIS Web Adaptor.

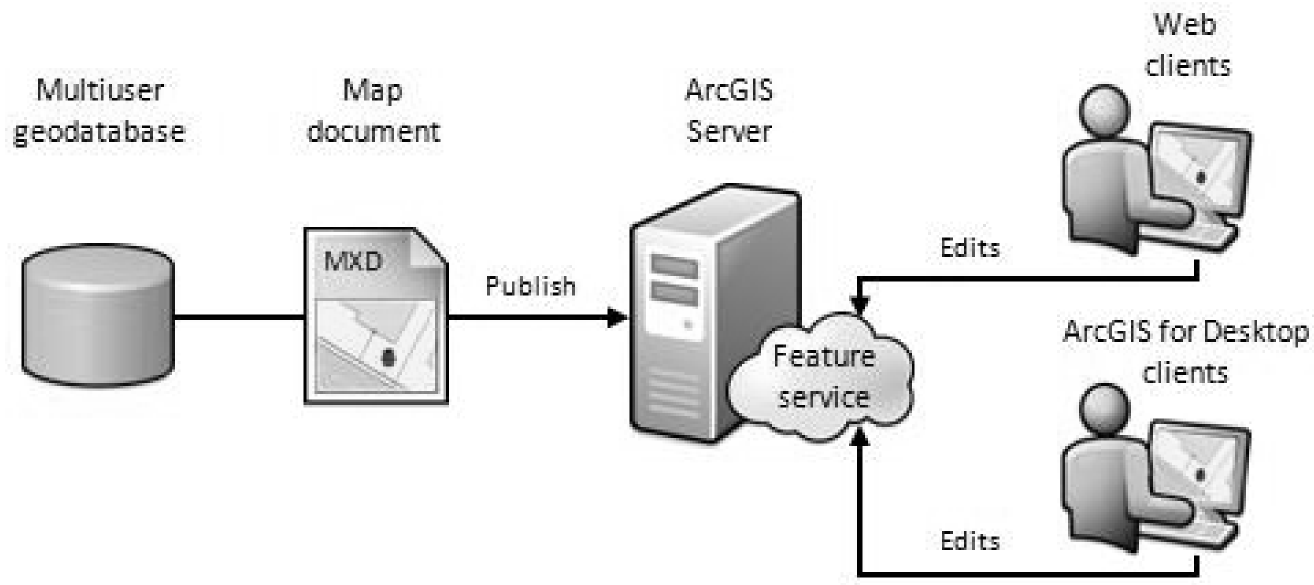
Disadvantages
- Use of server directories and data in shared network locations can negatively affect performance of services under heavy load.

Types of Services

- Map Services: The map service is a way to make maps available to the web. ArcMap is used to make the map, then map is published as a service to the ArcGIS Server site. Internet or intranet users can then use the map service in web applications, ArcGIS for Desktop, ArcGIS Online, and other client applications.

The items on the Share as Service dialog box can help to get started for sharing. Map services represent a map that has been made available to others on a server. They are designed to work in many web and intranet scenarios. The same map service may be used in ArcMap by one user, a web application by another user, ArcGIS Online by another user, and a mobile application by another.

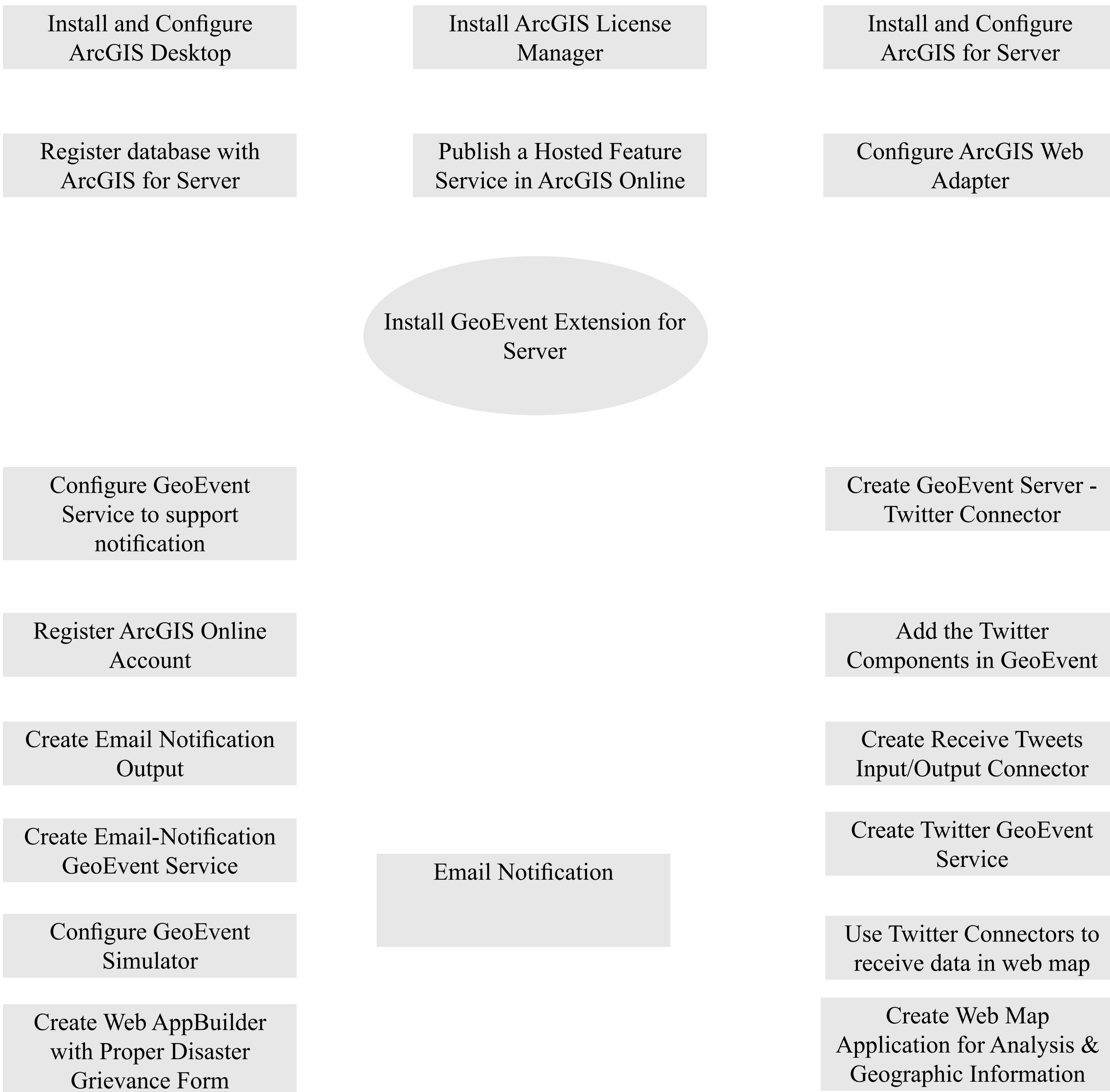
- Feature Services: Feature services allow users to serve features over the Internet and provide the symbology to use when displaying the features. Clients can execute queries to get features and perform edits that can be applied to the server. Feature services provide templates that can be used for an enhanced editing experience on the client. Data from relationship classes and non-spatial tables can also be queried and edited using feature services.



- Geocode Services: Geocode services support a wide range of applications, from business and customer management, to shipping and distribution to getting directions.. Geocoding allows to find and display addresses on a map and see how they relate to surrounding features. Sometimes relationships can be seen by reviewing the map; other times, by using spatial analysis tools to reveal information that can't be easily seen. To make geocode service available to clients, an address locator needs to be created in ArcGIS for Desktop and published as a geocode service to ArcGIS Server. Once the service is published, a client application is created that uses the geocode service to display address locations on a map.Geocode service can also be referenced in Portal for ArcGIS for use in maps and applications.
- Vector Tile Services: A vector tile service is an ArcGIS Server web service originating from a vector tile package in ArcGIS Pro. Vector tile services (also known as vector tile layers) enables users to share and consume vector tiles in the Portal for ArcGIS organisation and in custom applications. ArcGIS 10.4 and later is needed for this.
- ArcGIS GeoEvent Server: This Server is used for real-time mapping and analytics. Applications of this include monitoring valuable assets anywhere on the Earth like land, sea and air. This can even track dynamic assets that are constantly changing, hence enabling users to keep track and analyse values real-time. Data can also be filtered to display only the most useful results that are needed for analytics. Based on the changing flow of data, alerts and notifications can be customised based on pre-decided parameters to be sent my email, texts, etc to concerned personnel.
- ArcGIS Online: ArcGIS Online is a cloud-based mapping platform for the creation and dissemination of geographical information. It can be used to manage, share and create content. It can provide open access to optional users through its cloud-based platform. It has varied uses in government operations at a federal, provincial and municipal levels in different fields such as Public Safety, Business, Natural Resources and Utilities.

Being a collaborative web GIS and widely used among students for learning about spatial analytics, it has different versions to suit the needs of the users. Professional and government users have different levels of security and accessible features while student versions are focused on training facilities and basic operations like Network Analysis, Buffer, Spatial Correlation, etc.

Proposed Methodology



System and Program Setup

Installing and Configuring ArcGIS

ArcGIS for desktop can be installed based on the the requirement of the user and the features that need to be availed. Once installed, product levels can be changed between single or concurrent use versions.

- **Minimum System Requirements**

.NET Support

Microsoft .NET Framework Version 4.5 or above. If it is not detected, ArcGIS for Desktop setup will not proceed.

Microsoft Core XML Services (MSXML) 6.0

Setup.exe is a setup boot stripper executable that will automatically install msxml16 if it is not already installed and then run the setup.msi

Install the ArcGIS License Manager if it is not being installed as a single-use version.

- **Authorisation Information**

Single Use products require authorisation for use on individual machines. This can be obtained from the email specified at the time of order. The authorisation code will be sent by the ESRI Customer Service. The codes start with letters ESU or EVA, followed by nine numeric digits.

Installing and Configuring ArcGIS for Server in the Server Machine

- Prepare ArcGIS Server for installation by obtaining authorisation files, verifying system requirements and insert ArcGIS server media into the appropriate drive to launch setup program.
- Install ArcGIS Server.
- Create a Primary Site Account in the Server Manager, which will open up automatically on Google Chrome.
- Configure ArcGIS Web Adaptor after installation.

ArcGIS Web Adaptor allows ArcGIS for Server to integrate with the existing web server. The Web Adaptor is an application that runs in the existing website and forwards the user's requests to the GIS servers.

Connecting to ArcGIS Server from ArcGIS for Desktop (ArcMap)

ArcCatalog and the Catalog window allow three options:

i) 'Use GIS service connection' to use services

ii) 'Publish GIS service connection' to publish services

iii) 'Administer GIS server connection' to manage the site

The third option is feasible for this paper to administer the GIS server for which Primary Site account credentials are required.

Registering a Database with ArcGIS Server

This is required to choose the database that is required to be added. Choose authentication type and put in the credentials.

Publishing Feature Service to ArcGIS Server

This is done to generate the final output of the project. A Hosted Feature Service can be published by going to the Share as Service window and selecting the service to be published. An ArcGIS Server connection can be chosen from the "Choose a connection" drop down list.

The administrative URL needs to be entered and a name can be chosen to represent the service. Under Feature Access you can choose to give permissions to other users to make any form of edits like create, update, delete and query.

After these customisations it can be published.

Using ArcGIS Online

Launch and sign in to ArcGIS Online organisational account. Repeat the steps to publish a service like before after opening feature class in data frame.

Add the geolocated tweets and request form as a layer to the map with full editing control. Save the layer as WebMap.

ArcGIS GeoEvent Extension for Server

- Verify System Requirements and check administrative privileges.
- Browse to the downloaded folder containing ArcGIS GeoEvent Extension for Server setup.

- When the program launches, enter Software Authorisation by putting in ECP License Number to successfully install the GeoEvent extension.

Working with Twitter

The Twitter Connector for the GeoEvent Extension receives its event data from a public stream exposed by Twitter through their Public API. The GeoEvent Extension uses the POST status / filter stream which offers only a sample of the public data flowing through Twitter.

Obtain Twitter Oauth Credentials Go to the Twitter developer website and enter details of the application and organisation to list the application under Twitter apps. The following details are required for later:

- Oauth Credentials
- Consumer Key
- Consumer Secret
- Access Token
- Access Token Secret

AddingTwitter Components in GeoEvent

Twitter Transport

This can be found in Add Local Transport and add the Twitter Transport to GeoEvent Extension.

Twitter Adapter

In the ArcGIS GeoEvent Manager, go to Components>Adapter to add the Twitter Adapter. Create Twitter GeoEvent Definition with common tags to be used like TRACK_ID, TIME_START, etc.

Create an Input Connector with Receive Tweets

These are the proposed tags that can be tracked: floods, helpline, earthquake, hurricane, etc., depending on the trending tags. Localised events and tweets can be better tracked using specific tags than general tags, which might have a large history of tweets from the past. Create an Output Connector to Add a Feature

Create GeoEvent Service

You can configure to add events whose geolocated field value is true. This geolocated filter needs to be created onto the canvas.

Configure GeoEvent Service to Support Notifications

The options include Send an e-mail Output Connector to dispatch via SMTP (e-mail). The ‘Send an e-mail’ output will use information from events it receives to format a message, which will then be forwarded to an SMTP server to request an e-mail message to be sent to specified recipients. Create GeoEvent Service with the ‘Request Form’ as input to receive emails.

Constraints and the Way Forward

With hundreds of millions of users and over 500 million tweets being sent each day, Twitter offers a great opportunity for people to reach a global audience of new and existing customers. But even with this access it is not possible to plot the tweets on a map unless they’re geotagged. Tweets with location access can help us understand the location from which they were tweeted and dispatch help by determining the hotspots of tweet influxes for a particular tag.

Bringing a few other changes and enhancements into effect will require alignment of a number of factors:

- Sufficient bandwidth must be available to serve the online servers.
- A strong and dedicated network must be established.
- A Project Task Force must be employed to monitor the selected tags and tweets as any delay in disaster mitigation will lead to fatalities.

- The multiple systems currently required for this project employ different technologies, making finding a team with all the required skillsets a challenge.
- Capacity building of both citizens and service providers must be focused on to draw attention to this method of disaster response.
- Citizens will benefit from having a Citizen Helpdesk, both web and mobile-based, to support them in using the online process.
- During the event of a disaster, there should be no fluctuation in network and signals as it is the first prerequisite for citizens to address their grievances online.

Once these constraints are addressed, the merger of social media and Geographical Information Systems can be expanded to other platforms where there is a high activity of daily users. The spread of Internet to rural and remote corners of India is also necessary to ensure that this is a reliable method of disaster mitigation.

Conclusion

As social media witnesses exponential growth in users and activity by the day, geographical information systems is also a field that is witnessing an increase in strength and size.

This Disaster Grievance Registration application will also help to connect with the citizens to improve the efficiency of disaster response and mitigation during emergencies by displaying disaster alerts, which further will allow to view areas with affected service. This also includes additional information such as precautions to take, time of disaster, expected rescue time and number of affected or even where the nearest relief centre is.

Following the methodology used in this project, social media networking sites can be helpful for small businesses too. They can use tags to monitor customer feedbacks and keep a check on how aware people are of their brands with the GeoEvent Extension.

Most importantly, the power of social media sites like Twitter can help governments or environmental agencies across the world the scope and extent of the disaster. This spatial information will aid in investigative efforts and immediate response and help us build a stronger, disaster resilient society.

Notes

[1] ArcGIS 10.4 for Server Workgroup ships with Microsoft SQL Server Express 2012, which is limited to databases of up to 10 GB in size.

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Social Media and the Influence of Eyewitness Photography in Disaster Response and Recovery Operations in the Philippines

Jaypy T. Tenerife[a] and Romalyn L. Galingan[a]

Abstract

The study aimed to highlight the significant role played by social media and eyewitness photography in disaster response and recovery operations during calamities in the Philippines. Using photographic content that featured disaster and tragedy in the country caused by typhoons and floods, the study explained how volunteerism of the public was triggered by materials uploaded in the social media leading to several relief-giving activities formed through online social convergence. The research discussion focused on the contribution of these self-organised groups to the welfare and resilience of the affected communities. Qualitative study was used to discuss norms that lead to several governments, private and philanthropic disaster response and recovery efforts for the affected communities in the Philippines. The study provided a synthesis of related literature evaluation pertaining to effective decisions on disaster risk reduction and resilience. This paper also highlights the importance of the seventh global target of the Sendai framework for disaster risk reduction—to substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030—which is attainable in part through the optimal utilisation of popular social media sites as warning systems. Results of the study revealed that eyewitness photos from the public served as evidential documents of disaster information source resulting to better response from the community in terms of providing immediate help. People in the Philippines have capitalised on sharing public photos taken using camera phones for citizen participation and educating the public during disaster response and recovery operations. Consequently, social media sites were identified to be effective platforms for citizen journalism and reporting. These outcomes were perceived to contribute to the achievement of community and safety resilient goals of the country in general.

Keywords: citizen participation, disaster response, eyewitness photography, resilience, social media

Introduction

Over the past decade, many types of research have documented the wide variety of ways in which people use social media. The work of Boyd and Ellison (2007) and the more recent work of Pempek, Yermolayeva, and Calvert (2008) are few of the researches that suggest the extensive use of social media in the past ten years. It has been identified that many people use social media platforms such as Facebook, Twitter, and Myspace to connect and sustain created relationships with others (Boyd and Ellison, 2007). The study aimed to highlight some relief giving activities in the Philippines during calamities that were formed through online connections. These disaster response activities were formed because of common affinity found by people to shared photos in the social media featuring disaster and tragedy in the country caused by typhoons and floods. The study posits that volunteerism in times of tragedies can be activated by photographic content that features disasters and catastrophes experienced by people. This, in turn, results in the formation of several self-organised groups with an end in view of providing immediate help to the affected community.

Sharing of Information through Social Media

To a large extent, social media was used to create online communities, to share information, to raise awareness, to introduce new ideas, to send personal messages, and to forward other media content such as documents, pictures, and videos (Boyd and Ellison 2007; Pempek, Yermolayeva, and Calvert, 2008). Additionally, the invention of camera phones contributed to the increasing use of social media platforms in general. Because pictures can vividly depict events and human experiences, the rapid practice of sharing photographs becomes rampant in social media.

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The work of Martin and Martin (2004) explained that pictures and visual representation richly reinforce communication by showing things and events happening at the moment. Hence, the creation of a long-lasting memory, and close to reality experience for the receiver of the pictures or videos.

The study suggests that because of these advancements in technology, citizen participation in times of crises which was identified to be the right of participation in decision-making in social, economic, cultural and political life by Lister (1998) was triggered differently. Further, Lister (1998) identified citizen participation as an expression of human activity in a relatively broad arena. Lister (1998) point out that the human involvement in the context of citizen participation is not limited to exercising volunteerism, declaring a political stand, practicing a religious belief, and among other convergent activities that enable people to act as agents of change. However, the goal of this study was to focus on the role played by social media and online sharing of eyewitness photography in the creation of disaster response and recovery operations during calamities. Specifically, the study pointed out how volunteerism of the public was prompted by live events and experiences shared in the social media such as Facebook, Twitter, and Instagram that lead to several relief-giving activities formed through online social convergence.

Research Framework for Resilience

Hagar (2006) introduced the term crisis informatics or disaster informatics which was referred to as the interconnectedness of people, organisations, information and technology during the crisis. The continuing work of Hagar (2007) explained that disaster informatics scrutinises the relationship of both social and technical information during disaster specifically during preparation, response, and recovery operations. The study explained how social media was used as a platform for several governments, private, and philanthropic disaster response and recovery efforts in the country was formed, through crisis informatics produced by eyewitness photography shared on Facebook, Twitter, and Instagram from the year 2011 to 2016. Through the use of social media, online convergence was formed leading to the development of citizen participation and various disaster response and recovery operations in the country.

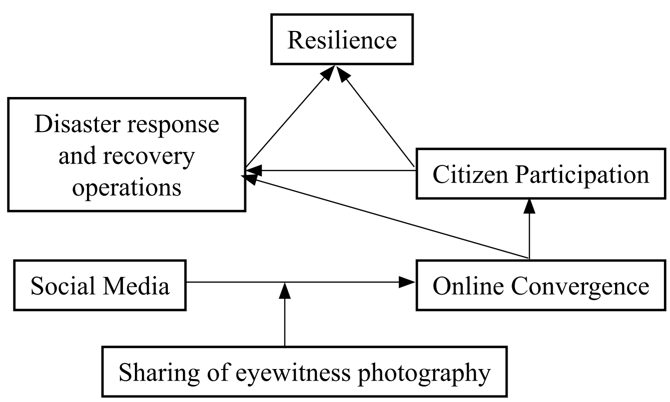

Figure 1: Research framework

Depicted in Figure 1 is the research framework. The study explained that resilience can be triggered directly or indirectly by citizen participation, and is triggered directly by the deployment of disaster and recovery response operations. Figure 1 shows that social media affects the formation of online convergence which in turn affects the development of disaster response and recovery operations and citizen participation. The research framework suggests that sharing of eyewitness photography mediates the effect of social media on the formation of online social convergence.

Disaster Risk Profile of the Philippines

There had been many international organisations around the globe that put premium in studying the disaster risk profile of a country and internationally-accepted principles on disaster management and emergency response. To name a few there is the annual Asia-Pacific disaster report, the International Federation of the Red Cross and Red

Crescent Societies (IFRC) the International Humanitarian Assistance Network (IHAN), ASEAN Agreement on Disaster Management and Emergency Response (AADMER), Oslo Guidelines, UNGPID, etc. In a report conducted by the Philippine office of civil defense, it was mentioned that

> ... the Philippines is susceptible to various types of natural hazards due to its geographical location and physical environment; being situated in the "Pacific Ring of Fire", between two Tectonic plates (Eurasian and Pacific), an area encircling the Pacific Ocean where frequent earthquakes and volcanic activity result from the movements of said tectonic plates. (Dumaguing Orrallo, 2011; p.2)

Relative to the study conducted by Orrallo (2011), in the asia pacific disaster report (2012) it was mentioned in the study focusing on reducing vulnerability and exposure to disasters that

> In Asia and the Pacific, over the past four decades, the average number of people exposed to annual flooding has increased from 29.5 to 63.8 million, whilst populations in cyclone-prone areas have grown from 71.8 million to 120.7 million. The region also represents more than 85% of global economic exposure to tropical cyclones pointing to a pattern of economic growth in typhoon-prone coastlines and flood plains. (see p.7 of the report)

In line with these reports, the natural disaster at a glance which is a senate report of the Philippines in the year 2013 indicated that

> ... the Philippines is known as one of the most hazard-prone countries in the world. In a study conducted by World Bank in 2008, the country was identified as a natural disaster hot-spot with approximately 50.3% of its total area and 81.3 % of its population vulnerable to natural disasters. Based on the 2012 World Risk Report published by the United Nations University Institute of Environment and Human Security (UNUEHS), the Philippines is the third most disaster risk country worldwide following Vanuatu and Tonga. (p.1 of the report)

The gathered information regarding the disaster risk profile of the Philippines made the government to continue to exert effort in making sure that on top of a legal framework that supports disaster and risk-reduction management in the country, an institutional capacity to support the resiliency of affected communities during crisis are also properly managed with organising actions leading to programs that will allow the communities to recover quickly from difficulties.

The literature review concerning the disaster risk profile of the Philippines established the high vulnerability of the country to natural calamities. It is important to note that natural disasters such as earthquakes, super typhoons, and tropical cyclones can cause a significant loss of livelihood and loss of homes of families which in turn affects the lives of many that have been affected by the tragedy. As a country, problems concerning health and increase in poverty can grow exponentially because of these calamities. Although numerous efforts have been explored by the government to mitigate the dangers brought about by natural calamities, many, who have been affected by the catastrophes in the past, are yet to recover from the disaster. Hence, researches in the fields of citizen participation, volunteerism, resilience, and best practices in disaster management operations are still needed in the country.

Notable Experiences from the Philippines

At present, the forecasting technology used in the country has the capacity to predict the time, place and magnitude of a natural calamity before it happens, as such, social media networks were used as early warning systems to the communities that are projected to bear most of the brunt of an impending calamity. Social media platforms can serve as early warning systems for people who might be greatly affected and as such could help them prepare for the impact and therefore lessen the effect of the disaster and its aftermath.

The national disaster risk reduction and management council (NDRRMC) of the Philippines, formerly known as the national disaster coordinating council (NDCC) under the office of civil defense has made its presence on various social media platforms. Presented in Figure 2 is the official Facebook page of NDRRMC which has been used since January of 2011. Presented in Figure 3 and Figure 4 is the NDRRMC's official Twitter and Instagram accounts that have been both active since December of 2013. These social media platforms have been used by NDRRMC to communicate with the public, and in institutionalising the national disaster risk reduction and management plan of the country. These social media platforms have also been instrumental in allowing NDRRMC to work with various government, non-government, civil sector, and private sector organisations of the government during the crisis.

Social media platforms used by the national disaster coordinating council in the Philippines

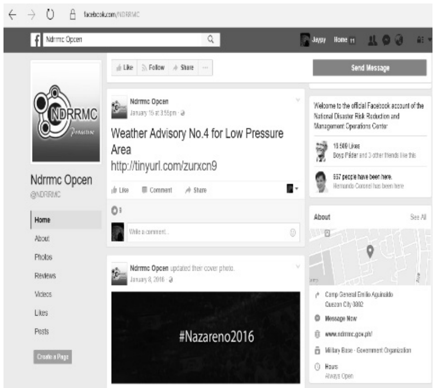

Figure 2: Ndrrmc official Faceook page

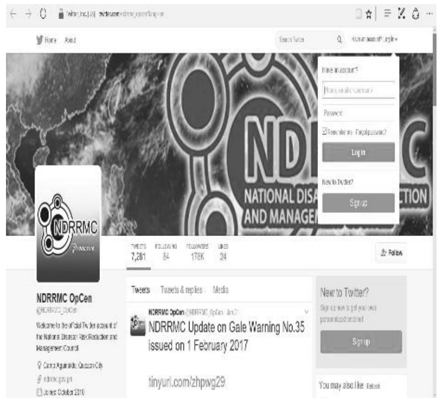

Figure 3: Ndrrmc official Twitter account

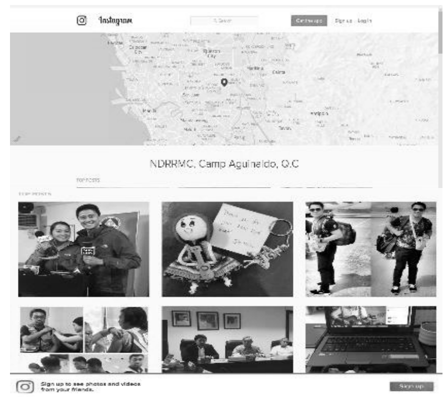

Figure 4: Ndrrmc official Instagram account

Another means of social convergence formed in times of disaster are presented in Figures 5 to 7. Figure 5 show how Facebook was used by affected residents as a means to communicate by posting short updates indicating that they are safe. The "safe check" feature of Facebook allowed people to get updates from loved ones and friends through prompt remarks, such as (i) letting friends and family know you are safe; (ii) checking on others in the affected area, and (iii) marking your friends "safe". This Facebook feature launched in 2014 was viewed to be effective by people in the affected areas, and by their friends and families who are anxious for news. Similarly, many other applications for mobile phones were made available for people to utilised in line with disaster preparation (see Figure 6), and disaster management operations including relief giving operations (see Figure 7).

At present, the "safe check" feature of Facebook is used not just for status updates during calamities, but also as a means of communication to call for help and request for vital needs of the communities during crisis. Many netizens have viewed this approach to be effective. In an online article published by Ng (2017) it was explained how Facebook can a be used as a tool for disaster response, and how people in the affected community can search for resources or help for those in need in times of crisis.

> The Safety Check feature has been a vital, if limited, resource during events like hurricanes and terrorist attacks, helping people find out if their loved ones in the affected area are OK… It becomes really easy to get in touch with people in your community who you may not be friends with, Chetan [Facebook Safety Check user] said.

The "safety check feature" in Facebook and other disaster response related applications in mobile devises

Figure 5: Facebook's safety check feature

Figure 6: Downloadable applications for safety check and updates during for disaster preparedness

Figure 7: Facebooks's call to action. Donate online for emergency relief operations

When typhoon Haiyan, known as Super Typhoon Yolanda hit the Philippines, the country's Department of Social Welfare and Development (DSWD) set up small internet stations to provide free internet access to people affected. Survivors took turns using the few desktops and laptops provided. Aside from DSWD the online article of Fadegurao (2016) reported that

> ...the Department of Science and Technology (DOST) launched the nationwide free Wi-Fi internet access in transport terminals and other areas by using its unused 2015 funds… Fadegurao (2016) added that Survivors of super typhoon Haiyan use free internet connection and charge their mobile phone batteries for free at a booth operated by Leyte Electric Cooperative along a main street of Tacloban City.

Although people were given few minutes to use the facility, Facebook was viewed to be an effective means of informing family and friends of one's current status. At such times, the use of the internet provided a quick and efficient method to communicate with family and friends during a period when communication lines were down (see Figure 8 and Figure 9). In addition to this, many organisations working for community development, relief operations, and disaster response has viewed internet connectivity to be fundamental in facilitating information sharing and for the provision of assistance to the affected communities. The work of Hall and Ashcroft (2014) reported that

> ...in Tacloban [City in the Philippines that was badly hit by Typhoon Haiyan] the electricity infrastructure was totally destroyed, the mobile phone networks were brought down, and the landline telephone networks and the internet service providers were all severely damaged… .
>
> The main challenges we face in these kinds of situations, especially with the typhoons and the tidal surge that they had here, is the damage to the infrastructure," says Neil Murphy-Dewar, Emergency Telecommunications Cluster (ETC) Team Leader in Tacloban. "In Tacloban the electricity infrastructure was totally destroyed, the mobile phone networks were brought down, and the landline telephone networks and the internet service providers were all severely damaged… .
>
> Today the ability to be on the internet and be able to share information with headquarters is essential," says Jesper Lund, Head of OCHA in Leyte and Samar. "Everything we produce here is immediately uploaded to the Internet so it is available to the wider community. We cannot imagine a situation anymore where we don't have Internet access.

Immediately after the super typhoon struck the Philippines in November 2013, a mass outpouring of donations, both in cash and kind, were channeled through different aid organisations to help those in need. The international donations amounted to billions Philippine Peso. The citizens were suggested to be vigilant, using the hashtag #aidmoniorPH, the "Netizens" which Hauben and Hauben (1997) coined from combining the words network and citizens, and now used by many to define people using the digital network – followed updates on how aid and relief goods are being allocated by the government. This trend may add value to the promising effectiveness of many social media platforms in public monitoring of government action needs thus directly or indirectly contributing to the formation of resilience. In an effort to help those in need for assistance after the destructive typhoon Haiyan in the Philippines, Facebook has called to action its users by asking for $10.00 donations which will be donated through the American Red Cross at the top of every user's news feed (see Figure 7).

Survivors of Super Typhoon Haiyan (Yolanda) use free internet from stations set-up by the Philippine government in cooperation with the country's leading telecommunication providers to give status updates to relatives and fiends

Figure 8: Survivors of super typhoon Haiyan use free Internet connection and charge their mobile phone batteries. Photo retrieved www.ibtimes.ph/dost-use-extra-funds-intall-wife-transport-hubs

Figure 9: Free Internet use for typhoon Haiyan survivors. Photo retrieved 06 February 2017, from www.edition.cnn.com.

According to Facebook user Sana Schifferer, who was in berlin during the typhoon, the social media network has "helped her help victims of typhoon Haiyan" and stay informed and up to date with the latest incident (personal communication, December 13, 2013).

> So there I was, sitting in Berlin in front of my laptop, talking to my mom and Jack on one end while browsing Facebook for information on the other — and I was finding it!...
>
> She did create a Facebook page and used their house in Manila as a drop off point for donations intended to help the victims. And even with a new page only 72 hours old, she, with the help of family and friends, was able to raise more than 3.5 Million Philippine pesos (USD $80,000). The page was also used by the people who donated to monitor their donations and make sure that these reached the victims.

The Twitter account with handle @HaiyanAid which was a project by restaurants in the United Kingdom to help raise funds for the victims of typhoon Haiyan (Yolanda). Started by a group of restaurants in London which added an optional ₤1.00 donation to every customer bill.

> We have chosen to support the Disasters Emergency Committee as a group that brings the 14 main UK aid agencies together at times of crisis. The breadth of experience across these teams make the aid appropriate, accessible, experienced and ensures its accessing where need is greatest.

Australian model and celebrity Elle McPherson took notice of the movement and featured the group on her tumbler account "ellemacpherson.tumblr.com" which contributed to the quick increase of donations to the cause. As of December 2013, Haiyan-Aid has raised more than ₤20,000.00 pounds or 1.25 Million Philippine Peso (US$25,000.00).

International celebrity using social media to call for action.

Figure 10: Celebrity call to action using Twitter

Figure 10 show how that celebrity status can also play a huge part in calling into action the younger populace belonging to the Millennials. A singing group in the United Kingdom (UK), One Direction member Harry Styles, using his Twitter handle "@Harry Styles" tweeted "Millions in the Figure 10. Celebrity call to action using Twitter

Philippines need clean water & shelter now. @oxfamgb is there: donate to their #Haiyan appeal!" on 12 Nov 2013 has helped garnered a total of 98,239 "retweets" [repost] and 116,141 "likes" [affirmation]. The comments of young Twitter users also flooded the post expressing gratitude and support for the actor as well as his cause. Comments include "@Harry_Styles @oxfamgb my school raised over £1,440.00 for them:-D" from Lucy✌ @yolucysaunders (15 November 2013); "@Harry Styles @oxfamgb harry my school raised over $1,000.00 for them 💞💖💕💘 from @Harryuracutie (17 November 2013); and "@Harry_Styles @oxfamgb my family donated like $100.00 it's not that much but u know...every penny counts" from sarah @blueberryblood (17 November 2013).

The Philippines' Republic Act 10639: "An act mandating the telecommunications service providers to send free mobile alerts in the event of natural and man-made disasters and calamities."

The study put forward some notable experiences from the Philippines illustrating certain innovative ways in which social media has been used as a tool to both communicate and gather information during crisis. The study showed examples of emergency service agencies (e.g., DSWD and DOST) utilizing the internet and social media to collect updates from public users in times of crisis.

The Philippine government also released the Republic Act 10639. An act mandating the telecommunications service providers to send free mobile alerts in the event of natural and man-made disasters and calamities.

> In the event of an impending tropical storm, typhoon, tsunami, or other calamities, mobile phone service providers are mandated to send out alerts at regular intervals as required by the National Disaster Risk Reduction and Management Council (NDRRMC), the Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), the Philippine Institute of Volcanology and Seismology (PHIVOLCS) and other relevant agencies…
>
> The alerts shall consist of up-to-date information from the relevant agencies, and shall be sent directly to the mobile phone subscribers located near and within the affected areas. The alerts shall include contact information of local government units and other agencies required to respond to the situation. The alerts may contain other relevant information such as, but not limited to, evacuation areas, relief sites and pick-up points…
>
> The alerts shall be at no cost, whether direct or indirect, to the consumers; and shall be included as part of the service providers auxiliary service. The alerts may be in the form of SMS (text messages), MMS, or e-mail, as needed and appropriate. (Section 4 – Mobile Alerts, The Official Gazette of the Republic of the Philippines, 20 June 2014).

This approach shows that aside from social media platforms, other forms of communication mechanisms were also explored to ensure the safety of communities who can be affected by crisis. Again, this strategy can directly or indirectly affect in exercising effective decisions on disaster risk reduction and resilience of the country in general.

Citizen Participation: The Philippine Experience during Crisis

Photo sharing activity, specifically eyewitness photography, as well as sharing of videos, is seen to be a custom nowadays. Duggan (2013) mentioned that sharing of photos and videos is a social currency after doing a research on the growth of photo and video sharing online. Duggan (2013) mentioned that around 54% of internet users have posted original photos or videos to websites and 47% share photos or videos they found elsewhere online. Although incidents like these were found to be evident in young adults and women lead the way in each of these activities (Duggan, 2013). In the Philippine context, Hofileña (2017) mentioned that the Philippines is now the top users of social media worldwide, spending an average of four hours and 17 minutes a day. In Hofileña's (2017) abstract submitted before a talk in a university in the Philippines, Hofileña (2017) emphasised that

> fifty-eight per cent of the Philippine population have active accounts on Facebook, the top social network with 1.87 billion users as of January 2017. This huge community on social media presents both possibilities and perils. (Social media in the age of likes, fakes, and trolls. Ateneo de Manila University, Department of Communication and Asian Center for Journalism. Abstract from the talk of Chay F. Hofileña, 13 March 2017)

The internet and the various platforms of social media served as the staunch supporter of citizen participation in the Philippines during crisis. Presented in Figure 11 and Figure 12 are examples of pictures shared by the netizen taken during crisis. Through the use of social media, many relief giving operations were formed during crisis because the sympathy and compassion that were heightened by actual photos and videos shared by netizens in the social media. In the account of Instagram user Red Herrero from the Philippines, for instance, it was stated "Christmas is all about giving... we are blessed and may even have more than enough... tara help pa tayo! [come on let's help!] Another batch of meds to be sent to the Yolanda Victims... #tabang [#help] #yolanda #christmas" (12 December 2013). Similarly, the CrossFit Taranis' (a fitness community in Victoria, Canada) Facebook account, announced "Join us tomorrow at the gym @ 12 noon for the #Yolanda Workout of the Day (WOD). A relief WOD for the survivors of Typhoon #Haiyan/#Yolanda. Wear the Philippine flag colours: red, blue and yellow! (24 November 2013). Additionally, the Facebook group Haiyan Relief Efforts in Harrisburg posted updates on the relief efforts for victims of the typhoon. The Facebook description of the community formed in Pennsylvania, USA says

> The strongest, most devastating typhoon in the history of mankind has hit my native country, the Philippine Islands last Friday. Over 10,000 people died and more than four million children will be affected by this typhoon. I feel paralyzed as I read and watch the footage of the wrath. I am turning my emotional paralysis into physical action. I am making meatball soup to sell to raise funds to send to the

> Philippines. If your family usually eat out on Friday nights, please stop by at the house for a container of delicious soup. If you are out of the area and would like to donate, please make your check out to Damayan At Tiyaga Foundation on the memo line please write: Yolanda Relief and send to 3601 Green Street Harrisburg PA 17110. This foundation is headed by my mom… and my brother… so it will go straight to the survivors and victims, without the administrative costs. Every day counts and we have to move and do something."

The spirit of volunteerism and citizen participation were both seen in local and in the international level. The social media posts made by netizens gain traction and reverberated through the international community and foreign aid in cash, kind, and humanitarian aid came pouring into the country (see Figure 13 and Figure 14).

The people of the Philippines, as a show of gratitude, also made viral posters and collages posted on social networks expressing thanks to all those who have helped the country in trying times. Other international figures (see Figure 15) and the Pope (of the Roman Catholic church) turned to twitter to express their support and call for prayers for the people affected by the typhoon (see Figure 16). A surge in donations from the general public has been reported because of the viral trend these celebrity posts generated on social media.

The Yolanda story (International name Haiyan), told through pictures and tweets posted on different social media platforms.

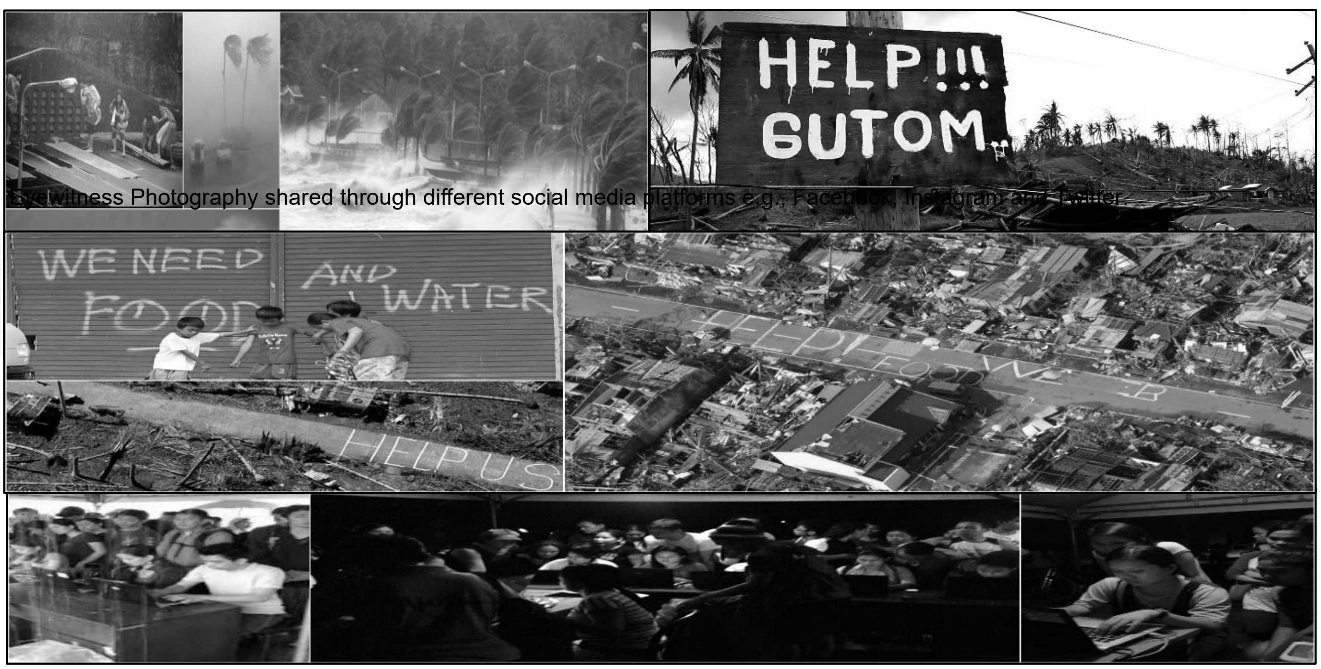

Figure 12: Aerial shot of Typhoon Yolanda victims asking for help. People have no access to food, water, electricity and phonelines are down. Internet access was also non-existent.

The general public does not have the means to personally thank the people who have given support but by sharing these posters, gave them a sense of fulfilling the desire to say 'thank you'. Affected residents did not allow the effects of the disaster to hinder them from saying thanks. Using creativity and the power of social media, residents affected by the crisis were able to express their gratitude to those who helped (see Figure 17 and Figure 18).

Relief operations from the Philippines and the international communities formed to help the people affected by natural calamities

Figure 13: Humanitarian aid from (clockwise left to right): Japan, USA, Indonesia, Australia, France, and China. People from all over the world expressed their sympathies and extended their help.

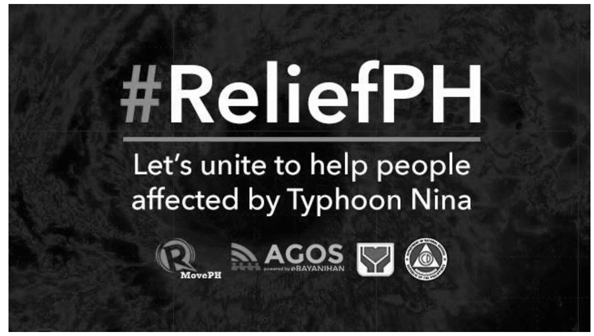

Figure 14: Tweet or post on Facebook with the hashtag #ReliefPH for help

Pictures of international celebrities using their influence to people around the globe through social media for relief giving operations

Figure 15: Call for relief giving operations through the use of international celebrities as ambassadors

Figure 16: International celebrities encouraging social media followers to participate in relief giving operations

People in the Philippines saying "Thank you" to the international groups for the community spirit showed during crisis

Figure 17: Facebook post of people from the Philippines showing gratitude to the various relief giving operations organised by the international community

Figure 18: Picture of a community in the Philippines showing gratefulness to Canada for extending help to the Filipino people when Typhoon Yolanda hit Tacloban, Leyte.

To give a succinct description of the Philippines' notable experiences during crisis, the Philippines as a country has benefited a lot from disaster response operations formed through online social convergence. The relief giving activities during crisis have been influenced by eyewitness photographs, disaster information campaigns for help, and individual post from netizens sharing the present status of the affected communities in the social media. Facebook, Twitter, and Instagram were among the commonly used social media platforms in the Philippines during crisis. Disaster response and recovery operations to assist the affected communities in the Philippines were coming from local and international groups that have been influenced by social media post from government agencies, volunteers, local and international celebrities, and philanthropic works organized by all walks of life who are active in social media. Aside from community work and relief giving operations, people in the Philippines also made use of social media in showing gratitude to all the help extended to the affected places by posting acknowledgments and recognitions to governments, private organisations, non-government agencies, religious congregations, and among others that extended help.

Methods

Qualitative method was used in this study to discuss norms that lead to several government, private, and philanthropic disaster response and recovery efforts in the country during crisis. Phillips (1997) mentioned that there is a general compatibility of qualitative research method in disaster studies.

As discussed in the earlier work of Erlandson et al. (1993), the qualitative research technique openly accepts the existence of multiple realities, holistic investigation, and the natural influence of the research proponent as well as the respondents to the data. Hence, allowing the researcher to make a rich description and a thorough understanding of the situation (Phillips, 1997). This line of thinking was also supported by the work of Guba (1981). Further, Phillips (1997) explained that both Guba (1981) and Erlandson et al. (1993) both mentioned that the naturalistic inquiry brought about by qualitative research gives relevance to emergent theory and attention to tacit knowledge. Qualitative method was also seen as a flexible research design. As compared to quantitative research, the qualitative techniques, such as observation, photography or videography, and documents and/or records review as discussed by Bogdan and Biklen (1992); Jackson, (1987) provides a natural setting that may not be available to a laboratory setup, making qualitative research suitable for disaster research efforts. This entails that the qualitative research methodology allows the researchers to better understand thoughts, feelings, and actions by means of creating or drawing a framework that describes the meaning of events (Atieno, 2009). Hence, in exploring the relationship among social media use, amateur photography, and disaster resilience, the qualitative type of research methodology was identified to be appropriate. The research made use of a qualitative technique as an empirical method of describing a social phenomenon. Inspired by the work of Quarantelli (2002), the concept of quick response research (QRR) was used in this study. The study aimed to directly and or indirectly contribute to the disaster management programs that is developed by the Philippine government for local communities to be easily assisted by disaster response and recovery operations in times of need.

Depicted in Figure 19 is the research design. A prototypical diagram depicts the linear association of each research phase, and the procedural approach used in the study to give a scientific explanation on the norms of the following: (i) sharing of eyewitness photography through social media during crisis; (ii) trigging citizen participation through online convergence during crisis; (iii) identification of factors that supports the development of disaster response and recovery operations from online convergence during crisis; and lastly (iv) identification of factors that supports the development resilience.

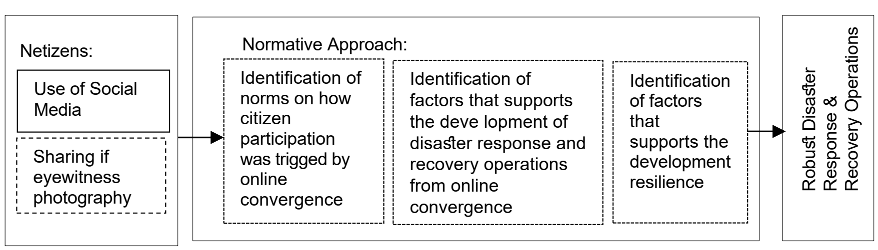

Figure 19: Research design

Procedure of Data Gathering

Inspired by Quarantelli (2002), QRR was used as a tool to gather data in this research. The QRR is a technique where a disaster social scientists take advantage of calamity sites to conduct direct observation and gather field documents and capture images for data collection. The same concept was used in this study, although the collected data were mainly eyewitness photography, recorded videos, and social media status updates of people affected by the crisis. Using these collected facts and figures, norming was discussed on how several disaster response and recovery efforts in the country were formed during crisis.

Granting that visual techniques remained to be underused in research according to Cohn and Wallace (1992), this qualitative technique has been used in many disaster types of research since then (Phillips, 1997). Many research proponents believe that pictures taken during disaster are truly worth a thousand words. Relative to this, the works of Currry and Clarke (1977); Wagner (1970); Collier and Collier (1986); and Hockings (1995) mentioned that because of technological advancements (e.g., camera phones) the visual technique could be a hot method in the coming years.

Data Analysis

Normative approach was used to describe the factors that support the development of disaster response and recovery operations from online convergence; the patterns on how citizen participation was trigged by online convergence; and the factors that support the development of a tough environment in times of crisis with the ability to endure, fostering resilience. The themes and the superordinate themes were consequential to the disaster risk profile and the recorded notable experiences from the Philippines in surviving crisis brought about by natural calamities and disasters in the recent past.

The continuous rise of social media and social networking in the Philippines; the regionalist attitude of the people in the Philippines; and the significant number of overseas workers from the Philippines were the three major themes identified to be the main factors that support the development of disaster response and recovery operations from online convergence during crisis. The uniqueness of the Filipino culture; the high percentual share of Filipino Facebook, Twitter, and Instagram users; and the influence of both local and international celebrities were identified to be the factors that contribute to the norms on how citizen participation was trigged by online convergence. The Filipino culture has four superordinate themes, these were identified as compassion, individualism, ride on attitude or simply going with the flow, and finding an affinity to the place. The Philippines' strong international solidarity including the good and worthy relationship of the Philippines as a country to the international community has helped the country to survive the crisis brought about by natural calamities in the past five years. Among other factors that contributed to the pliability of the Philippines in handling crisis were effectual governmental policies and valuable relief operations to the affected communities. Culture was also identified to play an important role in building resilience. The superordinate themes in the country's able governmental policies were early warning systems evaluation, risks transfer mechanisms, and risk assessment of the Philippines being one of the countries that is prone to natural disaster. The superordinate themes identified in the relief operations of the country were the notable rehabilitation and recovery operations from local and international community, and the role of local government units (LGU's) in disaster response operations.

Results

Results of the study revealed that eyewitness photos from the public served as evidential documents of disaster information source resulting to better response from the community in terms of providing immediate help. One of the factors that contributed to the effectiveness of online social convergence leading to valuable relief operations to the affected communities is the rise of social media use in the Philippines. Citizen participation that is developed through online convergence is triggered by an individual's attitude toward concern for the country and the regionalist attitude of people from the Philippines. This also means that culture plays an important role in the development of online social convergence and citizen participation. The resilience of a country can be enhanced by Effectual governmental policies and valuable relief operations to the affected communities and the unique feature of the Filipino culture as drivers of resilience. Consequently, social media sites were identified to be effective platforms for citizen journalism and reporting. These outcomes were perceived to contribute to the achievement of community and safety resilient goals of the country in general.

The Rise of Social Media Use in the Philippines

The work of Quinn (2010) explained that in a study performed by Tech Crunchies in the same year, the Philippines was ranked fourth among the countries worldwide to have the highest number of social networkers. In the year 2009, the Philippines is just next to India and Singapore but at present, "Philippines is now the top users of social media worldwide, spending an average of four hours and 17 minutes a day." Additionally, in the year 2017 "fifty-eight per cent of the Philippine population have active accounts on Facebook, the top social network with 1.87 billion users as of January 2017." Because of these events, organisations that are involved in providing early warning signals for calamities, specifically from government units that are involved in relief giving and recovery operations in the Philippines have identified the use of social media to reach the general public for information dissemination and to call for help (for example, NDRRMC, DOST, and DSWD).

Occurrence of Citizen Participation through Online Convergence

The occurrence of citizen participation is very evident in online convergence. There are a variety of techniques available to measure citizen participation, but the work of (Cogan, et al. 1986) mentioned that publicity, public education, public input, public interaction, and public partnership are good indicators and practices for public involvement. Through the sharing of photos and videos in various social media platforms, many people were persuaded to extend help to the affected communities. The users of the social media platforms are also being educated by the present condition of the people and the actual environment that has been affected by the calamity. This leads to public partnerships – often formalised by a continuous exchange of information and ideas among citizens, relief operation planners, and decision makers (for example, local government units). Similar to the theory of Cogan, et al. (1986), the techniques to trigger citizen participation does not fit exclusively into one category. In online social convergence, it has been observed that activating elements often overlaps if not becomes automatically causal and pivotal to another set of one or two elements. Thus, making citizen participation formed through online convergence to be noticeable. For instance, a picture shared by a person from the actual location of the crisis educates the public about the actual state of the affected community and at the same time serves as a publicity, which in turn becomes a material to persuade people to extend assistance. Similarly, the public partnerships formalised by a constant exchange of information and ideas among citizens, allows the participants to clearly articulate goals and objectives; develop political support from various governments, and serves an integral part of the decision-making structure. The continuous growth of the online convergence also allows the engagement to get adequate funding, staff, and time. The works of Cogan, et al. (1986) identified these as elements of successful citizen participation programs that are also evident in online social convergence.

Online Convergence as Staunch Supporter of Recovery and Relief Operations

It has been identified that various social media platforms have changed the way people communicate to create an avenue to exercise citizen participation in times of crisis. In the Philippines, many relief giving operations formed during the crisis were from groups created through online convergence. These are groups formed in the social media with an end in view of providing help to the affected communities (i.e., providing information to people in a disaster area, and using the provided information for pre and post disaster response through the internet). The messages sent through mobile phones, pictures uploaded to the web, videos shared in social media, and the formation of many online groups has made it possible to communicate and exchange ideas with a large number of people locally and even around the globe leading to relief giving operations and volunteer work. Many people easily find affinity and connection to a shared video or a picture uploaded on the internet coming from the actual location of the crisis, which in turn leads to the desire to provide help. Social media has played an important role in informing the public about these disasters by allowing social media users to share information and ask for help

Attitude towards Concern for the Country and Regionalism of People from the Philippines

For international communities, the use of social media provided convenience and expediency to show support (for example, disaster emergency committee that brings aid agencies together at times of crisis). Since the international community does not have the best understanding of the real situation in the locale where crisis happening, many have chosen to provide support from groups with active online presence, with the perception that "the breadth of experience across these teams (disaster emergency committees) shall make the aid appropriate, accessible, and ensures its accessing where need is greatest." But for people from the Philippines, many showed deep consciousness, affection, and loyalty to their hometowns leading to the formation of many self-organised groups in social media (for example, I feel paralysed as I read and watch the footage of the wrath. I am turning my emotional paralysis into physical action…"). People from the Philippines both residing local and abroad felt the need to provide help after knowing that their hometowns have been greatly affected by crisis (for example, "I am making meatball soup to sell to raise funds to send to the Philippines"). People who were born and raised in places who have been affected by calamities spontaneously felt the urge to help (e.g., "Christmas is all about giving... we are blessed and may even have more than enough..."). The social media, primarily the use of Facebook and Twitter was noteworthy in the creation of online social convergence with the end in view of providing direct help from the affected communities.

The Unique Attributes of the Filipinos and the Filipino Culture

Culture played a big role on how the Philippines managed to survive the crisis that hit the country over the past years. An average of 20 tropical cyclones visits the Philippines every year (de la Cruz, 2016). Although the Filipino attribute of "kanya-kanya" [being excessively individualistic] can be perceived as a negative attitude, this greatly contributed to the formation of many self-organised groups during crisis. For instance, many groups were formed in Facebook that aimed to provide help to the affected communities when typhoon Haiyan hit the Philippines in 2013. However, it is noticeable that members of the groups formed on Facebook were less as compared to the members of online communities formed by groups from the international communities. It has been observed that Filipinos would tend to form a new group with the same objective (for example, relief giving operations) instead of joining an existing group that has been earlier formed online. Additionally, the ride on attitude or simply going with the flow, and finding an affinity to the affected community also contributed to the formation of groups through online social convergence. For instance, an individual who is from Tacloban (i.e., province in the Philippines that has been greatly affected by Typhoon Yolanda, known as Typhoon Haiyan internationally) would form a Facebook group to invite people to participate in a self-organised relief giving operations. Another individual from the same province would rather form a new online group rather than joining or contributing to an existing online group that was earlier formed. This process continues and a larger number of social media users would notice the presence of the growing number of self-organised groups. This becomes a common practice thus the creation of more and more self-organised groups because of a ride on attitude. This practice was seen to be common on social media platforms like Facebook, Instagram, and Twitter being these digital tools to be more common in the Philippines. Further, the Filipinos were also highly influenced by star power to push activism and citizen participation. It has been observed that international and local celebrities can bring attention to the public, call for donations, and even pressure the public for action in times of crisis (for example, "@Harry Styles" tweeted "Millions in the Philippines need clean water and shelter now"). Greatly, the unique attribute of the Filipino culture contributed to the way people coped from crisis experienced in the past.

Strong International Solidarity, Effectual Governmental Policies, Valuable Relief-giving Operations, and the Unique Feature of the Filipino Culture as Drivers of Resilience

The Philippines has always had a good relationship with the international community. In times of crisis a strong international solidarity was seen to be an advantage and was, in fact, one of the major factors that contributed to the survival and fast recovery of affected communities in the country during crisis (for example, Typhoon Yolanda, international known as Typhoon Haiyan in 2013, when the Philippines received abundant donations from the international community). The Philippines, being a developing nation in the Southeast Asian region, benefited from the output of strong intergovernmental diplomacy that made global communications easy. Hence, encouraging both developed nations and even other developing countries to provide humanitarian interventions to the affected communities of natural disasters (for example, humanitarian aid from Japan, USA, Indonesia, Australia, France, and China. Many countries from all over the world expressed their sympathies and extended their help in 2013 when Typhoon Yolanda hit the country).

Among other factors that contributed to the resilience of the Philippines as a country in handling crisis brought about by natural calamities are effectual governmental policies and valuable relief operations to the affected communities. Because of effectual governmental policies, the role of local government units (LGUs) in disaster response operations was also seen to be very notable (for example, the country's Department of Social Welfare and Development (DSWD) set up small internet stations to provide free internet access to people affected and the Department of Science and Technology (DOST) launched the nationwide free Wi-Fi Internet access in transport terminals and other areas by using its unused 2015 funds in cooperation with LGUs of affected communities). Lastly, the unique attribute of the Filipino culture as earlier explained in the previous part of the study was also identified to play an important role in building resilience.

The Contribution of Self-organised Groups to Resilience

Survival in disasters relies on volunteers and local people in the stricken community as well as professionally trained first responders. Research has consistently shown community residents are the real first responders because it is observed that people tend to feel altruistic immediately after crises. The chaotic conditions of disaster emphasise how interdependent people are. Further, helpful behaviour tends to be contagious—people see those around them helping each other and that becomes the norm.

Social capital, the networks of relationships among people who live and work in a particular society, drives a community's post-disaster resilience. According to Aldrich (2012) social capital plays critical role in the ability of a community to withstand disaster and rebuild both the infrastructure and the ties that are at the foundation of any community. He also finds that those with robust social networks were better able to coordinate recovery; and that "after disasters, most survivors see social connections and community as critical for their recovery." Social capital also positively affects citizen participation by providing information to individuals in the affected areas as well as those outside and thru the use of social media resources could be guided to where it is needed most. After disasters, many citizens see social connections and the social media as critical for their recovery and survival thru mutual assistance.

Disaster studies repeatedly capture groups of ordinary citizens engaging in rescue and response operations, particularly within the disaster-affected communities (Takazawa and Williams, 2011).

The greatest challenge following a disaster is to provide the right aid to the right people at the right place and the right time. Social media interchange of real time disaster information creating the new avenue where people converge digitally responding to the needs of disaster-affected communities directly regardless of where they are located (Hughes and Palen, 2009). When a 9.0 earthquake hit Japan in March 9, 2011, one Japanese housewife living in Finland posted on her pre-existing blog a single post articulating compassion and, indeed, a sense of powerlessness. Four days later, the online interaction snowballed into group action and collaborative work and became a project to send Finnish milk formula to the disaster-affected communities (Takazawa, 2014). A single blog post fueled humanitarian efforts thru online convergence with the aid of social media.

New forms of citizen participation in disaster response continue to emerge as disasters create the need, and technology creates the opportunity. The rapidly evolving connectivity and technologically mediated environment promise to expand the role of citizens not only participating through organised efforts, but also self-organising group efforts—ordinary people come into being as a group for humanitarian efforts and maintain evolving processes of collaborative activities over time.

Discussion

Assessment of PH Disaster Preparedness vis-à-vis the Sendai Framework for Disaster Risk Reduction

After the 2005 Hyogo Framework for Action (HFA) implementation which ended in 2015, one of the identified gaps in the framework is that "There has to be a broader and a more people-centered preventive approach to disaster risk." It has to be noted that the HFA relied heavily on government action on the local and regional level and sets aside the contributory potential of citizens. One of the reasons is that the emergence of the mobile and internet platform did not flourish until the Hyogo Framework for Action was on its Last Cycle (2013-2015). Sendai Framework addresses this gap by emphasising that disaster risk reduction practices need to be "multi-hazard and multisectoral, inclusive and accessible in order to be efficient and effective". There is a need for the public and private sectors and civil society organisations, as well as academia and scientific and research institutions, to work more closely together and to create opportunities for collaboration, and for businesses to integrate disaster risk into their management practices. The framework outlines four Priority Actions: (i) Understanding Disaster Risk; (ii) Strengthening disaster risk governance to manage disaster risk; (iii) Investing in disaster risk reduction for resilience; and (iv) Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction

This paper focuses primarily on the first Sendai Framework priority of understanding disaster risks through social media network utilisation and content sharing before, during, and after a disaster. As the framework's first priority seeks "to promote national strategies to strengthen public education and awareness in disaster risk reduction, including disaster risk information and knowledge, through campaigns, social media and community mobilisation, taking into account specific audiences and their needs" this also emphasises the importance of "strengthening the utilisation of media, including social media, traditional media, big data and mobile phone networks, to support national measures for successful disaster risk. The Sendai Framework for Action is aptly conceived at a time when the Philippines is still reeling against the impacts of the strongest tropical typhoon ever recorded, Super Typhoon Yolanda, which left more than 6,000 people dead and P571 billion in loss and damage, slowing down economic growth by about 0.9 percentage points in 2013 and 0.3 percentage points in 2014. But the typhoon Yolanda experience as a whole "transformed the Philippine disaster management system from a focus on disaster response towards a more holistic Disaster Risk Reduction and Management approach," (Legarda, 2015).

Photographic content in the social media during disasters trigger voluntarism.

90% of the transmitted information in the human brain is visual. Around 100 thousand billion images circulate on Facebook (77% of the total shared content on Facebook) and 6 thousand billion in Instagram and Twitter. The image is, without a doubt, the preferred content by users. One powerful image can say more than 1,000 words. It can stir emotions in individuals and motivate them to act. In the sea of noise called the Internet, it is important to ensure that information reach as many relevant audiences as possible, especially during a disaster. Looking at the past disaster that occurred in the country, social media networks were used: (i) to replace telephone communications, which is usually affected due to the collapsing of telephone wires; (ii) as a means for local authorities and emergency agencies to communicate with citizens seeking help and rescue; (iii) as a means for local authorities and emergency agencies to receive information from citizens; (iv) by young citizens who used Facebook to support, organise and coordinate crisis response; and (v) to provide real time information and material (pictures, video) to report the disaster.

Social Media as Platform for Community Building and Resilience

When individuals, communities, and institutions build resilience, it reduces the likelihood that severe disruptions, such as the instabilities above, become debilitating. It allows them to avoid and mitigate the negative setback, or to rebound more quickly after a disaster occurs. Citizen participation plays a role in building resilience by reducing vulnerability and enhancing adaptability after disasters. The most important social media relationships are the ones between members of the immediate community. Social networks and online forums are shown to be an important and effective tool in community building and development especially in the aftermath of disasters.

The Use of Qualitative Techniques in Disaster Research

Qualitative research methods are underutilised in disaster research but because qualitative research is grounded in people's actual experiences, the possibility of identifying new, relevant questions becomes more likely. In so doing, qualitative research can empower and give voice to respondents (particularly disaster managers and victims). A few recent studies have provided some potential for regenerating underused qualitative methods. For example, Scanlon's (1996) retrospective look t the Halifax explosion uncovered new data, much of it qualitative in nature, including interviews and unobstructed measures (Webb et al. 1981), that is documents. Visual techniques also remain underused (Cohn and Wallace, 1992), truly a picture is truly worth a thousand words, especially as a tool for illustrating one's findings.

Conclusion

The occurrence of citizen participation through online convergence; online convergence as staunch supporter of disaster response and recovery operations; and the contribution of self-organised groups to resilience are all inputs to robust disaster response and recovery operations.

Sharing of eyewitness photography through social media during crisis and the spontaneous use of social networks by young citizens triggers citizen participation and online convergence as observed during the Yolanda Typhoon disaster. In addition to this, the successive endorsement of the netizens' social media initiative by the public authorities, as responding to deep notions of care, trust and empowerment on complex situations where there are high stakes and decisions need to be made with urgency under different types of uncertainty. And whilst we suggest here that these types of partnership are not just welcome, but rather necessary to ensure the quality of response and ultimately community resilience to disaster and crisis.

Factors supporting the development of disaster response through online convergence that were identified through norming are (i) the Filipino culture of fortitude (ii) rise of social media use in the country and (iii) effectual governmental policies and (iv) trust and empowerment. Trust is a basic aspect that needs to be nurtured in crisis and emergency situations; a communication model like the one during the Yolanda Crisis implies sharing of responsibility and consequently empowering citizenry to a number of functions usually attributed to authorities, namely ensuring quality of communications and action. Yolanda could have been a case for 'do it yourself crisis management'; instead the partnership created, as described by the social media response, citizen participation and online convergence, makes the story one of 'community based' collaborative response. Hence, the effective use of social media during and after a calamity or disaster can actually open up of the space for better coordination of societal resources to tame situations of crisis and emergency.

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India and Disaster Management in South Asia

Suman Sharma[a]

Abstract

South Asia with one fifth of world population is an extreme disaster prone region. The situation created by hazards of nature becomes worse because there are layers of vulnerability in the region - poverty, illiteracy, malnutrition and social inequities which aggravate the risk and lead to more disasters. In this context South Asian countries are left with no option but to work together at the regional level to deal with this complex matrix of hazards, risks and vulnerabilities. The role of India is very important because it's the largest country in this region.

This paper attempts to examine various initiatives taken by India on disaster management and climate change in South Asia. It will also focus on various initiatives taken by India on bilateral and multilateral basis in the region. The paper will highlight the latest launch of the South Asia Communication satellite by India to provide communication and disaster support connectively among the people of South Asia Region. Pakistan has decided not to be part of it. Mr. Ghani, Afghan President, described the launch as South Asia's giant step towards regional cooperation. This paper will finally analyse the problems in the regional integration process towards sustainable development.

Keywords: vulnerability, disaster management initiatives, South Asia Communication Satellite, regional integration, sustainable development

Introduction

South Asia with one fifth of world population is an extreme disaster prone region. The United Nations Secretary-General Antonio Guterres addressing the high level debate in the General Assembly on September 16, 2017 said that South Asia is one of the worst affected regions from natural disaster since 1995. He also appealed the world leaders to implement the historic Paris deal with ever greater ambition. He spoke out in favour of the Paris agreement on climate change, saying extreme weather events like Hurricane Irma are becoming "the new normal of a warming world". He further said that: "Climate change puts our hopes in jeopardy. Last year was the hottest ever. The past decade has been the hottest on record. Average global temperature keeps climbing, glaciers are receding and permafrost is declining. Millions of people and trillions of assets are at risk from rising seas and other climate disruptions".Hewarned that the number of natural disasters has quadrupled since 1970[1].

Maplecroft, a Global Risk Advisory Firm, brought out Climate Change Vulnerability Index(CCVI) in 2014. This firm calculated the vulnerability of 170 countries to the impacts of climate change over next 30 years. They identified some of the world's largest and fastest growing economies, including India as facing greatest risk to their populations, ecosystems and business environment. This index rated 16 countries as 'extreme risk'. Bangladesh (1), India (2), Philipines (6), Vietnam (13) and Pakistan (16) feature in the highest risk category.

It is indeed a sad historical irony of monumental proportions that South Asia, which was the ancient cradle of the principles of ecological harmony in its quest for spiritual and physical symbiosis, today faces such a bleak environmental outlook. The fundamental filial connect between humankind and Mother Earth was declared thousands of years ago in the ancient Indian sacred scripture Vedas in the Hymn to the Earth:

'Mata Bhumih Putroham Prithivyah: Earth is my mother, I am her son.[2]

His Holiness The Dalai Lama in The Buddhist Declaration on Nature articulating the ethical and ecological vision of Buddhism made following observations which are extremely relevant for our time:

> 'Destruction of the environment and the life depending upon it is a result of ignorance, greed and disregard for the richness of all living things. This disregard is gaining great influence. If peace does not become a reality in the world, and if the destruction of the environment continues as it does today, there is no doubt that future generations will inherit a dead world.

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> 'Various crises face the international community. The mass starvation of human beings and the extinction of species may not have overshadowed the great achievements in science and technology, but they have assumed equal proportions. Side by side with the exploration of outer space, there is the continuing pollution of lakes, rivers and vast parts of the oceans, out of human ignorance and misunderstanding. There is a great danger that future generations will not know the natural habitat of animals; they may not know the forests and the animals which we of this generation know to be in danger of extinction.
>
> 'We are the generation with the awareness of a great danger. We are the ones with the responsibility and the ability to take steps of concrete action, before it is too late.'[3]

It is this critical awareness of the existential threat to humankind that has impelled right thinking people and analysts to rethink the old traditional concepts of security and realise the threats posed by the adverse impact of Climate Change as threat to human security defined as freedom from danger, fear, want and deprivation. The Climate Change is thus perceived as a threat to security in the non-military sense. This requires an entirely new conceptual framework to understand the magnitude and extent of this threat and therefore, to formulate an entirely different strategy to counter and secure peace and security for humankind. This humanist view, which links environment and security focuses on the welfare of humankind in a world which has globalised and wherein technology has weakened the geographical and cultural barriers.[4]

Global Discourse: On Climate Change and Disasters

The Intergovernmental Panel on Climate Change (IPCC), which came into existence in 1988 in pursuance of first World Climate Conference organised under the aegis of UN Environment Programme(UNEP) and World Meteorology Organisation (WMO) defines Climate Change as the change in the state of the climate that can be identified by changes in the mean and/or variability of its properties persisting for an extended period. Further, this change could be due to natural variability or a result of human activity.[5] There is now acknowledged plethora of scientific evidence that climate change is occurring primarily due to human activity. The emission of green house gases (GHGs) and its effect on global warming leading to devastating consequences for the climate are now well known for quite sometime. The debate on Climate Change has acquired urgency of late due to the existential threat that its adverse impact poses for humanity and also since it raises serious political issues on the nature and ideology of the model of economic growth and progress based on fierce consumption of depleting fossil fuels.

The IPCC report provides strong evidence of the change in climate. It has noted CO_2 atmospheric concentration up from 280 ppm (pre-industrial) to 379 ppm (2005) and GHG emissions up by 70% between 1970–2004. This has resulted in rise in global mean temperature by 0.74°C between 1906–2005. The eleven years period between1995–2006 has been recorded among the 12 warmest years since 1850. Further, global sea level rose 1.8mm/yr during 1961–2003 and at a faster pace during 1993-2003 at the rate of 3.1 mm per year. The average warming in future is predicted to be 0.2°C per decade.[6] Scientists from US National Aeronautical and Space Administration (NASA) and National Oceanic and Atmospheric Administration(NOAA) revealed that the year 2015 temperatures continued a long-term warming trend. In fact, 2015 was declared the hottest year on record beginning 1880. The adverse impact of these changes would increase the risks of natural disasters like floods, cyclones, drought, coastal erosion, landslides, water famine, food scarcity, adverse impact on human health, damage to fresh water ecosystems etc. The socio-economic impact of such adverse changes could be devastating for a densely populated region like South Asia.

The modern twentieth century world formally woke up to the challenge of Climate Change much after the holocaust of Second War when in 1972 UN Conference on Environment was organised in Stockholm. While Climate Change became a dominant subject of international discourse, the deliberations of the international community have been marked by political deadlocks, scientific uncertainties, lack of trust, inadequate leadership, political regrouping, influence of business lobbies and geo-political considerations.[7] Ironically, the State apparatus in collaboration with Corporate lobbies in developing countries, which have been suppressing indigenous and deprived communities to impose their own model of 'development' within, have been using the idiom and phraseology of the deprived during negotiations with the developed/industrialised countries. The poor and deprived and their advocacy of an ecologically harmonious and genuinely sustainable development process thus became a potent pawn in the hands of hypocritical regimes in the developing world on the geo-political chess board.

The First World Climate Conference was organised by United Nations Environment Programme (UNEP) and World Meteorological Organisation(WMO) to look into climate data, identify its impact and to promote research on climate variability in 1979. This Conference recommended creation of an Intergovernmental Panel on Climate Change (IPCC) which later came into existence in 1988. This very year a group of 400 scientists and policy makers met in Toronto in a Public Scientific Conference (sponsored by UNEP and WMO) and suggested 20% reduction in GHG against 1998 levels by 2005. In subsequent year 1989, UN General Assembly passed a resolution 44/228 to recognise the importance of the protection and enhancement of environment for all countries and further decided to convene a UN Conference on Environment and Development.

The First Assessment Report (AR) of IPCC in 1990 put forth a proposition of 60-80 per cent cuts in CO_2 emissions to stabilise the concentration of GHG which was noted to be 25 per cent higher in the pre-industrialisation age. The Second World Climate Conference held in Geneva the same year laid down basic principles like 'common concern of humankind', common but differentiated responsibilities', principle of equity', 'precautionary principle' and further urged developed states, which were responsible for 75 per cent of world's GHG emissions to establish targets and/ or feasible national programmes or strategies which will have a significant effect on limiting emissions or GHG. This Conference also recognised that emissions from developing countries must still grow to accommodate their development needs. UNGA passed a resolution in 1990 to formally launch negotiations on a framework convention on Climate Change. The very next year in 1991, the Intergovernmental Negotiating Committee (INC) met for the first time.

A consensus on UN Framework Convention on Climate Change (UNFCCC) could be reached in 1992 where in the landmark Earth Summit in Rio de Janerio, Brazil this Convention was opened for signatures of the member states. The Convention finally came into force in 1994. The Rio action plan-Agenda21-launched in the Earth Summit echoed the humanist approach to development and Climate Change when its preamble declared:

> Humanity stands at a defining moment in history. We are confronted with a perpetuation of disparities between and within nations, a worsening of poverty, hunger, ill health and illiteracy, and the continuing deterioration of the ecosystems on which we depend for our well being. However, integration of environment and development concerns and greater attention to them will lead to the fulfillment of basic needs, improved living standards for all, better protected and managed ecosystems and a safer, more prosperous future. No nation can achieve this on its own; but together we can – in a global partnership for sustainable development.[8]

The UN General Assembly adopting Rio Declaration on Environment and Development in August 1992 echoed these sentiments when it proclaimed in its very first principle that:

> Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature.[9]

The UNFCCC signed by 153 states declared its objective in Article 2 'to achieve stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.' The framework convention thus acknowledged Climate Change as an existential threat for humankind and fossil fuels as a major source of problem.

The second Assessment report of IPCC in 1995 confirmed the rise in global temperature as being influenced by human beings. This report provided inputs for negotiations which culminated in landmark Kyoto Protocol.

The Kyoto Protocol pronounced in 1997 within the parameters of UNFCCC, divided the nations into two main groups, i.e. Annex1 parties and Non-Annex1 parties. Some non-annex1 parties listed in Annex-2 and hence Annex-2 parties. Developing countries 145 in number were Non-Annex-1 parties. The Protocol lays down three mechanisms as under following the principle of 'common but differentiated responsibilities':

(i) Joint Implementation: Annex-1 countries can get credits for funding projects to reduce GHG emissions in other Annex-1 countries(mainly former Soviet bloc countries termed as economies in transition)

(ii) Clean Development Mechanism (CDM): Annex-1 countries can get credit for funding projects in Non-Annex-1 countries which projects reduce GHGs.

(iii) International Emission Trading (IET): Annex-1 countries can buy and sell carbon credits where one country has exceeded its target and can sell its reductions by the tonne to another country.[10]

Conference of Parties (COP)

Ever since 1995, the parties to UNFCCC have been holding Conference of Parties(COP) in order to assess progress in dealing with Climate Change. The chequered history of international negotiations bereft of political will to accept common but differential responsibilities continued through annual COPs when in 2000, COP-6 reached an impasse in Hague. COP-6, however, resumed in Bonn in 2001 after US President George Bush declared official decision to abandon Kyoto Protocol and focused on financial support to developing countries. It committed to create a \$410 million fund by 2005. In 2001 again, COP-7 meeting in Marrakesh decided to set up a Climate Change Fund for mitigation and adaptation to climate change as well as Least Developed Country Fund for the poorest countries. The third IPCC Assessment Report in the same year provided new and strong evidence of global warming over the last 50 years. It cautioned against the wider security implications of the climate change due to melting of glaciers and rise in sea level.

COP-8 met in Delhi in 2002 and calling for sustainable development agreed that adaptation to climate change was as important as mitigation measures.

The ratification of Kyoto Protocol by Russia in November 2004 and its coming into force on February 2005, resurrected the Protocol to some extent after US declared its dissociation from the treaty and merely maintained an observer status.

COP-11 which was also the first meeting of parties to Kyoto Protocol after 1997 agreed on an action plan in Montreal(Montreal Action Plan) and agreed to extend the life of the Protocol beyond 2012 when it would have been due to expire. It also agreed to negotiate 'deeper cuts' in GHG emissions.

The real politic came to the fore in 2005 when a group of five nations(G5)- Brazil, India, South Africa, Mexico and China- met G8 countries during their summit meeting in Gleneagles to debate Climate Change. G-5 countries stressed on transfer of technology and financial support for a 'flexible, fair and effectual global framework' in this regard.

G-8 countries in their subsequent 2007 summit meeting pledged financial support for adaptation measures along with use of cleaner and renewable energy. Thus technology cooperation and financing became the latest buzz-words of global negotiations on Climate Change.

COP-13 meeting in Bali in 2007 laid down a Bali Road map after taking note of fourth report (AR-4) of IPCC. It made a strong scientific case for political action on the climate issues facing humankind.

G-8 countries in a significant move held a special climate summit of major industrialised and developing countries under the aegis of the Major Economies Forum on Energy and Climate at L'Aquilla in 2009. This conclave endorsed the important benchmark of a maximum permissible global temperature rise of 2°C above the pre-industrial levels and G-8 countries agreed to cut their carbon emissions by 80 per cent by 2050 with a pre-condition that developing countries would agree to a global 50 per cent cut in emissions by 2050. G-8 countries hoped that developing countries might endorse a target which was not accepted by them in the past. However, the developing countries only agreed to 'peak' their emissions before cutting down in absolute terms.

The international community, particularly rich club of industrialised nations and emerging economies of G-5 countries refused to accept mandatory obligations on GHG emissions. While there was no compliance of short-to-mid-term (2020) reduction plans envisaged in Kyoto Protocol, long-term declarations only seemed unconvincing and intended to buy time for promoting geo-political selfish interests. While US despite being largest per-capita emitter of CO_2 refused to accept binding cuts, developing countries like India and China insisted on seeking 'allowances' due to their need for economic growth. They maintained that any mandatory cut in CO_2 emissions would compromise their efforts to tackle poverty.

COP-16 at Copenhagen in 2009 was held against this background but ended in a failure since no country signed the accord proposed for limiting carbon emissions to below 2°C with efforts to 'peak' them early. Thus in complete violation of the principles evolved after decades of painstaking efforts, no legally binding emission cuts were accepted. While the COP accord was not approved, it was proposed as under:

(i) Developed countries would jointly mobilise US $100 billion a year by 2020 to address the needs of developing countries.
(ii) A Copenhagen Green Climate Fund would thus be established to support projects, programmes, policies and other activities of developing countries.
(iii) A Technology Mission would be established to accelerate technology development and transfer to developing countries.
(iv) An assessment of Copenhagen Accord will be completed by 2015.

The Copenhagen Accord and response of different group of countries underlined fragmentation of the past efforts and abandoning of basic principles evolved earlier.

COP-16 at Cancun in December 2010 while made an effort to restore the sanctity of multi-lateral negotiations under the UNFCCC failed to make any headway on securing 'common but differential responsibilities' and 'deeper cuts'. On the contrary, the difference between developed and developing countries was obliterated- while developed countries would no more commit legally to cut emissions, the developing countries will have to take binding commitments. There were no firm commitments either to provide technological and financial help by rich countries who merely made promises. The Cancun thus made an about turn with following Long-Term Cooperation Action (LCA) plan:

Developing countries agree to
(i) writing off historical debt of developed countries;
(ii) have their own domestic emission targets and actions;
(iii) allow third party verifications of targets, making it binding;
(iv) emission targets of developed countries that are not sufficient to limit global temperature increase below 2°C.

Developed countries agree to
(i) generate US $100 billion in long-term, $30 billion in 2010-12;
(ii) facilitate technology transfer through innovation centres;
(iii) funding reducing emission from deforestation and forest degradation (REDD) and address own actions leading to deforestation;
(iv) linking adaptation to Hyogo Framework for Action – a global treaty on disaster risk reduction;
(v) funding research on understanding vulnerability, impacts, development of plans and creating institutional responses.[11]

The critics of Cancun LCA maintain that this proposed cooperation has virtually negated Kyoto Protocol since second commitment period under the Protocol has not been decided and deferred till next Durban Summit, the base reference period for emission reduction is not indicated (whether it should be 1990, 2000 or 2025) and emissions reduction targets have not been set for countries individually or as a whole. All countries participating in Cancun summit accepted US position with the sole exception of Bolivia.

While the international community was getting ready for next round of climate negotiations at Durban, South Africa in 2011, there was consensus among experts that challenges the current perspectives on future emissions and nature of international cooperation. The International Council for Science and the International Social Science Council reached a consensus that the social and bio-physical sub-systems are intertwined in a manner that the conditions and responses of the system to external forcing are based on the synergy of the two sub-systems. Hence, the problem of climate change can be addressed by studying the full global system rather than its components.[12]

COP-17 at Durban reached an agreement to negotiate a new and more inclusive treaty and establishment of a Green Climate Fund. The EU and several countries agreed to continue Kyoto Protocol beyond 2012 if other governments, including major emitters from developed and developing countries, agreed to negotiate a new legally binding treaty with deeper emission reduction by 2015 to come into force afterwards. While the UN Under Secretary & UNEP Executive Director welcomed Durban proceedings as a boost for global climate action, the critics termed it as succumbing to Climate Apartheid, a crime against humanity by delaying real action till 2020 and permitting an increase in global temperature of 4 degree Celsius as a death sentence for Africa, Small Island States and the poor and vulnerable worldwide. Further, that postponement of decision on Second Commitment Period of Kyoto Protocol till next COP with no commitments for emission reduction by rich countries, implied that Kyoto Protocol is on life support until replaced by a new agreement which would be weaker. The critics also maintained that the Green Climate Fund should be managed by participatory governance and not by World Bank which they consider a villain of the failed neo-liberal economy.

Rio+20 Conference held in June 2012 marked revival of the spirit of The United Nations Conference on Environment and Development of 1992. Rio+20 reaffirmed commitment to UN MDG7 on Environment Sustainability. The Outcome Document of Rio+20 laid down the vision of a Green Economy in the context of sustainable development and poverty eradication. It reaffirmed that Climate Change is one of the greatest challenges of our time and expressed profound alarm that emissions of greenhouse gases continue to rise globally.

COP-18 at Doha in 2012 was termed a mere intermediate COP which enabled start of a new negotiating process aimed at delivering a new global climate agreement. The rich and powerful had their way which actually commenced at COP-2005 at Montreal and formalised at Bali COP 2007 which had set the basis for developing countries to also get involved in mitigation action. Now we have a state of confusion and uncertainty with Second Commitment Period of the Kyoto Protocol (2013-20) with legal binding targets for a smaller number of countries than the First Commitment Period (2008-12), voluntary commitments reached in 2010 under the Cancun Agreements by countries like the US and China and which run to 2020 and the negotiation of a new climate change agreement that will be completed by 2015 and will enter into force in 2020. The uncertainty and ad-hocism is now symbolised by an Ad-Hoc Working Group under the Durban Platform (ADP). The moderate voices maintained that no breakthroughs were expected or achieved but the UNFCCC process was kept on track.

COP-19 at Warsaw in November 2013 continued the insipid, prolonged game-plan of the rich and the mighty who were historically the worst polluters and never wanted legally binding commitments entailed in Kyoto Protocol. COP-19 considered only an interim show on way to 2015 climate agreement had two-fold objective:

i) to bind nations together into effective global effort to reduce emissions rapidly enough to chart humanity's longer-term path out of the danger zone of climate change, while building adaptation capacity; and
ii) to stimulate faster and broader action.

The governments of participant countries agreed to communicate their respective contributions towards the universal agreement well in advance of the meeting in Paris in 2015. The usual noises were made on helping the poorest countries adapt to the impacts of climate change and build their own sustainable, clean energy futures. It was further agreed for the rule book for reducing emissions from deforestation and forest degradation together with measures to bolster forest preservation and aresults based payment system to promote forest protection. There was agreement on a mechanism to address loss and damage caused by long-term climate change impacts. The Green Climate Fund was to be ready for capitalisation in the second half of 2014.

The fifth IPCC assessment report adopted in November 2014 reiterated observed changes due to human influence on the climate system and underlined thatrecent anthropogenic emissions of greenhouse gases were the highest in history. The report observed:

> Warming of the climate system is unequivocal, and since 1950, many of the observed changes are unprecedented over decades to millennia. The atmosphere and oceans have warmed, the amount of snow and ice have diminished and sea level has risen….
>
> Anthropogenic greenhouse gas emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever. This has led to atmospheric concentration of carbon-dioxide, methane and nitrous oxide that are unprecedented in at least the last 800,000 years. Their effects, together with those of other anthropogenic drivers, have been detected throughout the climate system and are extremely likely to have been the dominant cause of the observed warming since mid-20th century….

> Continued emission of greenhouse gases will cause further warming and long lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems. Limiting climate change would require substantial and sustained reduction in greenhouse gas emissions which together with adaptation, can limit climate change risks….
>
> Many aspects of climate change and associated impacts will continue for centuries, even if anthropogenic emissions of green house gases are stopped. The risks of abrupt and irreversible changes increase as the magnitude of the warming increases.[13]

The IPCC's concluding observation above on climate changes, risks and impacts continuing for centuries even if anthropogenic emissions of GHGs stop, underscores the gloomy picture of the damage already done and the historic culpability of the industrialised nations to proportionately share the burden of 'Climate Action'.

COP 20 at Lima in December 2014 was again a preparatory for the 2015 show but glamorously named a milestone on the road to Paris. There was a call for Climate Action striking a balance in what regards accelerating climate action and achieving the common objective of not exceeding 2 degrees of temperature above pre-industrial levels. The warring country parties fought a pitched battle over two weeks, the rich nations conceded the principle of ''differentiation'', i.e. how to divide the responsibility for carbon cuts between rich and poor nations but the different interpretations and implications of the principle caused discrepancies between developed and developing countries, particularly so called 'emerging economies'. While the principle of common but differentiated responsibilities (CDR) was acknowledged (even though this was hard earned earlier at Kyoto in 1997) but it added a flexible element since it was qualified as CDR and respective capabilities to be considered under the light of different national circumstances. The rich countries further evolved an ingenious stratagem to dilute their historical culpability of GHG emissions by imposing a condition of each country submitting Intended Nationally Determined Contributions (iNDCs), i.e. plans concerning mitigation and adaptation by October 1, 2015 before Paris COP.

Lima decisions produced a negotiation draft that incorporated and acknowledged progress made to date and included elements that will be the base of the new agreement to be adopted at COP21. COP 20 also established mechanisms to increase the ambition and reduce greenhouse gas emissions before 2020, which was intended to be the year of start of effectiveness of the agreement to be signed at Paris in 2015.

The Green fund exceeded the initial target of US$10 billion to reach US$10.2 billion at COP 20.

The initial work plan for two years on the mechanism of "Losses and Damages" created in 2013 for situations in which climate change impacts are so large that they exceed the capacity of populations to face them, was approved.

The experts termed the Lima outcome as a half-baked plan belying hopes of an agreement that would compel rich countries to include information in their pledges on climate adaptation and financial help. There was no imposition of requirement but mere urging parties to consider including an adaptation component in their pledges and on finance similarly the COP ''urged'' developed countries to provide support.

The Millennium Declaration by the international community under the aegis of the United Nations in the year 2000 set for itself Millennium Development Goals (MDGs) to be achieved by 2015. The UN Sustainable Development Summit in September 2015 rededicated the human community to achievement of MDGs and build on the performance of 15 years to declare the agenda for next 15 years christened. The 2030 Agenda For Sustainable Development. Thus 17 Sustainable Development Goals and 169 targets were announced in an ambitious universal agenda. This agenda declared, inter-alia, its determination to end poverty and hunger in all forms and dimensions to ensure that all human beings can fulfil their potential in dignity and equality and in a healthy environment, to protect the planet from degradation including through sustainable consumption and production, sustainably managing its natural resources and taking urgent action on climate change so that it can support the needs of the present and future generations.[14] Goal 13 of this Agenda acknowledging that UNFCCC is the primary international, intergovernmental forum for negotiating the global response to climate change, expressed its solemn and pious hope bereft of partisan agenda of the rich and the poor to take urgent action to combat climate change and its impacts by following:

> 13.1. Strengthen resilience and adaptive capacity to climate related hazards and natural Disasters in all countries.
>
> 13.2 Integrate climate change measures into national policies, strategies and planning.

13.3 Improve education, awareness raising and human and institutional capacity on climate Change mitigation, adaptation, impact reduction and early warning.

13.a Implement the commitment undertaken by developed country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible

13.b Promote mechanisms for raising capacity for effective climate change related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities.[15]

COP-21 Paris November 30-December 13, 2015

The all important Conference of Parties to UNFCCC, post Kyoto Protocol in 1997, was held amidst hectic international political parleys, high expectations, declarations of INDCs by different countries and a pious and innocent declaration of Goal 13 of the UN's 2030 Agenda For Sustainable Development in Paris, France.

The Agreement reached at Paris aimed to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by:

(a) Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognising that this would significantly reduce the risks and impacts of climate change;

(b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production; and

(c) Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.

This Agreement will be implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances. (Art. 2)[16]

The agreement enjoins that the Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognising that peaking will take longer for developing country parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty.

- Each Party shall prepare, communicate and maintain successive nationally determined contributions that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions.
- Each Party's successive nationally determined contribution will represent a progression beyond the Party's then current nationally determined contribution and reflect its highest possible ambition, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.
- Developed country Parties should continue taking the lead by undertaking economy-wide absolute emission reduction targets. Developing country Parties should continue enhancing their mitigation efforts, and are encouraged to move over time towards economy-wide emission reduction or limitation targets in the light of different national circumstances.
- Support shall be provided to developing country recognising that enhanced support for developing country Parties will allow for higher ambition in their actions.
- Nationally determined contributions communicated by Parties shall be recorded in a public registry maintained by the secretariat.
- All Parties should strive to formulate and communicate long-term low greenhouse gas emission development strategies, mindful of Article 2 taking into account their common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.

- Parties recognise the importance of averting, minimising and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow onset events, and the role of sustainable development in reducing the risk of loss and damage.
- The Warsaw International Mechanism for Loss and Damage associated with climate change impacts shall be subject to the authority and guidance of the Conference of the Parties.
- Developed country Parties shall provide financial resources to assist developing country Parties with respect to both mitigation and adaptation in continuation of their existing obligations under the Convention.
- The Conference of the Parties shall periodically take stock of the implementation of this Agreement to assess the collective progress towards achieving the purpose of this Agreement and its long-term goals (referred to as the "global stocktake"). It shall do so in a comprehensive and facilitative manner, considering mitigation, adaptation and the means of implementation and support, and in the light of equity and the best available science.
- The Conference of the Parties shall undertake its first global stocktake in 2023 and every five years thereafter unless otherwise decided by the Conference of the Parties.
- This Agreement shall enter into force on the thirtieth day after the date on which at least 55 Parties to the Convention accounting in total for at least an estimated 55 per cent of the total global greenhouse gas emissions have deposited their instruments of ratification, acceptance, approval or accession.[17]

The run up to the twentieth Conference of Parties in Lima and twenty-first at Paris was marked by high expectations on the one hand and outright cynicism on the other. There was cynicism due to virtual demise of Kyoto Protocol due to non-ratification by the US and high expectations since the world community was already late and there was no choice but to confront the challenge of climate change head on. While the EU announced deep cuts (40% on 1990 levels) by 2030, the US committed 26-28% cut in emissions on 2005 levels and China committed to peak emissions around 2030 and cut carbon intensity(emissions per unit of GDP) by 60-65% from 2005 levels by 2030. India, on its part acknowledging that its development needs could not be ignored did not commit any year for peak emissions but announced a very ambitious climate action plan which envisaged 33-35% reduction in emission intensity of its GDP by 2030 from 2005 levels, sought to achieve this target by generating 40% of electricity through non-fossil fuel sources such as solar, wind, hydro, bio-mass and nuclear and by creating additional carbon sink of 2.5 to 3 billion tonnes of $CO2$ by increasing forest and tree cover. India is the third largest polluter after China and US in absolute emissions but 1/8th of US and 1/3rd of China in terms of per capita emissions. In all 186 countries submitted their Intended Nationally Determined Contributions (INDCs) which post-Paris will be called Nationally Determined Contributions(NDCs). The Agreement calls upon all countries to submit an NDC every five years and each successive NDC to be more ambitious than the previous one. Further, these will be recorded in a public registry. The ensuing COP at Morocco will consider whether all countries should submit their plans for the same time frame, i.e., NDCs by 2020. Other salient outcomes on important issues in Paris can be summarised as mentioned below:

- The all important issue of the principle of 'Common but Differentiated Responsibilities'(CBDR) referred as "Differentiation" as well, enshrined in UNFCCC of 1992 and bitterly fought for by developing countries has not been given up although qualified in Lima(COP-20) to make it flexible as CDR and respective capabilities to be considered under the light of different national circumstances. The Agreement mentions different kinds of commitments for developed and developing countries – on mitigation: developed countries asked to take 'economy-wide absolute emission reduction targets' while developing countries only 'encouraged' to do so; on finance: developed countries to indicate every two years amount of money that they would be able to raise over the next two years while developing countries 'encouraged' to do so on voluntary basis; on capacity building: developed countries asked to provide support to developing countries.
- The UNFCCC mandates that the developed countries, being responsible for historical emissions from 1850 to 1980s, to provide finance to developing countries to help them fight impacts of climate change. It was their commitment articulated by the then US Secretary of States Hillary Clinton, that developed countries would mobilise $100 billion every year from 2020 as climate finance. Paris COP deliberations seek developed nations to provide this finance although this has been shifted from draft agreement to the "decision next" at the insistence of developed countries – while the Paris Agreement is a permanent document, decisions recorded

in "decision next" can be modified. Further, the developed countries will not scale up annual amount of $100 billion in subsequent years as demanded by developing countries but may consider so after 2025. While no specific commitment of timeframe within which this finance is to be raised is mandated but developed countries have been successful in providing for developing countries also to raise financial resources as a voluntary effort.

- The Least Developing Countries(LDCs) and Small Island Developing States(SIDS) have been expressing apprehensions that in view of rising sea levels and possible high cost of adaptation, the target of restricting temperature above pre-industrial levels should be well below 2 degrees. The Agreement thus mentions objective to keep global average temperatures to "well below" 2 degrees while "pursuing efforts" to keep it below 1.5 degrees.

India and South Asian Cooperation

South Asia with its ancient lineage of environmentalism and current dismal state of environment outlook entered the phase of regional cooperation rather late as compared to other regional groupings in the world.

SAARC Study on Environment Preservation and Natural Disasters

The Third SAARC Summit which was convened in Kathmandu, Nepal on 2-4 November, 1987 decided, inter-alia, to commission a study on the 'Protection and Preservation of the Environment and the Causes and Consequences of Natural Disasters' in a well-planned comprehensive framework. In fact, while deciding to commission this study, the Summit leaders expressed their deep concern at the fast and continuing degradation of the environment including extensive destruction of forest, in the South Asian region. They also noted that South Asia was afflicted with such natural disasters as floods, droughts, landslides, cyclones, tidal waves which have had a particularly severe impact causing immense human suffering.[18]

This study which was finalised in December 1991 was formulated after a very comprehensive national studies by individual Member States to bring out the conditions prevalent in the countries of the region on environment and natural disasters. The individual country reports also mentioned the preventive and remedial measures taken with regard to adverse climate conditions and natural disasters. The individual country studies were amalgamated with the help of consultant experts. The study report noted that:

> The region is one of the poorest in the world and has a high rate of population growth and population density – the SAARC Member states comprise 20 per cent of the world's population living on 3.5 per cent of the total land area and generate only 2 per cent of the world's GNP. The pressures that these socio-economic conditions create on the natural environment are enormous. In addition, development programmes in the area of industry, agriculture and energy, which are necessary to improve the standards of living of the people, create environmental problems through the generation of wastes and heavy demands they put on natural resource base. SAARC region because of its high level of poverty…. Degradation of the environment has a particularly adverse effect on the poor, and results in increased natural disasters, especially in the high slopes of the mountain regions, dry and desertified areas, and in the flood plains. The natural resource base of South Asia Has to be managed extremely carefully and with great ingenuity to ensure increased productivity on a sustainable basis so that present and future generations can meet their needs and aspirations and live in harmony with their environment.19

The Report made recommendations on measures to protect and manage environment and suggested measures and programmes for strengthening disaster management capabilities. Specific issues covered by recommendations on protecting and managing environment included strengthening the environment management infrastructure, environmentally sound land and water planning, research and action programme on mountain development in the Himalayan Region, coastal zone management programme, integrated development of river basins, SAARC forestry and watershed programme, programme on energy and environment, pollution control and hazardous wastes programme, network on traditional water harvesting techniques, SAARC cooperative programme for biodiversity management, people's participation in resource management, information exchange on low-cost and environmentally sound habitat related technologies, SAARC network of environmental NGOs, participation of women in environment, SAARC Fund for environment, SAARC report on the state of environment and cooperation among SAARC Members on environmental issues in international forums.

Further, the Report incorporated measures and programmes for strengthening disaster management capabilities and covered topics on networking of institutions on natural disaster planning and management, establishment of a SAARC relief and assistance mechanism for disasters, cooperation on the development of modern disaster warning systems, programme for research related to drought prone areas and information exchange system on management of human activities in disaster prone areas.

Finally, the Report suggested an appropriate institutional mechanism for coordinating and monitoring implementation of its recommendations in the form of a SAARC Committee on Environment.[20]

SAARC Study on Greenhouse Effect

Coinciding with Public Scientific Conference held in Toronto SAARC heads of States and Governments in their Fourth Summit held in December 1988 decided to undertake a study on the Greenhouse effect and its impact on the region. The unprecedented floods, cyclones and earthquakes during the year attracted their attention and they observed as under:

> The Heads of State or Government expressed their deep sense of sorrow and profound sympathy at the loss of valuable lives and extensive damage to property suffered during the year by Bangladesh, India, Nepal and Pakistan as a result of unprecedented floods, cyclones and earthquakes. In this connection, they recalled their earlier decision at Kathmandu in November, 1987 to intensify regional cooperation with a view to strengthening their disaster management capabilities and took note of the recommendations of the meeting of the SAARC Group of Experts on the Study on the Causes and Consequences of Natural Disasters and the Protection and Preservation of the Environment, that met in Kathmandu in July 1988. They expressed the conviction that identification of measures and programmes as envisaged by the Group of Experts would supplement national, bilateral, regional and global efforts to deal with the increasingly serious problems being faced by the region as a result of the recurrence of natural disasters and the continuing degradation of the environment. They urged that the study should be completed in the shortest period of time so that it could provide a basis for the member countries to draw up an action plan for meaningful cooperation amongst the Member States. They decided that a joint study be undertaken on the "Greenhouse Effect" and its impact on the region.[21]

This study recommended regional measures in sharing experiences, scientific capabilities and information on climate change, sea level rise and technology transfer. The regional discourse among SAARC countries was keeping pace with the global debate and proceedings in different forums.

The studies on natural disasters/environment and Greenhouse Effect culminated in adoption of SAARC Plan of Action on Environment in 1997. Subsequently, there was a series of meetings of SAARC Environment Ministers and flurry of regional activity in the wake of this discourse acquiring critical global dimension.

SAARC Common Position in UN Conference of Parties (COP4)

SAARC Member states also evolved a common position on climate change. On the eve of the Fourth Session of the Conference of the Parties to the UN Framework Convention on Climate Change (COP-4) which was held in Buenos Aires, SAARC Environment Ministers met in Colombo on October 30-November 1, 1998 and agreed to urge Annex-1 countries to expedite signing of Kyoto protocol for its ratification and coming into force and further to take urgent and effective steps domestically to implement commitments undertaken by them to reduce their emission of greenhouse gases. Significantly, they also emphasised fundamental prerequisite for designing emission trading, as provided in the Kyoto Protocol, is the determination of equitable emission entitlement of the Parties. It was maintained that the entitlements cannot be derived from the past emissions which were inequitable.[22] Earlier, in tenth SAARC Summit held in July 1998, the leaders expressed their satisfaction on adoption of a common position prior to adoption of Kyoto protocol in following words:

> The Heads of State or Government expressed their satisfaction over the adoption of a common position by Member States prior to the Third Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, held in Kyoto, Japan and welcomed the adoption of the Kyoto Protocol to the United Nations Framework Convention on Climate Change in December 1997, and underscored the importance of the Protocol for the protection of the climate system. They urged all industrial countries to ratify the Protocol and to undertake urgent and effective steps to implement the commitments undertaken by them to reduce their emissions of green-house gases.[23]

SAARC Year of Green South Asia: 2007

SAARC declared year 2007 as the Year of Green South Asia. SAARC leaders meeting for Fourteenth Summit in April this year reiterated that collaboration in addressing the problem of arsenic contamination of groundwater, desertification and melting of glaciers and assistance to affected peoples should be deepened. They expressed deep concern over global climate change and the consequent rise in sea level and its impact on the lives and livelihoods in the region. They emphasised the need for assessing and managing its risks and impacts. They called for adaptation of initiatives and programmes; cooperation in early forecasting, warning and monitoring; and sharing of knowledge on consequences of climate change for pursuing a climate resilient development in South Asia. They agreed to commission a team of regional experts to identify collective actions in this regard.[24]

In December 2007, SAARC Council of Ministers discussed the issue of climate change in the context of increasing vulnerability of the region due to environmental degradation. The Ministers felt that given the vulnerabilities, inadequate means and limited capacities, there was need for rapid social and economic development in the region to make SAARC climate change resilient.

SAARC Environment Ministers Meeting 2008

Action Plan on Climate Change

SAARC Environment Ministers meeting in Dhaka in 2008 adopted SAARC Action Plan on Climate Change. The objectives of the Action Plan were to identify and create opportunities for activities achievable through regional cooperation and south-south support in terms of technology and knowledge transfer, to provide impetus for regional level action plan on climate change through national level activities and to support the global negotiation process of UNFCCC, such as Bali Action Plan, through a common understanding or elaboration of the various negotiating issues to effectively reflect the concerns of SAARC Member States.[25] The thematic areas of the Action plan included adaptation to climate change, actions for climate change mitigation, technology transfer, finance and investment, education and awareness programme, management of impacts and risks associated with climate change and capacity building for international negotiations. The Action plan epitomised the predicament and frustration of the developing countries on the slow progress and virtual negation of the concerns of Non-Annex-1 countries defined in Kyoto Protocol. The efforts at collective self-reliance as indicated in the objectives of the Action Plan was reminiscent of older era when North-South stalemate debate was at its peak.

Sixteenth SAARC Summit: Green and Happy South Asia

Sixteenth SAARC Summit held at Thimpu, Bhutan in April 2010 was dedicated to the theme of Climate Change. The Summit declaration which was silver jubilee of the beginning of SAARC was termed 'Towards a Green and Happy South Asia'. The Thimpu Statement on Climate Change adopted at the Summit meeting called for a review of the implementation of the Dhaka Declaration and SAARC Action Plan on Climate Change and ensure its timely implementation. There was an agreement to establish an Inter-governmental Expert Group on Climate Change to develop clear policy direction and guidance for regional cooperation as envisaged in the SAARC Plan of Action on Climate Change. It was resolved that the Inter-governmental Expert Group on Climate Change shall meet at least twice a year to periodically monitor and review the implementation of this Statement and make recommendations to facilitate its implementation and submit its report through the Senior Officials of SAARC to the SAARC Environment Ministers.

Seventeenth Saarc Summit 2011: Agreement on Rapid Response to Natural Disasters

An inter-governmental meeting on draft SAARC Agreement on Rapid Response to Natural Disasters held in Colombo, Sri Lanka in May 2011 reached a broad consensus on the Agreement. This agreement has now been adopted in the Seventeenth SAARC Summit held in Maldives in November 2011. The agreement based on the principle of respect for the sovereignty, territorial integrity and national unity of all member states aims to put in place an effective mechanism for rapid response to disasters to achieve substantial reduction in loss of lives and loss of social, economic and environmental assets in times of a disaster. The Summit also resolved to ensure timely implementation of Thimpu Statement on Climate Change.

Eighteenth SAARC Summit, Kathmandu, November 2014: Reiteration of the Basic Tenets of UNFCCC

The Leaders SAARC in their summit in November 2014 recognised that the Post-2015 Development Agenda, following its adoption at the UN, would present opportunities to compliment national and regional efforts on sustainable development and hence directed to initiate an Inter-Governmental process to appropriately contextualise the Sustainable Development Goals (SDGs) at the regional level.

Further, on the eve of COP 20 to be held in Lima in December 2014, SAARC leaders underlined the urgency for the global community to arrive at a Protocol, another legal instrument, or an agreed outcome with legal force applicable to all by the end of 2015, based on the principles of Common but Differentiated Responsibility (CBDR), Respective Capabilities and Equity under the UNFCCC.

Recapitulating past SAARC decisions, they also directed the relevant bodies/mechanisms for effective implementation of SAARC Agreement on Rapid Response to Natural Disasters, SAARC Convention on Cooperation on Environment and Thimphu Statement on Climate Change, including taking into account the existential threats posed by climate change to some SAARC Member States and welcomed the decision to establish the SAARC Environment and Disaster Management Centre.

At Lima COP 20. Nepal on behalf of all SAARC countries brought out their common position which strictly adhered to the basic tenets of the UNFCCC and its Kyoto Protocol. Accordingly, the rich nations were asked to fulfil their promises on emission cuts during pre-2020 period as this alone would convince the rest of the world about their intention and commitment to post-2020 period based on ensuing global climate deal in 2015. This position was put forth in pursuance of decision of Eighteenth SAARC summit in Kathmandu.

India and the First 'BIMSTEC Disaster Management Exercise 2017

In addition to SAARC, India has led a number of initiatives in BIMSTEC also the First 'BIMSTEC Disaster Management Exercise-2017' (BIMSTEC DMEx-2017) will be conducted by the National Disaster Response Force (NDRF) as the lead agency from October 10-13, 2017 in Delhi.

Delegates from all seven nationals of the 'Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation' (BIMSTEC) grouping – namely Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka and Thailand, representatives from Embassies/High Commissions of BIMSTEC nationals in Delhi, National Disaster Management Authority (NDMA), and Senior Officers from the Nodal Ministries are participating in the event.

The main focus of the BIMSTEC DMEx-2017 will be on testing the region's preparedness and resilience towards effective activation of inter-Governmental interaction/dialogue/agreements for immediate deployment of regional resources for disaster response. It will help create synergy and synchronise efforts to institutionalise regional cooperation among the member countries. The exercise will help strengthen the effective utilisation of the Search & Rescue Teams for Disaster Relief & Emergency Response, including Emergency Rapid Assessment Teams and Management of mass casualties especially in situations involving breakdown of infrastructure and communication[26].

Conclusion

South Asia is home to world's one fifth of the population and is vulnerable to several climate change issues. Between 1990 and 2008, more than 750 million people-50 per cent of South Asia's population- were affected by natural disasters. It resulted in almost 230,000 deaths and about $45 billion in damages. Beside floods, which have accounted for over 50 per cent of more than 900 disasters reported in the region in the last 4 decades, disasters frequenting the region include landslides, windstorms, sea surges, and cyclones. Although compromising only 2 per cent of the total number of events, droughts hit the most number of people- more than 50 per cent of the total disaster-affected population.

South Asia needs a consolidated effort at the national and regional level to effectively deal with these challenges. It is where one can clearly make a case for how countries that have contributed relatively so little to the causes driving climate change stand to lose so much from its adverse effects. Considering the regions' extensive poverty, tackling its problems requires sustained, coordinated and substantial efforts to rapidly spur development in critical sectors in a direction that is both low carbon and climate change resilient. If this is not done, the most vulnerable areas may soon reach their tipping points. More and more, reducing poverty and sustaining development cannot be separated from addressing and disaster preparedness.

Our foreign Minister Sushma Swaraj aptly remarked at the United Nation General Assembly in September, 2017, "When we talk of world peace, we mean peace not only among human beings but also peace with nature. We understand that human nature is sometimes inimical to nature, but we would like to amend human nature when it tends in the wrong directions…when we inflict our greed upon nature, nature sometimes explodes. We must learn to live with the imperatives, cycles and creative urges of nature; in that lies, our own salvation"[27].

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BUILDING RESILIENCE TO DISASTERS

Resilience and Mitigation; Inevitable at the Forefront

Krishna Kumar Tamang[a]

Abstract

There are several factors for consideration in responding disasters by individual nations and they are interlinked to propensity for disaster, local and regional economic resources, organisation of government, and availability of technological, academic and human resources. In the face of large-scale disasters and urgency of time in rescue, the response ability of individual nations could get insufficient but outside assistance must be called upon. Despite the constraints of mastering over the nature and natural phenomenon the worldwide national and international endeavours towards mitigation of implications the subjectivities of natural disasters go unabated. The truth of disaster causation cannot be ruled out either, for the human negligence in terms of infrastructure and construction works.

Keywords: large scale disasters, human negligence, mitigation, disaster preparedness, awareness, resilience

Introduction

There are several factors to be considered while responding to disasters by individual nations and they are interlinked to propensity for disaster, local and regional economic resources, organisation of government, and availability of technological, academic and human resources. In the face of large-scale disasters and urgency of time in rescue, the response ability of individual nations could get insufficient but outside assistance must be called upon.

Despite the constraints of mastering over the nature and natural phenomenon, the worldwide national and international endeavours towards mitigation of implications, the subjectivities of natural disasters go unabated. The truth of disaster causation cannot be ruled out either, for the human negligence in terms of infrastructure and construction works.

Noted Issues of Disaster in South Asia

Analysis of disasters in recent years shows the reasons for floods, such as

Deforestation

Due to deforestation the soil erosion leads to earth slides in the hills. On the other hand, lacking sufficient time for water absorption into the soil the underneath water table goes to decrease. Bushes, shrubs and plants in the jungle serve as deterrent to torrent water flow to lowland and so do the roots, forage and logs in the forest slowing the current of down flowing water.

Altered Modes of Land Use

There were days when farmers used their land properties for farming and cultivation. However, in recent days the modes for use of the land has changed. Owing to modernity for fast money cultivators opt for something else that would fetch them money in as short period as possible. As a result brain drain has been a main reason. Apart from that all, situations and environment for farming does not seem profitable good enough to earn livelihood for poor farmers but to migrate abroad. This leads to dependency of countries on foreign imports whilst the existent canals and water sheds dry out.

Effects of Climate Change

According to the reports of the Inter Governmental Panel on Climate Change since 1880, it has risen to 0.85 degrees Celsius (1.5 degrees Fahrenheit).

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The temperature increase melts ice at the earth's poles, creating a change in sea level and climate as well. Yearly increasing environmental temperature contributes to unnatural happenings like excess rain or no rain. Nepal is no exception to it either for no rainfall and sometimes early torrential rains.

Climate change includes freak weather, increased flooding, hotter heat waves, stronger hurricanes and more droughts. Droughts can create dry conditions to fuel massive wildfires. From another point of view, climate change affects earth's biodiversity, which is needed for healthy ecosystems.

Effects of Water Blockades and Dams

In context of Nepal border populace face yearly hapless calamity due to dams, barrages and embankments raised at Nepal-India border. These structures certainly have positive aspects as well. However, in rainy season, they create havoc and ironically recalled while local people suffer flood catastrophe.

Measures for Controlling Flood Chaos

There are short- and long-term measures for adoption in the initiation. For long lasting affects the following steps could be instrumental:

- Policy for utilisation of land must be given importance against plotting of cultivable land for housing. Illegal occupation of land by deforesting people needs immediate expulsion and forest restoration.
- Training the river flows for irrigation and hydropower should be planned for flood control. For control over flooding construction of high dams on the rivers are contributing to results.

The United Nations Development Projects (UNDP) conducts investigations into private investment in developing countries, to explore the natural resources of those countries, and to train the local population in development activities, such as mining and manufacturing.

The Latest Earthquake of Nepal

Nepal is the most vulnerably ranked 11th in the earthquake-prone countries of the world. It lies between the Indian and Tibetan plates assumed subducting the latter about 2 cm per year whilst the former at the rate of 3 cm per year.

The last devastating earthquake of Nepal on April 25 and May 12, 2015 killed 8,773 people including 94 foreigners from 16 various countries. Additionally 2,638 government buildings, 505,577 private houses, 392 public health facilities and 32,145 classrooms got completely damaged.

Means for Pre-empt to Adopt

Disaster Preparedness and Awareness

Disaster awareness approach involves, planning coordinated activities like disaster awareness day or week, publications, putting on air the radio, television plays, performing disaster drills in community schools and public places.

The damage caused to life and property can be wisely mitigated to a great extent by proper disaster management, which includes pre-disaster planning, preparedness and providing suitable rescue and relief materials to affected people. In addition to the government agencies, voluntary national as well as international organisations and educated and well-trained communities can play important roles in disaster management.

More effectiveness bringing points in rescue and relief could be the following as:

- The more the security forces are equipped the more capable they get for efficient performance.
- General public ought to be oriented towards resilience against disasters and awareness.
- Warehouses arrangements of food stuff, life-saving drugs and relief materials meet the emergency crisis.
- Close coordination and co-work of stakeholders yield good results.

International Involvement in Mitigation

Japan though the most hazardous country in terms of earthquakes, has the fatalities and causalities level far less compared to the global scenario. Japan has lately observed Disaster Management Volunteer Week on January 15- 21, 2017.

Nepal observes January 15 as the Earthquake Safety Day, as for awareness and in commemoration of the worst ever earthquake of January 15, 1934.

Across the globe there exist various international agencies to address the aforesaid kind of disasters. SAARC the South Asian Regional Cooperation Committee has New Delhi; India based SDMC (SAARC Disaster Management Centre) in the premises of National Agency of Disaster Management since October 2006. It has policies and programs for launching awareness campaigns against disasters and educative vocational training.

United Nations Organisation annually celebrates the International Day of Natural Disaster Mitigation on the second Wednesday of every October to mark the significance of disaster mitigation. This motivates worldwide people and governments towards building risk-resistant communities and nations.

The United Nations under their regular development projects serves to promote prevention and mitigation activities. They work for increasing local capacity to adequately boost local and regional preparedness by encouraging the building of early warning systems and the conducting of monitoring and forecasting routines.

The United Nations International Strategy for Disaster Reduction (UNISDR) established in 1999 from its headquarters in Geneva, Switzerland accomplishes operations in Bangkok, Nairobi, Brussels, Cairo and Latin America.

The International Federation of Red Cross (IFRC) engages in disaster preparedness and has identified several strategies towards mitigation. The activities related to reducing the impact of disasters to working towards better prediction and prevention methods are a fundamental component of the local Red Cross / Red Crescent Society.

United States Agency for International Development (USAID)'s sub-unit Prevention, Mitigation, Preparedness and Planning (PMPP) assists foreign nations with assistance to develop their ability to mitigate and prepare for disasters.

Office of Foreign Disaster Assistance (OFDA)'s Technical Assistance Group (TAG) comprising scientists, and specialists in various disciplines like agriculture, food security, emergency, public health, etc., work in preparation and mitigation for future disasters to increase its capabilities in planning and programming. However, many of these natural hazard risks can be reduced or eliminated by proper planning, environment management, and mitigation.

Lessons Learnt

The 2008 Sichuan Wenchuan Earthquake and the 2013 Sichuan Lushan Earthquake

Recommendations for focus on seven factors to reduce future losses as:

- Basic information
- Preparedness
- Government response
- Local residents' responses
- Medical rescue teams' work
- Earthquake-induced secondary effects
- Injurious character

It recommends three major actions for emphasis to facilitate the most effective course of disaster planning and actions. First, sufficient preparedness and strict preventive measures form the foundation to minimise damage and reduce casualties. Second, once the disaster had occurred, a single well-run headquarters increases efficiency in rescue efforts. Thirdly, the local rescue strength of both professional staff and citizens is the most critical factor to lower disaster casualties.

The disasters in the past show the importance of pre-disaster mitigation and no preparedness proved sufficient. People do not get killed by the earthquake but by building structures.

The Indian Institute of Technology's Department of Civil Engineering, the National Research Institute for Earth Science and Disaster Prevention of the Earthquake Disaster Mitigation Research Center recommend as:

India, Bhuj Earthquake 2012 Recommendations

- A support system must be developed to assist in government actions and long-term mitigation.

- People need to have confidence in earthquake-resistant technology; they need to participate in the recovery and rehabilitation process and be aware of risks and need to be trained in disaster planning.
- Academics and Professionals should transfer existing knowledge in mitigation, they need to create training modules and guidelines (Sinha and Shaw, 2001)

Nepal Earthquake 2015, Landmarks to Cope with Future Disasters

- Long service retiree veterans having expertise and experience in various trades and disciplines can contribute to the nation in distress. They would be inspiring to youths for volunteering.
- Political figures with leadership attributes need to come forward uniting all communities and political entities together for fighting against disaster in pre- and post-phases.
- Technical consultation and insurance policy are the inevitable prerequisites for construction works under consideration of preparedness and mitigation deserving priority than anything else. In the year 1863–67, Nepal suffered severe draught to which the then government had covered emergency insurance policy.
- Rescuers need patience and human sentiments to tackle the uneasy situations wherein the survivors rush in search of their kith and kin. Miko High School students of Kobe, Japan have been doing an incredible job of sharing their experience and knowledge of rescuing people in Nepal under the international program of UNCRD Hygo Office and NSET-Nepal.

The disasters in Nepal and of course, India better exemplify the importance of mitigation, preparedness and prevention measures. The actions taken were to ensure that future events be less destructive and to empower the national government to better to respond future events. The developing world suffers more because of their unpreparedness. When a disaster affects a country the ability to absorb such an impact is uncertain therefore mitigation and preparedness must be overseen in advance.

Nepal Earthquake 2015- Some Incidents could have been Averted

- Educating people in life saving techniques had somewhat drawbacks in Nepal. Specially, the kids in schools were taught to save head by getting cover and shelter in the event of earthquake which was realised later that they did not understand the real meaning. What happened was, the children playing outside while felt shaking the earth ran into houses to save their heads and on the contrary got killed under rubbles.
- Teachers and elders alike need proper orientation for common sense particularly in disaster concerns. It was Saturday a weekly holiday in Nepal while the trembler happened. Large number of people involved in prayer at churches could have survived it but upon insistence and assurance of Pasters, the headmen of prayer all the victims waited for miracle to happen by the grace of Lord and didn't rush out. Whoever tried were forcibly stopped to run away, next moment there was nothing but death and silence.

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Evaluation of Government Approaches in Disaster Risk Reduction

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Abstract

Disaster Risk Reduction (DRR) and Building Community Resilience is a global challenge. Helping poor rural people adapt to the impacts of disasters and enabling them to contribute to risk reduction is not a task that can be performed by Government alone; it requires cooperation and coordination from the community, local administration and the private sector. The best way to tackle the threat to poverty reduction and sustainable development is risk mitigation before a disaster. Undoubtedly, government investments in DRR are very low in developing countries. Financial constraints have often been quoted as the excuse for it. India is leading a global intervention on bringing down disaster losses which are pushing more than 26 million people into abject poverty every year hit by natural calamities.

Keywords: approaches, Disaster Risk Reduction (DRR), community resilience, sustainable development, cooperation, coordination

Introduction

Historically, dealing with disasters focused on emergency response, but towards the end of the twentieth century, it was increasingly recognised that disasters are not only natural and man-made affecting human beings; and, that it is only by reducing and managing conditions of hazard, exposure and vulnerability that we can prevent losses and alleviate the impacts of disasters. In the recent past, climate-related disasters are regularly taking place in Urban areas across the globe. In India, Hyderabad, Mumbai and Chennai cities are flooding regularly due to torrential rains. The flooding of Rajasthan and Ananthapur (infertile regions) is also observed flooding which is a new phenomenon. Even developed countries are unable to escape from natural calamities like hurricanes, cyclones, earthquakes, tsunamis and volcanoes and as human beings, we just remain silent sufferers. All these climate disasters are foreseen in advance by environment researchers and scientists and warned the governments. With the help of technological advancements, we regularly get updating information and warnings related to climate change and its disastrous effects. However, governance is not changing its traditional approaches towards DRR and not learning lessons from them.

DRR vs. DRM

Anticipating and reducing risk is called disaster risk reduction (DRR). Although often used interchangeably with DRR, disaster risk management (DRM) can be thought of as the implementation of DRR, since it describes the actions that aim to achieve the objective of reducing risk. Disaster risk is an indicator of poor development, so reducing disaster risk requires integrating DRR policy and DRM practice into sustainable development goals.

Governments Need to Manage Risks, Not Just Disasters

DRR is a part of sustainable development, so it must involve every part of society, government, non-governmental organisations, professionals and the private sector. It, therefore, requires a people-centered and multisector approach, building resilience to multiple, cascading and interacting hazards and creating a culture of prevention and resilience. Consequently, DRM includes strategies designed to

- avoid the construction of new risks
- address pre-existing risks
- share and spread risk to prevent disaster losses being absorbed by other development outcomes and creating additional poverty

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Although DRM includes disaster preparedness and response activities, it is about much more than managing disasters (UNISDR, 2015a).

Successful DRR results from the combination of top-down, institutional changes and strategies, with bottom-up, local and community-based approaches. DRM programmes should not be standalone but instead be integrated within development planning and practice, since disasters are an indicator of failed or skewed development, of unsustainable economic and social processes, and ill-adapted societies (UNISDR, 2009b, 2011, 2013 and 2015a). Approaches need to address the different layers of risk (from intensive to extensive risk), underlying risk drivers, as well as be tailored to local contexts. There is no 'one-size fits all' approach to DRM, but there exist several approaches and frameworks, which have been effectively implemented to reduce disaster risk. But, before being able to reduce risk, governments need to understand the hazards and the exposure and vulnerability of people and assets to those hazards.

How do Governments Reduce Risk?

Disaster risk management (UNISDR, 2017) involves activities related to:

Prevention

Activities and measures to avoid existing and new disaster risks (often less costly than disaster relief and response). For instance, relocating exposed people and assets away from a hazard area.

Mitigation

The lessening or limitation of the adverse impacts of hazards and related disasters. For instance, constructing flood defences, planting trees to stabilise slopes and implementing strict land use and building construction codes.

Transfer

The process of formally or informally shifting the financial consequences of particular risks from one party to another whereby a household, community, enterprise or state authority will obtain resources from the other party after a disaster occurs, in exchange for ongoing or compensatory social or financial benefits provided to that other party. For instance, insurance. Governments ought to give incentives liberally to attract Private sector investments in the DRR domain.

Preparedness

The knowledge and capacities of governments, professional response and recovery organisations, communities, NGOs and individuals to effectively anticipate, respond to and recover from the impacts of likely, imminent or current hazard events or conditions. For instance, installing early warning systems, identifying evacuation routes and preparing emergency supplies.

Implementation of these activities and measures is rarely done in isolation and includes several associated activities, including:

- Identification and measuring disaster risk
- Education and knowledge development
- Informing people about their risk (awareness raising)
- Incorporating DRM into national planning and investment
- Strengthening institutional and legislative arrangements
- Providing financial protection for people and businesses at risk (finance and contingency planning)
- Integrating DRR across multiple sectors, including health, environment, etc.

Identifying and understanding risk: the foundation of risk reduction

Awareness, identification, understanding and measurement of disaster risks are all fundamental underpinnings of disaster risk management (UNISDR, 2015b). Disaster risk reduction is about decisions and choices, including a lack of, so risk information has a role in five key areas of decision making:

Risk Identification

Because the damages and losses caused by historical disasters are often not widely known, and because the potential damages and losses that could arise from future disasters (including infrequent but high-impact events) may not be known at all, DRM is given a low priority by government. Appropriate communication of robust risk information at the right time can raise awareness and trigger action.

Risk Reduction

Hazard and risk information may be used to inform a broad range of activities to reduce risk, from improving building codes and designing risk reduction measures (such as flood and storm surge protection), to carrying out macro-level assessments of the risks to different types of buildings (for prioritising investment in reconstruction and retrofitting, for example).

Preparedness

An understanding of the geographic area affected, along with the intensity and frequency of different hazard events, is critical for planning evacuation routes, creating shelters, and running preparedness drills. Providing a measure of the impact of different hazard events—the potential number of damaged buildings, fatalities and injuries, secondary hazards—makes it possible to establish detailed and realistic plans for better response to disasters, which can ultimately reduce the severity of adverse natural events.

Governments need to invest in the collection, management and dissemination of risk information, including disaster loss and impact statistics, hazard models, exposure databases and vulnerability information. At the same time, they need to put standards and mechanisms in place to ensure openness and transparency so that users not only have access to the information they need but are aware of its underlying assumptions and limitations. The generation of understandable and actionable risk data ought to be particularly sensitive to extensive risk, which, because it is configured to a large extent by social, economic and environmental vulnerability, can be reduced effectively through risk management and sustainable development approaches.

Are Governments Reducing Disaster Risk?

While all countries across the globe have made some progress in reducing disaster mortality associated with intensive risks, increasing exposure of people and economic assets means that mortality and economic losses from extensive risk are trending up and absolute global economic losses from disasters are increasing, although not relative to GDP. Some low and middle-income countries may not have the financial resilience to accommodate the likely average annual losses from future disasters, which threaten the very economic existence of many small island developing states.

Governments have been Generating Risk Faster than Reducing It

More needs to be done to prevent new risks, which are already emerging owing to increasing urbanisation, the threat of climate change and other risk drivers. In an increasingly interconnected world, we are seeing that disasters can also result in synchronous failures. Development can be sustainable; it is just a question of whether we can change our approach in time to prevent disaster risk from reaching dangerous levels.

Governments have made More Progress in Managing Disasters than in Reducing Our Disaster Risk

Over the last 10 years, there has been significant progress in strengthening disaster preparedness, response and early warning capacities and in reducing specific risks, according to the HFA Monitor. However, progress has been limited in most countries when it comes to managing the underlying risks.

Although Governments Know How to Reduce Disaster Risk, There is Often a Lack of Incentive to Do So

Both individuals, governments and businesses tend to discount low-probability future losses and seem reluctant to invest in DRM. Despite the magnitude of disaster costs, reducing risks is often perceived as less of a priority than fiscal stability, unemployment or inflation (UNISDR, 2011). New evidence demonstrates, however, that the opportunity cost of disasters is high and that many low and middle-income countries, and small island developing states are financially unable to cope with the predicted future losses from disasters while also maintaining their capacity to develop (UNISDR, 2015a). In other words, they are not resilient.

The costs and benefits of disaster risk management need to become fully encoded into a public and private investment at all levels, into the financial system, and the design of risk-sharing and social protection mechanisms. Cost-benefit analyses can be expanded to highlight the trade-offs implicit in each decision, including the downstream benefits and avoided costs in terms of reduced poverty and inequality, environmental sustainability, economic development and social progress (UNISDR, 2015a). They can also help to identify who retains the risks, who bears the costs and who reaps the benefits. Such a broad approach to cost-benefit analysis can increase the visibility and attractiveness of investments in disaster risk reduction.

The good news is that Governments can achieve great things when investing in DRR. There are countless success stories of reducing disaster risk ranging from community-based participatory approaches to the global reduction in disaster mortality associated with intensive risks.

However, governments need to recognise that the impact of some DRM measures may not be immediate. It may take decades for the outcome of improved planning regulations and building standards to translate into reduced disaster losses, as a critical mass of a new, risk-sensitive building and urban development has to be achieved.

The future of DRR requires that governments assess the costs and benefits of DRM, reform risk governance, move from risk information to knowledge and strengthen transparency and accountability.

Global loss trends indicate that the rapid growth of economic assets in hazard-prone areas is increasing disaster risk.(Source: UNISDR (2015A; GAR, 15).

Challenges

First and foremost the major challenge to action on Disaster Risk Reduction is the willingness and political commitment of various agencies including the government and major donors, which is further exacerbated by the resources available for the same. There has to be a deep analysis of what budget the government has spent on DRR activities. Governments also need to look at how many donors are supporting DRR programmes and what % of their total budget goes for DRR interventions.

It has been observed that the poorest nations are most vulnerable to any kind of disaster. The ability of the affected region as a whole to bounce back is even further limited. Even if there is a commitment from the governments, there is no resource to fulfill the commitment. Hence, governments think out of the box and persuade the private sector to invest in disaster infrastructure development through offering incentives.

Very often we hear from the governments whether they should take care of the basic needs of their people with the limited resources they have or whether they should invest in issues related to the disaster. Inter alia, it is the moral responsibility of the international community to pitch in and help the countries to reduce the vulnerability of the community. The problem could also be overcome by sensitising and educating the governments that money spent on DRR activities will help sustain the development initiatives which is otherwise lost in the event of a disaster. The linkage between development and DRR needs to be reinforced. Another major challenge that we see irrespective of the country and its economic status is the lack of coordination between various DRR actors.

Observance in Bangladesh

There was a study carried out in Bangladesh recently focusing on DRR interventions being carried out in the field. It was observed that there were some geographical areas where the concentration of agencies working on DRR was much more than other areas even if the other area is more vulnerable and deserves better attention. After thorough analysis, it was found that these areas were the areas with easy access and high visibility.

These are the areas which are preferred for the donor visit or visit by other VIPs. The money which should have gone otherwise to the more deserving areas is not being utilised properly. With the shrinkage of resources with the donor and other agencies, this needs to be given serious thought. One of the ways of overcoming this type of problem is proper coordination between various agencies, which is led by the government and supported by OCHA. Detailed vulnerability analysis needs to be carried out jointly and based on the needs the geographical location and the interventions that needs to be planned. Of course, it has been observed that the governments have taken some proactive steps in this regard. The CDMP (largest DRR program in Bangladesh) is carrying out the mapping exercise of the vulnerable areas and the required interventions. This will be made available on the government websites and can be used by anybody for reference while planning any DRR interventions. It is high time that similar planning and proactive approaches should be adopted in other countries for ensuring proper coordination among various DRR players.

Another major challenge that was witnessed is the inconsistency in DRR interventions and the lack of a standardised approach. It was observed in the field that different organisations are using different training modules and reference materials to enhance the capacities of the community on DRR. One organisation was giving the training for one day on a particular topic/issue while the other doing the training on the same topic/issue but the duration was different. This leads to differential capacity enhancement of the community. Governments should be able to recognise this problem and come out with a standardised training curriculum for different stakeholders.

Observance in Nigeria

There are so many obstacles and major challenges to action on disaster risk reduction and building resilience in Nigeria, where there is a federal system of government with three tiers of government: the central, state and local governments.

- The powers of these governments are allocated according to the Exclusive, Concurrent and Residual lists as provided by the constitution. The ACT establishing National Emergency Management Agency (NEMA) provides for the same three tiers or levels of the emergency agencies to reflect its federalism. However, this arrangement is militating against its efforts towards efficient disaster risk reduction and building a resilient nation.
- Related to this, is a weak national funding framework. The government budgetary allocation for disaster Management is negligible and the private sector does not see the economic justifications for investment in disaster risk reductions projects.
- The various government agencies that ought to work hand in hand in disaster risk reductions are in complete disarray and do not complement one another.

The factors contributing to these challenges are:

- Lack of Political will on the part of decision-makers
- Priority of developmental activities as against protecting the hard-earned developments achieved against disasters
- The federal/central government has not enforced the ACT that set up NEMA
- The aforesaid challenges may be tackled through:
- The constitution review to move the NEMA activities/powers into the exclusive list, where the federal/central government owns up to the full responsibility of disaster risk reduction throughout the country.
- Allocation of at least 5% of the annual budget for disaster risk reductions.
- The private sectors especially those that contribute toward global warming and environmental damages must be compelled to invest in disaster management through taxes.
- Creating a unified emergency agency that brings all relevant government participants under a single umbrella, that is, The NEMA, Fire services departments, Road Safety Corps, Civil defense Corps, anti-terror squads, Military Disaster Response Units and so on should be brought under one Command for effective and efficient disaster Management.

Observance in Cameroon

The floods are badly affecting Cameroon. Since August 15, 2012, areas in the North and Far North Regions of Cameroon have been experiencing heavy rainfall and subsequent flooding. The rains and floods have destroyed or damaged many houses, leaving about 25,000 people homeless. Most of them have found shelter with host families, but 5,000 have sought refuge in school premises. Almost all crops and granaries of the affected families have been destroyed, and livestock was lost as well. The flood situation is likely to deteriorate in the peak rainy seasons. The challenges here are the high vulnerability of local populations and their inability to anticipate flood occurrence. These challenges could be tackled through building capacity and preparedness at the local level.

Observance in Philippines

It is quite amazing with the updates noted about the Pacific Islands adopting their regional framework on DRR. It should be underlined that in the Southeast Asia region there have been seriously thinking and discussions as well on DRR within ASEAN and it has some active NGO participation in those discussions.

Governments would agree to the points raised earlier on the challenge of: (i) political will of the government to put priority to DRR and HFA implementation and (ii) resources generation for DRR action. Other than these two points, another challenge is still about mindsets and paradigms of communities towards disasters. In the Philippines, many communities are still adamant and complacent in responding to the need for DRR. The prevailing trend that is happening is that people tend to realise the importance of DRR after they have experienced extreme losses after a tremendous disaster event. For instance, in TS Washi on the southern island of the Philippines what happened in the Mindanao event! Local people were taught that no typhoons will come to Mindanao because it is away from the typhoon “belt”. So when there was a government warning on TS Washi some people in Mindanao were in disbelief and many have not acted on the warning thus resulting in huge disaster losses, which until now is rehabilitation is still ongoing and DRR then becomes a major action. For governments and organisations facilitating DRR, this is a challenge in terms of convincing local governments as well as communities to act on DRR before any disaster event strikes them.

Observance in Developing Countries

The key challenge, as already mentioned above is lack of resources for developing countries. Resource is a huge factor in implementing DRR actions from the ground and up. Although the policies are there to have a sustainable source of funds for DRR, the governments are burdened with huge amounts of targeted spending to address the needs of the growing population, such as more schools, public health (which every year, the government has to build thousands of classrooms to absorb new students), more health care, housing and economic development. After facilitating risk assessments and risk reduction planning ultimately, the question of funding becomes dead-end on the road towards DRR work.

A challenge is also in the area of how resilience is understood but more importantly measured. Do we have minimum indicators or a clear understanding of what is meant of resilience at the community level? Many organisations have been doing a lot of good in the area of developing tools on how to facilitate community DRR actions but very few have been done about indicators for resilience which will serve as benchmarks for DRR actions and resilience building.

Lastly, on the Government approaches in various countries, it is emphasised that there is a challenge of DRR being disconnected to the overall discussions for national and community level development. DRR is seen as another layer, another policy pronouncement that local governments have to comply with instead of viewing DRR as something essential to achieve sustainable development, development that is safeguarded from hazards and climate change effects. Integrating and mainstreaming DRR in many development facets such as linking DRR to health, livelihoods, education and ecosystems management has been a key theme in many DRR actions in developing countries.

How do Governments Tackle and Go Beyond these Challenges and Underlying Factors?

There have been positive "solutions" towards addressing these barriers. One way is to work with new and not so to be engaged stakeholders in DRR work. For example, Philippines have good actions on engaging the private sector to contribute in securing resources for community actions on DRR. Corporate social responsibility served as the entry point for channeling some CSR resources to DRR. Many NGOs in the country have also engaged the educations sector for DRR. Children are at risk of disasters because of their vulnerability and level of capacities and working in schools is also the best way to correct the traditional thinking towards disasters. Sometimes children becomes the best educators to their parents as well. Other than working with the private sector and education sector, some NGOs have also worked with the academe for research and development of technologies that will improve risk assessments and hazard-specific and cost-effective early warning systems. These are some of the solutions explored to address the challenges to resources and cultural mindsets towards disasters.

Another solution is that Governments understand the value of continuing linking and learning among DRR actors and players. It is through this linking and learning that best practices are shared, joint problem solving and advocacies are borne and pursued. Linking and learning also allowed for a better understanding of the principles and practice of DRR which has been quite interesting among many organisations. The concept and interpretation of vulnerability, capacity and disaster risk have been quite different among organisations resulting in differences in approaches and tools. It is a proven fact that tools and approaches need not be uniform among organisations and agencies but it is true that all tools and approaches, definitions will all lead to the reduction of risks and the resilience of the community. For all we know, in the eyes of the local communities, villages and community organisations– they don't care about any "DRR formula", what they care about is to keep their communities safe and resilient from hazards and climate change.

In Pakistan, an agency of Aga Khan Development network AKDN", is working in the field of Disaster management. There are Geo hazards, like floods, debris flows, landslides, GLOFs, snow avalanches and many others affecting the human lives in the country. Climate change is one of the triggering factors, which has activated these metrological and geological hazards worldwide. Flash floods 2010, which have affected 104 villages in Gilgit Baltistan leaving the population homeless and destroying all livelihood options. Atababd landslide in Hunza, which lost 19 human lives and blocked the river as a result 26 km long, and 125m deep landslide dam formed which blocked the international road (KKH), which connects Pakistan with China. 2500 population upstream of the lake has become disconnected to access the region. The lake is still intact for 2 years of its formation leaving an ongoing risk to the downstream population of the region. During these disasters mentioned above, government and other actors played their role to response the disasters. But there were many challenges in the way of taking appropriate actions.

Conclusion

In conclusion, some lessons that the governments ought to learn while dealing with such disasters are as follows:

Challenges

1. Lack of awareness regarding the disasters and its lack of training in DRR initiatives.
2. Non-availability of emergency funds for DRR
3. Formulation of DRR related policies and their implementation
4. Lack of technical knowledge regarding the geo-hazards
5. Lack of uniform policy for relief and emergency response among the DRR agents including government
6. Lack of capacity building among the institutions regarding the relief, recovery and reconstruction phases.
7. Mindset of the rural communities
8. Cultural sensitivity
9. Private Sector partnership in DRR
10. Mindset of Bureaucrats, cooperation and coordination among various departments in DRR activities
11. Political will

How to Make Resilience?

1. Formulation of particular laws and policies and its implementation in DRR
2. Hazard identification and anticipations in the remote areas and formulation of contingency planning accordingly.
3. Capacity building of the institutions
4. Utilisation of local resources and indigenous knowledge for making training manuals for capacity building
5. Natural resource management and reducing the risk from the reckless usage of forests, weeds and unstable slopes. Pasture management should be established in the mountainous areas through community organisations

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Humanitarian Early Warning System http://www.hewsweb.org

World Climate Research Programme http://www.wmo.ch

Livelihoods Connect http://www.livelihoods.org

Building Resilience to Natural Disasters: Towards Sustainable Agricultural Practices in Sri Lanka

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Abstract

Agriculture is highly connected with human lives as it is associated with food production. Agriculture remains the world's economic activity, employing over 20% of the world population and 50% of the South Asian population (World Bank, 2016). Floods, landslides, drought and hurricanes are common disasters that affect the agriculture sector including livestock. During the period of natural disasters, poor people are the most vulnerable segment in society. According to the World Bank, (2016) 78% of the world's poor live in rural areas and depend largely on farming for their survival. The poor people in the rural sector employed in the agricultural sector are unsurprisingly helpless during disaster situations. Around 75,000 families have been affected due to a flood that occurred in Sri Lanka in May, 2016 (Disaster Management Information System in Sri Lanka, 2016). Thus, there is an urgent need to initiate a sustainable agricultural policy that ensures the survival patterns of the farmers as their income level is lower due to the effect of disasters causing declines in crop yields.

Keywords: agriculture, food production, sustainable practices, policies, strategies, building resilience

In this context, the main objective of this study is to propose strategies for sustainable agriculture. More specifically, the study aims to identify the strengths and weaknesses of the existing agriculture policy of Sri Lanka and also to propose the best strategies to cope with disasters by examining good practices.

This study used a qualitative approach based on secondary data. This study will be significant as it suggests better guidelines for policy makers and administrators towards a sustainable agricultural policy in Sri Lanka.

Background of the Study and Problem Identification

The agriculture sector remains the backbone of many rural economies (Mitchell K.A, 2016). The World Bank (2011) reports that the agriculture sector contributes 3% to global GDP and more than 25% to the GDP in many least developed countries. Also, the agricultural population in the world is highly significant; by 2010 the figure is about 32.3% in the world and 40.5% in developing regions (WB, 2011). Normally, the agricultural sector has been badly affected by natural disasters, particularly floods and drought.

According to the UNISDR (2013) during the period of 1980-2011, 3455 flood situations, 2689 number of storms, 470 droughts and 395 number of extreme temperature situations have been recorded worldwide. The International Federation of Red Cross and Red Crescent Societies (2016) noted that the total number of natural disasters reported during the period of 2005-15 in worldwide as follows; Asia 2556; 1522 Africa; 1242 America; 846 Europe and 147 in the Oceanian continent. The Food and Agriculture Organisation of the United Nations noted that Asia is the most affected region, with estimated losses adding up to $28 billion to the Agriculture sector. A general trend is that damage and losses from mega-disasters in agriculture are higher in countries where the contribution of agriculture to GDP is still high and where agriculture provides the main source of employment (UNO, 2014).

According to the Agriculture Ministry of Sri Lanka (2016) the agriculture sector has always performed as a major economic force in the country, making a significant contribution to the national economy, food security and employment. More than 70% of the population are living in rural areas engaging agriculture for their livelihoods. Thus agriculture sector is identified as one of the keystones in the economy in Sri Lanka as currently the agriculture sector contributes to about 18% of the Gross Domestic Product (GDP) and 30% of the employment (Agriculture Ministry, 2016). Rice is the staple food of the inhabitants of Sri Lanka and paddy crops are cultivated as a wetland

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crop in all the districts. According to the Sri Lanka Paddy statistics (2016) the total land devoted to paddy is estimated to be about 708,000 Hectares at present. There are two cultivation seasons based on two monsoons (Yala and Maha) which bring rains for the cultivation. Maha Season falls during "North-east monsoon" from September to March in the following year. Yala season is effective during the period from May to end of August.

Floods, drought, landslides and lightning are frequent disasters in Sri Lanka. Frequent Climate change and delayed monsoon has caused 20% loss of paddy harvest in Sri Lanka particularly in Maha Season 2013 (OCHA, 2014). The International Water Management Institute (2014) mentioned that during the past 10 years Sri Lanka faced 23 flood occurrences with over 500 loss of lives and 9 million people affected and these floods caused an economic loss of USD 1 billion (cited in OCHA, 2014). The Department of Agriculture reported that lack of rain has damaged 83,746 hectares of paddy planted area resulting in an estimated production loss of 280,000 MT of rice (cited in OCHA, 2014). Many households in the disaster-affected areas engage in small-scale farming activities in Sri Lanka. The disaster damages are also reported in the livestock sector. According to the Statistics of the Department of Animal Production and Health (2014) over 19,900 cases of Foot-and-Mouth Disease among the livestock are reported from 18 districts (cited in OCHA, 2014). Around 75,000 families have been affected due to a flood that occurred in Sri Lanka in May, 2016. (Disaster Management Information System in Sri Lanka, 2016).

During period of natural disasters, poor people are the most vulnerable segment in society. According to the World Bank, (2016) 78% of the world's poor live in rural areas and depend largely on farming for their survival. The poor people in the rural sector employed in the agricultural sector are unsurprisingly helpless during disaster situations. Around 75,000 families have been affected due to a flood that occurred in Sri Lanka in May, 2016. (Disaster Management Information System in Sri Lanka, 2016). In this context, there is an urgent requirement for ensuring their survival and improving living conditions through sustainable agricultural methods. It has been observed that the existing agriculture policy has not adequately addressed the above issues of the agriculture sector. Thus, this study tries to fill this gap.

Objectives of the Study

Main objective: To suggest strategies towards a sustainable agriculture policy in Sri Lanka.
Specific objectives:

1. To identify the strengths and weaknesses of the existing agriculture policy of Sri Lanka
2. To propose best strategies to cope-up with disasters by examining good practices in other countries.

Methodology

This study uses a qualitative approach based on secondary data. Best practices of sustainable agricultural policies of some selected countries were reviewed. Government circulars, newspaper articles, journal articles and e-sources were used as secondary data. Thematic analysis with substantial description was used to analyse the data.

Significance of the Study

Agricultural policies should be sustainable even in disaster situations. Therefore, this study will be significant as the recommendations would be useful in designing and maintaining sustainable agriculture policy in the country.

Limitation of the Study

The study is mainly based on secondary data thus it is considered as one of the limitations of the study. Further studies could be conducted to examine the organisational effectiveness based on the primary data particularly from farmers and relevant agricultural institutions.

Literature Review on Agriculture and Disasters

This section discusses important concepts of disaster and agriculture. Selected best policies and practices related to sustainable agricultural policies and related empirical research are also presented.

Disaster Resilience

UNISDR (2005) defines Disaster resilience as the ability of individuals, communities, organisations and States to adapt to and recover from hazards, shocks or stresses without compromising long-term prospects for development. According to the Hyogo Framework for Action, (2005) disaster resilience is determined by the degree to which individuals, communities and public and private organisations are capable of organising themselves to learn from past disasters and reduce their risks to future ones, at international, regional, national and local levels. Cannon T. et al, (2016) mentioned that the development work should aim to protect and reinforce livelihoods in such a way that people can become more resilient to hazards and be better protected from them. International Food Policy Research Institute (2013) states that resilience is the ability of critical physical infrastructure to absorb shocks. From a psychological point of view, it is the process of adaptation and of developing a set of skills, capacities, behaviours and actions necessary when dealing with adversity. Thus, disaster resilience could be considered as the ability of the affected community to bounce back from shocks and adverse effects and improve their capacity of mitigating the impact of disasters.

Vulnerability

The International Federation of Red Cross and Red Crescent Societies (IFRC) (2016) defines vulnerability as the diminished capacity of an individual or group to anticipate, cope with, resist and recover from the impact of a natural or man-made hazard. however, it is not the same as poverty, marginalisation, or other conceptualizations (Cannon T. et al, 2016) but there is generally a very high (but not absolute) correlation between the chances of being harmed by natural hazard events and being poor. Thus, vulnerability is a way of conceptualizing what may happen to an identifiable population under conditions of particular risks and hazards. The level of vulnerability is depending on the type of livelihood in a particular community and the agricultural population is more vulnerable in disaster situations.

Natural disasters make serious damages for the sustainability of the agriculture sector. The rural farmers constantly deal with unfavorable weather conditions, variability in prices of inputs and outputs, livestock disease outbreaks and pests (Miranda and Vedenov 2001). There is huge uncertainty in the future activities of this community. On the other hand, lending institutions are less willing to provide loans to farmers as the probability of default is relatively high. Harvey et al., (2014) mentioned that there is an urgent need for the global community to focus its attention on identifying adaptation measures that can help farmers to reduce their vulnerability to climate change and cope with adverse consequences.

Early Warning Systems

The United Nations' International Strategy to Disaster Reduction *ISDR* (2006) identified an early warning system as a major element of disaster risk reduction in preventing loss of life and reducing the economic and material impact of disasters. What is.com (2016) defines an early warning system (EWS) as technology and associated policies and procedures designed to predict and mitigate the harm of natural and human-initiated disasters and other undesirable events. According to ISDR (2006) early warning systems should have four components like Risk knowledge, monitoring and warning service, dissemination and communication and response capability. Further to be effective, early warning systems need to actively involve the communities at risk, facilitate public education and awareness of risks, effectively disseminate alerts and warnings and ensure there is a constant state of preparedness (ISDR, 2006).

Sustainable Agriculture

The term Sustainable agriculture has received increased attention in the last three decades. Dictionaries define the word "sustains" as to keep in existence or maintain, implying long-term support or permanence. Sustainable agriculture is key for long-term and inclusive growth, especially in developing countries, due to its strong multiplier impact on other sectors (European Union, 2012).

There is no agreed definition for sustainable agriculture and the term has been defined from various perspectives. European Union, (2012) mentioned that the delivery of public goods such as environmental benefits is closely interlinked with the capacity of agriculture to be economically sustainable, generate adequate family income, and be socially sustainable. European Union also identified four main reasons for introducing sustainable agriculture policies: (i) More people will need more food in the future; (ii) Farming is a key source of income that can help make poverty history; (iii) Agriculture has a dual role in adapting and mitigating climate change; (iv) Agriculture uses natural resources that are becoming scarce.

John Ikerd quoted by Richard Duesterhaus (1990) describes the term sustainable as pertains to agriculture and farming systems that are capable of maintaining their productivity and usefulness to society indefinitely. According to the author, such systems must be resource-conserving, socially supportive, commercially competitive, and environmentally sound.

Even though their description focuses on the farming systems, one could better understand the term sustainable in relation to various fields in broader perspectives of other aspects of social, economic, commercial and environmental concerns. Thus, sustainable agricultural policy concerns three main domains that are economic, social and environmental. Hence, policies and strategies of agriculture should be economically viable, socially fair and environmentally sustainable.

D'Souza, Douglas Cyphers, and Tim Phipps (1993) focus on what specific practices constitute a sustainable production system and classify a sustainable agriculture system as one involving a combination of sustainable production practices, rather than a single practice used in isolation. The author defines sustainable agriculture as one involving the continued or increased use of a combination of appropriate practices or technologies such as manure utilisation, crop rotations, integrated pest management, rotational grazing, tillage for seed bed preparation, cultivation for weed control and reduced use or non-use of petroleum-based products, commercial fertilisers, pesticides, hormones or growth stimulators and antibiotics. Their definition encourages to use of production practices which may have the potential for reducing environmental damage.

Sustainable Agricultural Policies and Best Practices

The United Nations report on Agriculture and Disaster (UNO, 2014) described risk reduction policies in developing countries and highlighted several areas to be focused on when preparing an agriculture-related national policy. Agriculture planning, Post/disaster recovery assessment and planning, Agriculture legislation/policies, Capacities for Disaster Risk Reduction in agriculture sector agencies, Agriculture preparedness, Annual budget allocation, Agriculture specific institutional mechanisms and set-up are some of such focused areas in the report. According to the framework designed by them, the following major areas are related to this study.

- Prioritise critical sectors and themes, propose clear financial commitments and reinforce the systematic incorporation of Disaster Risk Reduction
- Better integrate Disaster Risk Reduction (DRR) and Climate Change Adaption (CCA) in sectorial policies, investment plans, and development programmes to reduce emerging risks associated with extreme climate events.
- Address vulnerabilities beyond natural hazards.
- Improve linkages between humanitarian and development interventions to risk management for agriculture, food security and nutrition.

Plan of Action for Disaster Risk Reduction in Agriculture in Cambodia (2013) has identified five priority areas in their Disaster Risk Reduction plan.

- Strengthen institutional and technical capacities for disaster risk reduction and climate change adaptation in agriculture and enhance coordination mechanisms.
- Promote and enhance early warning systems for proactive disaster risk reduction and climate change adaptation.
- Enhance knowledge management and innovation in support of disaster risk reduction and climate change adaptation in agriculture.
- Reduce vulnerabilities to disasters by improving technical options and implementing community-based disaster risk reduction and climate change adaptation measures in agriculture.
- Strengthen effective preparedness and response capacities and the integration of disaster risk reduction and climate change adaptation into agriculture interventions.

Those focused areas must be suitable for many Disaster Risk Reduction plans.

USAID (n.d.) also proposes several strategies for risk reduction in agriculture in disasters situations. Those proposals apply to any country in the agriculture sector. Some of them are outlined as follows;

- Mapping potential disasters
- Ensuring appropriate crop selection, cultivation methods and introducing new varieties of crops (quick growing crops, etc., to sustain in disaster situations
- Introducing alternate farming systems
- Helping to develop contingency crop planning
- Promoting post-harvest management
- Encouraging the development of water control and water conservation techniques
- Helping farmers to link with risk sharing and transfer instruments, such as crop, livestock, fishery insurance compensation and calamity funds, microcredit and cash transfers
- Promoting livelihood diversification
- Disseminating and demonstrating good practices for disaster risk reduction to increase the resilience of existing farming systems.

However, the success of those strategies depends on the availability of various organisational arrangements, better coordination, adequate resources allocations through government intervention.

When designing sustainable agricultural policies strategies have to be included in managing vulnerability and enhancing the capacity to adapt and respond to natural disasters. The Government of Nepal had brought into force the National Agricultural Policy (2004) which takes into consideration several aspects that are related to Climate Change Adaptation and Disaster Risk Management. Accordingly the sustainable practices are:

- Introducing surveillance system to assess the impact of heavy rainfall, droughts, diseases, insects and other natural calamities as well as to mobilise agriculture relief schemes.
- Providing special facilities to the targeted groups to construct and install small irrigation infrastructures such as pedal pumps, rower pumps, sprinklers, drips and water harvest ponds.
- Developing safety nets (food and nutrition) in climatic hazard and/or natural disasters, for farmers
- Extending the existing livestock insurance program; besides poultry/chicks, seeds of selected crops and high-value agricultural products need to be gradually introduced for insurance.
- Minimising the negative impact and other environmental problems resulting from the use of agricultural chemicals on soil and water bodies.

Empirical Research on Sustainable Agricultural Practices

Harvey et al., (2014) summarises the coping strategies devised by the agricultural households in facing the challenges such as reduced number of meals per day, change the diet, sold assets to buy food, borrowed money, receiving food from relatives, increased consumption of wild plants and animals, sent older children away to work, received food from neighbours/community, took children out of school, made children work more on the farms, sent an adult household member to get an outside job, leased their land to other farmers or received food aid from organisations, etc.

> According to Harvey et al., (2014) different coping strategies had been adopted by farmers in different disasters. *"In a drought situation the affected farmers normally change timing of crop planting, change crops grown, change crop varieties, change location of crop fields, built a water-harvesting system for crops and install an irrigation system; In a flood situation farmers replant crops after flooding subsided, built diversion ditches to remove water from fields, change timing of crop planting, change crop varieties, stop farming the land that was flooded and change crop type; In climate-changing situations generally farmers increase use of intercropping, built a communal granary or food storage system to store crops, change the location of fields, diversified production system by incorporating trees and implement soil and water conservation practices, change crop varieties and change type of crop; In a situation where the water availability is changing owing to climate change, build ditches to direct water or floods away from certain areas, develop Irrigation system for crops, build a water-harvesting scheme*

*for crops, build water-harvesting system for livestock and build water-harvesting system for domestic consumption"(*Harvey et al., (2014).

The State of New South Wales (1998) has found that it is important to promote long-term economic, social and environmental benefits of sustainable agriculture among the farmers and general public. Also, they have highlighted the appropriate use of agricultural and veterinary chemicals and biological pest control in sustainable agriculture. According to them, sustainable farming systems replace soil nutrients harvested as pasture and crop products, with a view to long-term on and off nutrient balance.

When discussing about Sri Lankan context, Weerakoon L. (2009) noted that sustainability gives priority to the retention of soil fertility. In this regard, preservation of soil erosion, utilising natural resources obtained from farm land or the environment such as cow dung, cow urine, leftovers from the previous season farming, waste material and plants are useful.

The author summarised several sustainable agricultural practices adopted by Sri Lankan farmers. Those are presented in Table 1.

Table 1: Sustainable Agricultural Practices Adopted by Sri Lankan Farmers

Soil and water conservation	Stone bunds and organic bunds Eye Brow bunds Mulching SALT technology (Sloping Agricultural Land) Alley cropping Live fencing
Improving soil fertility	Live compost pits Wormy compost Compost fertiliser Panchagavya/ Panchakawya Jeewamurtha Using straws as fertilisers
Cropping systems	Mixed cropping Terracing SRI System, Nawa kekulama
Herbal pest control	Neem mixture Chili, Anoda, Garlic mixture Leaf mixtures Castor oil
Self-production of seeds	Saving the balance seeds Setting up plant nurseries Selection of seeds and storing seeds

Source: Weerakoon L., (2009)

Data Analysis and Discussion

This section consists of two main parts. The first part of this section summarises the existing agriculture policy in Sri Lanka in terms of its policy statement, goals and objectives and existing institutional mechanism. The second part of this section examines the strengths and weaknesses of agriculture policy in Sri Lanka.

Analysis of Agriculture Policy in Sri Lanka

Agriculture Policy included policy statement which directs several important aspects in the policy (National Agriculture Policy, 2015).

Some of the salient features are summarised as follows:

Promoting Agricultural Production

The policy focuses to implement technically sound, economically viable, environmentally friendly and socially acceptable programs to promote sustainable agricultural development with efficient and effective utilisation of resources.

Seeds and Planting Material

This policy aims to produce and supply high-quality seeds and planting material of commercial varieties in a competitive environment with the participation of the state and private sector.

Fertilisers

The policy encourages not use chemical fertilisers but promotes production and utilisation of organic and bio-fertilisers and gradually reduces the use of chemical fertilisers through Integrated Plant Nutrition Systems (IPNS).

Pesticides

The policy encourages minimising the use of synthetic pesticides through promoting bio-pesticides and Integrated Pest Management (IPM). Accordingly, Sri Lanka government recently banned the usage of some harmful pesticides.

Irrigation and Water Management

The policy encourages the use of efficient water management and moisture retention techniques to achieve high productivity in agriculture and conserve the existing water resources for sustainable agricultural development.

Agricultural Credit

The policy aims to strengthen rural credit institutions connected with farmers' investments, savings and risk management and introduce simple procedures in providing loan facilities for agricultural activities and agro-based industries.

Post-harvest Technology

The policy promotes to develop and popularise better harvesting, processing, value addition, storage and transport methods to minimise pre and post-harvest losses to improve quality to meet domestic and export market demands.

According to the National Agriculture Policy proposed by the Ministry of Agricultural Development and Agrarian services, the present agriculture policy in Sri Lanka focuses on several goals and objectives. Those are outlined as follows:

- Increasing domestic agriculture production to ensure food and nutrition security of the nation
- Enhancing agricultural productivity to ensure sustainable growth
- Maximising benefits and minimising adverse effects of globalisation on domestic and export agriculture
- Adopt productive farming systems and improved agro technologies with a view to reduce the unit cost of production and increase profit
- Adoption of technologies in farming that are environmentally friendly and harmless to health
- Promoting agro-based industries and increasing employment opportunities
- Enhancing the income and living standard of a farming community

Institutional Mechanism of Agriculture Policy in Sri Lanka

Ministry of Agriculture in Sri Lanka

The Ministry of Agriculture is the main responsible authority for all agriculture-related activities in Sri Lanka. Currently, several organisations and departments are operating under the Ministry of Agriculture.

The following diagram (Figure 01) shows the organisational structure of the Agriculture Ministry, Sri Lanka,

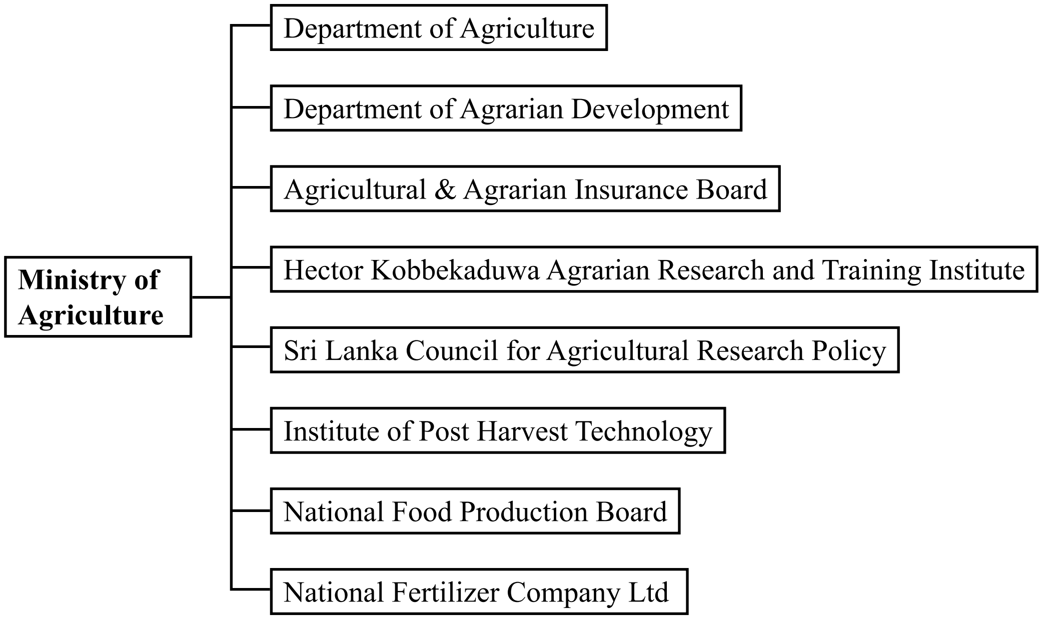

Figure 1: The organisational structure of Agriculture Ministry

Department of Agriculture

The objectives of the Department of Agriculture is to maintain and increase productivity and production of the food crop sector for the purpose of enhancing the income and living condition of the farmer and making food available at affordable prices to the consumer. The major functions of the Department of Agriculture include research, extension, production of seed and planting material, regulatory services related to plant quarantine, soil conservation and pesticides (The Department of Agriculture, 2016).

Department of Agrarian Development

The mission of the department is "Formulation and timely Implementation of Institutional Facilitator, Legal and Management Services for optimum productivity of all Agriculture lands as well as Sustainable Development of Farming Community of Sri Lanka. The Department involves in various tasks in the field of agrarian development to ensure the maximum utilisation of agricultural lands in accordance with the government's agricultural policies, making arrangements to protect cultivating rights of agricultural landlords, agricultural landlord cultivators and occupiers tenant cultivators, making regulations regarding registration and functioning of farmers' organisations and to ensure the execution of those regulations, establishment of Agrarian Development Councils and supervision and guidance of the execution of powers of those councils, etc. (Department of Agrarian Development, 2013).

Agricultural & Agrarian Insurance Board

Agricultural & Agrarian Insurance Board is providing insurance services for agriculture related activities in Sri Lanka. Currently it provides the following insurances for Sri Lankan agriculture sector. They are Agricultural crop insurance, livestock insurance, tractors and agricultural machinery Insurance, store insurance, health care insurance and accident insurance (Agricultural Insurance Board, 2016).

- Agricultural Crop Insurance

Agricultural & Agrarian Insurance Board currently providing Paddy Insurance, Buck- wheat Crop Insurance, Vegetable Crop Insurance and Other Crop insurance for Sri Lankan farmers (Agricultural Insurance Board, 2016).

- Livestock Insurance

Livestock Insurance is to reduce the risk of farmers who engaged in livestock industry. It mainly focusses on improving dairy production in Sri Lanka. Another aim of this livestock insurance is to encourage younger population to the industry by providing a fixed survival pattern. Main focus of this policy is on cattle and goats since they are the most common livestock in Sri Lanka (Agricultural Insurance Board, 2016).

- Tractors and agricultural machinery insurance

The insurance plan has been introduced to provide coverage on devices including agricultural tractors used for those engaged in agriculture. This coverage is for agricultural equipment, such as water pumps and leaf harvester machines. As well as covering the use of equipment in the field of natural damage insurance policy has been formulated. The investors will be encouraged through the mechanisation in agriculture (Agricultural Insurance Board, 2016).

- Store Insurance

Until the time of sale in the market the harvests are stored in bulk. The insurance scheme has been introduced to minimise the risk of investors being assembled stocks. Is designed to provide insurance coverage to be able to cover the cost of the damage in natural disasters as well as from animals and insects to stocks (Agricultural Insurance Board, 2016).

- Health care Insurance

The insurance scheme is for farmers to reduce the financial difficulties faced. Even if hospitalisation due to accident or illness. (Agricultural Insurance Board, 2016).

- Accident Insurance

This Insurance will cover accident faced by farmers. In the case of a death, the insurance plan is helpful for their family members (Agricultural Insurance Board, 2016).

Hector Kobbekaduwa Agrarian Research and Training Institute (HKATI)

The main role of this organisation is to generate a range of policy analysis that would cover those key determinants of human and resource development in the agrarian sector. It has developed into the premier national Institute in the field of socio-economic research relating to the use of land and water in Sri Lanka and has also developed the requisite skills and infrastructure for providing relevant training to farmers, field workers and managers in both the state and non-state sectors (Hector Kobbekaduwa Agrarian Research and Training Institute, 2014).

Sri Lanka Council for Agricultural Research Policy

This is an internationally to ensure agricultural research, development and innovations are directed towards national development goals through policy formulation, facilitation, coordination, monitoring and evaluation, and impact assessment and publish in journals (Sri Lanka Council for Agricultural Research Policy, 2016).

Institute of Post -Harvest Technology

The Institute of Post -Harvest Technology (IPHT), operating under the Ministry of Agriculture development and Agrarian services, functions as the main Institution in Sri Lanka engaged in improving the Post -Harvest Technology of rice/other grains, field crops, fruits and vegetables, Spices through Research, Training & Extension, Consultancy, Advisory and other development activities (The Institute of Post Harvest Technology, 2016).

National Food Promotion Board

The main objectives National Food Promotion Board are: (i) to provide incentives to develop economic and social status of the agricultural community and guide them to sustainable agriculture pattern. (ii) to forward strategic recommendations and ensure their coordination for organisations which are engaged in local agricultural activities. (iii) to coordinate and secure obtaining aid of local and foreign agencies for Government's agricultural programs. (iv) to monitoring and providing recommendations to local and foreign nongovernmental organisations who engaged in agriculture field. (v) Acting as a party intervenient for encouraging, coordinating, technical and other aids of agricultural investment. (vi) Providing incentives for agriculture product diversification, increasing productivity and product distribution and marketing. (vii) Taking convenient technology to agriculture community for yield management, value addition for products and packaging. (viii) Providing incentives to community to promote the usage and awareness of Indigenous & Traditional Agriculture Crops (Sri Lanka National Freedom from Hunger Campaign Board, 2011).

Ceylon Fertilizer Company Ltd

The company is marking sustained efforts towards promoting agricultural development of Sri Lanka by supplying quality products to the agricultural sector via the marketing infrastructure and support network of warehouses all over the country (Ceylon Fertilizer Company Ltd, 2015).

Strengths and Weaknesses of Sri Lankan Agriculture Policy

The agriculture policy in Sri Lanka enriched with several strengths and already recognises the importance of the concept of sustainable agriculture. The policy consists of several goals and objectives in promoting agriculture in the country with a view to reduce risk reduction in disasters. The main focuses of the Agricultural policy is to increase agriculture production, reducing farming cost, promoting agro based industries and enhancing employment opportunities for farmers. Several steps have already taken to establish an institutional mechanism to achieve these goals.

Encouraging development of water control and water conservation techniques is one of concerned areas for Disaster risk reduction in sustainable agricultural policy. The Agricultural policy in Sri Lanka incorporates this aspect in their policy statement under the Irrigation and water management which could be appreciated. Under irrigation and water management of the policy, consideration was given in safeguarding irrigation reservoirs, canals, drainage systems and other structures from damage by neutral climate and usage and promoting conservation of rain water and ground water and increasing water use efficiency and promoting modern and intensive irrigation technologies for water conservation. However, the effectiveness of all the organisational initiatives has to be further examined with the empirical data.

Under the agricultural credit and insurance, the policy encourages strengthening rural credit institutions connected with farmers' investments, saving and risk management. Thus, initiation of appropriate agricultural insurance schemes helps farmers to reduce risk associated with natural calamities. However, evidence shows that there is a gap between the current level of external supports and farmers' capability to adapt with climate change. Hence, the government intervention seems not adequate to cope properly at the climate changes.

The policy documents have salient several weaknesses in promoting sustainable agriculture with a view to reduce risk reduction in disasters. These weaknesses could be highlighted as follows;

Even though the concept of sustainable agriculture integrates three main goals namely environmental health, economic **profitability**, and social and economic equity, the exiting policy mainly focuses on improving productivity. Measures that have been taken to ensure social justice as well as environment sustainability seem inadequate. As the many farmers' main survival method is agriculture, their income level is very low, hence they are in poor. That situation violates the social and economic justice of the people who involve in agriculture. On the other hand, no attempt has been given to promote diversification of agriculture and diversification of livelihood of the farmers which tend become farmers economically and socially more vulnerable.

Environment sustainability means protecting natural environment for the future generation while engaging agriculture for achieving the needs of the present generation. That is another dimension of sustainable agriculture. Under the agricultural policy in Sri Lanka, no organisation under the agricultural policy has been taken the responsibility in preserving environment. Even though policy statement emphasises to promote, produce and utilise organic and bio fertilisers in agricultural activities, no serious attempt has been taken to materialise that goal as intended. Even though an organisation (Ceylon Fertilizer Corporation LTD) has been functioned for the last 50 years under the Ministry of Agriculture, its main mission is "ensuring the profitable sustainability of the company by manufacturing and distributing fertiliser catering to the multitude of market demands in order to increase products, income and profitability in the Sri Lanka agricultural and Farmer Community services with the maximum contribution of the 'Lakpohora family' in compliance with state policies" (The Ceylon Fertilizer Corporation LTD, 2017). Hence, the company seems promoting the use of chemical fertilisers and those fertilisers have to be imported. However, in the field of sustainable agriculture, the use of organic fertiliser has to be encouraged. But a lack of attention has been given in this regard. On the other hand, the use of chemical fertiliser is recognised as one of main causes of water pollution, deterioration of farmers' health (kidney disease) and degradation of the quality of soil fertility.

Promoting and enhancing early warning systems for proactive disaster risk reduction and climate change adoption is a major element in ensuring sustainable agriculture. However, the policy does not pay attention in establishing improved use of climate and weather information and forecasts and early warning about potential disasters. In this context, farmers become vulnerable at disaster situations.

Even though there are several institutions involving in research related to Agriculture who are mainly responsible for national level policy formulation and implementation, no authorities is effectively responsible in improving farmers' awareness and introducing appropriate crop selection, cultivation methods and new varieties of crops and quick growing crops and alternative farming systems to sustain in disaster situations. Under this situation farmers become vulnerable in disasters.

No awareness of livelihood diversification practices and improving awareness of good practices for disaster risk reduction to increase the resilience of existing farming systems and appropriate methods of land and natural resources. Even though there are various institutions under the Ministry of Agriculture involving research and training relevant to the field of agriculture, each and every organisation functions their role in isolate without proper coordination.

Even though there are various organisations implementing several programmes aiming at sustainable agriculture, the effectiveness of these programmes has to be examined with the empirical data.

Recommendations

On the light of weaknesses of the policy, several suggestions could be proposed to enhance and maintain sustainable agricultural Policy in the country.

Enhance Public Awareness about Disaster Prone Lands and Time Periods

Relevant authorities should take measures to increase public awareness about disaster prone areas particularly the residencies and agriculture lands. After having proper identification by Geographical Survey and Mines Bureau, the government can announce particular areas as disaster prone land by prohibiting human settlements or agriculture. This strategy is followed by Uganda to increase their public awareness and the New South Wales Government has also mentioned about importance of effective information system in making public awareness. This should be further considered in Sri Lanka because people hardly access to those documents like the government's Gazates especially, in village level. Thus, it will be more useful if the local authority displays some danger or early-warning notices about potential disasters. This will enhance public awareness about the disaster-prone lands and they will tend to move on to some alternative places.

Provide Proper Consultation for Farmers about the Strategies on Resilient Agriculture

The farmers are the most and immediate affected group in a disaster situation. Thus, they should have proper knowledge about pre-arrangements for disasters to reduce the adverse impact on agriculture. Hence, relevant authorities could provide them occasional consultations on how to reduce disaster risk. As examples farmers could be consulted about the appropriate crop selection for different climate situations. Also, they can be informed about the crop varieties, fast growing corps, need of changing locations, timing of crop planting and new cultivation methods. Specially, the contingency crop planning (such as inter crop farming) and post harvesting techniques should be introduced to make the agricultural sector sustainable. Similar strategies could be found in Madagascar context as per the study conducted by Ceila A. Harvey et.al (2014) regarding extreme vulnerability of smallholder farmers to agriculture risk and climate change.

Introduce livelihood diversification practices to vulnerable community

Farmers in most cases are living in vicious cycle of poverty due to regular shocks, low yield, low income, more debt burden and so on. As the disaster risk is inevitable to any country, diversifying farmers' livelihood activities and alternative employment opportunities could be introduced with their existing agricultural knowledge. As example some countries like namely Nepal and Bhutan have introduced Agro tourism where farmers can earn some additional income.

Preserve and Re-awake the Indigenous Agricultural Knowledge and Technology

Sri Lanka is a country that experienced an excellent eco- friendly agricultural technology and knowledge in the past. Many historical evidences are still found regarding the sustainable agricultural practices in early Sri Lanka. The farmers had sound indigenous agricultural knowledge, which is robust even in disaster situations. Unfortunately, that implicit knowledge and agricultural technology used by early farmers has been deteriorated after introducing the plantation sector by Europeans. However, the relevant authorities should take urgent attention in re-awaking and preserving those traditional, indigenous agricultural knowledge in ensuring sustainability in this field.

Increase Access to Credit and Safety Nets

During disaster periods and following catastrophic events, such as extreme weather events many farmers are depend on informal support gain from relations or familiar parties. As formal safety nets are lacking or most probably delaying their service so that, farmers who are affected by disasters become more vulnerable struggling to survive. Therefore, it is necessary to establish formal and working safety nets and also strengthen existing mechanism, such as Agricultural Insurance Scheme.

Encourage Farmers to Use Organic Fertilisers

To establish a sustainable agriculture, it is necessary to comply with eco-friendly practices and techniques to a greater extent. Due to the poor attention in this field, the farmers in North Central province currently suffer from a serious kidney issue as well. Therefore, it is necessary to encourage to use sustainable agricultural practices and materials (such as fertilisers and pesticides). Encouraging organic fertilisers as it is healthy and eco-friendly and discouraging chemical pesticides as it damages species living in the soil and water.

Establish proper coordination among agricultural institutions

Though there is a plethora of agencies in the field of agriculture it is questionable whether there is a proper coordination among them. Due to this lack of coordination, no institution takes the immediate and direct responsibility when something happens. Especially, in disaster situations the agricultural sector and the farmers are severely and adversely affected. However, the farmers are frequently yelling with their grievances through media, about unsatisfactory support given by these institutions. Also, when there is no proper coordination, the public resources will be wasted by the authorities due to multiplications of activities. Therefore, it could be suggested to take proper coordination among the institutions for a sustainable agriculture policy.

Recognise Disaster Resilience as a Key Priority Area in the Agriculture Sector

There is a comprehensive intuitional mechanism in Sri Lanka pertains to the Agriculture sector. However, it is clear that no institution has given their attention to the disaster resilience in their priorities. Since, all the institutions have separate set of functions and responsibilities, apparently, they are not functioning beyond that scope. But it is highly important to take measures for disaster resilience thus, the direct responsibility should be allocated to a separate or existing institution. Then only, such institution could perform and go ahead with this area which is not happening in the country. Currently, the government takes several ad-hoc actions to make the community resilient, in front of disasters but no proper mechanism is established.

Conclusion

Sri Lanka is a developing country with a larger rural agricultural sector. Floods, earthquakes and droughts are the most common natural disasters in Sri Lanka. People who involve in Agriculture are rural poor are adversely affected from natural disasters. Even though there is an agriculture policy in Sri Lanka, mitigating adverse effects on agriculture due to disasters seems not adequate. Therefore, this study examines strengths and weaknesses of the existing agriculture policy in terms of concept of sustainable agriculture. Encouraging development of water control and water conservation techniques and agricultural credit and insurance and encouraging and strengthening rural credit institutions are strengths of the exiting policy. However, measures have to be taken in improving the effectiveness of these programs. Lack of attention of establishing improved use of climate and weather information and forecasts, lack of early warning about potential disasters, lack of attention on improving awareness and introducing appropriate crop selection, cultivation methods and new varieties of crops and quick growing crops to sustain in disaster situations are salient weakness of the existing policy.

The analysis pointed out best practices from other countries to strengthen the policy. Finally, recommendations are suggested such as enhancing public awareness about disaster prone lands and time periods, consultation for farmers about the strategies on resilient agriculture, proper coordination among agricultural institutions, recognizing disaster resilience as a key priority area in the agriculture sector, encourage Farmers to use organic fertilisers. These However, commendations could be used for future policy making towards sustainable agriculture in Sri Lanka.

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Climate Change Impact on Agriculture Sector and Vulnerability of Rice Growing Farmers in Sri Lanka

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Abstract

Emissions of agriculture have slightly declined in the developed countries since 1990, mainly due to fewer cattle and reduced inputs of nitrogen fertiliser. It is further reiterated that agricultural emissions are already higher in developing countries than in the developed countries. Despite the fact that Sri Lanka is a less contributor to agriculture emissions, the country is inevitably facing the impact of climate change and it has adversely affected the agriculture sector. As a result of climate change, annual cropping patterns are being changed and losses and damages have been incurred in the agriculture sector relative to the other sectors. Farmers are becoming a vulnerable to climate change in the course of their livelihoods. Consequently, the government expenditure on subsidies and compensations are increasing to draw back the farmers and their families from the effect of these adversities. Despite rapid urbanisation during the past years, more than 75 per cent of the population of the country lives in rural areas and their main livelihood is agriculture. Under these circumstances the main challenge Sri Lanka faces causing agriculture sector is the issue of feeding more than 20 million people in the country. Many farmers in the rural sector are involved in rice and vegetables cultivation while others are involved in growing other crops. Of all crops, rice growing requires a lot of water. The most generally practiced method involves flooding the fields. Hence, rice growing requires an adequate water supply on time to farming practices on a seasonal pattern to get the expected harvest from cultivation. Unprecedented changes of rainfall regimes, increase of temperature, salinity of water as a result of rise of sea level, invasive plants and pests, floods and droughts damage crop and change the cropping pattern and most of it is beyond the farmer's control. This can also affect other kinds of cultivation in this sector. Rice is grown by the majority of the farmers, regardless of its vulnerability of climate change effects, because rice is the staple food of the nation. In the short term, losses and damages it can be compensated by a government involvement to ameliorate the conditions of the farmers. In some instances, insurance methods are also introduced to help farmers recover their losses. But in the long term, many worst-case challenges could be faced in food security and nutrition, shifting the potential farmers to other sectors, causing social mobility of young generation of farmers to a worst case scenario of 'family to service sector' in the urban areas, letting cultivable lands lie fallow in potential arable areas. Another important challenge is that farmers are becoming poorer as a social class of dependent characters on the social security system and it could tantamount to a huge proportion of government annual budget allocation. Government has initiated some strategies and policies to mitigate the adverse effects of climate change. Hence, this study mainly focuses on to what extent climate change has affected the agriculture sector and envisages what the measures taken are by the government in the long term to mitigate and adapt to these changes while transforming them towards resilient economic scale and its anticipated beneficial impact. Hence, the methodology used survey and secondary data collection and the data were analysed based on vulnerability indicators, assessment and adaptation.

Keywords: climate change, vulnerability, emission, resilience

Background

Climate change has become a major concern to human society because of their potentially deleterious impacts, worldwide. It has significantly affected the developing countries in their development process. Asian Development Bank (2012) states that Climate change is projected to have a wide range of impacts on various aspects of the agriculture sector. On the whole, it is suggested that climate change will significantly undermine crop production in the region, posing a serious threat to food security, even after adaptation and productivity improvement have been considered for. According to Sakeena (2014), as a result of climate change, in tropical countries including Sri Lanka, their economies have become more vulnerable by dint of their location, a larger fraction of agricultural area happens to be located in climate sensitive sectors. Munasinghe (2010) states that it poses significant threats to

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sustainable development of the developing nations, which possess limited resources and there are more vulnerable than other countries. Sri Lanka as an agricultural country also has been subjected to climate change regimes during the last several decades. Consequently, it has resulted in severe fluctuations of the rainfall regimes during the past few decades. The country has experienced much more rain than the usually expected quantum and that is also not at the expected time. Also, there would be more rainfall when it is not the usual rainy season in the country. The annual mean of air temperature anomalies, also have shown significant trends of fluctuation during recent decade in the country (Punyawardena, 2009 cited by Sakeena). Despite the impact of climate changes and rainfall regime changes, people of the country depend on a wide range of agriculture products. Nevertheless, Climate is a major determinant of the agriculture productivity, since rice is the stable food of the inhabitants of Sri Lanka and a large number of people are involved in paddy cultivation throughout the agriculture sector of the sector. Paddy crops are cultivated as a wetland crop in all the districts. Costa (2010) states that climate change involves long term slow changes in climate, short term year to year climate variability of unpredictable extreme climatic events. Agriculture, especially crop production, is highly dependent on the prevailing weather conditions and therefore is highly sensitive to climate change. Among all corps, the paddy plant is one that is highly influenced by variations in temperature and rainfall. Rice is a crop that is grown with standing water for most of its life cycle. According to the Department of Census and Statistics (2016), the total land area devoted for paddy cultivation is estimated to be 708000 hectares at present. There are two cultivation seasons namely; the North-east monsoon period from September to March and other season is effective during the period from May to end of August which is the heavy rain bringing period. However, the whole arable area devoted to paddy is not cultivated due to a number of reasons, such as shortage of water during the cropping seasons, prevailing unsettled conditions on the arable land. Under these circumstances rice growing people are becoming the most vulnerable community to climate change despite the government policies and strategies that are being implemented to climate change adaptation and mitigation in the agriculture sector. Thus, this study focuses on the climate change impact on the agriculture sector and vulnerability of the rice growing farmers in Sri Lanka.

Objectives

The main objective of this study is to assess the climate change impact on the agriculture sector and the vulnerability of rice growing farmers in Sri Lanka, namely;

- To assess the impact on climate change on agriculture
- To assess the climate change and vulnerability of rice growing farmers
- To assess the climate change adaptation and mitigation policies and strategies that are related to the agriculture sector in Sri Lanka

Methodology

This study is based on secondary data, literature review and interviews with respective officers in Agriculture Department and Farmer Organisations.

This study followed the following definitions.

Climate change refers to any change in climate over time, whether due to natural vulnerability or because of human activity.

Vulnerability is the degree to which a system is susceptible to, cope with, have adverse effects of climate change including climate vulnerability and extremes. Vulnerability is a function of the character, magnitude and the rate of climate variation to which a system is exposed, its sensitivity and its adaptive capacity.

Adaptation is an adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm of exploits beneficial opportunities (Third Assessment Report, Working Group II).

Exposure is what is at risk from climate change (e.g. population, resources, property) and the change in climate itself (e.g. temperature, sea level rise, precipitation, extreme events).

Sensitivity is the biophysical effect (e.g. flooding, strong winds, land inundation, etc.) of climate change which also considers the socioeconomic context of the system being assessed.

Adaptive capacity is the ability of a system to adjust to climate change (including climate vulnerability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences. The IPCC Third Assessment Report outlines that it is a function of wealth, technology, institutions, information, infrastructure and social capital.

Socio-economic Background in Sri Lanka

Sri Lanka is a lower middle-income country with a total population of 21.0 million people and a per capita income of USD 3924 in 2015 (World Bank Report, 2016). Out of the population 21.0 million 1.96 million people are employed in the agriculture sector (Sri Lanka Labour Force Statistics, 2016). Further, the Agriculture sector with a percentage of 25.1 represents the employed population, (Sri Lanka Labour Force Statistics second quarter of 2016). Though agriculture is one of the key sectors of the Sri Lankan economy, its contribution to National Gross Domestic Product in 2014 was 11.9 per cent. As stated in the World Bank Report (2016) that the agriculture sector's contribution in 2015 was 8.7 per cent to the Gross Domestic Product.

Climate Patten in Sri Lanka

The climate pattern of Sri Lanka is determined by the generation of monsoonal wind patterns in the surrounding oceans. The four basic seasons based on rainfall that existed in the country, are namely, the south -west monsoonal period during May to September; an inter-monsoonal period during October to November; the north-east monsoonal period from December to February; and another inter-monsoonal period lasting from March to April. 55 per cent of the rainfall is attributed to the monsoons. The mean annual rainfall ranges from 900mm to 6000 mm, with an island – wide average of 1900 mm. The country is divided into three broad climate zones, namely, the Wet zone, the Dry zone and the Intermediate zone. Sri Lanka is further divided into 24 agro-ecological regions based on rainfall expectancy, altitude, soil class, and landform.

Climate Change in Sri Lanka

According to Costa (2010), statistically significant long–term increasing trends in annual mean air temperature and decreasing long term trends in annual precipitation discernible in several locations represent different agro-ecological zones of Sri Lanka. Further, long term decreasing and increasing trends are discernible in the four principal rainfall seasons. Marabe et al., (2012, 2013, 2015) and Punyawardena (2010) state that there is slow and continuous rise of ambient temperature (0.01- 0.03 0 C per year), more often with occurrence of extreme weather events, high intensity rain, wet area getting wetter and dry area getting drier and other changes related to climate. Further, National Climate Change Adaptation strategy has shown that changes in rainfall pattern and intensity lead to frequent droughts and floods, extreme rainfall events, rising temperature, sea level rise and inundating coastal lands with sea water.

Rainfall Extremes and Agriculture

The annual rainfall of the country is considered as ranging between 1000 mm in the driest part to more than 5000 mm in the wettest part of the country (Manawadu and Fernando, 2008). Rainfall extremes have adverse impact on the society and the environment of Sri Lanka. Different regions of the country have witnessed either flooding or drought in quick succession in recent years (Manawadu and Fernando, 2008). The Author reiterates that rainfall is of primary importance to both the physical and the cultural landscape of any region. Rainfall plays an important role in agriculture as any shortfall or excesses of rain gives way to reduction in the crop yields. Manawadu and Fernando (2008), stated in their study on climate change in Sri Lanka that it revealed although the number of rainy days has decreased, the intensity of rainfall, events may have increased together with increased durations of dry spells. The apparent incidence of flooding and landslide as well as droughts in the recent past could probably be attributed to such changes in the temporal pattern of rainfall distribution. As a result of extreme rainfall, there are many adverse effects that have hindered paddy cultivation such as delaying cultivation due to heavy rain or floods.

Drought and Paddy Cultivation

According to Chithranayana and Punyawaradena (2008), drought occurrence is inevitable in almost all regions of the country. All agro-ecological regions of the dry zone are highly vulnerable to droughts. In contrast to Yala seasons, almost all Agricultural Ecological Regime (AER) of the dry zone are likely to experience droughts during the Maha season except those located in the extreme northwestern and southwestern region. Nevertheless, the Disaster Management Act No 13, 2005 of the Government of Sri Lanka has identified 21 natural or man-made disasters in Sri Lanka and drought is the most frequent disaster listed. Drought or extreme negative rainfall anomalies are experienced in Sri Lanka under three major meteorological situations namely Dry, wet and intermediate (Chithranayana and Punyawaradena, 2008). The situation is slightly different in the low country wet zone. Drought occurrence has hindered the paddy cultivation in all regions in the country.

Climate Change Impact on Paddy Cultivation in Sri Lanka

The climate factors are changing at a rapid rate in Sri Lanka. To adapt farmers with the changes, government and other external agencies are play supportive roles, but still there exist a gap among farmers' adaptability in Sri Lanka (Research Paper). Author reiterate that there are certain impacts of climate change on paddy cultivation. However, government's support is not enough to cope adequately with climate change. There is a high sensitivity of paddy cultivation in Sri Lanka, principally due to increased temperature and decreased rainfall regimes and extreme climate events. Government has promoted some initiatives in order to mitigate and adapt to climate changes. Some polices and strategies have been developed to address climate change adaptation and mitigation. However, even the most effective mitigation measures would not be able to completely reverse the atmospheric processes, which are set in motion to cause climate change (Costa 2010). Author reiterates that implementation of effective adaptation measures to climate change requires leadership at the top administrative level as well as willingness to pursue those adaptation measures at grassroots level. However, paddy farmers at ground level are not much aware about these adaptation measures. Hence, rice growing farmers are often vulnerable to the impact of the climate changes. Extremely low rainfall and severe drought during 2003 and 2004 respectively caused damage to crop cultivation during those years. According to Costa (2010), 52652 ha of crops were damaged affecting 231,076 families. The drought relief allocations cost 477 million Sri Lankan Rupees. Floods are a common occurrence during the monsoon seasons in the country and it has caused substantial crop damage and displaced large number of farmers.

Conclusion

This study focused attention to assess the impact of climate change on agriculture and vulnerability of rice growing farmers. It reveals that generally both irrigation and rain-fed farmers are vulnerable to changing climate. However, rain-fed farmers are relatively vulnerable to changing climate. It is observed that vulnerability caused to climate change is due to low level of education of the farming community, they poor economic background, available infrastructure and technology. In the Sri Lankan context, many of the rice growing farmers are smallholders who are highly vulnerable to climate change. Government policies and strategies which are formulated to climate change adaptation and mitigation are also not effectively implemented to minimise vulnerability of the rice growing farming community. There exists a gap between implementation and the climate change adaptation plan and the policies. Hence, it is imperative that all stakeholders address these issues collectively regarding infra-structure development introducing innovative technology introducing innovative and practical strategy to withstand and recover for a impact of extreme events of climate change and rainfall pattern.

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A Call for Action to Mitigate the Cost of Natural Disaster in the Agricultural Sector: A Case Study

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Abstract

India's topography, geo-climatic conditions as well as the prevalence of socio-economic vulnerability among the marginalised and weaker sections make it a disaster prone country. Fifty-five per cent of the country's total area is in seismic zone III to V and is vulnerable to earthquakes, sixty per cent of the net area sown is vulnerable to drought, four crore hectare of land mass is vulnerable to floods, sub–Himalayan/western Ghat is vulnerable to landslides and the coastal states are vulnerable to cyclones. Apart from the natural disasters, the entire country is prone to man-made disasters.

The high susceptibility of the country makes it imperative to have a thorough disaster management plan in place. This point of view has been developed on the basis of research methodology and policy initiatives and guidelines issued by different agencies involved in mitigating the impact of natural disasters in India.

Thus, disaster management has emerged as an important aspect of Public administration. India has taken many policy initiatives and formulated strategies for prevention, mitigation and management of disastrous situations before and after natural calamities. As Article 21 of the Indian Constitution guarantees every person the right to life and personal liberty, it casts a positive obligation on the State to ensure steps for prevention, preparedness and mitigation of disasters. Further, Article 38 directs the state to promote the welfare of people. Therefore, in the Concurrent list of the Constitution, the states can also make its own Legislations on the subject under consideration., An attempt will be made to study the cost of natural disasters in the agriculture sector. Agriculture still remains the mainstream of the people in India as it is backbone of the Indian economy. Despite major emphasis on increasing industrial output especially after the major reforms carried out in 1990's, agriculture dominates the economy. It is the main source of employment generation apart from meeting the food needs of the country. Due to constraints of time, an attempt has been made to study the cost of natural disasters in one sector that is of agriculture and to mitigate it's affect in one state that is, Himachal Pradesh where a majority of people still depend on agriculture. As it falls in Seismic Zone V, Himachal Pradesh is exposed to frequent natural disasters of various intensity. Their impact on society and land is one such problem that hampers the development process of the State. Earthquakes, landslide, cloudbursts, flash floods, avalanches, forest fires, hailstorms, etc. have caused tremendous loss to the state. Besides loss of life, these disasters also strain the state exchequer. The limitation of this article is that an attempt will be made to assess the damages caused due rain during monsoon period over the last few years. The major indicators like human life lost, animal lost, houses damaged, damage to roads, infrastructural facilities, agricultural crops and horticultural crops. In the end, an effort will be made to suggest ways and means to bridge the gap between the expectations and the response efforts by the State Administration.

Keywords: natural disasters, socio-economic vulnerability, agriculture sector, damage assessment, response efforts

India's topography, geo-climatic conditions as well as the prevalence of socio-economic vulnerability, among the marginalised and weaker sections of the population, make it one of the most disaster-prone countries in the world. Fifty-five per cent of the country's total area is in the seismic zone III to V and is susceptible to earthquakes. Sixty per cent of the net area sown is exposed to drought, four crore hectares of landmass to floods, sub-Himalayan/ Western Ghats to landslides and the coastal states are vulnerable to cyclones. Apart from natural disasters, the entire country is also prone to man-made disasters.

Disaster management, as an important aspect of Public Administration, is put to test in the event of catastrophe (Ray 2001). This is true in the case of the high susceptibility of the country making it imperative to have a through management plan in place. This point of view has been developed based on the research methodology adopted by

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reviewing the existing literature, policy initiatives and guidelines issued by different agencies at the international and national level in mitigating the effects or impact of natural disasters in India.

India has taken many policy initiatives and formulated strategies for prevention, mitigation and management of disastrous situations before and after natural calamities. Article-21 of the Indian Constitution (https://india.gov.in) guarantees that no person shall be deprived of his life or personal liberty except according to procedure established by law. It casts a positive obligation on the State to take all possible steps for prevention, preparedness and mitigation of disasters.

This point of view is further substantiated by Article 38 that the State shall strive to promote the welfare of the people by securing and protecting as effectively as it may, a social order, in which justice, social, economic and political, shall inform all the institutions of the national life. Hence, it is the duty of the State to secure a social order for the promotion of the welfare of the people. Further, the States have been empowered in the Concurrent List of the Constitution to make its legislations on the subject under consideration.

Objectives of the Study

In this article, an attempt has been made to study the status of disaster management and governmental programmes in the context of mitigation and preparedness of disasters in Himachal Pradesh. The broad objectives of this study are to assess:

1. Hazard and vulnerability profile of Himachal Pradesh; and
2. The extent of damages due to heavy rainfall in the State.

Research Methodology

The methodology followed in this article was to utilise the secondary data published by the different government agencies, non-governmental organisations and informal interviews with the various sections of the society. Hence, the approach is deductive. The diagrammatic representation of the hazard profile has been given in Figure 1. It is evident from the Diagram that hazards in Himachal Pradesh have been classified into five major categories, viz. hydro-meteorological, geological, industrial, man-made and biological. It is nowhere mentioned that heavy rainfall in a country/state can create havoc no the economy. Hence, in this article, the thrust is to study the impact of heavy rainfall as a natural disaster in the agriculture sector. Therefore, an attempt has been made to highlight the persisting gap and to rethink the concept of disaster management in a situation as it occurs in a state.

The central theme of this article can be two-fold:

(a) Understanding the disaster risks in Himachal Pradesh; and
(b) Evaluating the impact of damage due to monsoons over the years in the agricultural sector.

Agriculture has played a dominant role in the development of the State and India. The study aims to fill the current gap of impacts of disasters triggered by national hazards in the agriculture sector. The major indicators are human life loss; animal loss, houses damaged, damage to roads, infrastructural facilities, agricultural and horticultural crops.

Profile of Himachal Pradesh

The State of Himachal Pradesh comprises 30 former princely states and areas ceded by Punjab. It came into being centrally administrated territory on the April 15, 1948, eight months after India's independence. It was declared a State of the Indian Union with Shimla (formerly Simla, Summer residence of the British Viceroys) as its capital on 25th January 1971. The population is around 6.8 million (2011) as explained in Table 1. Its density is 123 people per square kilometre. The district-wise area density and decennial growth of population in different districts in Himachal Pradesh are depicted in Table 2. It can be concluded from the given data that Himachal Pradesh is one of the smallest states. It is not as industrialised and developed as many other states of the Indian Union.

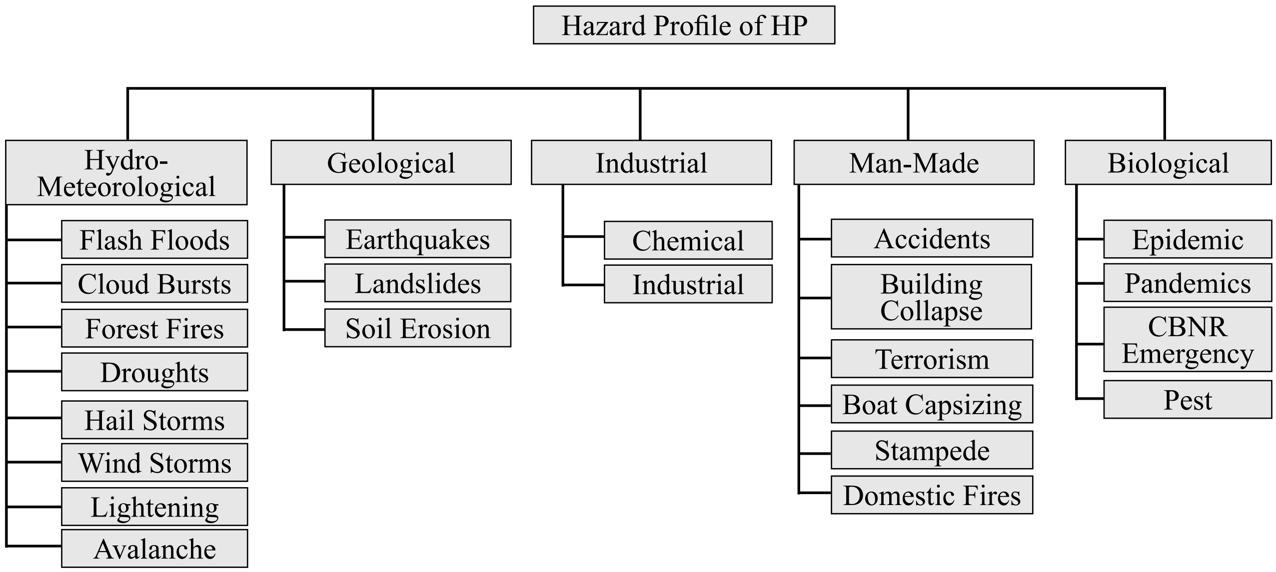

Figure 1
Source: Himachal Pradesh State Policy or Disaster Management, 2011, p. 3.

Table 1: Demographic Features Since 1901

Year	Population	Decennial Growth rate	Female Per 1000 Males	Density per sq. km (persons)	Scheduled Caste (Percentage)	Scheduled Tribes (Percentage)
1901	1920294	-	884	34	-	-
1911	1896944	-1.22	889	34	-	-
1921	1928206	1.65	890	35	-	-
1931	2029113	5.23	897	36	-	-
1941	2263245	11.54	890	41	-	-
1951	2385981	5.42	912	43	22.69	0.26
1961	2812463	17.87	938	51	22.88	4.35
1971	2460434	23.04	958	61	22.24	4.09
1981	4280818	23.71	973	77	24.62	4.61
1991	5170877	20.79	976	93	25.34	4.22
2001	6077900	27.54	968	109	24.72	4.02
2011 (P)	6856509	12.81	974	123	-	-

Source: Census of India (2011)

Table 2: Area, Density and Decennial Growth Population in Different Districts of Himachal Pradesh

S. No.	Districts	Area in sq. km	Total Population		Decennial Growth (2001-2011)	Density per sq. km (2011) (P) census
			2001 census	2011 (P) Census		
1.	Bilaspur	1167	340885	382056	12.08	327
2.	Chamba	6528	460887	518844	12.58	80
3.	Hamirpur	1118	412700	454293	10.08	406
4.	Kangra	5739	1339030	1507223	12.56	263
5.	Kinnaur	6401	78334	84298	7.61	13
6.	Kullu	5503	381571	437474	14.65	79
7.	L&S	13835	33224	31528	-5.10	2
8.	Mandi	3950	901344	999518	10.89	253
9.	Shimla	5131	772502	813384	12.58	159
10.	Simour	2825	45893	530164	15.61	188
11.	Solan	1936	500557	576670	15.21	298
12.	Una	1540	448273	521057	16.24	338
13.	Himachal Pradesh	55673	6077900	6856509	12.81	123

Source: Census of India (2011)

Limitations

The study is confined to the time period of 2013–2015 disasters that disrupted the progress and destroyed the hard-earned fruits of painstaking development effort, often pushing nations in the quest for progress back by several decades. This efficient management of disasters was response to their concurrence which has received increased attention both in India and abroad (Government of Himachal, 2011). In this article, an attempt has been made to assess the damages caused due to rain during monsoon period over the last few years.

Findings and Discussions

The Indian economy is heavily dependent on agriculture and the livelihood of the Indian farmer largely depends on the Monsoon rains. According to rough estimates, about 70 per cent of the Indian population depends on farming, either directly or indirectly and around 50 per cent of the total employment in the country is through agriculture. Also, the agricultural sector in our country contributes to around 18 per cent of Gross Domestic Product (www.skymetweather.com)

Hazard and Vulnerability Profile of Himachal Pradesh

Himachal Pradesh is prone to various hazards, both, natural and manmade. Main hazards consist of earthquakes, landslides, flash floods, snowstorms and avalanches, droughts, etc. The hazard which poses the biggest threat to the State is the earthquake hazard. The State has been shaken more than 250 times by earthquakes (Government of Himachal Pradesh).

Seismically, the state lies in the great alpine Himalayan seismic belt ranging from the Alps mountains through Yugoslavia, Turkey, Iran, Afghanistan, Pakistan, India, Pakistan, Nepal, Bhutan and Burma. As mentioned earlier, the impact of rainfall as a national disaster in the agricultural sector in Himachal Pradesh has not received attention over the period, although excess or failure of monsoon has a huge impact on the life of the farmers.

Profile of Agriculture in Himachal Pradesh

Himachal Pradesh is predominately a mixed farming state consisting of agro-pastoral, silvi-pastoral and agro-horticultural as it is hilly terrain. The State has 16,997 inhabited villages and 90 per cent of the State's population lives in the rural area.

The State's agrarian economy is only a little over 10 per cent of the total area which is cultivated. Population pressure on the cultivated land is high and holdings of most of the cultivators are small and scattered, 88 per cent of the farmers are small and marginal and their holdings are self-cultivated. About 20 per cent of the cultivated area is under irrigation and the remaining 80 per cent is rain-fed (Department of Agriculture (2017).

The central theme of the article concerns the issue of smallholdings and irrigation facilities that are connected only to 1/5th of the land. Hence, the farmers depend upon rainfall for their productivity. The characteristics of Agro-ecological zones have been depicted in Table 3.

Table 3: Characteristics of Agro-ecological Zones

Character	Zone-I	Zone-II	Zone-III	Zone-IV
Ecology	Low hill sub-tropical	Mid hill sub-humid	High hill temperate wet	High hill temperate dry
Geographical Area (0%)	35	32	25	8
Cropped Area (0%)	33	53	11	3
Irrigated Area (0%)	17	18	8	5
Altitude (MASL)	Up to 914	915-1523	1524-2472	2476-7000
Rainfall (cm)	100-150	150-300	100-200	200-500
Area (Districts)	Kangra, Hamirpur, Solan, Sirmour	Kangra, Mandi, Solan, Shimla, Sirmour, Chamba	Kangra, Mandi, Sirmour, Shimla, Kullu, Bilaspur and Chamba	Lahaul & Spiti, Kinnaur, Chamba, Kullu

Source: Agricultural Statistics at a Glance H.P., 2001

Considering the precipitation, altitude and irrigation, the State has been divided into four agro-ecological zones. It is evident from Table 3 that more than 70 per cent of the rainfall occurs during the monsoon season and for the rest of the year, there is a water shortage in areas where irrigation is scarce. Table 3 shows that most of the crop area lies in zone II where rainfall and irrigation are maximum and the least is in zone IV (Planning Commission 2005).

The distribution of operational land holdings and area operated by the size class of holdings in Himachal Pradesh has been shown in Table 4.

Table 4: Number of Operational Holdings and Area Operated by Size of Class of Holdings in Himachal Pradesh

Category	No. of Holdings	Per cent	Area (Hectare)	Per cent
Marginal (less than 1 hectare)	670425	69.78	273270	28.63
Small (1.00 to 2.00 hectare)	174596	18.17	243942	25.55
Semi Medium (2.00 to 4.00 hectare)	84868	8.83	230469	24.14
Medium (4.00 to 10.00 hectare)	27606	2.88	156459	16.39
Large (10.00 hectare above)	3270	0.34	50511	5.29
Total all sizes	**960765**	**100.00**	**954651**	**100.00**

Source: Compiled from Statistical Abstract of Himachal Pradesh (2015–16)

It is evident from Table-4 that 69.78 per cent of operational holdings fall under the marginal category, that is, less than 1 hectare about 97 per cent of operational holdings, all less than 4 hectares, covering about 78 per cent of the total area operated by marginal, small and semi-medium categories. Due to sub-division and fragmentation, landholdings have become uneconomic. Hence, the holdings are scattered and are often unmanageable and that becomes a limiting factor for crop production. Another major reason for uneconomic production is that 20 per cent of land comes under irrigation by canals and tube well. Approximately, in 80 per cent land of the remaining land, cultivation depends upon the rainfall. As mentioned earlier, 70 per cent of the rainfall occurs during the monsoon season and this crop area lies in Zone-II where rainfall is maximum during the monsoon.

An Assessment of the Extent of Damage due to Monsoon

The State of Himachal Pradesh received heavy to very heavy rainfall during the period of the study. The extent of damage assessed, furnished in Table 5, is based on selected indicators. The details of the damage caused in Himachal Pradesh are as follows:

1. Loss of Human Lives

It is evident from Table-5 that the number of human lives lost during the period has shown an upward trend. It was 29 in the year 2013 followed by 45 and 133 in 2015. Similarly, the total relief as compiled from records is on the rise. It was Rs. 5.32 crores in 2015 and by August 2016. This figure was ₹ 3.76 crores.

2. Loss of Animals

Around 23,449 animals including cows, sheep and goats perished in 2013. Loss on this account was assessed at Rs. 4.05 crores. The loss in the year 2014 and 2015 was comparatively less but it incurred Rs. 8.05 crores by August 2016.

3. Houses Damaged

Around 3,246 houses were fully or partially damaged in different parts of Himachal Pradesh due to landslides triggered by heavy rain and over all loss to property which was assessed at Rs. 100.00 Crores in 2013. The loss of the property was less during the following years.

Table 5: Extent of Damage

S. No.	Type of Damage	2013 (Rs. in crore)		2014 (Rs. in crore)		2015 (Rs. in crore)		2016* (Rs. in crore)	
1.	Human lives lost	29	-	45	0.70	133	5.32	94	3.76
2.	Animals lost	23449	4.05	698	0.22	686	0.59	81	8.05
3.	Houses Damaged	3246	100.00	127	3.71	3364	6.59	1004	4.61
4.	Damage to Roads	4100	1046.00	336	450.00	-	404.27	-	187.46
5.	Damage to Irrigation & WS	2263	214.12	2726	120.00	5307	214.52		78.46
6.	Damage to Agriculture Crops in Hectares	20573	200.37	12136	26.68		16.18		-
7.	Damage to Horticultural Crops (in hectare)	2.14	301.11	1550	173.40		104.00		
8.	Damage to Electricity Infrastructure		472.35		3.87		32.15		7.15
9.	Damage to Community/ Govt assets		165.00		50.00		2.55		3.08
10.	Loss to Fisheries		5.00		-		0.75		-
	Total		**2508.45**		**828.86**		**786.92**		**292.56**

Source: Compiled from Records 2016 (Information as on 09-08-2016)

4. Damage to Roads

Many districts of the State received a highly magnified rainfall which led to excessive damage to roads, bridges and culverts, etc. Further, Monsoon aggregated the situation leading to huge landslides, stretches of roads being washed away due to heavy and sudden inflow of rainy water carrying slush and big boulders, blockage of cross-drainage and blocking of roadside drains which landslides caused damage throughout the State, during the Monsoon period.

More than 4,100 roads in the State were affected during 2013 which led to the loss of Rs 1,046 crores in 2016 and the damage to roads was assessed at Rs. 187.46 crores during the period covered. In fact, during Monsoon, the worst-affected are roads, bridge and culverts, etc.

5. Damage of Agriculture Crops

Agriculture is the main occupation of the people of Himachal Pradesh which plays an important role in the economy of the State. About 70 per cent of the population is either directly or indirectly involved in agricultural activities. About 20 per cent of the income of the State comes from agricultural and allied sectors. As per the information given in Table-5, the extent of damage in the agriculture sector is high. The loss was assessed at Rs 200.37 crores during 2013 and Rs. 214.52 crores in the year 2015. The assessment of loss was carried out as per the NDRF guidelines for assessing the loss of agriculture cropped areas affected due to heavy rains.

6. Damage to Irrigation and Water Supply Schemes

The heavy rains during the period of study have led to huge damage to the water supply, irrigation, sewerage and flood control works. In Himachal Pradesh, the source for water of most of the water supply schemes and irrigation schemes are *khuds*/*nallahs*/ rivers. During the monsoon, landslides trigger damage to the assets of the schemes. Due to heavy rains, the loss was calculated to be Rs. 214.12 crores in 2013 and estimated at Rs. 78.46 crores till August 2016.

7. Damage to Horticultural Crops

Horticulture is an important sector of economic development in the State, which is contributing about Rs. 3000 crores towards the State economy (Government of Himachal Pradesh, 2014). The horticulture sector in Himachal Pradesh can generate more income and employment. It is evident from Table 6 that many marginal, small and other farmers have been affected due to rains. In certain parts, more than 50 per cent of crop loss has been reported during the period of study because the horticulture industry is exposed to various types of weather vagaries like hailstorms, droughts, strong winds, untimely and excessive rain. There was a huge loss of fruit crops in 2013. The losses calculated, as per the Government of India guidelines, amounts to Rs. 301.11 crores in 2013 and Rs. 173.40 crores in 2014.

8. Damages to Electricity Infrastructure

The electricity infrastructure has severely been damaged in many of the districts in Himachal Pradesh. The total loss was assessed to the time of Rs. 472.35 crores in 2013 and Rs. 32.15 crores in 2015.

9. Damage to Community/Government Assets

A lot of community assets in the State like Bhawans, community centres, villages paths, etc., get damaged during the monsoon period in the State. The total loss due to rains resulted in the loss of over Rs. 165 crores in 2013 and Rs. 50 crores in 2014.

10. Loss of Fisheries

Silt and flooding of the rivers, lakes, reservoirs have caused major damage to the fisheries sector. The total damage to fisheries was assessed to the tune of Rs. 5 crores in 2013.

It can be concluded from the above discussion that rainfall during the monsoon season played havoc and destruction during the time period of the study. It not only resulted in the loss of human lives but also contributed to huge economic loss. The monsoon plays a dominant role in Himachal Pradesh as it is an agrarian economy with 70 per cent of the land holdings depending on rainfall. The State receives majority of rains during the monsoon season, although, because of the topographical conditions, certain areas receive normal to above normal rainfall resulting in loss of human lives, animal lives and other losses as mentioned in Table 5 and Table 6

Mechanism for Calculation of Assistance

The Manual on Administration of State Disaster Fund and The National Disaster Response Fund (2013) has laid down the criteria for calculating the assistance (Appendix1). The Government seeks the amount of financial assistance from the Central agencies. As per 2014, the amount of Rs. 4,500 was sought for the rainfed agricultural area. It is Rs. 9,000 for agricultural irrigated area and Rs. 12,000 for the perennial category of crops. The Government of Himachal Pradesh has calculated the total loss arising out of agricultural input subsidy for the small and marginal farmers, based on the approved rates. Accordingly, an assessment of horticultural cropped area along with loss of agricultural and horticultural land is assessed.

Table 6: Assessment of Horticultural Cropped Area Affected due to Rains

year	**Name of Horticulture Crop Affected**	**Category-wise Number of Farmers Affected**				**Category-wise Affected Areas (in hectares)**				**Loss of Nursery Plants**	**Loss of Pros Any Trees**	**Expected Loss to Fruit Crops**	**Total Area Affected where Crop Loss is More 50%**	
		No. of Marginal Farmers	No. of Small Farmers	No. of Other Farmers	Total no. of Farmers	Marginal Farmers	Small Farmers	Other Farmers	Total Farmers			Qualitative Loss (MT)	Quantitative Loss (MT)	
2013	Fruits crops	48472	18572	12623	79667	26422	12220	3435	42077	165661	155541	70311	24145	2244
2014	Fruits crops	18912	10499	11731	41002	8204	3712	4418	17474	61583	135409	17987	3171	9827
2015	Fruits crops	27562	9746	4271	41579	16963	7900	4881	29744	11914	93599	49938	10465	5460

Source: Department of Horticulture, Himachal Pradesh

Present Institutional and Legal Arrangement

The National Policy concerning disasters has been framed keeping in mind the National Vision to build a safe and disaster-resilient India. In this connection, the Disaster Management Act, 2005 was passed to provide for effective management of disasters and matters connected with this. The Act lays down the institutional, legal, financial and coordination mechanisms at the National, state, District and Local levels. These agencies are expected to lay greater emphasis on the preparedness, prevention and mitigation of disasters. The National Disaster Management Authority (NDMA), as the apex body at the national level for disaster management, was established 'to build a safer and disaster resilient India by a holistic, pro-active, technology-driven and sustainable development strategy that involves all stakeholders and fosters 'a culture of prevention, preparedness and mitigation'. The NDMA is headed by the Prime Minister.

State Disaster Management Authority

At each state level, the State Disaster Management Authority (SDMA), under the Chairmanship of the Chief Minister, is responsible for disaster management in the State. The Chief Secretary is the Chief Executive Officer of the SDMA, who is responsible for coordination and implementation of response to disasters. Various Departments of the State ensure the integration of prevention, preparedness and mitigation measures, capacity building and preparedness for the Departments.

The State Executive Committee

The role of the State Executive Committee (SEC) is to coordinate and monitor the implementation of the National Plan and the State Plan. The SEC also provides for necessary technical assistance to District Authorities to carry out their functions properly and effectively.

State and District Crisis Management Group

The purpose of the State Crisis Management Group (SCMG) at the State level and District Crisis Management Group (DCMG) normally handle the crises situations arising out of disasters. Similarly, at the District level, District Disaster Management Authority (DDMA) has been created to identify the vulnerable areas to disasters and measures for the prevention of disasters and the mitigation of the effects with the help of local authorities. DDMA is headed by the District Collector and includes elected representatives and other officials to carry out its activities effectively.

Future Requirements

In this study, an effort has been made to understand the impact of monsoons on disasters. Therefore, effective disaster management must focus on minimising the loss of lives and property. It is beyond the control of mankind to stop the disaster but pains must be taken to reduce the risks through ingenious, timely and effective measures. Some of the major requirements for reduction of the adverse effects of disasters are:

Need to Understand the Nature

It is pertinent to understand the nature and characteristics of the disaster. Disaster risk reduction and management should be systematically embedded into the agricultural sector. Accordingly, the plans and the required investment should be pumped in, especially, in a state like Himachal Pradesh where agriculture is a critical source of livelihood for the people.

Agricultural Insurance and Compensation of Losses

Crop Insurance should be made compulsory so that it becomes a logical means to provide compensation and incentive to avoid the losses arising out of disaster. The insurance agencies and the State Governments should work together in reducing and assessing the compensation to the affected people on time. The claims should be settled in a prescribed time limit to avoid any hardships to the people.

Warning Systems

Warning systems should be in place in all major cities/towns and villages. These monitoring systems can be utilised to protect lives and property. Awareness campaigns about the utility of the warning systems should be carried out extensively in the State. This will work as a confidence-building measure among the people of the State.

Increased Financial Resources

Increased financial resources should be on the agenda of any nation and the State. It should be particularly directed towards the agricultural sector where the economy is based on agriculture. The Government should also rope in the private sector in dealing with this problem under Corporate Social Responsibility. This will help in achieving sustainable agricultural growth and in turn, will lead to better economic growth.

Reducing Risks from Flash Floods

It is evident from the discussion that the monsoon triggers flash floods in the country every year. Almost over 10 Indian states are under the impact of floods at present. Hence, the states should develop comprehensive policies and plans to link rivers across the country. Accordingly, the capacity of the institutions should be enhanced effectively to implement the plans.

Role of Communities and Local Government

People and local bodies like Panchayats and Municipalities should be consulted for the preparedness, planning, relief and rehabilitation work. Local bodies are the most appropriate institutions from the local level to the district in view of its proximity. Their involvement will help in countering disasters as well as in preventive and protective activities to mitigate the impact of the disasters. It is the right time to define the role of local bodies and sensitise the communities regarding preparedness and mitigation measures of disasters to minimise the destruction of life and property.

It can be observed that the disasters cannot be prevented but their impact on the lives and property can be reduced to the maximum possible extent. It will also help to mitigate the socio-economic aspects to a large extent. The greater responsibility lies with the National and State Governments to identify its role to help people in crisis. Lastly, the people themselves should play a greater role with responsibility to face disasters bravely rather than depending solely on the State Governments

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Appendix-1

Format of Summary of Damages Caused by the Natural Calamities and Calculation of Financial Assistance

S.No.	Items/Sectors	Amount Required (Rs. in Lakhs)
1.	Gratuitous Relief	
2.	Search and Rescue Operations	
3.	Relief Measures	
4.	Clearance of Affected Areas	
5.	Agriculture	
6.	Animal Husbandry-Assistance to Small and Marginal Farmers	
7.	Fishery	
8.	Handicrafts/Handloom-Assistance to Artisans	
9.	Housing	
10.	Infrastructure	
11.	Procurement	

Natural Disasters in Agriculture of Bangladesh and Management Practices

Nasim Banu[a]

Abstract

The purpose of this paper is to identify and impact analysis of natural disasters that affect agricultural production of Bangladesh and to summarise the various activities that have been taking place in the public sector to minimise the agricultural loss and damage from natural disasters and environmental stresses based on collected facts and figures using simple research methodology.

Bangladesh is a country of the highest density of population with the scarcity of land; here land is used primarily for agricultural production that includes crops and non-crops. Agricultural is the mainstay of the national economy and has been supporting major developments of the country. The agricultural sector's contribution to GDP growth is 3.5%, it employs 47.5% of labour force and earns 5% of export. Bangladesh agriculture is mostly dependent on the nature which is full of uncertainties and increasing vulnerabilities like a flood, drought, cyclones with tidal surge and salinity intrusion. During 2006-11, Bangladesh experienced aggregate losses of US$ 114 million from 11 floods and US$ 2,570 million from 15 cyclones. Flood is a regular phenomenon of Bangladesh; anywhere from 30% to 50% of the country is affected by flood, which results from heavy rainfall in the monsoon and water flow coming from the upper stream. Normal river floods regularly affect 20% of the country which increase up to 68% in extreme years. Floods with high magnitude inundate large areas and cause huge loose to crop production. Flood also caused river-bank erosion thus, when erosion is associated with widespread flood the magnitude of destruction becomes enormous with loss of sanding of crops and cultivable land. Cyclone accompanied by storm surges is another major natural disaster that destroys crops; forest and livelihood assets of the victim for survival; kill livestock and; inflict human casualties. Saline water intrusion affected area raise 10% in the monsoon to over 40 per cent in the dry season in the coastal belt, which affects agricultural production including mangrove forest in the dry season. Bangladesh is predominantly an agricultural country thus, the main objective of its planning envisages protecting agriculture from natural disasters. To mitigate the impacts of floods Government has been developed and implemented flood control, water management and, flood early warming system projects, utilised groundwater sources for irrigation to combat the drought situation and, established the institutional framework to construct coastal embankments to protect agriculture from tidal surges and saline water intrusion. The dominance of structural measures and billion dollars investment is seen in Bangladesh as the primary mode of agricultural development, besides that, Bangladesh is needed regional cooperation on flood management, strengthening disaster forecasting and timely dissemination of warnings to the vulnerable peoples and enhancement of their capacity towards resilience.

Keywords: natural disaster, agricultural production/loss/damage and Bangladesh

Introduction

Bangladesh is a country with a geographic area of 144,000 sq km where the population of 163 million depends on agriculture includes livestock, fisheries and forestry which are very sensitive to climate change. From the intensifying global climate change Bangladesh is at high risk, which is adversely impacting both human and natural systems; human systems include rivers, water bodies, agriculture, etc. and natural systems include rainfall, mangroves, tropical forests, ecosystem, etc. Natural disasters like floods, drought, cyclones with tidal surges and salinity intrusion are becoming more frequent and devastating in terms of economic losses and human casualties in Bangladesh due to its geographical location, global warming and climate change associated with a high density of population. Natural disasters destroy infrastructure, properties, agriculture includes crops, livestock, fishery, forestry and economic activities of the country and thus, poverty prevails. Agriculture is the mainstay of the country by its share in GDP and employment. During the sixth five year plan period (2011–15) agricultural sector achieved

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GDP growth of 3.5 while the average GDP growth was 6.3. Agriculture employs 47.5 per cent of labour force, about 5 per cent of total export earnings (GoB, Seventh FYP, 2015)

The soil of Bangladesh is alluvial and fertile; there is variation in climate and sufficient water is available in the monsoon which supports agricultural production in the country throughout the year. Heavy rainfall in the monsoon and the three mighty rivers the Ganges, Brahmaputra and Meghna having networks of more than 200 streams and tributaries is the main source of agricultural water; though Bangladesh has very little control over the water resources as it enters from the upper riparian county. Heavy rainfall in the monsoon and extreme water flow of rivers is main cause of natural disasters in form of flood and river erosion. Besides that, costal zone of the country frequently suffers water-related hazards due to cyclones with tidal surges, the cause of salinity intrusion.. During 2006–11, Bangladesh experienced aggregate losses of US$ 114 million from 11 floods and US$ 2,570 million from 15 cyclones (Skander et al. 2016). Most of these losses occur to agriculture, which has been playing a significant role in the development of the country. Thus, the solution to the threat of natural disasters for agricultural production has been a national objective of the plan, planning of the Government of Bangladesh to ensure that resources and operations in the public sector produce the best possible results in counter disaster efforts.

The core objectives of this paper are to identify and take stock of disasters, which mainly hamper the growth of agricultural production in Bangladesh; to analyse public sector practices and operations in managing disasters in bringing food security and environmental sustainability to the country. To meet the objectives attempts have been made to describe impacts of some selected natural disasters on agricultural production in Bangladesh collecting information and data from government documents, reports and related literature and finalising the paper having unstructure interview with concerned policy makers, experts and disaster management officials.

Impacts of Natural Disasters on Agriculture

Bangladesh is a low-laying deltaic country having more than 310 rivers and tributes. The country's environment is under threat from natural phenomena include floods, river erosion, drought, cyclones accompanied by storm surges and salinity ingress in the coastal belt mostly due to its geographical locations, monsoon climate and the impacts of global climate change.

Flood

Bangladesh has been experiencing twin problems of excess water during the rainy season and scarcity during the dry period. An excessive rainfall causes flood threats overhang as serious risk to agricultural production, so is aridity that effects overall water availability for crops and non-crops production. Flood is a regular phenomenon of the country; some 30 to 50 per cent of total land and surface (GoB, Sixth Five Year Plan, 2011) is affected by floods which results from heavy rainfall in monsoon, drainage congestion, high tides/storm surges and overflowing of major rivers of the country with high water level coming from the upper stream. Normal river floods regularly affect 20 per cent of the country which increase up to 68 per cent in the extreme years (GoB, 2010) Normal floods provide vital moisture and fertility to the soil, are considered as a blessing for crop production. However, floods with a high magnitude that inundate large area of the country with large-scale destruction to agriculture and cause death of people and livestock, render people homeless and damage homes and infrastructure. Flood also causes river-bank erosion thus, when erosion is associated with widespread flood the magnitude of destruction becomes enormous with loss of sanding of crops and cultivable land.

There are four types of floods in Bangladesh namely: (i) Flash Flood- is encountered in the northern and eastern part of the country during April-May and September-November; (ii) Rain Flood- triggered by heavy rains and drainage congestion: (iii) Monsoon Flood- caused by major rivers during mid-August to mid-October: (iv) Coastal Flood- caused by storm surges and tides. Heavy rainfall in monsoon; snow melting in the Himalayas during August-September; deposits sediment in river beds causing drainage congestion; deforestation in the catchment area; unplanned construction of roads, embankments; depressions in the Bay of Bengal and magnitude of the wind and; construction of barrages in rivers by riparian country are the primary causes flood in Bangladesh. Majority of the agriculture-based households suffer losses of standing crops; landless household suffer from unemployment and; women to marginal land owners mostly suffer from loss of homestead like vegetable, livestock and poultry production during the flood period.

Bangladesh witnessed extreme floods in 1974, 1987, two consecutive floods in 1988, floods in 2004 and 2007. The floods of 1988 altogether lasted for 65 days started from July 12 to September 14. The inundated areas and economic losses of the said floods are as follows:

Table 1: Past Major Floods in Bangladesh

Events	Flood: 1974	Flood: 1987	Flood: 1988	Flood: 1988	Flood: 2004	Flood: 2007
Affected area (%)	40	30	60	67	38	42
Economic Loss (US$ in million)	Crop production lowered by 15%	1.0	1.2	2.8	6.6	2.2

Source: Quashem, 2001 and GoB, 2010

Besides the floods shown on the able above, there was a flood in 1984 and 2000. Due to the flood of 1984 seasonal losses of the first three crops, i.e. Boro, Aus and broadcast Aman were about 01 million Mt and causing reduction in employment estimated 25 million person-days. In 2000, the country faced unusual floods in flood-free south western part of the country that caused massive damage to agriculture and infrastructure.

This year, 2017 Bangladesh is experiencing one of the most severe floods; more than one-third of the country and 3.9 million people in 20 districts have been affected; pre-monsoon and monsoon floods of this year submerge vast swathes of land destroying Boro and Aman rice of about 3,62,000 hectare. In March-April 2017, Bangladesh has faced pre-monsoon severe flash flood in the Hoar area of six districts in the northeast region, i.e. Sunamganj, Moulvibazar, Habiganj, Sylhet, Kishoreganj and Netrokona caused huge damage to crop production. Flood has destroyed nearly ready for harvesting Boro rice in about 160,170 hectors areas. Heavy rainfalls as well as onrush of water from the upstream have led to the inundation of vast areas of croplands of Haor and low-lying northeast areas of the country.

Table 2: Loss in Hoar Flood, 2017

Destroyed Area of Rice Production	Loss of Rice Production	Loss of Local Farmers Day Labor	Damaged Potential Rice Crop	Loss due to Damaged Rice Crop (US$)
1,60,170 hectare	8,00,000 Mt	19,22,04,000 person day	354840 Mt	10,645.2 million

Source: Ministry of Agriculture

Besides, flood in Hoar, Northern part of Bangladesh has also faced severe flood from mid-July as on now mid-August due to excessive monsoon rainfall and upstream water flow which has water logged population of the affected area and damaged crops. The central part of the country i.e. Faridpur, Munshiganj, Shariatpur and Rajbari districts are affected by flood; people believe that the misery and suffering of this flood, 2107, is not less than that of 1988. However from an agricultural point of view, northern districts Rangpur, Kurigram, Gaibandha, Lalmonirhat, Nifamari, Shirajganj, Jaypurhat, Bagora and Tangail are the worst affected; flood destroyed standing crops, mostly rice, and delayed next crop production at least for another 2 months. According to the preliminary estimation of Agriculture Extension Directorate, the flood has damaged vegetable crop of 3,317 hectares and Aman crop of 2,01,000 hectares (Daily News Paper Kalerkantho 15 & 18 August, 2017); the details are given in the Table 3.

Table 3: Affected Crops Production

	Rangpur	Lalmonirhat	Nilfamari	Kurigram	Gaibandha	Tangail	Shirajganj	Jaypuhat	Bagora
Afeected crops area	38,000 hectares	31,000 hectares	38,000 hectares	46,000 hectares	30,000 hectares	23,000 hectares	15,000 hectares	15,000 hectares	11,000 hectares

The Government of Bangladesh had reported the severity of Flood, 2017 which is given in Table 4.

Table 4: Damage due to Flood, 2017

District Affected	People Affected	Home Damaged	Death Toll	Emergency Response Plan
32	more than 8 million	620,000	145	US$ 12 million

The flood of 2017 has caused huge damage mostly to domestic rice production that destabilised the food stock of the country and hence, the government had taken an emergency step of importing rice form countries like India, Myanmar and Vietnam to meet crisis ensuring food security for the national populace. Flood is also the major cause of river bank erosion which is quite high at the beginning and receding time of the flood. The magnitude of the destruction is enormous when erosion is associated with flood, around 10,000 hectares of land is eroded per year in Bangladesh (GoB, NWMP, 2001). A study shows that during 1973-2004, bank river erosion along Padma and Jamuna River was 29,390 and 87,790 hectares of land respectfully (CEGIS, 2005); the eroded land was mostly agricultural land.

Drought

Another unpredictable natural hazard is drought which affects seasonal crops of Bangladesh as well as fruit-bearing trees, forestry and environment. Drought is the reverse of flood; continual absence of rainfall or low rainfall causes drought, desertification in the Baridra area (northern part of the country) and inadequate groundwater replenishment in certain dire parts of the country. In the context of Bangladesh, drought can be defined as dry soil condition for a period when soil moisture supply is less than required for satisfactory crop production (Brammer, 1987). The northern region of the country suffers most from drought due to inadequate and uneven rainfall that causes loss of as much 17 per cent of paddy (GoB, 2010).

Drought creates uncongenial conditions having a lack of sufficient water required for the normal needs of agriculture, livestock and human use, generally associated with semi-arid or desert climates (ADB, 1991). Water shortage is the main effect of drought in Bangladesh which leads to reduction of stream flow, ground water and soil moisture. In the field of agriculture drought affects rice production most, based on severity of drought in Bangladesh crops loss ranges between 20 to 60 per cent (Iqbal, 2000).

Drought is a temporary, spatially irregular and non-periodic phenomenon, which generally affects farmers by reducing their crop production drastically (Quashem, 2001). Bangladesh gained independence in 1971 at the cost of human lives and economic devastation. Just after independence, the country faced drought in 1972 and then in 1979, 1981, 1982 and 1994–95 and hence, crop damage. The drought in 1972, 1979 and 1994–95 was the most severe reducing the rice production. The 1994–95 droughts were lengthy, continued from October 1994 to July 1995.

Table 5: The Severe Droughts in Bangladesh

Year of Drought	Affected Area (%)	Reduced Rice Production (Mt)
1972	42.48	-
1979	42.04	2.0 million
1995	40.00	3.5 million

Source: GoB, 2010

Cyclone and Storm Surges

Cyclones associated with storm surges cause catastrophic devastation's to life, agriculture, mangrove forest and properties of Bangladesh. Due to rising sea surface temperature and the presence of high vertical wind since independence in 1971 to 2009 Bangladesh witnessed 11 occurrences of cyclone with related storm surges in the Bay of Bengal which struck the coastal area of Bangladesh and caused catastrophic devastation with the death of more than 0.168 million people. The entire 710 Km long coastal belt of Bangladesh is exposed to a topical cyclone. Topical cyclones accompanied by storm surges destroy agriculture including forest, kill people, damage embankments and other infrastructure. The cyclones in 1985, 1991, 1997, 2007 and 2009 with storm surges are remarkable by their devastating character among which Gorky (1991) Sidr (2007) and Aila (2009) were most severe. Just a year before independence, the cyclone 'Bhola' attacked in November 1970 which took the life of 400,000 people. The devastating cyclone Sidr and Aila accompanied by tidal surge respectfully struck southern and south-western coast of Bangladesh washing away everything, affected people lost all their worldly possessions including standing paddy in the field and destroyed Sunderbans mangrove forest and hence, marginal and landless people lost their employment opportunity for which they had to migrate elsewhere to find jobs to survive. Aila alone caused estimated damage to agriculture US$ 155.30 million.

Table 6: Magnitude of Major Cyclones in Bangladesh

Date and Year	Maximum Wind Speed (Km/hr)	Strom Surge Height (meter)	Death Toll
25 May 1985	154	3.0-4.6	11,069
29 April 1991	225	6.0-7.6	138,882
19 May 1997	232	3.1-4.6	155
15 November 2007	223	4.5-6.1	3363
25 May 2009	90	1.8-3.9	170

Source: Banu, 2015

Table 7: Damage and Loss due to Devastating Cyclone in Bangladesh

Events	Bhola (1970)	Gorkey (1995)	Sidr (2007)	Aila (2009)
Area affected	12%	11%	48%	12.5%
Crops damaged	1.2 million acres	0.35 million acres	2.4 million acres	95,920 acres
Livestock lost	-	-	17,78,507 nos.	62,472 nos.
Home damaged	85%	10,00,000 nos.	23,00,000 nos.	1,81,028 nos.
People homeless	36,00,000 nos.	1,00,00,000 nos.	15,22,077 nos.	6,37,851 nos.

Source: Banu, 2015

Because of the funnel-shaped coast line; Bangladesh very often becomes the landing ground of cyclones formed in the Bay of Bengal. More so, due to global climate change, it is increasing the sea level surface temperature which creates sea events like cyclones with tidal surges. The cyclone intensity might have increased in Bangladesh as much as 10 per cent. However, when cyclone accompanied by storm surges hit it breaches the costal embankments destroying standing crops, salinity inundation and hence, diminishing economic activities, so the poor people losing their livelihoods has to migrate elsewhere.

Salinity intrusion is mostly a seasonal phenomenon in Bangladesh, which affects the coastal region of the country; the affected area raises 10 per cent in monsoon to over 40 per cent in the dry season (GoB, 2010). Agricultural production includes fisheries; livestock and Sunderban mangrove forest of the country are affected by salinity particularly in the dry season. High salinity in monsoon and dry season in the south-west part of the country is associated with the decrease of upstream fresh water flow as well as silting of major channels (WARPO, 2005). The upstream diversion of Ganges water has been marked with increased salinity which has engulfed more than 10,000 square miles causing manifold problems like crop damage, river water turning un-portable, increased incidences of water-borne diseases and disruption of industrial operations in Khulna industrial belt (Ali, Islam and Kuddus, ed., 1996). About 1.2 million hectares of arable land are affected by direct salinity intrusion which is expected to increase in the future (GoB, Sixth FYP, 2011). However, due to inundation from sea water and saline water intrusion inwards, the land for crop farming within a large coastal belt of Bangladesh is reducing gradually.

Management Practices in Facing Natural Disasters

Agriculture including crop production, fishery, poultry livestock and forestry is still the mainstay of Bangladesh economy which has been contributing to the national GDP, employment and export also. During Liberation War agriculture mostly food output damage was estimated at BDT 2400 million and thus, per capita availability of rice/wheat was to increase by 20%, so managing the situation Government of Bangladesh (GoB) spent US$ 320.80 million during 1973–74 importing 2.8 million metric tonnes (Mt) of rice and wheat. Before 1974, the country did not face any serious flood or natural calamity, 1973–74 the agriculture sector as a whole increased by 11 per cent over 1972–73. However, in July-August 1974 Bangladesh faced unprecedented floods seriously damaging Aus and Aman crops. Because of this flood employment opportunities declined to affect the purchasing power of the people who used to live on agriculture, thus, the impact of prevailing famine conditions was most severe in flood-affected areas. Climatically 1975 was a relatively good year for Bangladesh, there was no natural disaster and thus, production of food grains increased 14 per cent (Samad, 1983).Thus, managing the natural disasters, improvement in agriculture production has been the main concern of the plan and planning of Bangladesh.

As development effort Bangladesh has followed course of planned action since 1973 in a medium-term framework. In July 1973, GoB launched First Five Year Plan (1973–78), which was followed by Two Year Plan (1978–80). From 1980, the five year plan frameworks were restarted and during 1980-1995, i.e. second, third and fourth Five Year Plans (FYP) were implemented in succession, but after the expiry of the fourth FYP there was a planned holiday during 1995–97. Again in 1997, the FYP was reinstated; during 1997-2015 fifth and sixth FYPs were implemented and seventh FYP (2015–20) has started its journey. All the plans emphasised the development of rural development with food and agriculture thus, have been attempted to put together strategies and policies, with other constituent elements, bringing improvement in the field of agriculture to generate rural employment, food security and hence, reduction of national poverty. But the planning effort is frustrated by frequent natural disasters like flood, cyclone and drought, etc. The disruption of agriculture, particularly food grains production by natural calamities during the first, second, third and fourth plan periods are shown in Table 6:

Table 8: Food Grain Productions in Bangladesh During FYPs

Five Year Plan	Target Production (Mt)	Actual Production (Mt)	Shortfall (Mt)	Main Cause of Shortfall
First FYP 1973–78	15.14	13.11	2.03	Due to natural calamities like floods in 1974 & 1975, cyclone in 1974 &1975 and drought in 1975.
Second FYP 1980–85	17.50	15.80	1.70	Due to floods in 1984, cyclones in 1981, 1983 & 1984 and drought in 1979, 1981, 1982 & 1984.
Third FYP 1985–90	20.60	18.75	1.85	Due to floods in 1978, 1987 & consecutive severe floods in 1988, cyclone in 1985, 1986 & 1988 and drought in 1989.
Fourth FYP 1990–95	21.98	19.07	2.91	Due to natural calamities like flood in 1993 devastating cyclone 1991, severe drought in 1994 and salinity.

Source: GoB, Fifth FYP, 1998

Like crops, other non-crop constituents of agriculture production i.e. forestry, livestock and fisheries also plays important role by their contribution in GDP and employing labor force which are equally vulnerable to natural calamities like flood, cyclone drought and salinity.

Table 9: Contribution of Agriculture to GDP (%)

Sub-Sectors	2005-06	2006-07	2007-08	2008-09	2009-10
Crops	11.09	11.49	15.25	15.06	14.98
Livestock	2.36	2.36	2.30	2.36	2.42
Forestry	1.51	1.51	1.43	1.38	1.34
Fisheries	3.89	3.89	3.76	3.67	3.61
Total	14.97	15.35	15.25	15.06	14.98

Source: GoB, Sixth FYP, 2011

The growth of agriculture in Bangladesh is declining due to industrialisation and urbanisation. However still, the contribution of agriculture in the economy is about 19 per cent (Sixth FYP, 2011) which will continue to play a very important role in the country's economy. The growth performance in agriculture is mainly dependent on nature which is influenced by natural disasters hence, is full of uncertainties and vulnerabilities. So, sustaining agricultural production of the country and building resilience to natural calamities has been the continuing key issue of planning. Proper policy adaptation, crop diversification and efficient water management are considered by the policy makers as crucial elements in achieving sustainable agricultural growth. Thus all the FYPs have envisaged a target for increasing and expansion of agricultural production through flood control and drainage; expansion of irrigation; scientific use of fertiliser and generation of high yielding new varieties of seeds; providing institutional support and; bringing structural change within the agriculture sector.

Water Management

Improvement in agriculture is crucial for development; it ensures peace in economic development since most people in Bangladesh earn their livelihood from agriculture and agriculture stimulates the demand for manufacturing goods. Food grain production is the main activity within the agriculture sector accounting for more than two-third of all production engaging over 80 per cent of total cultivated land. Water resource management has been chosen to lead the substantial agricultural production growth which is guided by The National Water Policy, 1999; Coastal Zone Policy, 2005; Bangladesh Water Act, 2014 and Participatory Water Management Regulations, 2014. The water resource management cover (i) protection against flood in monsoon, river erosion, saline water intrusion and water-related hazards, i.e. cyclone accompanied by storm surge in the coastal belt; (ii) irrigation in the dry and wet season.

Under water management, GoB has been proceeding with a definite project to bring flood vulnerable land under improved flood control and drainage facilities. Bangladesh Water Development Board (BWDB) under the Ministry Water, resource is the main actor in the field of water resource management of the country. Up till June 2014 BWDB completed 776 under which: (i) 6.2 million hectare flood agricultural land has made flood free and drainage congestion, (ii) 1,572 million hectares has provided with irrigation facilities creating the necessary infrastructure and hence producing by-annual additional of 10 million Mt food grain, (iii) reclaimed about 10,020 sq. km i.e. about 0.10 million hectare land from the Bay of Bengal and (iv) constructed 11,283 km embankment of which 4571 km in the coastal area. Due to the implementation of these projects the nation has enjoyed benefits like: (i) creation of a secured environment for crop production, (ii) generation of rural employment, (iii) protection of land including agricultural land from river erosion, (iv) security from flood, drought, water logging, cyclone, storm surge and saline intrusion, (v) primary protection against the impact of sea-level rise due to climate change and (vi) augmentation of agro-based economic activities in a flood-free secured environment (Seventh FYP, 20150). Against the set target of 3.64 million hectare during the fourth FYP period 3.84 million hectare flood land was brought under flood control and drainage facility which has increased by 5.90 hectare in June 2009.

Besides, BWDB, the Local Government Engineering Department (LGED) under the Ministry of Local Government and Cooperatives is another actor for the management of water resources but in a small scale. During 1995–2015, LGED has developed around 720 sub-projects for water resources with participation of the local stakeholders and communities which improved the sustainable use of water resources manage around 450,000 hectares of land in the sub-project area (Seventh FYP, 2015). These small-scale management practices have been proven to improve food production, women empowerment and hence, poverty reduction of that particular area.

Irrigation

Expansion of irrigation system has been the most important determinant of the country's agricultural growth in facing the challenge of damage to irrigation infrastructure by natural disasters. Irrigation has been supporting high-yielding crops enabling Bangladeshi farmers to go with multiple-cropping freeing them from dependence on rain. Bangladesh is in the wake of continued stress on surface water during the dry season, the situation becomes severe when the drought exists. In the dry season extraction of large quantities of sub-soil water and withdrawal of available river water is used for irrigation. Ground water irrigation has been proved as the major driver of crop production, which are mostly based on shallow tube well (STW), but deep tube well (DTW) are also being used in extraction for irrigation. It is extended over 5.5 million hectares of 8.0 million hectares land of the area where ground water is used by installed shallow tube wells for irrigation. Irrigated Boro rice in the dry season has increased the country's rice production by more than 80 per cent during the last two decades (Sixth FYP, 2011). Extraction of large quantities of ground water will cause of depletion of soil nutrients and; due to climate change and excessive lifting of ground water has already been considered by the policy makers and experts as a threat to the maintenance of ecological balance. Thus, GoB has laid special emphasis to discourage the use of DTW and rain water harvesting for irrigation and accordingly Directorate of Agricultural Extension (DAE) has been working in awareness-building programme among the farmers.

Use of Fertiliser and High Yielding Variety (HYV) Seeds

During the last few decades' dramatic advancements have been made in global crop production with balanced use of fertiliser and developed new varieties of seeds with high yields. Bangladesh is also the beneficiary of practicing the global trend of agriculture on a significant scale. Fertiliser is considered as one of the critical inputs for increased agricultural production and has great demand for farmers. Considering the increased demand for fertiliser, it is an essential responsibility of the policy makers to promote balanced use for fertiliser at the right time in correct quantities. Therefore, GoB ensures the production and timely supply of fertiliser at a subsidised rate to the farmer according to their demand. and The public policy makers/experts are alert from, unscientific and imbalanced using of chemical fertiliser which causes land degradation resulting in decline in soil fertility and as well reduction in yield. So, the government has been given emphasised the production of natural friendly bio-fertiliser and pragmatic measure to encourage farmers using balanced fertiliser for increased production and to maintain soil fertility.

Bangladesh Agricultural Development Corporation (BADC) under the Ministry of Agriculture is the main actor for the development of agriculture in the country. BADC has been concentrated its efforts on the production of HYV seeds of crops and non-crops in the seed farms and also using farmers to multiply seed on a contract basis beyond the foundation seed. The government has been given: emphasis to create facilities and infrastructural support for hybrid seed production of climate resilience varieties for saline drought-tolerant; training and technical assistance to farmers to extend the improved method of seed production. 'BRRI Dhan" and 'Hori Dhan' is the best example of HYV development. Bangladesh, meanwhile developed high yield saline tolerate jute seed and cultivated with the newly developed seeds this year under a pilot project in the Shatkhira district, the most saline intrusion area of the country, highly satisfactory production was found; this will change the scenario of jute production. Meanwhile, through the development implementation of HYV, per acre crops production in Bangladesh has doubled than the 1970s. About 50 per cent of cropped area of the country is now under HYV, with the current development rates soon almost all the suitable land will come under HYV network (Sixth FYP, 2011).

Agricultural Research

The growth of agriculture largely depends on development in research. Bangladesh has established some autonomous research institutes like (i) Bangladesh Rice Research Institute (ii) Bangladesh Agriculture Research Institute (iii) Bangladesh Jute Research Institute (iv) Seed Research and Development Institute (SRDI), etc., to conduct service-oriented research for the growth of agriculture in the country. Agriculture research is an ongoing priority activity of GoB under its National Agricultural Research System (NARS) coordinated by Bangladesh Agriculture Research

Council (BARC). Continued production growth in Bangladesh is visualised from progress in research emphasising stress-tolerant climate change effects, diversification of natural disasters resilient agricultural production, development of varieties/species, pest and disease management and, improvement on-firm water management.

Table 10: Improvement of Crops Production

Crops	Unit	Production 1974	Production 1978	Production 2011	Production 2015	Projected Production 2021
Foodgrains	Million Mt	11.83	13.10	34.51	35.25	38.21
Potato		0.72	0.85	8.33	8.76	10.43
Oil-seeds		0.214	0.264	0.40	0.45	0.52
Pulses		0.208	0.236	0.23	0.26	0.31

Source: Samad, 1983 & GoB, Seventh FYP, 2015

More so, the Government of Bangladesh has been providing institutional support to farmers for sustainable agricultural growth in facing common natural disasters. Agriculture credit is one of the most important components; inadequate access to credit hinders agriculture production, particularly, poor and marginal farmers. So, the government has been trying to extendi credit facilities at a lower interest through banking channels, cooperatives and even NGOs. The Department of Agriculture Extension has been entrusted to acquire up-to-date research findings on improved technology diversification to transfer them to the farmers and obtain feedback.

In responding to environmental challenges the government of Bangladesh has developed Climate Change Strategy and Action Plan (BCCSAP) and National Adaptation Program of Action (NAPA) in 2009, National Plan for Disaster Management (NPDM) and Standing Orders on Disasters (SOD) in 2010, National Environmental Policy (NEP) in 1992 and National Forest Policy (NFP) in 1995 to take appropriate initiatives in facing natural disaster and climate-resilient development with strategies, for sustainable agricultural growth, to conservation and enhancement biodiversity, use of surface water, reduce floods risk and pursue for effective flood and drought management and basin-wide trans-boundary river management.

Concluding Remarks

Bangladesh is predominantly an agricultural country thus, the main objective of its plan and planning envisages protecting agricultural production mostly from natural disaster events. Agriculture is an integrated activity with inter-relationship between crops and non-crops like livestock, fishery and forestry. The contribution of livestock to GDP averaged at 2.5 per cent during the fiscal years 2011–13 and currently employs 20 per cent of the rural workforce; the share of fisheries in GDP about 3.6 per cent which engages more than 11 per cent rural workforce and by exporting country has earned 4660.60 core foreign exchange during 2014–15 from this sub-sector and; in social forestry program of the country about 500,000 poor people are involved (Seventh FYP, 2015). Crops and non-crops of agriculture are equally vulnerable and at risk of natural disasters arising from intensified global climate change. The degradation of the environment in Bangladesh due global climate change rising the sea level the coastal belt of the country may be inundated, salinity will spread; excessive and low rainfall will continue to cause floods and drought. Considering the impacts of climate change GoB has been taken all the possible steps to reduce disaster risk, to protect mainstream agricultural production and from natural calamities and climate change issues into mid-term planning and budgetary process.

Geographically, Bangladesh is low-laying and flat situated at the bottom of the mighty river net work of the Ganges, the Brahmaputra and the Meghna with a long coastal belt; over 92 per cent of annual water enters to the Bay of Bengal through Bangladesh that flows from the upper riparian country; Bangladesh has little control over this water which is one of the critical aspects of flood drought and salinity. Thus, Bangladesh has to pursue more bi-lateral and regional cooperation with upper riparian countries in case of effective water and basin trans-boundary management to reduce the impact of flood, drought and salinity for agricultural growth.

Under the prevailing situation, agricultural loss due to natural disasters can not be stopped or tamped by any ad-hoc measures. For mitigation of disasters and to minimise losses GoB has been looking forward with the programme and task to:

- right forecasting by issuing weather bulletins and warning signals and setting up an efficient system for dissemination of disaster warning through institutional networks like BMD, SPARRSO, BWDB, Radio, TV and CCP to allow people and concerned government agencies as well as the NGOs to take proper preparation, for facing the disaster and reduce losses;
- organise public education and community mobilisation activities to promote greater awareness in relation to preparation and response to disaster. Comprehensive Disaster Management Program, a multi development supported program jointly managed by the MFDM has been working since 2004 in improving awareness and education to reduce the risk of disasters toward resilience;
- build embankments in coastal areas and on river banks and timely/rightly maintain them to mitigate on rush of surge, harmful saline effects and flood;
- effective use of land in forestation with community focused particularly in the coastal belt for absorption and weakening of disasters like cyclone/storm surges; and
- adopt appropriate law, standing orders, national-level policies, guidelines and action plan improving inter-sectoral coordination, arranging training, providing specialist disaster management services to concerned agencies and weighting to climate change adaptation and disaster potentials considering the disasters issues that includes: food security, social protection and health, comprehensive disaster management, infrastructure, research and knowledge management, mitigation and low carbon development and capacity building and institutional strengthening.

Undoubtedly, natural disaster is a major threat to sustainable agricultural production and its growth in Bangladesh which can not be eliminated but can be reduced through appropriate measures. This is a priority issue of the plan, planning and program of national policy makers and government has been utilising the national resources to combat the situation. The dominance of structural measures and billion dollars investment is seen as the primary mode of agricultural development, but limited national resources may take up all mitigation tasks. Bangladesh needs regional cooperation on water management initiatives and promotes evidence-based claims from the effect of global climate and its impacts of disaster events and resilience. However, intensifying global climate change is a threat to national development; regional countries including Bangladesh may work together for climate change management to protect and enhance their collective common interests in natural disaster risk reduction and climate change adaptive capacities.

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Disasters and Medicinal and Aromatic Plants (MAPs): Preparing Governance for Resilient MAP based Livelihoods in Uttarakhand

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Abstract

Uttarakhand, the Himalayan State of India located in north western part of the country is considered one of the major contributors in the medicinal and aromatic plants legacy of India. Throughout history the evidence of exemplifying the medicinal and aromatic plants for various purposes, such as to cure and heal the health conditions of humans and livestock, sources of livelihood, is evident. Nevertheless, at the same time the Uttarakhand by virtue of its unique geographical settings is also very much unpredictable for various kinds of disasters, like landslides, forest fires, cloudbursts and flash-floods and earthquakes (NDMA). As a result, the loss of biodiversity or the elements of biodiversity in the form of habitat destruction and extraction of high value species are major threats to biodiversity (FAO). But the impact of such types of disasters on the existence of MAPs is merely studied in contemporary studies.

In relation to some developing counties "The Food and Agriculture Organization of United Nations" (FAO), has conducted some studies concerning how the various kinds of disasters are affecting the incredible biodiversity of mother nature, but specific studies are not in existence. Often it has been seen that the protection of biodiversity remains concentrated within the boundary of land and forest, but the protection from such events gets little attention (FAO).

Since last three years Uttarakhand has been the victim of two major disasters, the one is the disaster of Kedarnath in the year 2013 and another is the massive forest fire of 2016. These disasters badly affected the lives and resources of the State. But, unfortunately, no information is available on the quantity of medicinal and aromatic plants are vanished or extracted from these disasters. This incident highlights the need to fulfill the information gap in the event of any occurring disasters. Moreover, the extraction of valuable species also leads to the destruction of the resources of livelihood of the associated communities. There are many departments which could be held accountable for the health and sustenance of the MAP sector. Resilience building would mean that these institutions be made functional and responsible towards the communities which they serve or towards the purpose for which they were constituted.

Although various agencies working for the development of MAPs such as state medicinal plant board (SMPB), herbal research and development institute (HRDI), center for aromatic plants (CAP) and the forest department are working towards the integrated development of the sector along with policy formulation, coordination and implementation (Kuniyal et al., 2015), but the focus on disaster related issue on the sustainability of medicinal and aromatic plants are not part of their policy documents. Thus, the conservation of the medicinal and aromatic plants in ordinary circumstances is well managed, but in case of any occurring disasters, their survival becomes challenging.

In this paper, based on a reflexive research approach conducted qualitatively and quantitatively, we have demonstrated the impact of different disasters on the diversity of medicinal and aromatic plants in Uttarakhand and its consequences on society, economy, livelihood and the ecosystem. The key objectives of this paper are (a) to revisit the major disasters and their impact on the existence of the medicinal and aromatic plants in Uttarakhand (b) to analyse the role of various institutions, such as research and development institutes, commercial organisations, non-governmental organisations, self-help groups community organisations, etc., in promoting the conservation and management of medicinal and aromatic plants in the event of any kind of disasters (c) how the gap in information is leading the loss of the valuable species of medicinal and aromatic plants and (d) how the proactive role of associated stakeholders could promote the conservation of the medicinal and aromatic plants before reaching them for extraction.

Keywords: Medicinal and Aromatic Plants (MAPs), biodiversity loss, stakeholder's role, conservation, management

Introduction

In the Indian context, the use and utilisation of herb and herbal-based formulations is too long to cure and heal the various health conditions of humans (Thakur, 2014). Similarly, the Indian traditional scripture and Vedic literature, such as Sushruta Samihta, Rig Veda, Atharva Veda, Charaka Samhita, Bhela Samhita, and the medical

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part of Bower Manuscript (Zimmerman and Veith, 1961; Raju, 2003; Loukas et al., 2010), demonstrated by various traditional herbalists of India, also firmly justify and describe the use and utilisation process of such herbs and herbal formulations for various health conditions.

The herbal legacy of India is fundamentally maintained by the Indian Himalayan Region (IHR), which contributes around 1748 species (32.2% of India) of valuable MAPs in the medicinal and aromatic plants sector of India. In IHR, Uttarakhand, the northwestern Himalayan State of India is endowed with rich diversity of medicinal and aromatic plants (MAPs) and represents nearly 40.10 per cent MAPs of Indian Himalaya Region (IHR) (Samant and Pal, 2003; Kuniyal et al., 2015). The inherent biodiversity of Uttarakhand is primarily attributed to its suitable Geo-climatic conditions and unique landscape of the region. Geographically, Uttarakhand is situated on the south slope of the Himalaya range which varies from glaciers in the high mountains to tropical forest at lower altitudes and forms different types of landscape and climatic conditions. In addition, the ancient scriptures of India on medicine and medical science, viz. Rig Veda, Charak Samhita, Sushruta Samhita, Ayurveda, and AgniveshaSamhitas (Aswal, 1993; Rautela, 1998), also describes the Himalaya as a suitable habitat and veritable emporium of medicinal and aromatic plants.

The flora of Uttarakhand includes 701 species (Bisht et al., 2016) of medicinal and aromatic plants (about 40.10 per cent of MAPs found in IHR), of that 31 % are native, 15.5 % are endemic, 14% are threatened elements (Dhar et al., 2000; Bisht et al., 2016). Out of 701 species, 28 species of MAPs are categorised as Globally Significant Medicinal Plants (GSMP) (Ved and Goraya, 2008; Kuniyal and Sundriyal, 2013, Kuniyal et al., 2015) by the government of Uttarakhand with an objective of cultivation and conservation from socioeconomic as well sustainability perspectives. In addition to that to acknowledge the herbal heritage of Uttarakhand, in the year 2003, the government of Uttarakhand has also declared Uttarakhand as “Herbal State” (Sati, 2013) and classify 132 species of medicinal and aromatic plants (indigenous and exotic) as substantial the economic and socio-economic development of the State (Kuniyal et al., 2015).

On the other hand, the various kind of issues related to trade, commercialisation and most importantly the several natural disasters are always associated with the natural sources of Uttarakhand create vulnerability

Role of Medicinal and Aromatic Plants in Livelihood

The bio-diversity is a leading source of livelihood in Uttarakhand (Ram, 2003), which includes agriculture, commercialisation of forest based products, fodder, an alternative source of energy and trade of medicinal and aromatic plants. The trade of medicinal and aromatic plants has a significant role in the household income of many rural communities in the region. It has been estimated that 17%-35% household income of rural inhabitants of the state comes through trade and sales of medicinal and aromatic plants (Chauhan, 2010).

The trade of medicinal and aromatic plants from the forest in the form of wild harvested MAPs is also a profitable source of revenue generation for the state government. In the year 2005-06, the sales of MAPs from Uttarakhand forest have generated ₹ 174.459 lakh, whereas up to March 2012-13, it has grown 274-914 lakhs. (UAFDC).

Disasters and Natural Resources

The Food and Agriculture Organization of the United Nations (FAO), 2015, in its report “The impact of disasters on agriculture and food security” clearly, mentioned that the ‘Disasters jeopardise agricultural production and development and often have cascading negative effects across national economies. That notation of the report heavily draws the intention of the policy makers and associated stakeholders that the various kind of disasters i.e. natural and manmade disasters always creates serious vulnerability for the natural resources.

Same as in agriculture the disasters also creates various negative impact on the sustainability and existence of other valuable natural resources such as medicinal and aromatic plants, which now has become an important commodity for the pharmaceuticals and big organisations.

The disastrous events primarily affect the existence of natural resources by distracting the habitats and by changing the pattern of landscape.

Institutions Working for the Betterment and Management of the Medicinal and Aromatic Plants in Uttarakhand

In Uttarakhand, because of the rich availability and yield of medicinal and aromatic plants, the state as well as central government has established various research and development organisations for the betterment and development of the medicinal and aromatic plants sector. These organisations are:

- National Medicinal Plants Board (NMPB)
- United Nations Development Programme (UNDP)
- State Medicinal Plant Board (SMPB)
- Uttarakhand Forest Development Corporation (UAFDC)
- Herbal Research & Development Institute (HRDI)
- Centre for Aromatic Plants (CAP)
- G.B. Pant National Institute of Himalayan Environment & Sustainable Development (GBPNIHESD)
- High Altitude Plant Physiology Research Centre (HAPPRC), HNBGU Srinagar Garhwal
- And other various non-governmental organisations and cooperatives are also working in the area of medicinal and aromatic plants

The common objectives of these organisations are the research and development of the MAP, sector; facilitating the farmers and interest group for Cultivation of medicinal and aromatic plants; providing marketing and commercialisation platforms for the farmers to facilitate them for their livelihood. These organisations are also very much concerned with the sustainability of the medicinal and aromatic plants in the State, but the sustainability and protection of these resources are surrounded by illegal commercialisation, overharvesting and extensive utilisation of the valuable medicinal and aromatic plant species. The sustainable perspective, from the disasters point of view is highly lacking in their objectives. Thus, the resilience for MAP based livelihood, in Uttarakhand, in the event of disasters is lacking.

Major Disasters of Uttarakhand and their Impact on Natural Resources

Uttarakhand is a sensitive ecosystem (Kala, 2014) therefore always remains vulnerable to various kinds of disasters. Like the disasters of Kedarnath in 2013 (Sharma et al., 2015) and the massive forest fire of 2016. Expert has estimated that the total loss of the land and resources is still uncountable and these disasters have washed out numerous natural resources and distracted the landscape in the various ecologically sensitive zones of the State. Thus, this has created a need to document and monitor the important natural resources, i.e. medicinal and aromatic plants for their sustainability and long-term existence.

The several challenges exhibit in the policy and institutional framework of the State become a barrier in the disaster risk reduction for medicinal and aromatic plants sector. Here we have discussed the various challenges and possible solutions through which the medicinal and aromatic plants based livelihood can be managed properly in case of any occurring disasters in Uttarakhand.

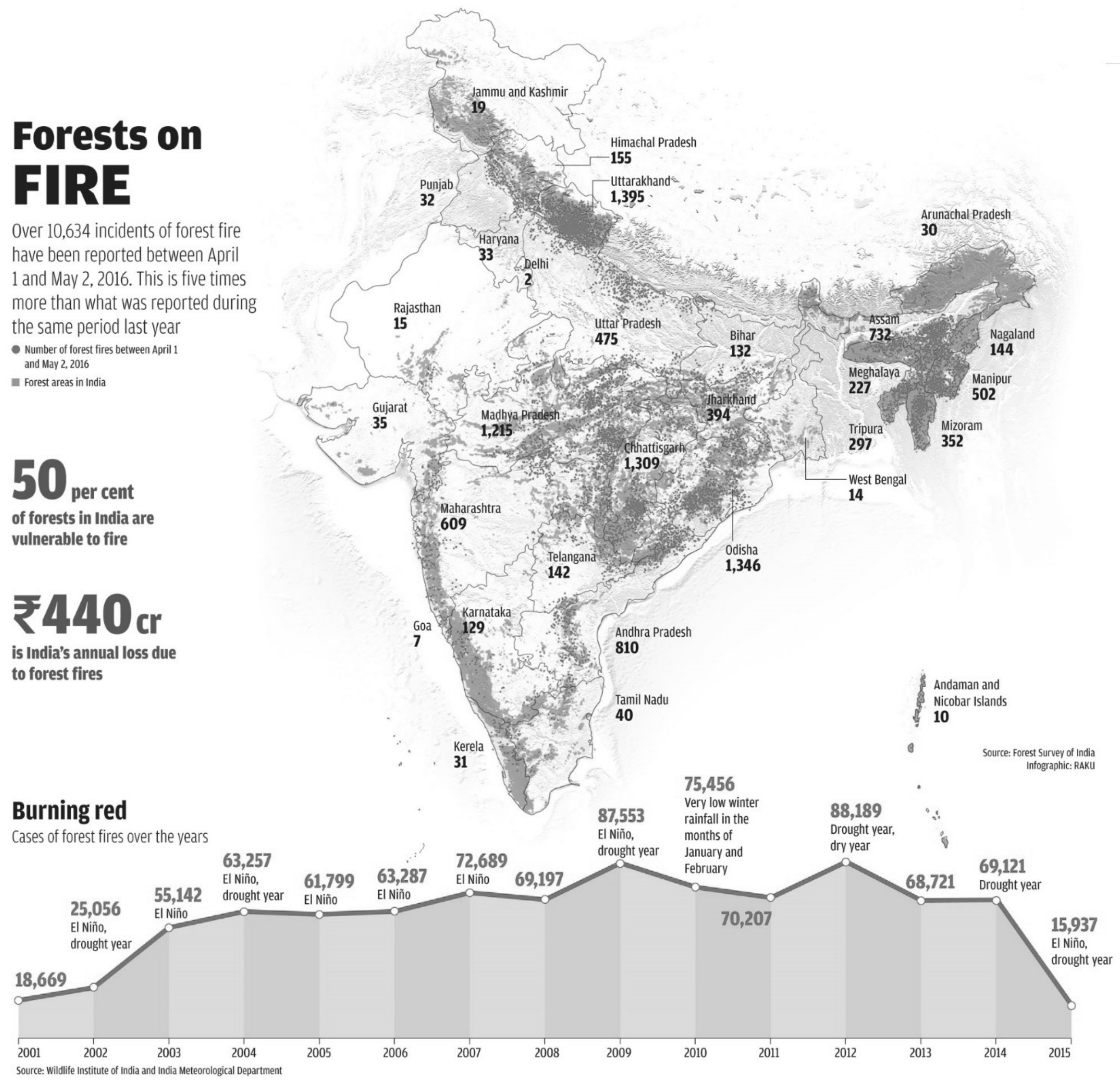
Policy Gap and Natural Resources in Uttarakhand

The policy gap embedded in the policy framework for medicinal and aromatic plants in Uttarakhand is affecting the sustainability of the natural resources (medicinal and aromatic plants) in Uttarakhand in the event of any occurring disasters.

Like the example of forest fire in Uttarakhand. The excessive fall of pine needles is usually considered a major cause of forest fire in the higher forests of Uttarakhand. As a result, the Himalayan ecosystem is increasingly deteriorating for the past couple of decades and the forest fire caused by pine needles is a prime cause for the same (Joshi et al., 2015).

Moreover, the strict legal regulations in Uttarakhand also prohibit public participation in conservational measures (Joshi et al., 2015) of medicinal and aromatic plants, hence community participation is also missing in the conservation of the resources. One another reason which also leads to the loss of resources in Uttarakhand in any disastrous event is the absence of quantitative information about the number of medicinal and aromatic plants susceptive to disasters in a particular area.

It is also calculated that about 50 per cent forests of India is very much vulnerable to forest fire and the forest is the major source of medicinal and aromatic plants as about 90 per cent of these plants are harvested from wild collection. Therefore, proper measures should be implemented to prevent and minimise the impact of forest fire on medicinal and aromatic plants.



Source: http://cdn.downtoearth.org.in/library/original/2016-05-16/0.39023500_1463399829_forest-fire-20160531.jpg

Informational Gap and Its Impact on Medicinal and Aromatic Plants in the Vent of Occurring Disasters

In line with the challenges suggested by FAO for the agricultural sector in the event of any occurring disasters, the medicinal and aromatic plants are facing the same but are far from the part of policy and implementations.

- The medicinal and aromatic plants sector is observing huge data gaps at global, national and regional levels to understand the impact of disasters on their sustainability and existence. Thereby hampering the resilient activities of the sector.
- FAO also focused on strengthening the regional and global database and information system based on available data to capture the extent and impact of disasters on the sector.
- The non-standardisation process of data collection is also leading the criticality for the disastrous events for the medicinal and aromatic plants sector.
- The regular monitoring and reporting of the existence of the medicinal and aromatic plants and the impact of disasters is the need of the hours.
- The systematic collection and monitoring of the damage information is also critical for measuring the impact of disasters on the medicinal and aromatic plants sector.

In order to meet the above challenges the necessary interventions are very much required as a part of the policy to tackle the loss and damage of these important resources and for the long sustainability of the medicinal and aromatic plants, as they are not only required to meet the need for the contemporary but they are also important ecosystem services.

Policy Intervention Required for Resilient MAP based Livelihoods in Uttarakhand

To reduce the impact of disasters on medicinal and aromatic plants, especially in the areas where the disaster causes heavy losses to natural resources, the following points are necessary to be addressed. These guidelines and points are also with the line of FAO guidelines for reducing the impact of disasters on agriculture and natural resources.

- Disasters risk reduction for resilience building in medicinal plants based livelihood has become an essential part of all the societies those directly or indirectly are associated with them. And it must be a priority for government and private stakeholders to invest n the sector for resilience activities.
- The disaster risk reduction and management, which are considered as a backbone of resilience must be systematically entrenched into the medicinal and aromatic plants sector and its development, as it is an important source of livelihood, contemporary medicine and a key driver of economic well being of many mountain communities.
- The activities and strategies of disaster risk reduction must be integrated with the post disasters recovery efforts in the medicinal and aromatic plants sector to ensure the investment made in the disaster response and recovery also build resilience for future occurring disasters.
- The Stage regime along with the support of national and global societies must find ways for financing the disaster risk reduction in the medicinal and aromatic plants sector of Uttarakhand to prevent and mitigate the future impact of disasters on medicinal and aromatic plants.

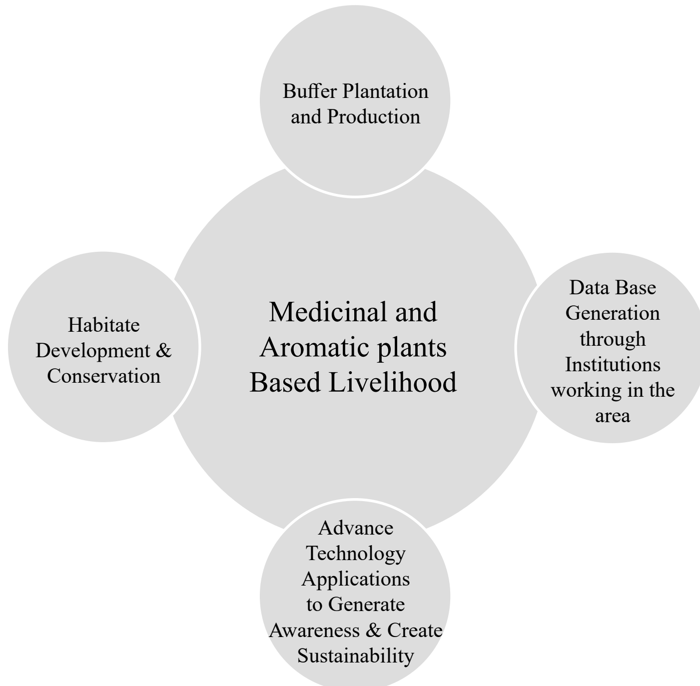


Figure 2: A framework for preparing governance for resilient MAP based livelihoods in Uttarakhand

Conclusion

This paper explores the current position and worth of the medicinal and aromatic plants sector in Uttarakhand the northwestern state of India and the importance of this sector for the native residents of the Uttarakhand for their livelihood and employment. But the policy framework which is currently embedded in the medicinal and aromatic plants sector is lacking a huge informational gap in terms of disaster risk reduction for the medicinal and aromatic plants sector. Thus the MAP based livelihood of the State is facing several challenges and instability. Hence the policy framework of the Uttarakhand State for the medicinal and aromatic plants sector needs immediate intervention associated with disaster risk and mitigation in the medicinal and aromatic plants sector.

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Nuclear Disaster and Sustainability of Indian Agriculture

Rajesh Kumar[a]

Abstract

The Fukushima nuclear disaster in 2011 destroyed thousands of farm buildings and fishing boats and resulted into widespread radioactive contamination of their soil, crops and marine environment including Pacific Ocean. India is expected to generate nuclear power to a tune of 60000 MWs by 2030 and it is faced with a dilemma that despite technological advancements guaranteeing zero accidents on-site, areas under mega nuclear power projects remain prone to being struck with nuclear disasters. Any natural hazard-induced nuclear disaster shall have serious ramifications for sixty per cent population dependent upon agriculture and food security for 3/4th population of the country. The paper analyses India's preparedness and capabilities of handling nuclear disasters and mitigating the risks. The first section, deals with reasons for India's huge dependence upon nuclear energy. Second Section, deals with post-disaster scenario and its likely to impact upon agriculture and food security in the country. The last section deals with the shortcomings and future policy interventions needed. The methodology used is content analysis and conduct of a random sample survey based upon a population of 350 University students. The paper is based on assumption that given vast population exposure and poor records of handling non nuclear disasters by the governments in past, managing the effects of nuclear disasters on agricultural production would be very difficult. The paper's contribution to Disaster Management Research would be as it focuses on the role of education and knowledge among youth of India in building a culture of resilience.

Keywords: nuclear disasters, impacts, Indian agriculture, education, knowledge management, culture of resilience, sustainability

Introduction

The 2011 Fukushima tsunami induced a nuclear disaster not only destroyed thousands of farm buildings and fishing boats along hundred miles of coastline, but rather it also resulted in widespread radioactive contamination of their soil, crops and marine environment. The release of large amounts of radioactivity have made a severe impact on the livelihoods of the farmers and fishing communities of the region. India in recent years has embarked upon a massive nuclear power generation programme to a tune of 60000 MWs, and it already has 22 nuclear reactors operational and several new nuclear reactors are coming up in the different Indian States. The issue of setting up and operating of new nuclear power and reprocessing plants stands intertwined between development, environmental concerns, and areas under mega projects being struck with natural calamities like floods, earthquakes, tsunamis, man-made accidents or breach of security all leading to nuclear disaster, which in turn are going to make a severe impact upon agriculture and fishing communities residing in those regions. Operating a nuclear power reactor is never entirely free of risk; assessments do not eliminate all risk no matter how well the hazards have been assessed but are an important source of information for identifying and mitigating vulnerabilities to events that can occur as a result of natural hazards.

The entire process of nuclear power generation is caught in a vicious circle as it is considered to be a form of clean and green energy hence, the dependence of countries upon nuclear power generation is considerable. India recently joined the UNFCCC cum treaty concluded during Paris Summit on 02 October 2016. Climate Change is responsible for earthquakes and tsunamis as happened in the case of Fukushima in March 2011 at the same time any serious accident or case of nuclear war will be responsible for raising the overall temperature of the atmosphere thereby also leading to Climate Change.

Indian agriculture sector employs around 58 per cent of the country's population directly or indirectly, any natural hazard induced nuclear disaster shall have serious ramifications for the food security in the country. Huge dependence on nuclear power, storage and disposal of nuclear waste, areas surrounding reprocessing plants, transportations of

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nuclear warheads and their safety is a highly risky proposition in the country. The risk remains very high in India and raises serious questions over the capabilities and responsibilities of Central and State Governments in India which cannot match the state preparedness and disaster planning in Japan and other developed countries of the world. Going by the past experiences of handling of natural disasters in India by government agencies, it can be said that the NDMA Guidelines for dealing with nuclear disasters remain by and large on papers only.

The paper analyses India's preparedness and capabilities of handling nuclear disasters and mitigating the risks. **First section**; deals with reasons for India's huge dependence upon nuclear energy. **Second Section**; deals with post-disaster scenario and its likely impact upon agriculture and food security in the country. **The last section** deals with the shortcomings and future policy interventions needed. The **methodology** used is content analysis and a conduct of a random sample survey based upon a population of 500 University students. The paper is based on **assumption that** given vast population exposure and poor records of handling non nuclear disasters by the governments in past, managing the effects of nuclear disaster on agricultural production would be very difficult. The paper's **contribution for Disaster Management Research** would be as it focuses on the role of education and knowledge among the youth of India in building a culture of resilience.

Nuclear Disaster Risks In India

Climate Change Concerns and India's Nuclear Energy Programme

India became a party to Climate Change Agreement finalised during Paris Summit on October 02, 2016. All countries including India are obliged to stop constructing new coal-fired power plants. As a result India, for the last one decade it has taken to nuclear path in a big manner for generating electricity considering it is a cheap source of clean energy and its costs can be reduced to the level of energy through coal and it does not affect the Climate Change as it is considered as clean and green energy.

At present India has seven nuclear plants with 22 nuclear reactors (20 operational and 2 under completion) apart from research reactors at BARC, IGCAR and other production-related establishments. They produce around 4700 Mwe of electricity only. Many new nuclear power plants are coming up at places like Jaitapur in Maharashtra, Fatehabad in Haryana, Haripur in West Bengal and Andhra Pradesh are in line with the new policy of generating around 60,000 MWe of electricity through nuclear mode by 2032 after the 123 Agreement between India and USA.[1] As per World Nuclear Association (WNA), India **expects to have 20,000 MWe nuclear capacity online by 2020 and 63,000 MWe by 2032. It aims to supply 25% of electricity from nuclear power by 2050.**[2] As discussed, India's international obligations with regard to reducing the carbon emissions for preventing climate change, switching over to generation of electricity through nuclear mode suits her largely. India recently announced Intentional Nationally Determined Contributions (INDC) after the culmination of the Paris Summit on Climate Change in 2016.

The Report of Women in Europe for Common Future (WECF) says it is erroneous to consider nuclear energy as the source of clean energy and this group is campaigning for a complete ban on production of nuclear energy in Europe. As per the report of IEA and IPCC, tripling the nuclear power output by 2050 would save five billion tonnes of CO2 compared to a reduction of 25 to 40 billion tonnes by conventional methods by 2050. Since uranium is also a limited resource and, may last for about 70 more years, then switch to thorium for fuel, which is also finite, or to the Fast Breeder Technology together with fuel reprocessing – a polluting and dangerous production system that generates even more toxic nuclear waste.[3] A sense of prudence is needed on part of all countries, including India.

Natural Hazards led Nuclear Disaster Threats at Nuclear Power Plants

As per **National Disaster Management Guidelines: Management of Nuclear and Radiological Emergencies (NDMG-NRE)** document observe **'nuclear disaster'** as that dimension of the emergency leading to mass casualties and destruction of large areas and property, unlike a nuclear emergency, the impact of a nuclear disaster is beyond the coping capability of local authorities and such a scenario calls for handling at the national level, with assistance from international agencies, if required.[4]

Experts and scholars are of the view that nuclear power currently remains the largest, proven, carbon-free generation option. One tonne of uranium produces the equivalent amount of electricity as 16, 000 tonnes of coal and 80 000 barrels of oil. The spent fuel from the reactor still contains 235U, so it can be recycled. Reprocessing the spent fuel produces uranium, plutonium and waste. Safe disposal/storage of waste from the nuclear fuel cycle does present a challenge.[5] Natural hazards such as droughts, floods, hurricanes, earthquakes, tsunamis and landslides, are major sources of misery for the agricultural sector. Marred by consistent losses in the aftermath of hazardous events, the agricultural sector remains one of the most vulnerable sectors for a populated country like India. The paper ponders over the possibility of a natural hazard like earthquake cum tsunami induced Fukushima kind nuclear disaster becoming a reality in India leading to nuclear famine-like situation badly affecting Indian agriculture resulting in millions of deaths.

To some experts, the risk of major disaster is negligible, a nuclear power station is typically a system where dangerous and destructive processes can be set in motion because it is thought that all the safety backup systems in place will guarantee our safety. However for sceptics, the main threat came from the nuclear power stations also.[6] Fukushima nuclear accident of 11 March 2011 has compelled countries and experts to realise that it was **natural hazard like earthquake cum tsunami** that resulted in nuclear disaster at three of the Fukushima Daiichi nuclear power plants out of six blew up leading to serious radioactivity all over. It resulted in the loss of more than 20,000 lives and destroyed property, infrastructure and natural resources.[7] India's records so far have been fair barring a few small accidents at certain nuclear power plants, especially, Madras Nuclear Power Plant at Kalpakkam when it was struck with Tsunami and the nuclear reactor could be stopped successfully averting any disasters. Another Report on Fukushima nuclear disaster strongly emphasised that no country, developed or developing, is immune to such disasters. Advanced democracies are not necessarily more resistant or better prepared than developing countries to deal with such events. The Japanese experience thus offers many unique lessons for other democracies in terms of dealing with future disasters including India.[8]

Disaster Threats because of the Risks of Accidental Nuclear War and Nuclear Proliferation

Nuclear disasters can also occur because of the outbreak of nuclear war between countries because of certain reasons like; Accident, error, or malfunction or system failure; The actions of a 'rogue general'; Miscalculations; The continuing military build-ups; A 'bolt-from-the-blue' pre-emptive first strike; Technologically advanced nuclear weapons; Role of third parties; and Nuclear proliferation.[9] As discussed, a hypothetical nuclear exchange between India and Pakistan, in which each country targeted major cities through dozen, 25-kiloton warheads, as per Natural Resources Defence Council (NRDC) study which calculated that 22.1 million people in India and Pakistan would be exposed to lethal radiation doses of 600 rem or more and 8 million people would receive a radiation dose of 100 to 600 rem, causing severe radiation sickness and potentially death, especially for the very young, old or infirm and as many as 30 million people would be threatened by the nuclear attack. NRDC estimates that 8.1 million people live within this radius of destruction.[10] Similarly report of ICNND presented before the **United Nations,** says, a nuclear war between India and Pakistan could cause severe "climate cooling" and may have a devastating impact on agriculture worldwide.[11] The explosion of even a low-yield nuclear weapon in an urban or semi-urban area would cause massive loss of life, injury, sickness and destruction due to the high population density and the concentration of high-value assets. They also represent an enormous and instantaneous loss of human and physical capital.[12]

A 2007 study by Toon et.al[13] considered the consequences of a possible nuclear war between India and Pakistan and showed that such a conflict would loft up to 6.6 Tg (6.6 tera grams or 6.6 million metric tonnes) of black carbon aerosol particles into the upper troposphere. Robock et.al then calculated the effect that this injection of soot would have on global climate assuming a war in South Asia occurring in mid-May. Their study used a state-of-the-art general circulation climate model, Model E from the NASA Goddard Institute for Space Studies, and employed a conservative figure of only 5 Tg of black carbon particles. They found that "A global average surface cooling of -1.25°C persists for years, and after a decade the cooling is still -0.50°C. The temperature changes were largest over land. A cooling of several degrees occurred over large areas of North America and Eurasia, including most of the grain-growing regions. In addition, the study found significant declines in global precipitation with marked decreases in rainfall in the most important temperate grain-growing regions of North America and Eurasia, and a large reduction in the Asian summer monsoon.[14] Two additional studies, one by Stenke et al., and the other by Mills et al, each using a different climate model have also examined the impact on global climate of this limited nuclear war scenario and they have both found comparable effects.[15]

The New Challenge of Terrorism

The danger of terrorists gaining access to nuclear weapons is heightened during crises. Though, nuclear weapons cannot be manufactured directly from the key raw material found in nature, uranium. For this reason, *a terrorist organization can acquire a nuclear explosive only (1) by obtaining an intact nuclear weapon from a national stockpile or (2) by obtaining fissile material from stocks that were produced in highly advanced industrial facilities and then making the fissile material into a nuclear explosive.* The most important and effective steps for reducing the threat of nuclear terrorism are therefore to secure, consolidate, reduce, and, where possible, eliminate nuclear weapons and fissile material. Programs to implement such measures are underway in many countries but are far from reaching their goals.[16] There are an estimated 7,700 nuclear weapons deployed throughout the world as of today, plus more than 14,000 nuclear weapons that are inactive, in reserve status, or awaiting dismantlement.[17] The international community urgently needs to expand its efforts to secure existing stockpiles of nuclear weapons and materials, particularly in Russia, Pakistan, and India. The elimination of nuclear weapons should be high on the global public health agenda deaths and billions of dollars in property damage if a cask of spent fuel rods were dispersed anywhere in the world. Additional measures by Govt. of India like raising of more Battalions of Para-Military forces, setting up of National Investigation Agency (NIA), National Intelligence Grid like institution or amendment of the Prevention of Unlawful Activities Act and making it more stringent, pointed in this direction that how serious such threats have become for India too. Countries need to pool their energies for preventing non-state actors from gaining control of nuclear assets of the country.

Impact of Nuclear Disaster on Agriculture

Impact on Agriculture (General)

In the event of releases of radioactivity following an emergency at a nuclear power plant, land, rivers, sea and structures in the vicinity of the power plant can become contaminated with a mixture of radionuclide generated inside the reactor, also known as "nuclear fission products". Individuals can therefore become exposed to radiation from these fission products. When large amounts of radioisotopes are discharged into the environment, they can affect foods by either falling onto the surface of foods like fruits and vegetables or animal feed as deposits from the air or through contaminated rainwater/snow. Radioactivity in water can also accumulate in rivers and the sea, depositing on fish and seafood. Once in the environment, radioactive material can also become incorporated into food as it is taken up by plants, seafood or ingested by animals.

Although many different kinds of a radionuclide can be discharged following a major nuclear emergency, some are very short-lived and others do not readily transfer into food. Radionuclides generated in nuclear installations and that could be significant for the food chain include; radioactive hydrogen (3H), carbon (14C), technetium (99Tc), sulphur (35S), cobalt (60Co) strontium (89Sr and 90Sr), ruthenium (103Ru and 106Ru), iodine (131I and 129I), uranium (235U) plutonium (238Pu, 239Pu and 240Pu), caesium (134Cs and 137Cs), cerium (103Ce), iridium (192Ir), and americium (241Am).[18]

The radionuclide of most concern for possible transfer to foods of immediate concern is **iodine-131**, it is distributed over a wide area, found in water and on crops and is rapidly transferred from contaminated feed into milk and its accumulation in the thyroid gland. However, iodine-131 has a relatively short half-live and will decay within a few weeks. If radioactive iodine is breathed in or swallowed, it will concentrate in the thyroid gland and increase the risk of thyroid cancer.

In contrast, radioactive caesium which can also be detected early on is longer-lived (Cs-134 has a half-life of about 2 years and Cs-137 has a half life of about 30 years) and can remain in the environment for a long-time. Radioactive caesium is also relatively rapidly transferred from feed to milk. Uptake of caesium into food is also of long-term concern. Other radioisotopes that could be of long-term concern if released, are strontium and plutonium. **Strontium-90** has a half life of about 29 years and **plutonium** has a much longer half-life than that (Pu-238: 88 years, Pu-239: 24100 years, Pu-240: 6564 years). However, both strontium and plutonium are relatively immobile in the environment and are of concern more locally, thus it is unlikely to cause a problem in international food trade in the immediate and medium-term.[19]

Commodities of Concern

Open-air vegetables and plants can be affected by the atmospheric release of radionuclide, resulting in radioactive contamination. Thus, radionuclide tends to be detected from leafy vegetables especially the ones with large leafy parts in the early phase after a nuclear accident. Milk is also associated with the early-phase contamination due to the rapid transfer of radioactive iodine and "relatively" rapid transfer of radioactive caesium from contaminated feed into milk. Over time, radioactivity can also build up within food, as radionuclides are transferred through soil into crops or animals, or into rivers, lakes and the sea where fish and other seafood could take up the radionuclides. Foods collected from the wild, such as mushrooms, berries and game meat, may continue to be a radiological problem for a long time. Fish and aquatic micro-flora may bio-concentrate certain radionuclides, but due to the high dilution of radionuclides in water, contamination tends to be confined relatively locally.

Health Effects

The main health concern for consumers in the long term due to high radiation exposure is the development of cancer. Cancer types and target organs depend on the radionuclide. Consuming contaminated food will increase the amount of radioactivity inside a person and therefore increase their radiation exposure, thereby possibly increasing the health risks associated with radiation exposure. The exact health effects will depend on which radio nuclides have been ingested and the amount being ingested.

Contamination of Agrarian and Food Products Specific Case of Nuclear Fukushima Disaster

Contamination of crops, livestock and agri-food products by radionuclide in a large scale happened as a result of the direct radiation exposure, fallouts and distributed by wind and rains radioactive elements, crop and livestock uptakes from soils, waters and feeds, diffusion from affected inputs, buildings and equipment, dissemination through transportation, wildlife, etc.

Impact on seafood safety of the nuclear accident in Japan - 9 May 2011

Pathways of contamination of the marine environment

The Fukushima power plant is located on the east coast of the island of Honshu, 200 km northeast of Tokyo. Radioactive pollution of the marine environment has occurred through:

i) direct leakage of highly contaminated water used to cool the damaged reactors;
ii) voluntary discharge of low-contaminated water to increase the on-site storage capacity for highly-contaminated water;
iii) transport of radioactive pollution by rainwater run-offs of contaminated soils; and
iv) radioactive fallout of the atmospheric plume on the surface of the Pacific up to tens of kilometres from Fukushima.[20]

Radionuclide in the Marine Environment

To date, mainly iodine 131, Cs-134 and Cs-137 were measured in the marine environment. No long-term impact can be expected from I-131. It rapidly decays within eight days. The two longer-lived caesium-isotopes (Cs-134, 2 years half-life and Cs-137, 30 year half-life) had got transported over long distances by ocean currents, mainly eastwards by the Kuroshio current system. The great quantity of water in the Pacific Ocean, however, had rapidly dispersed and diluted these radioactive materials. Testing of marine water 30 km off the coast of Japan had shown that the concentrations of radionuclide had dropped rapidly to very low levels. Near the discharge areas, a few other mostly short-lived radionuclide were detected. The levels of Sr-90 and Plutonium isotopes seemed to be relatively low.[21]

Radionuclide in Seafood

(a) Seafood in Japan: The Japanese regulatory authorities had imposed provisional regulation limits for Radio-nuclides and other restrictions (http://www.mhlw.go.jp/english/topics/2011eq/index.html) for food, including seafood, and are monitoring fish caught in the prefectures surrounding the damaged nuclear power plant. The

Japanese sand lance is the only fish for which levels of radionuclide exceeding their provisional regulation limits were measured till date. This fish is not exported and contaminated products were not allowed to enter the local market. Results of the inspection in fisheries products were published by the Japanese Fisheries Agency (http://www.jfa.maff.go.jp/e/inspection/index.html).

(b) Migratory fish from Japanese waters: Migratory fish, such as the Juvenile North Pacific albacore tuna or the Alaska salmon, spend most of their transoceanic migration period outside of Japan's coastal or offshore waters. The level of short-lived radionuclide such as I-131 had dropped significantly through natural radioactive decay. Radioactive caesium had also declined when fish left contaminated waters as caesium is not bound in the body and was gradually excreted. The biological half-life of caesium in sea fish is typically between 5 to 100 days. Hence there were no health concerns at that point from the food source. Levels of radioactivity in seafood collected away from the waters surrounding Japan were expected to remain significantly below levels of any public health concern. As control measures limits for various radionuclides in fish were implemented by several authorities. The Japanese government was monitoring the presence of I-131, Cs-134 and Cs-137 in local seafood. Regular sampling of seawater took place at 16 different sites (near-shore, at 3 km, 8 km and 15 km off-shore). Some countries and regions outside Japan had put measures in place to monitor seafood.[22]

Natural/Nuclear Disaster and Agriculture Sustainability in India

Exposure to and losses resulting from natural disasters in particular hydrological disasters are increasing worldwide, affecting people's livelihoods and food security. Worldwide, there are currently 842 million undernourished people; about 14% per cent of the population living in developing countries suffer from chronic hunger. Most of them live in rural areas and depend on agriculture, fisheries, forests and livestock for their livelihoods. Agriculture is one of the sectors most affected by natural hazards and disasters, which enhance vulnerabilities of resource-poor farmers/fishers/herders in particular, and often threaten their livelihood security. Over the past decade, natural disasters have caused an estimated USD 1.3 trillion in damages, causing the loss of life of 1.1 million and affecting another 2.7 billion people. For 2013, the Centre for Research on the Epidemiology of Disasters registered 334 natural disasters that affected 97 million people and caused over USD118 billion in economic damages. Large shocks and extensive risks cause serious long-term damage to livelihoods and food security, often diminishing or reversing gains in poverty reduction, agricultural development and the reduction of hunger.[23] A generic trend is that damage and losses from mega-disasters in agriculture are higher in countries where the contribution of agriculture to GDP is still high and where agriculture provides a main source of employment. Both characteristics feature high in LDCs. On top of the recorded events, recurrent "silent disasters" (extensive disasters) – more frequent, smaller in size, often localised and not systematically recorded by governments - account for an additional estimated 50% of damages and losses.[24]

For India with a population of 1.3 billion, one of the main objectives of food management is to maintain food buffer stock for food security and price stability. India's National Food Security Bill aims to cover 75 per cent of the rural and 50 per cent of the urban population for subsidised food grains under the Targeted Public Distribution System.[25] In the direction of achieving sustainability in the agriculture sector, the Government of India (GOI) has launched programmes like National Food Security Mission (2007), National Mission for Sustainable Agriculture which is one of the eight missions under National Action Plan on Climate Change (NAPCC). It has also launched *Rashtriya Krishi Vikas Yojna* (2007) for bringing Green Revolution to Eastern India (2011) apart from National Horticulture Mission.[26] Though Five Year Plans have been discontinued after the creation of NITI Ayog in place earlier Planning Commission, the figures under both 11th Five Year Plan and 12th Five Year Plan(2012-17), Indian Government always wanted average annual growth of 4 per cent in the Gross Domestic Product from agriculture and allied sectors. However, the growth remained close to 3.6 per cent only. As per GOI, Agriculture, including allied sectors contribution in total GDP (2015) of the country is around 14 per cent, but the share of agriculture in providing employment is 58 per cent (2011) Census which means the role of agriculture sector has been very crucial to country's economy.[27] Indian states like Punjab and Haryana always remain prone to nuclear disaster because of being situated next to Pakistan border and it is expected to bear the largest amount of impact of any war getting fought between India and Pakistan. Any breakout of war with Pakistan shall have severe bearings upon country's agricultural production as Punjab and Haryana both act as a food bowl for the entire country. These two neighbouring states have very important role to play in achieving India's National Food Security Goals.

Natural hazards, such as droughts, floods, hurricanes and landslides, are major sources of misery for the agricultural sector in India. Marred by consistent losses in the aftermath of hazardous events, the agricultural sector remains one of the most vulnerable sectors for India. Every year monsoon rains bring flood with them in north and central India. States like Bihar, Assam, Bengal, Gujarat and Andhra Pradesh are known for getting hugely affected on account of floods annually. Even this year in 2017, Bihar, Assam, and Rajasthan are worst hit on account of floods due to heavy rains during the monsoon. Natural disasters on account of floods have grave implications for the sustainability of the sector and more so the viability of the rural economy. India has seen an increasing number of natural hazards on an annual basis with the most frequently occurring ones to affect the sector being floods, landslides and droughts. The agriculture sector has been impacted by several of these events all over the country resulting in huge losses. Historically, the agriculture sector has been hard hit by natural disasters, particularly floods and drought. The geographical setting of India exposes it to such disasters risks always. The issue of food security has been on the forefront of the world agenda recently due to rising food prices globally. Prices have risen by as much as 40% since mid-2007, and the prices of staples have risen by 80 per cent (Buddan, 2008). With such a worrying global trend, the agricultural sector is being called on to transform in order to guarantee food supply and ultimately food security. With such widespread devastation to the sector from natural disasters, India's local food security is constantly under threat.

FAO's Concerns Regarding Food Security World Over

As per the UN Food and Agriculture Organization June 2013 Report estimated that world over grain stocks were 509 million metric tons, 21% of the annual consumption of 2,339 million metric tons. Expressed as days of consumption, this reserve would last for 77 days. The US Department of Agriculture estimates were somewhat lower at 432 million metric tons of grain stocks, a mere 19% of their estimated annual consumption, of 2,289 million metric tons. Expressed as days of consumption, this reserve would last for only 68 days. Furthermore, the UN Food and Agriculture Organization estimated in 2012 that there are 870 million people in the world who already suffer from malnutrition. Given this precarious situation, even small further declines in food production could have major consequences. The large and protracted declines in agricultural output predicted by Ozdogan and Xia are unprecedented in modern times, and the full extent of their impact on human nutrition is difficult to predict.[28]

Another 2011 study by Webb et al, drawing on the data generated by Ozdogan, attempted to estimate the effect that the shortfall in agricultural output following a limited **nuclear war** would have on the price of food, and therefore on its accessibility. Using a global economy-wide model, the Global Trade Analysis Project (GTAP), the study examined the effects on food prices, and the numbers of people who are malnourished. In order to simulate the shock's effect on cereal and soybean prices, the study assumed that all crops produced globally suffer yield declines to the same extent that Ozdogan predicts for maize and soybeans in the US corn belt. The study found that the rise in food prices associated with the average yearly decline in food production would cause an additional 40 million people to become malnourished, and that the largest annual decline in food production in year 5 would cause 67 million to enter the ranks of the malnourished. The cumulative effect over 10 years would cause a total of 215 million people to become malnourished. The study concluded that a one year 20% decline in crop yield would cause crop prices to rise 19.7%. But this rise would be very unevenly distributed across the globe. In East Asia, the rise would be 21.4% and in South Asia 31.6%.[29]

As per another study on the impact of nuclear war on agriculture completed by the Radiological Protection Institute of Ireland (RPII), says that there are currently over 400 nuclear power plants in operation across the world, of which 185 are in Europe. A severe accident at any one of these plants could lead to radioactive contamination reaching Ireland, with the amount reaching Ireland depending on the severity of the accident and prevailing weather conditions. In 2013, the RPII published the results of a study of the potential radiological impact on Ireland of the new nuclear power plants that may be built at up to eight sites in the UK before 2025. This study included the assessment of a range of severe nuclear accidents at any one of these power plant locations. Given Ireland's distance from any current or proposed nuclear power plant locations, it is only severe accidents that are of real interest in terms of radiological implications. The risks remain very high in the South Asian sub-continent where three nuclear weapon states India-Pakistan-China share land boundaries with each other

The RPII's study found that over 90 per cent of the radiation dose following a severe accident could be from consumption of contaminated food if no action was taken to prevent this. The timely introduction of appropriate agricultural management actions and food controls would substantially reduce or even eliminate most of this radiation dose. While these controls are very effective in controlling radioactivity levels in foods for sale, and hence in reducing radiation doses to people, they do have significant socio-economic implications and costs. These effects could last for months or years following an accident, depending on its severity. India needs to work on these lines for mitigating such risks.

Japan's Nuclear Disaster and EU Strategies and Lesson's for Indian Agricultural Sector

Food self-sufficiency has always remained a priority in the case of India too, it remains an agrarian country where approximately 58 per cent of the population is dependent upon agriculture in getting direct or indirect employment. However, the contribution of the agriculture sector in the country's GDP remains close to ten per cent only. Like Japan, India also gives a lot of priority to Food Security policy in its governance. India's dependence on Food Security is much bigger than Japan as it is the second largest populated country in the world with a population of 1.28 billion people. The FAO report has been expressing concerns regarding precarious conditions existing in South Asia.

The widespread devastation from the March 2011 earthquake and tsunami affected many agricultural and fishery areas in Japan. Most reports acknowledge that Japan's current production and supply shortages, along with rising food safety concerns and possible longer-term radiation threats to its food production, could limit Japan's food exports while possibly increasing its need for food imports in the future.[30] The CRS report of May 2011 points out that Japan's assessment of the damages to the fisheries, agriculture, and forestry sectors from the March 2011 earthquake is currently estimated at $21.5 billion.[31] Of this estimated total, $11.0 billion is attributed to losses in Japan's fisheries sector, along with $9.1 billion in damages to agricultural lands and crops, and another $1.4 billion in damages to forested lands and facilities. Damages to crops, land, and facilities have been reported in several prefectures, including Aomori, Iwate, Miyagi, Akita, Yamagata, Fukushima, Ibaraki, Tochigi, Gunma, Saitama, Chiba, Kanagawa, Yamanashi, Nagano, Niigata, and Mie, among others. Damages to the agriculture sector cover nearly 4,700 farmland areas and about 16,400 food facilities.[32]

In case of any nuclear disaster, India's losses to the fisheries, agriculture and forestry sectors would be very huge as India is much a bigger country in terms of the size of its territory in comparison with Japan and its coastal area is as long as 7000 kms. As discussed in preceding paragraphs, the similarity between Japan and India exists as India's most of Nuclear Power Plants are also located in states like Maharashtra, Karnataka, Tamilnadu, Gujarat and Andhra Pradesh as all of them are coastal states having significant fishery areas. In case of any nuclear disaster, a lot of damage would get caused to its fishery sector.

On the patterns of EU countries, India also needs to train its population about the contents of RPII and Ireland Government's handbook which outlines actions that will reduce or eliminate the transfer of radioactive fallout to the food-chain following a nuclear emergency and ensure that all food on sale in India on patterns Ireland is safe to eat. However, as noted in the NDMA-NRE Guidelines to deal with nuclear and radiological disasters does have these important instructions for the people and all other stakeholders. On the patterns of the RPII, India also needs to develop strategies, guidance and tools for the management of contaminated goods, including food and animal feed. RPII-EU project has a particular emphasis on inclusion of the views of producers, processors, retailers and consumers in the process and it remains very relevant for India too. In India too, all state governments are under statutory obligation to have the establishment of SDMA as well as DDMA completed for mitigating such disaster risks and move in the direction of being a disaster resilience society. India needs to continue to emulate EU practices of involving all national stakeholder panels have been established in India on patterns of European countries that include a wide range of stakeholders who are supposed to meet several times for sharing of their experiences of dealing with real and perceived contaminated products, impacts on trade and the implementation of control measures.

Outcomes of Survey Done by Author in 2017 Summers

A Random Sample Survey was conducted during 2017 summers on a population size of 350 for testing general awareness about nuclear disaster management among students/youth of Guru Nanak Dev University, Amritsar, Punjab, India. A Questionnaire having 10 questions was supplied to 350 students as a flash on the spot survey on students covering all departments on the campus. The Questions asked were as follows**:** ***Q.1*** *Name the body which is responsible for disaster management in India.* ***Q.2*** *Who holds the disaster management responsibility at State / District level in India?* ***Q.3****Do you know about the latest disaster management act in India?* ***Q.4*** *Are you aware of the hazards your district is prone to?* ***Q.5*** *Do you know how many nuclear reactors does India possesses?* ***Q.6*** *Are you aware of harmful radiations from the nuclear disaster and what does it do to our bodies and the environment?* ***Q.****7.Do you feel that nuclear power generation poses more risk to society than a benefit?* ***Q.8*** *Do you know about Chernobyl Disaster?* ***Q.9*** *Do you know about the Three Mile Island Accident?* ***Q.10*** *Are you aware of the Fukushima Daiichi nuclear disaster and its impact on agriculture.* **The responses are given below in the Table 1.** This Survey did not make use of any statistical tools as the study was preliminary only.

Table 1: Nuclear Disaster Management Awareness Among Youth

Response To Question No:	Unsure	Fully Aware	Who said YES	Partially Aware	No Awareness at All	Did not Give Any Response	Any Other Remarks	Total
Q. 1	58	52	46	18	24	114	_	312
Q. 2	74	36	38	04	24	134	_	310
Q. 3	32	_	54	04	122	82	_	294
Q. 4	16	_	170	20	46	42	_	294
Q. 5	98	10	48	_	76	50	_	282
Q. 6	--	10	226	34	20	24	_	314
Q. 7	16	_	204	_	58	32	_	310
Q. 8	--	_	102	_	168	40	_	310
Q. 9	--	_	70	_	196	48	_	314
Q. 10	--	04	130	_	124	42	_	300
							36 Students returned the questionnaire blank.	

Source: Author conducted personal survey among 350 University students during 2017 summers.[33]

From **Table** 1 it can be concluded that University students lacked awareness about NDMA/SDMA and DDMA (**Q.1-3**). Students hardly knew about District level disaster management mechanism. Close to 50 per cent of students were aware about the hazards their district towns were prone to (**Q.4**). A large number of students did not know about the total number of reactors India has set up in different parts of the country (**Q.5**). 226 students said that they have heard about the harmful impact of nuclear radiation (**Q.6)**. Close to two-third respondents agreed that nuclear power generation poses more risks to society than benefits (**Q.7**). Close to 200 respondents did not know about Chernobyl Disaster (**Q.8**). Around 250 respondents did not know anything about Three Mile Island Nuclear Accident ever (**Q.9**). Lastly, only one-third respondents knew about the Fukushima Daiichi Nuclear Disaster of 2011 (**Q.10**).

Conclusion

To conclude, India needs to take a cautious path for the implementation of its ambitious nuclear power programme in light of its need as well as its realistic capabilities of managing nuclear disasters. A lot of education and training of citizens at a massive scale need to be undertaken. There is an urgent need for developing a new culture of resilience towards such disasters on part of average citizens/farmers/labourers of the country. The Union Government of India needs to encourage the state governments for preparing themselves in the light of current realities. Schools, Colleges and Universities of the country need to introduce a course on Disaster Management at every level of education. Youth of the country need to be attracted towards the creation of an exclusive wing of volunteers who would ever remain ready to offer their services in the hours of crisis on the patterns of N.S.S. The private sector of the country will also have to assume responsibility for such causes in a very big manner. A 'disaster cess' on patterns of education or petrol cess can be imposed for creating a financial reserve for training of youth and human resources exclusively for disaster related needs.

On the patterns of EU countries, India also needs to train its population about NDMA handbook which outlines actions that will reduce or eliminate the transfer of radioactive fallout to the food-chain following a nuclear emergency and ensure that all food on sale in India which would be safe to eat. The NDMA Guidelines to deal with nuclear and radiological disasters carry these important instructions for the people and all other stakeholders and need to be told to people on regular basis through the conduct of periodic drills regarding such disasters. A joint training exercise with the help of NDRF Specialists for citizens of Amritsar and other border towns should be conducted regularly for creating a large pool of trained personnel. The supplies of medicines to be administered in aftermath of nuclear disaster should be augmented in all government run hospitals. All other necessary equipment and special protective gear should be procured and kept ready by the Government and District agencies all the time. India also needs to develop strategies, guidance and tools for the management of contaminated goods, including food and animal feed by involving all stakeholders regularly.

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Studies on the Forest Ecosystem Function of the Aravalli Hills at Alwar, Rajasthan

Harish Samaria[a]

Abstract

The Aravalli hills intersect Rajasthan diagonally into two major geographical units. The western part occupying about 2/3 of the State, is almost arid and the eastern part is comparatively well drained and fertile. Aravalli hills extend about 692 km from Palampur in Gujarat upto Delhi union territory through Rajasthan and Haryana States. It checks the spread of the desert towards eastern Rajasthan and Indo-Gangetic plains. It also acts as one of the significant resource areas for this part of the country and influences the climate of the region. The Aravalli hills have undergone serious transformations during the recent past. Forty years ago this range was endowed with 50-60% forest cover ranging from dense sub-tropical forest to open scrubland. Unfortunately, rapid increase in human and cattle pressure has reduced the forest cover over the Aravallis to less than 5% of the area. The rural communities in the region are dependent upon the forested hill slopes for their fuelwood, fodder and timber needs. Animal husbandry being an important activity for livelihood of these village communities, the pressure on forests for fodder is immense. The major objectives of the present study are: to consider as to how forest ecosystem types function under different degradation regimes and place it in the context of the human dimension of the problem of biomass utilisation and management. Hence, the present study attempts to do a detailed analysis of forest ecosystem structure and function with respect to different degree of degraded regimes at Alwar, Rajasthan, India.

Keywords: forest ecosystem, animal husbandary, degraded regime land degradation, biomass utilisation, management

Introduction

About 40% of the earth's tropical and subtropical landmass is dominated by open or closed forests. Of this, 42% is dry forest, 33% is moist forest and only 25% is wet and rain forest (Holdridge, 1967). Deciduous forests, ranging from moist to dry types, constitute 66% of the tropical forest area of the world (Brazier *et al.,* 1976) of which 70% of the total forest are in India (Singh and Pandey, 1981). The deciduous forests are distributed over 896 million ha in the tropics, of which the bulk (588 million ha) is of the dry type. In India, of the total 64.6 million ha tropical forest area, only 6.3 million ha supports wet evergreen and semi-evergreen types and the remaining area supports deciduous types, 23.9 million ha moist-deciduous and 34.4 million ha dry deciduous (Kaul and Sharma, 1971).

The warmer plains and the lower altitudes in the hills are predominantly under one or the other type of tropical forest. The most comprehensive forest type classification in India-first proposed by Champion (1936) and later revised by Champion and Seth (1968)– recognises several main tropical types; namely wet evergreen, semi-evergreen, moist deciduous, dry deciduous, thorn, littoral and swamp and dry evergreen forests. Of these, the Vindhyan and Rajasthan forests in India are examples of dry deciduous or thorn forests.

Study Area

Alwar district is situated at 03' to 14' north latitude and 07' to 13' east longitude. Geographically the district is distributed into three broad areas-middle hilly region comprising of Thanagazi, Rajgarh, Alwar, Kishangarh and Tijara, an eastern plateau consisting of Ramgarh, Lachhmangarh and western sandy region where Behror, Bansur and Mundawar tehsils are situated.

Total geographical area of the district is 8380 square kilometers. There are four rivers passing through the district- Sahibi, Ruparel, Bangangaand Landuva. Big dams of the district are Jaisamand, Silisedh, Mansarovar, Jaitpur, Agar and Harsora. The district is adjoining Haryana and Delhi and is important for mining, commercial and business activities. There

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are four industrial areas located at MIA Alwar, Bhiwadi, Behror and Shahjahanpur. Marble is the main mineral excavated in Khoh, jhiri, Mallana, Govadhanpura and Tehla.

The climate is typically semi-arid with an average annual rainfall of 530 mm, most of which (70%) falls from July to September. The average maximum and minimum temperatures during the rainy season wen~ 35° and 23°C, respectively; during the winter season were 27° and 7°C, respectively; and during the summer season were 400 and 20°C, respectively.

Soil Distribution

The soil of loam type occurs in major parts of the Alwar district specially in Umred, Behror, Thana Ghazi, Kathumar, Bansur and Mundawar. However, sand, sand clay loam and clay loam also occur in other tehsils of the district. The soil map of the district, based on the data of the National Bureau of Soil Science and Land Use Planning (NBSS & LUP) is presented in the report.

Land Classification as per Aravali

The Ministry of Environment and Forests, Government of India vide its notification dated 7th May, 1992, has restricted developmental activities on the following categories of land.

(i) All reserved forests, protected forests or any other area shown as “forest in the land records maintained by the State Government as on the date of this notification in relation to the Alwar District of the State of Rajasthan.

(ii) All areas shown as:

- (c) Gair Mumkin Pahar, or
- (d) Gair Mumkin Rada, or
- (c) Gair Mumkin Behed, or
- (d) Banjad Beed, or
- (e) Rundh.

In the land records maintained by the State Government as of the date of this notification in relation to the Alwar district of the State of Rajasthan.

(iii) All areas of Sariska National Park and Sariska Sanctuary notified under the Wildlife (Protection) Act, 1972 (53 of 1972).

Forest Land/Cover

The total forest area of Alwar region is 90302.88 Ha excluding the Sariska Sanctuary. This includes the following:

- Reserve forest area - 40108.62 Ha
- Protected forest area - 36068.96 Ha
- Unclassified forest area - 14125.30 Ha

Total - 90302.88 Ha

The above is spread in Alwar, Thana Ghazi, Rajgarh, Behrod, Bansur, Kishangarh Bas and Lakchhmangarh tehsils.

In the Sariska Tiger Project, the classification of forestland is as under:

Sariska Wildlife Sanctuary

- Reserve forest area - 39705.00 Ha
- Protected forest area - 9494.54 Ha

Total - 49,199.54 Ha or 492 sq.kms.

Forest Blocks Other Than Sariska Wildlife Sanctuary

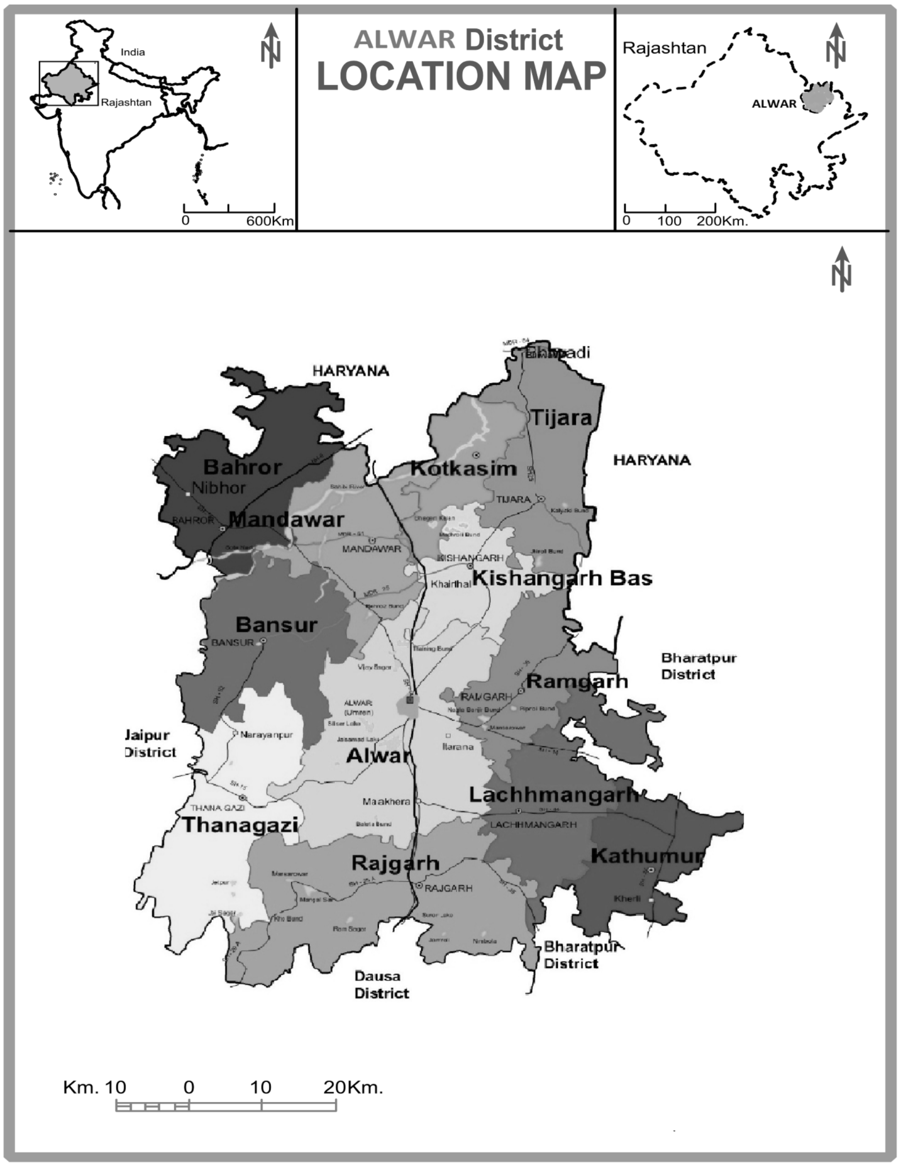
- Reserve forest area - 20,792.52 Ha
- Protected forest area - 16,620.84 Ha

Total - 37,413.36 Ha or 374 sq.kms.

Total Area of STR - 866 sq. km

The exploitation of the forest resources in the district took place for many decades and the expected regeneration of the resources did not take place due to various reasons. As such, the carrying capacity of the forest resources is already exhausted.

On the basis of the degradation of sites due to disturbance, four different vegetation types were identified: a protected site (PS) with no disturbance located in the core area of the national park; two other sites, that is least (LDS) and moderately degraded (MDS) located in the buffer zone; and a fourth site that is highly degraded (HDS) located outside the parking area. The disturbances are largely due to grazing and browsing by animals and lopping by humans.



Source : Cense Department, Govt. of Rajasthan, Jaipur

Methods of Study

In this study three broad methods have been used viz. the visual interpretation of remotely sensed data, mathematical analysis and field survey. The Government data has also been taken for this study The phytosociological analyses were done at the end of the growing season (September - October) along a transact down the slope. In the case of tree species, individuals with CBH in the range of 10.5 - 30.4 cm were classified as saplings while those above this range were treated as mature trees {Knight, 1963). In the case of shrubs and herbaceous species, diameter of the main axis was measured just above the soil surface using vernier callipers. The importance value index (lVI) of different life-forms and a given species was calculated as an integrated measure of relative frequency, relative density and relative dominance (Curtis, 1959).

Species diversity was computed following Margalef (1968),

$H = -\sum [(ni/N) \log (ni/N)]$

where, H = Shannon index of general diversity, ni = importance value of a given species and N = sum of importance value indices of all species.

Index of dominance of the community was calculated by Simpson's index (Simpson, 1949) as:

$C = \sum(ni/N)2$

where, C = index of dominance, ni and N is the importance value of a given species and total importance value of all species, respectively.

To know the size-class distribution of tree species in different degradation regimes, saplings were distributed into four girth classes with *5* cm girth increments, starting with 10.5-15.4 cm and ending with 25.5-30.4 cm. The trees were distributed into six girth classes with 30 em girth increments, starting with 30.5-60.4 cm and ending with 180.5-210.4 cm. The following CBH(circumference at breast height) classes were established: Class Range in CBH (cm)

A .0 - 10.4 (seedlings)
B 10.5 - 30.4 (saplings)
C 30.5 - 60.4
D 60.5 - 90.4
E 90.5- 120.4
F 120.5 - 150.4
G 150.5 - 180.4
H 180.5 - 210.4

The ratio of abundance to frequency was used to interpret the distribution pattern of the species. The distribution was considered regular if the value of the ratio so obtained was below 0.025; it was random if it was in the range of 0.025 - 0.05; and contagious .if it was more than 0.05 (Curtis, 1959).

Highly Degraded Site

Species	Density	Basal Area	Frequency	IVI(Importance value Index)
Tree				
Acacia senegal (L.) Willd	0.1	3.0	3.0	4.0
Anageissus pendula Edgew.	19	435	100	279
Prosopis juliflora (SW.) Dc.	0.3	17	14	17.4
Shrubs				
Adhatoda vasica Nees.	7	23	18	63.2
Calotrapis procera (Ait.) R. Br.	1	9	20	62.1
Capparis deciduas Edgew.	0.4	3	6	30.5
C. sepiaria L.	1	7	18	64.2
Grewia tenax Fioris.	0.2	1	4	24.5
Lantana camara L.	1	13	13	41.0
Zizyphus nummularia (Burm.f.) Wt. & Arn.	0.2	3	3	15.2

Forbs				
Achyranthes aspera L.	22	1	9	2.4
Aeschynomene indica L.	13	1	13	3.6
Argemone mexicana L.	7	3	6	3.6
Barleria cristata L.	98	3	28	9.8
Blainvillea latifolia (L. f.) DC.	41	7	27	11.8
Boerhavia diffusa L.	82	5	36	12.4
Cassia obtusifolia L.	28	5	14	7.9
Indigofera cordifolia Heyne ex. Roth.	17	1	9	2.7
Grasses				
Acrachne racemosa (Heyne.) Ohwi.	47	2	6	4.8
Aristida adscensionis L.	313	9	27	22.6
Bothriochloa pertusa L.	750	33	43	60.5
Brachiaria ramose (L.) Stapf	506	18	43	38.9
Dactyloctenium aegyptium (L.) Beauv	67	2	16	6.4
Dichanthium annulatum (Forsk.) Stapf.	83	6	8	9.5
Digitaria adscendes (H.B. & K.) Hern.	55	1	13	5.7
	35	1	8	3.1
	118	4	15	9.2
	63	5	8	7.2
	90	3	9	6.4

Moderately Degraded Site

Species	Density	Basal Area	Frequency	IVI
Tree				
Acacia leucoploea Willd	0.1	23	2	3.4
A. senegal (L.) Willd.	0.5	119	27	31.5
Anogeissus pendula Edgew.	7.0	735	89	191.6
Bauhinia variegata L.	0.1	2	3	2.5
Boswellia serrata Roxb. Colebr.	1.0	627	36	68.5
Butea monosperma Lamk.	0.1	8	2	2.6
Saplings				
Anogeissus pendula Edgew.	1	17	50	300.0
Shrubs				
Adhatoda vasica Nees.	3	8	10	26.2
Calotropis procera (Ait.) R. Br.	1	4	9	7.8
Capparis deciduas Edgew.	1	17	18	34.4
C. sepiaria L.	1	6	10	16.7
Dichrostachys cinerea (L.) Wt. & Arn.	1	19	15	28.7
Grewia Flavescences Juss.	8	65	22	138.7
Grewia tenax Fioris.	1	6	13	24.4
Lantana camara L.	1	6	3	8.8
Zizyphus nummularia (Burm.f.) Wt. & Arn.	1	3	9	10.6

Forbs				
Acalypha indica L.	109	6	52	9.2
Achyranthes aspera L.	76	9	37	8.6
Blainvillea latifolia (L. f.) DC.	119	26	57	17.9
Boerhavia diffusa L.	46	3	13	2.7
Commelina benghalensis L.	176	15	38	19.1
C. Kurzii Cl.	18	2	13	2.2
Cyperus compressus L.	327	15	31	12.5
C. niveus Retz.	84	3	10	2.6
C. triceps (Rottb.) Endl.	36	2	8	1.7
Indigofera cordifolia Heyne ex. Roth.	18	1	13	1.8
.Others	237	11	184	27.5
Grasses				
Acrachne racemosa (Heyne.) Ohwi.	120	5	16	5.1
Aristida adscensionis L.	131	6	15	6.3
Bothriochloa pertusa L.	116	5	15	5.2
Brachiaria ramose (L.) Stapf	1658	50	47	47.4
Dactyloctenium aegyptium (L.) Beauv	81	3	14	3.8
Digitaria adscendes (H.B. & K.) Hern.	202	6	19	7.4
Eragrastis diarrhena (Schult.) Steud.	230	7	12	7.6
Oropetium thomaeum (L. f) Trin.	3523	71	28	61.1

Least Degraded Site

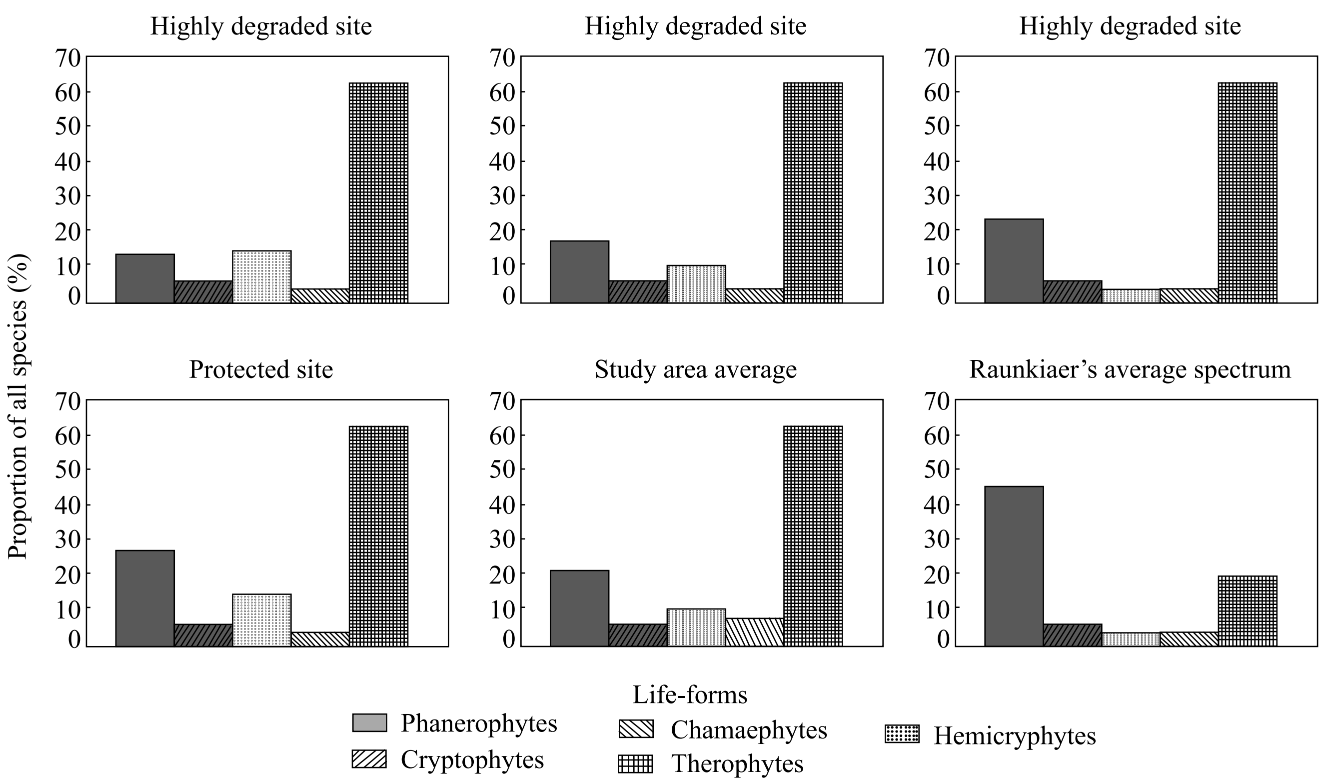
Species	Density	Basal Area	Frequency	IVI
Tree				
Acacia leucoploea Willd	0.3	96	15	19.0
Albizzia lebbek Benth.	0.1	3	2	1.8
Anogeissus pendula Edgew.	5.0	1999	100	257.0
Bauhinia variegata L.	0.1	180	5	5.3
Cassia fistula L.	0.1	24	5	5.3
Saplings				
Anogeissus pendula Edgew.	1	39	57	300.0
Shrubs				
Adhatoda vasica Nees.	2.0	4	6	25.2
Calotropis procera (Ait.) R. Br.	0.1	1	3	11.0
Capparis sepiaria L.	1.0	10	13	69.2
Dichrostachys cinerea (L.) Wt. & Arn.	0.1	3	3	12.8
Forbs				
Acalypha indica L.	160	8	52	19.2
Achyranthes aspera L.	97	18	42	19.8
Barleria cristata L.	29	3	7	3.3
Blainvillea latifolia (L. f.) DC.	114	44	46	32.8
Commelina benghalensis L.	157	14	38	19.1
C. Kurzii Cl.	60	6	21	9.9
Others	108	14	90	24.1

Grasses				
Acrachne racemosa (Heyne.) Ohwi.	112	5	29	11.6
Brachiaria ramose (L.) Stapf	1437	58	42	68.7
Eragrastis ciliaris (L.) R. Br.	31	2	9	3.3

Distribution of life-forms of different vegetation types undervaried disturbance regimes of the dry deciduous forest of Alwar, Rajasthan, India

Species Categories	Individual Sites				
	HDS	MDS	LDS	PS	All Sites
Tree	3	5	7	9	14
Shrubs	6	9	6	5	9
Forbs	33	34	25	26	79
Grasses	11	9	3	2	11
Annuals Total	37	38	25	25	59
Perennials Total	16	19	16	17	31

Biological spectra (% of the total species) of different vegetation types under varied disturbance regimes of the dry deciduous forest at Alwar, Rajasthan, India.



A comparison of the profile diagrams shows some striking contrasts. In the protected site, the tree layer forms a closed canopy, whereas with increase in disturbance the tree species get more and more stunted due to grazing, browsing and lopping off branches. In the highly degraded site, the tree species are only in the form of scattered short stumps close to the ground.

Detailed vegetation analysis of a dry deciduous forest under varying levels of degradation at Alwar were quantitatively analysed. The number of tree I species increased in the protected site, whereas shrubs and herbs tended to increase in disturbed sites. Grasses were fewer in the protected site. Different girth classes for trees ranging from seedling/sapling stage to mature trees were found only in the protected site, indicative of better regeneratiQn here. Tree species diversity in the protected forest was higher, whereas richness of shrub and herbaceous species was higher in the degraded sites. Density of trees increased in the degraded sites but occurred in a depauperate state.

In the Aravalli hill region at Alwar in Rajasthan, the two sites under consideration represent extreme ecological conditions, one being the highly degraded and the other relatively well protected. A comparative evaluation of growth and allocation strategies of a few herbaceous species common to these two habitats was done in this study. It may be noted that the highly degraded site is subjected to intense soil erosion and large soil moisture fluctuations, the soil itself being highly infertile, in contrast to the relatively fertile and ·more moist soils of the protected site. It was expected that such a comparative evaluation would provide information regarding adaptation of species population to ecologic conditions created by biotic stress. Hence, this study compares growth and allocation pattern of four species common to a protected site and a highly degraded site in the Aravalli hill region at Alwar, Rajasthan.

Growth functions (mean ± S.E.) of different species from the protected site and the highly degraded site (values in parentheses) at Alwar

Species	**Relative Growth Rate ($mg\ mg^{-1}\ day^{-1}$)**	**Net Assimitation Rate (mg (cm^2) mg -l day^{-1})**	**Leaf Area Ratio ($cm^2\ mg^{-1}$)**
Blainvillea latifolia	0.0483±0.0111 (0.0455±0.0201)	0.0005±0.0001 (0.0004±0.0001)	5.7176±2.9504 (1. 7714±0. 5592)
Ipomoea sindica	0.0533±0.0283 (0.0352±0.0216)	0.0004±0.0001 (0.0005±0.0001)	1. 4883±. 0. 5673 (1. 4176±0. 8361)
Melochia corchorifolia	0.0424±0.0060 (0.0394±0.0064	0.0006±0.0001 (0.0004±0.0000)	1.3028±0.4605 (0.6984±0.0484)

Three growth functions, namely, relative growth rate (RGR), net assimilation rate (NAR) and leaf area ratio (LAR) were calculated following Hughes and Freeman (1967) and Radford (1967) as:

In W2 -In W1

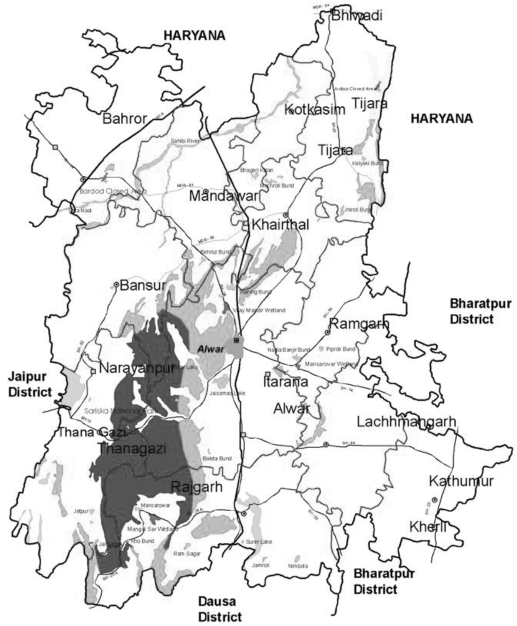
$$\text{RGR} - \frac{\text{In } W_2 - \text{In } W_1}{t_2 - t_1} \qquad \text{NAR} - \frac{(W_2 - W_1)(\text{In } A_2 - \text{In } A_1)}{(A_2 - A_1)(t_2 - t_1)}$$

$$\text{LAR} - \frac{(A_2 - A_1)(\text{In } W_2 - \text{In } W_1)}{(\text{In } A_2 - \text{In } A_2)(t_2 - t_1)}$$

where, W_1 and A_1 are the biomass and leaf area values at time t_1 and similarly W_2 and A_2 at time t_2·

Relative growth rate of all the species was higher ($P < 0.05$) in the protected site compared to that on the highly degraded site. Leaf area ratio was also higher in the protected site for all the species. However, no significant difference was noted for the net assimilation rate between the two sites for any of the species.

These species grow in the highly degraded site where the soil is infertile and in the protected site where soils are relatively more fertile, in the Aravalli hills at Alwar in Rajasthan, India. The species growing in the protected site had a higher relative growth rate and leaf area ratio than those growing in the highly degraded site. In the highly degraded site, biomass allocation is relatively more to the underground parts, a strategy for survival



Biological Diversity Map

Source: Forest Department, Jaipur

Conclusion

The forest cover in Aravalli hills of Alwar region in Rajasthan is under considerable biotic pressure both through increasing human and cattle populations. Heavy grazing pressure from cattle and repeated lopping of the branches of trees and whole shrubs for fuelwood and fodder have been two important causes of site degradation. Starting from the core area Sariska National Park, which is relatively well protected, one does find varied levels of site degradation, as one moves outwards. The protected forest had a high species diversity with a larger number of tree species, whereas small shrub and herbs increased under disturbance. A few tree species, such as Anogeissus *pendula* found in the highly degraded site were in 'a'depauperate state, largely represented by a thick rootstock and poorly developed aboveground biomass. With reduced biomass and low net primary productivity under the influence of disturbance, the nutrient release through litter gets considerably reduced at a highly degraded site. Further, litter decomposition is faster in the highly degraded site under the impact of direct insolation on the soil surface.

The above approach to forest management would not only provide cash income to families in the fringe areas of forests but would also provide fodder and fuelwood. As shown here, fuelwood needs of the local community of the four villages are either met from extraction from the forested national park area (in the case of the three villages, Haripura, Kundalaka and Madhogarh) or the degraded site outside (Lewari). The per capita per day fuelwood consumption in Madhogarh, Kundalaka and Haripura is about 2kg (33MJ) for cooking purposes. This is obtained from the forested national park where the local villagers are allowed to collect dry wood. The per capita per day consumption in the village Lewari at the Highly degraded site is about 1 kg (20MJ) which is largely the dugout rootstocks of *Anogeissus pendula.* This fuelwood source is partly supplemented here with cattle dung which otherwise could be an important source of organic manure for agriculture. Branches of *Prosopis juliflora* are also lopped wherever available in the village commons. It may be noted that a 12 kg headload bundle of roots stock of *Anogeissus pendula* is harvested by an individual labourer over a 5-hr period of heavy work. Apart from the time and drudgery involved in this, the nutrient cycling process in these highly degraded sites would also get distorted, partly due to root harvest and the direct and indirect impact through soil disturbance. The only option available here is an integrated rehabilitation action plan. Restoration of degraded sites, therefore, should take into consideration the ecological processes centred around successional concepts. While species that are native to the area such,Anogeissus *pendula, Boswellia serrata* and *Acacia* species are important in designing a restoration plan, exotics such as *Prosopis juliflora* which is an exotic may be of value in accelerating successional processes.

Inadequate Practical Knowledge in High School Textbooks Impeding the Disaster Readiness amongst the High School Students: A Study on Bangladesh

Md Zahir Ahmed[a] and Akbaruddin Ahmad[a]

Abstract

Education through the academic curriculum is the basic component of global readiness towards climate change. It has the long-term need of the young people's understanding the impact of global warming and disaster which likewise identifies the development and speculation on environmentally sound advances and infrastructure, sustainable livelihoods and behaviour and lifestyle. The lessons on climate change and disaster provide requisite convenience for high school students to become promised in certifiable issues that transcend classroom walls. They can grope the significance of their curriculum's lessons to the perplexing climatological manifestation envisaging the earth and they can attain the expertise to become a powerful protagonist on the particular issue. These students are considered specialists of climate change and play a significant role in lessening the risk of climate change and disaster if expressly prepared. Environmental debasement, climate change, species annihilation, rising sea levels, resource exhaustion and absence of health on our earth are nearby and a worldwide issue, so they need to realise what is going on in real.

This present study will examine the inadequate practical knowledge on climate change and disasters amongst the high school textbooks enlisted in national curriculum of Bangladesh which makes the degeneration of sustainable readiness towards climate change and disasters and possible way out.

Keywords: education, climate change, readiness

Introduction

Bangladesh is a natural disaster-prone country with an area of about 147,570 sq. km with a population of over 160 million (BBS, 2015). It is with a long historic and successful experience of cramping both natural and man-made disasters such as floods, cyclones, droughts, tidal surges, tornadoes, river erosion, high arsenic contents of ground water, waterlogging, increasing water, soil salinity, fire, collapse of building and so many. Bangladesh is suffering from multifarious natural disaster due to its geographic and geologic setting (Carter, 1991). The geo-physical area of this country makes it inclined to different perils, for example, surge, cyclone, drought, earthquake, landslide and so on. Other than the catastrophic events; because of the skullduggery and some exceptionally social awful practice we additionally experienced some man-made debacles, for example, fire, building collapse, mischance for most recent few years. Disasters are annual events in Bangladesh (Nasreen, 2004). From time immemorial, the geographical location, land characteristics, multiplicity of rivers, monsoon climate and coastal morphology of Bangladesh have been a mixed blessing (Sabur, 2012). Bangladesh likewise needs the basic pre, amid and post-catastrophe administration operations that slack the moderation systems. Bangladesh is likewise lingering in a joint effort of various associations with modernised equipment. Disaster management in Bangladesh is mainly concerns to disaster mitigation and preparedness (Kafiluddin, 1991). Disasters cause massive misfortunes of lives and harm to properties, livelihood and financial framework. The country faces at least one major disaster a year; it has lost on average 3.02 % of its GDP every year during the last 10 years and holds the highest disaster mortality rate in the world (UNDP 2004). Conversely, Bangladesh is one of the most densely populated countries in the world. The population density here is 1266/ Km^2 (August 2017). With the population Growth 1.18%, as of Saturday, August 5, 2017, the total population of Bangladesh is 164,999,297 (Worldometers, 2017).

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Internationally Reported Losses 1990 – 2014 of Bangladesh by Disaster

Source: Prevention Web

The characteristic increment is relied upon to be certain, as the quantity of births will surpass the quantity of passing by 2 792 593. If external migration will remain on the previous year's level, the population will be declined by 322895 due to migration reasons (Worldometers, 2017). With the per capita income $1,602 (BBS 2017), Bangladesh experiences a very high physical and social Bangladesh encounters high physical and social vulnerability. We have discovered a solid relationship between disaster and poverty. Most of the dense areas are marked as with lower socio-economic conditions along with the disaster prone as well. Climate change along with the vicious practice and skullduggery of some immoral people adding a new dimension to community risks and vulnerabilities and according to Germanwatch (2009), As a result, Bangladesh is now at the top of a global climate risk index.

The Ministry of Education has given emphasis climate change studies along with disaster management and DRR. But we have seen a notable address of disaster management and climate change in the 2010 National Education Policy. In all levels of education, the policy has broadened the study and research is on the disaster and climate change issue. According to the policy principle no. 18-

"to build student as skilled human resources to fight the challenges of the world threatened by climate change and other natural disasters and to create in them a social awareness about environment"

Primary level education	Natural environment with emphasise topics like climate change
Ibtedaye level (Madrasa)	Environment Science with the inclusion of the concept 'climate change'.
High School level	Included the climate change and DRR issue in all classes of high school.
Higher level education	the subject Climate Change has got new horizon for higher studies
Agricultural Studies	Undertaking intensive research on agriculture development in the context of the threat of climate change, initiative will be taken for research on high yielding seeds, climate change, agriculture and biotechnology.

Source: Education Policy (2010)

According to the national disaster management and DRR strategy, Bangladesh has merged its educational curriculum with the DRR education. It has an exceptional and intense school education modules with similar reading materials utilised across the country. The National Curriculum and Textbook Board (NCTB) has presented fiasco and environmental change-related topics (i.e., hazards, vulnerability, preparedness) inside parts in various distinctive course books, for example, Bangla, English, Social Science, General Science.

Examples of topics included in textbooks in high school are as follows:

S. No.	Class	Subject	Topic
1.	Class 6	Science	Definitions of disasters, classifications of different types of disasters, planning for disaster mitigation
		English for Today	Water crisis, flood, etc.
2.	Class 7	General Science	Floods, river bank erosion and drought in Bangladesh
3.	Class 8	General Science	Natural disaster: cyclones and tidal surges (Islam, undated)
4.		Bangladesh o Bisshoporichoy (Bangladesh & Introduction to the world)	Global Warming- cause and effect, concept of disasters and types, brief discussion on disaster management and DRR
5.	Class 9-10	Geography	Natural disasters of Bangladesh; disaster and hazard, types and effects of disasters, disaster management and DRR, impact of a disaster, prevention-mitigation-preparedness-recovery and development for disaster.
6.		Science	Effect of climate change, cause of environmental problems, cause-prevention-strategies-measures of disasters, conservation of nature, social awareness for prevention of disasters.

Lessons inside reading material are frequently refreshed and checked on by the NCTB to make them more hazard administration situated (Ministry of Women and Children's Affairs, 2010). Considering there are four distinctive geo-climatic zones in Bangladesh and that diverse districts are influenced by various types of risks (for instance, dry spell in the north, twister and tidal surges in the south, waterway disintegration and surge amidst the nation) (Das, 2010, 7), it is extremely sketchy whether brought together course books can adaptably address provincially and locally particular perils.

Current textbook driven DRR educational programmes combination is not paralleled by instructive help for educators. There are only small-scale initiatives for teacher capacity building and teacher resource development. Hence, 'considering the sector size, the resources are inadequate' (UNISDR, 2011, 46). To fill the present crevice, ADPC and ActionAid Bangladesh (2001, 34) have made various recommendations which include: the arrangement of instructing helps to educators; giving consistent preparation to recently enrolled instructors by the National Teacher Training Institute; portion of spending plan for instructor preparing and materials advancement by the Ministry of Primary and Mass Education; building up a nearby organisation between the National Pedagogical Department and the Disaster Management Bureau. So for the practical knowledge on disaster management and DRR is far away from the effective learning outcomes and competencies amongst the high school students.

This present study will be intended to the pertinence and the adequacy of the practical knowledge on disaster management and DRR among the high school students with the immediate association and legitimate connection up from their textual knowledge. Besides others objectives of the study were as follows-

1. To know whether the level of disaster-related knowledge, readiness, awareness, adaptation, perception, curriculum text book knowledge was sufficient or not;
2. Whether any differences in disaster related knowledge, readiness, awareness, adaptation, perception, curriculum textbook knowledge by gender;
3. Whether any differences in disaster related knowledge, readiness, awareness, adaptation, perception, curriculum textbook knowledge by resident areas;
4. To know whether these knowledge sufficient enough for disaster readiness or not;
5. To find out more effective ways to arise disaster readiness-related knowledge among high school students.

Method

Participant

The study population of this present study was high school students. The sample was comprised of 400 high school students. They were selected, as sample, purposively on the basis of two basic phenomena. The first and absolute one was the gender (e.g. boy and girl), the next one was the residence (e.g. urban and rural). Since disaster management and DRR is all about community engagement so we emphasised class 8, 9 and 10 not on class 6 and 7. They remain inexistent due to the maturity issue on textual knowledge. If we illustrate the sample in statistical way then 50% (200) respondents were from urban area and 50% (200) of rural. On the gender basis, 50% (200) were boy and 50% (200) girl. Among boys, 40% (80) were from class 8, 30% (60) from class 9 and 30% (60) were from class 10. The overall statistics of boy continued identical for girl. Their age ranged from 13 years to 17 years.

Measures

To gather necessary information for the present study, the Bangla version (Ahmed, 2017) of DRR and DM Knowledge Questionnaire for High School Students (Tuladhar, Yatabe, Dahal, & Bhandary, 2014) was used. To make it more compatible to Bangladeshi perspective, a section consisting of 4 quantitative and 1 qualitative items were systematically adopted and included in the main measure as well.

DM Knowledge Scale for High School Students

DRR and DM Knowledge Scale for high School Students comprises 5 sections. The very first one is entitled as "Disaster Related Concerns" which has 3 items or statements. The next section is "Readiness Behaviour" with 7 items; the next one is Adaptation with Disasters with 7 items. The following section is Disaster Awareness with 7 items and the last section is the Disaster Risk Preparedness which has 4 items. For each item, the respondents were asked to indicate their responses in 3 possible levels, Yes, No and Don't Know.

Additional Section

To make the measure more conceptualised with the study, an additional section entitled 'Textual Knowledge' was adopted systematically with 4 quantitative and 1 qualitative items. The levels remain same; Yes, No and Don't Know for the first 4 items but the 5th item was qualitative, which leads the respondents to their freedom to write in brief about what else is/are required to include to their text books related to the disaster.

Study Design

The cross-sectional survey design was used in the present study.

Procedure

For collecting data for the present study, the discerned and previously adopted measure was administrated with the help of 6 separate teams altogether simultaneously. For the urban area, we have chosen schools from Dhaka, Chittagong and Sylhet and for rural area Tangail, Bhola and Satkhira. Since this present study is disaster focused so we have chosen most disaster prone areas. Respondents were given a brief written instruction along with the measure with total 28 quantitative and 1 qualitative or descriptive item. They were assured verbally that the information collected from them would be strictly confidential and would be used only for the disaster related research. Respondents were asked to read the questionnaire and express their feelings accordingly. They expressed their opinion by putting tick (√) mark on the appropriate response boxed those were best fit for their opinion. After completing their task, they were thanked for their extended kind cooperation.

Results

As said in methodology, fundamentally three sorts of analysis have been done to explore general DRR information of high school students in Bangladesh. The impacts of gender orientation and residential differences were likewise taken care in the analysis section. The collected data on textual knowledge on disaster management was subjected to percentage test in order to examine whether there is any differences in gender orientation and residential position on disaster related textual practical knowledge. Aftereffects of examination are given in the accompanying headings.

Eventual results of tests are given in the following with separate tables:

Table 1: Overall Percentage of All Sections

S. No.	Item	Percentages of Responses		
		Yes	No	Unknown
1.1	Do you know when a disaster will occur?	70	18	12
1.2	Do you think that disaster cannot be prevented?	55	28	17
1.3	Do you think that there is the applicability of taking part in disaster management training	85	1	15
2.1	Do you think that to come across a disaster and remain alive depends on your luck?	70	20	8
2.2	Do you think that there is significance of disseminating textual knowledge and experiences?	77	7	16
2.3	Do you think that government is capable enough to cope with disasters?	69	19	13
2.4	Do you think that government and people are confident and capable for reconstruction activities after a disaster?	60	23	17
2.5	Do you think it is necessary to discuss resembling disasters?	82	6	13
2.6	Do you think that it is essential listening to people who work or do activities for disaster management?	73	12	16
2.7	Do you think that there is a necessity to disseminate your textual knowledge resembling disasters with others?	66	9	26
3.1	Do you think that it is essential to take shelter at a shelter house or shelter center?	85	5	10
3.2	Do you know the information about which government office needs to be contacted after the disaster?	14	75	11
3.3	Do you know the disaster-prone areas of Bangladesh?	24	61	15
3.4	Did you get any information from INGO/NGO about disasters?	5	95	0
3.5	Do you have consciousness about evacuation procedures during disasters?	17	81	3
3.6	Do you know the community activities during disasters?	38	47	16
3.7	Do you know the life after the state of evacuation after disasters?	29	51	21
4.1	Do you think that volunteer's role is necessary to mitigate disasters?	68	14	19
4.2	Do you think that enforcing buildings is important to escape from disasters?	91	4	6
4.3	Do you think that preparing emergency bags is important to subsidise disasters?	86	5	10
4.4	Do you think that it is important to be good with community from everyone's side to mitigate the disasters?	80	11	9

4.5	Do you think that repair of road blockage and transportation break is must as soon as after disasters?	75	10	16
4.6	Do you think that it is important to build disaster awareness in local, regional and national level?	28	46	26
4.7	Do you think that rapid rehabilitation is necessary after disasters?	69	15	16
5.1	Do you think large-scale disasters will certainly occur in Bangladesh in next 10 years?	43	43	15
5.2	Do you think your area is safe from all kinds of disasters?	39	38	23
5.3	Do you think your building is well designed and will withstand an earthquake event?	26	50	24
5.4	Do you have any idea about security of sleeping space?	12	70	18
6.1	Do you think your knowledge of disaster is textual?	16	68	18
6.2	Do you think your textual knowledge of disaster applies to practical scale?	30	48	23
6.3	Do you think your textual knowledge regarding disaster is adequate?	18	54	28
6.4	Do you think your textual disaster related knowledge is applicable during an emergency?	25	44	31

Figures in Table-1 indicate that, for the Disaster Related Concerns section responses are as, 69.66%-Yes, 15.75%-No and 14.59% Don't Know. For the Readiness Behaviour section, responses are 70.7%-Yes, 13.8%-No and 15.5%-Don't Know. For the section Adaptation with Disasters, 70.85%-Yes, 14.75%-No and 14.4%- Don't Know. For the Disaster Awareness section, 30.2%-Yes, 59.1%-No and 14.4% responded as Don't Know. For the Disaster Risk Perceptions section, 29.9% Yes, 50.2%-No and 19.9% responded as Don't Know. And for the last section, Textual Knowledge, 22.1%-Yes, 53.1%-No and 24.8% responded as Don't Know.

Table 2: Overall by Sections

S. No.	Concerns	Percentages of Responses		
		Yes	No	Unknown
1.	Disaster Related Concerns	69.7	15.7	14.6
2.	Readiness Behaviour	70.8	13.7	15.5
3.	Adaptations with Disasters	70.9	14.7	14.4
4.	Disaster Awareness	30.2	59.1	10.7
5.	Disaster Risk Preparations	29.9	50.2	19.9
6.	Textual Knowledge	22.1	53.2	24.7

Figures in Table 2 indicate that, for the Disaster Related Concerns section responses are: 69.66%-Yes, 15.75%-No and 14.59% Don't Know. For the Readiness Behavior section, responses are 70.7%-Yes, 13.8%-No and 15.5%-Don't Know. For the section Adaptation with Disasters, 70.85%-Yes, 14.75%-No and 14.4%- Don't Know. For the Disaster Awareness section, 30.2%-Yes, 59.1%-No and 14.4% responded as Don't Know. For the Disaster Risk Perceptions section, 29.9% Yes, 50.2%-No and 19.9% responded as Don't Know. And for the last section, Textual Knowledge, 22.1%-Yes, 53.1%-No and 24.8% responded as Don't Know.

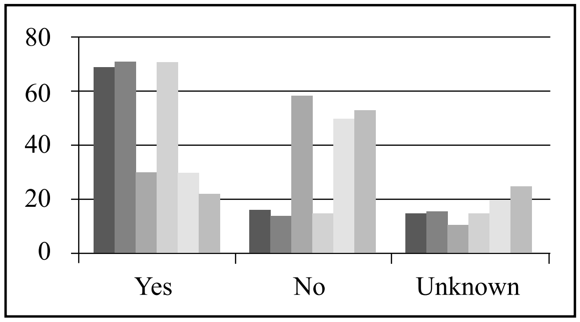

Figure 1: Overall percentage of all sections

Table 3: Gender Differences

S. No.	Concerns	Male (Percentage)			Female (Percentage)		
		Yes	No	Unknown	Yes	No	Unknown
1.	Disaster Related Concerns	73.2	18.7	8.1	67.1	13.5	19.4
2.	Readiness Behaviour	74.2	13.4	11.6	67.1	13.5	19.4
3.	Adaptation with Disasters	76.4	15.2	8.4	65.3	14.3	20.4
4.	Disaster Awareness	34.2	58.2	7.6	26.2	60.1	13.7
5.	Disaster Risk Preparations	34	45.5	20.5	25.7	54.9	19.4
6.	Textual Knowledge	27	52.3	20.8	17	54	29

Figures in Table 5 indicate that, there is a certain difference between disaster management and DRR knowledge. The tables shows that for Disaster Related Concerns 73.2% responded as Yes; 18.7%- No and 8.1%- Don't Know for the male or Boy on the other hand; girl's responses are 67.1%- Yes; 13.5%-No and 19.4%- Don't Know. For Readiness Behaviour section 74.2% responded as Yes; 13.4%- No and 11.6%- Don't Know for the male or Boy on the other hand; girl's responses are 67.1%- Yes; 13.5%-No and 19.4%- Don't Know. For the Adaptation with Disasters section; 76.4% responded as Yes; 15.2%- No and 8.4%- Don't Know for the male or Boy on the other hand; girl's responses are 65.3- Yes; 14.3%-No and 20.4%- Don't Know. For the Disaster Awareness section; 34.2% responded as Yes; 58.2%- No and 7.6%- Don't Know for the male or Boy on the other hand; girl's responses are 26.2%- Yes; 60.1%-No and 13.7%- Don't Know. For the Disaster Risk Preparations section; 34% responded as Yes; 45.5%- No and 20.5%- Don't Know for the male or Boy on the other hand; girl's responses are 25.7%- Yes; 54.9%-No and 19.4%- Don't Know. For the last section- Textual Knowledge; 27% responded as Yes; 52.3%- No and 20.8%- Don't Know for the male or Boy on the other hand; girl's responses are 17%- Yes; 54%-No and 29%- Don't Know. From these figures, it is clearly illustrated that male or boy's knowledge over disaster management and DRR is better than the female or girl students. In every section, we have seen some notable differences among the two groups.

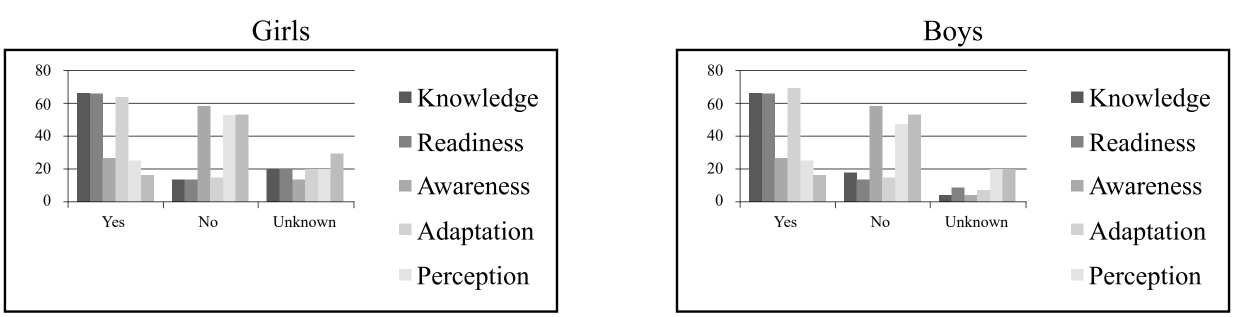

Figure 2: Gender differences on disaster management and DRR knowledge

Table 4: Residential Differences by Percentage (%)

S. No.	Concerns	Urban (Percentage)			Rural (Percentage)		
		Yes	No	Unknown	Yes	No	Unknown
1	Disaster Related Concerns	80.5	10.2	9.3	58.8	21.3	19.9
2	Readiness Behaviour	71.7	16.6	11.7	69.7	10.6	19.7
3	Adaptations with Disasters	78.2	10.9	10.9	63.5	18.6	17.9
4	Disaster Awareness	38.4	52.6	9	22	65.7	12.3
5	Disaster Risk Preparations	39.3	41	19.7	20.5	59.5	20
6	Textual Knowledge	24.4	56	19.6	19.9	50.8	30.3

We have got the demographic difference which is also supported by the figures in Table 6. It indicates that, for Disaster Related Concerns 80.5% responded as Yes; 10.2%- No and 9.3%- Don't Know for urban area on the other hand; rural perople's responses are 58.8%- Yes; 21.3%-No and 19.9%- Don't Know. For Readiness Behaviour section 71.7% responded as Yes; 16.6%- No and 11.7%- Don't Know for urban area on the other hand; rural people's responses are 69.7%- Yes; 10.6%-No and 19.7%- Don't Know. For the Adaptation with Disasters section; 78.2% responded as Yes; 10.9%- No and 10.9%- Don't Know for the urban area on the other hand; rural student's responses are 63.5- Yes; 18.6%-No and 17.9%- Don't Know. For the Disaster Awareness section; 38.4% responded as Yes; 52.6%- No and 9%- Don't Know for the urban area on the other hand; rural student's responses are 22%- Yes; 65.7%-No and 12.3%- Don't Know. For the Disaster Risk Preparations section; 39.3% responded as Yes; 41%- No and 19.7%- Don't Know for the urban area on the other hand; rural student's responses are 20.57%- Yes; 59.5%-No and 20%- Don't Know. For the last section- Textual Knowledge; 24.4% responded as Yes; 56%- No and 19.6%- Don't Know for the urban area on the other hand; rural student's responses are 19.9%- Yes; 50.8%-No and 30.3%- Don't Know. From these figures, it is clearly illustrated that urban students' knowledge of disaster management and DRR is better than the rural area's students. In every section, we have seen some notable differences among the two groups.

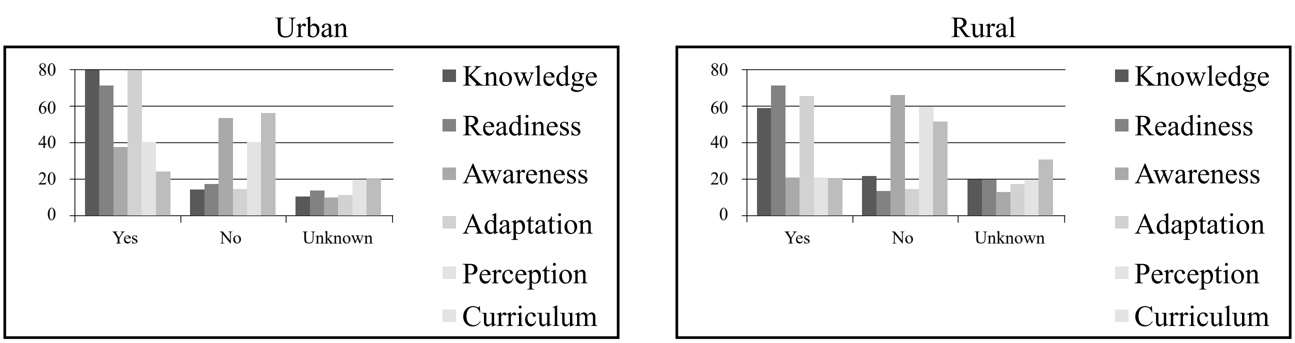

Figure 3: Residential differences on disaster management and DRR knowledge

Discussion

The present study is committed to uncover the significance of understanding disaster management and DRR knowledge scattering process among the high school students of both urban and rural zones of Bangladesh. For disaster management and DRR knowledge we have accentuated over the youthful part of the general populace since they are anything but difficult to form in the building the disaster management cordial practices alongside the sound information of DRR. According to Hassanian (2006), children and youth are the part of the population that are most severely affected by disasters, as they can easily panic and become difficult to manage during emergencies or crises, especially when a school or a house catches fire. As per the instruction service and other developmental agencies e.g. INGO, NGO, UN organisations guarantee that the disaster management and DRR concept is as of now being acquainted successfully with the national educational curriculum of Bangladesh and all high school students notwithstanding for some broaden the primary level students are picking up the learning about the esteemed matter fundamentally.

For collecting data, the discerned and previously adopted measure was administrated with the help of 6 separate teams altogether simultaneously. For the urban area, we have chosen schools from Dhaka, Chittagong and Sylhet and for rural areas: Tangail, Bhola and Satkhira. The number of total respondents were 400 among them 200 male and 200 female and the ratio remains 50% for urban and 50% for rural area. It was pre-determined that Class 6 & 7 will remain out of the sample population since we have emphasised the maturity level and class 8,9 & 10 were the best suited and befitted in this manner. Their age ranged from 13 years to 17 years.

This present study analysed the is there any viable learning gap connected to the course reading as indicated by the national educational modules of Bangladesh of the high school students in regards to the disaster management and DRR information that blocks a similar practice in real life when required to them and others. In other word, the learning which is guaranteed by the government and other developmental agencies is appropriate or with provisos when required to be completely practical. No doubt that the lessons are adequate in the textbooks of national curriculum but the question arises when the practicality comes to concern.

A questionnaire with six separate sections (Disaster Related Concerns, Readiness Behaviour, Adaptations with Disasters, Disaster Awareness, Disaster Risk Preparations, Disaster Awareness, Disaster Risk Preparations and Textual Knowledge) explored the high school student's understanding regarding disaster management and DRR knowledge. Where we have discovered that some noteworthy and alarming findings for example in respect of overall percentage, 30.2% of the aggregate examination populace is disaster aware; 29.9% is prepared with the challenges of disaster management and DRR and 22.1% is satisfied with the textual knowledge regarding the disaster management and DRR knowledge incorporated their educational programs. For the other three sections, Disaster Related Concerns, Readiness Behaviour, Adaptations with Disasters, Disaster Awareness seems to be alright for now for the overall study population. Paton and Johnston (2001) maintain that vulnerability is essential in understanding disasters in terms of preparedness, response and recovery and that it can be defined in terms of demographic, socio-economic and environmental circumstances.

So we have seen two basic differences in this present study, gender and residential which are significant and notable to mention in the discussion part. The level of understanding the disaster management and DRR sound knowledge. For section by section analysis, Disaster Related Concerns 73.2% responded as Yes; 18.7%- No and 8.1%- Don't Know for the male or Boy on the other hand; girl's responses are 67.1%- Yes; 13.5%-No and 19.4%- Don't Know. For Readiness Behavior section 74.2% responded as Yes; 13.4%- No and 11.6%- Don't Know for the male or Boy on the other hand; girl's responses are 67.1%- Yes; 13.5%-No and 19.4%- Don't Know. For the Adaptation with Disasters section; 76.4% responded as Yes; 15.2%- No and 8.4%- Don't Know for the male or Boy on the other hand; girl's responses are 65.3- Yes; 14.3%-No and 20.4%- Don't Know. For the Disaster Awareness section; 34.2% responded as Yes; 58.2%- No and 7.6%- Don't Know for the male or Boy on the other hand; girl's responses are 26.2%- Yes; 60.1%-No and 13.7%- Don't Know. For the Disaster Risk Preparations section; 34% responded as Yes; 45.5%- No and 20.5%- Don't Know for the male or Boy on the other hand; girl's responses are 25.7%- Yes; 54.9%-No and 19.4%- Don't Know. For the last section- Textual Knowledge; 27% responded as Yes; 52.3%- No and 20.8%- Don't Know for the male or Boy on the other hand; girl's responses are 17%- Yes; 54%-No and 29%- Don't Know. From this, it is clearly illustrated that male or boy's knowledge over disaster management and DRR is better than the female or girl students. In every section, we have seen some notable differences among two groups. The matter DRR and disaster management is knowledge based and training driven so incorporating with the training program is essential for the learners to become a significant CPP volunteer or active member of disaster management. But we have seen the acute reluctance of the female or girls to be incorporated with such. Besides the dependency mentality of the female and protective mentality of male leads such gender differences in disaster management and DRR. Then again, we have got the demographic difference which is also supported by the figures in Table-6. It indicates that, for Disaster Related Concerns 80.5% responded as Yes; 10.2%- No and 9.3%- Don't Know for urban area on the other hand; rural people's responses are 58.8%- Yes; 21.3%-No and 19.9%- Don't Know. For Readiness Behaviour section 71.7% responded as Yes; 16.6%- No and 11.7%- Don't Know for urban area on the other hand; rural people's responses are 69.7%- Yes; 10.6%-No and 19.7%- Don't Know. For the Adaptation with Disasters section; 78.2% responded as Yes; 10.9%- No and 10.9%- Don't Know for the urban area on the other hand; rural student's responses are 63.5- Yes; 18.6%-No and 17.9%- Don't Know. For the Disaster Awareness section; 38.4% responded as Yes; 52.6%- No and 9%- Don't Know for the urban area on the other hand; rural student's responses are 22%- Yes; 65.7%-No and 12.3%- Don't Know. For the Disaster Risk Preparations section; 39.3% responded as Yes; 41%- No and 19.7%- Don't Know for the urban area on the other hand; rural student's responses are 20.57%- Yes; 59.5%-No and 20%- Don't Know. For the last section- Textual Knowledge; 24.4% responded as Yes; 56%- No and 19.6%- Don't Know for the urban area on the other hand; rural student's responses are 19.9%- Yes; 50.8%-No and 30.3%- Don't Know. From this result, it is clearly illustrated that urban student's knowledge of disaster management and DRR is better than the rural area's students. In every section, we have seen some notable differences among two groups. But for the three sections Disaster Related Concerns, Disaster Awareness and Disaster Risk Preparations is more conflicting with their results because the differences are 21.7%; 16.4% and 18.8%, respectively. The disasters in last 30 years including; flood, earthquake, cyclone and many others affect the urban areas deeply. Although the loss and death toll is not less rural areas but the reviving scale is much faster that the urban area. So naturally the rural people are adopted with the disasters and its consequences without having any systematical and scientific knowledge and on the other hand, for the basic of survival in the fast growing and unplanned urbanisation people are opt to know the DRR and disaster management matters.

But there was one thing common for all of male, female, urban or rural and that is of textual knowledge. Since this is the main concern for this present study where only Textual Knowledge 22.1% responded as Yes, 53.2% No and 24.7% as Don't Know. For the gender difference section for male or boy 27% responded as Yes; 52.3% No and 20.8% Don't Know and on the other hand for the female of girl; 17% responded as Yes; 54% No and 29% Don't Know. Which clearly and significantly showed that everybody believes irrespective of gender that the Textual Knowledge on disaster management and DRR are inadequate when needs to be practiced.

Alongside, the respondents from urban; 24.4% responded as Yes; 56% No and 19.6% Don't Know and for the rural respondents 19.9% Yes; 50.8% No and 30.3% Don't Know. It shows that there is serious confusion regarding the textual knowledge for the esteemed matter irrespective of residential location.

Recommendations

The recommendations have made by the respondents themselves at the last and only qualitative question of the assigned questionnaire. They are:

1. The illustrations should be detailed and specific for practice;
2. History of previous disasters and learning must be incorporated;
3. The knowledge of process of relief distribution;
4. During disaster; which agencies to be notified and where is the shelters are located;
5. Sound knowledge of evacuation procedures;
6. Preparing mass measures before striking disaster;
7. When all the measures are operational, which final resources to be mobilised;
8. How to disseminate the early warning;
9. How to be skilled personnel incorporated with the preparation;
10. Protection knowledge of bunds, drain and damps;
11. Protection of agricultural land, forests, communication infrastructure and residence;
12. Intensive first aid training;
13. Shelter and food storage management knowledge;
14. Knowledge of the responsibilities of all agencies and authorities;
15. Sound knowledge of post-disaster rehabilitation.

Limitations of the Study

The sample size needs to be more to represent the whole nation. The rural respondents were not open to response. For the qualitative question; the respondents were reluctant to respond to put their opinion. We have faced immense problems while entering the knowledge storage of the agencies. While adopting the scale, some other procedural problem we have faced as well.

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Building Resilience to Disasters: UN 17 SDGs and Sendai Framework a Holistic Approach towards Poverty Eradication

Gajadhar Choudhary[a]

Abstract

The world economic vulnerability was only 54 billion US$ in the year 1980, became 63 billion US$ in 1990, 210 billion US$ in 2011 and finally to 300 billion US$ in 2015. Expected future disaster losses, climate change US $ 435 billion, by 2050, 40% of the global population will be living in the river basins in Africa and Asia. Global average annual loss is estimated to increase up to US$ 415 billion by 2030. "The Human Cost of Weather Related Disasters", from 1995-2015, 6,457 recorded floods, storms, heatwaves, droughts and other weather-related events, caused 606,000 lives, 4.1 billion people have been injured, left homeless.

The adoption of 'Transforming Our World through 2030 Agenda for UN 17 SDGs by 169 global targets with Sendai Framework Action, 'Words into action-Vulnerability into resiliency' sets poverty eradication as an overarching aim and has, at its core, the integration of the economic, social and environmental dimensions of sustainable development.

Keywords: economic loss, UN17 SDGs, Paris Agreement, Sendai Framework, poverty eradication

Introduction

Building the resilience of communities and nations is fundamental to achieving the goals in the outcome document and succeeding in attaining development that is sustainable. With the magnitude of losses over recent decades, the likely impact of disaster risk on development efforts and the projected increase in losses over the coming decades present a strong case for the inclusion of disaster risk and resilience in the 2030 Agenda for Sustainable Development.

Disasters resulting from natural hazards such as floods, drought, earthquakes, cyclones, forest fires, desertification and insect infestation impact development in several ways. Disasters damage infrastructure, lifelines and critical facilities, resulting in human, financial and environmental losses. Rehabilitation requires a large amount of funding planned for development and services to the peoples and also decrease the economic potential of society by exacerbating poverty, disrupting small business and industry activities. The climate change induced extreme weather events increasing trends of hydro-meteorological disasters escalating economic losses. The average global economic cost of disasters increased approximately six-folds from 1970 to 2000 (Munich Re; 2001). According to UNISDR disaster impacts 2000-2012, total economic losses to 1.7 trillion, 2.9 billion affected and 1.2 million killed. Losses from disasters reached US$ 370 billion in 2011, US$ 300 on average annually in 2015, and in 2016 it becomes US$ 210 billion. In 2017 only Texas losses to Hurricane Harvey is about US$ 160 billion and India about US$ 40 billion by floods. 61% of GDP in damage and loss suffered by Vanuatu from cyclone PAM in 2015, 15% increase in poverty rate due to the 2013 Typhoon Yolanda is the worst affected areas of Philippines, Nepal's increase in the poverty rate from 2.5-3.5 after the 2015 earthquake. US$ 50 billion to 200 billion US$ increase in annual average weather-related losses and damage alone since the 1980s.

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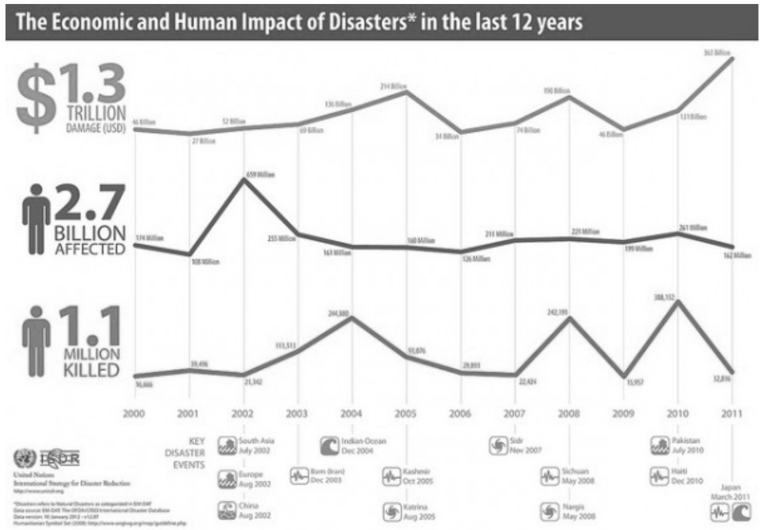


Figure 1: Economic and human impact of disasters, 2000-2012

Source: UNISDR, 2015

Climate change is the driver of weather induced disasters, the biggest threat to development which disproportionately affects poor and vulnerable people. The Intergovernmental Panel on Climate Change (2015) predicts that by 2100, climate change is expected to increase the number of poor people in both developed and developing countries, jeopardising sustainable development.

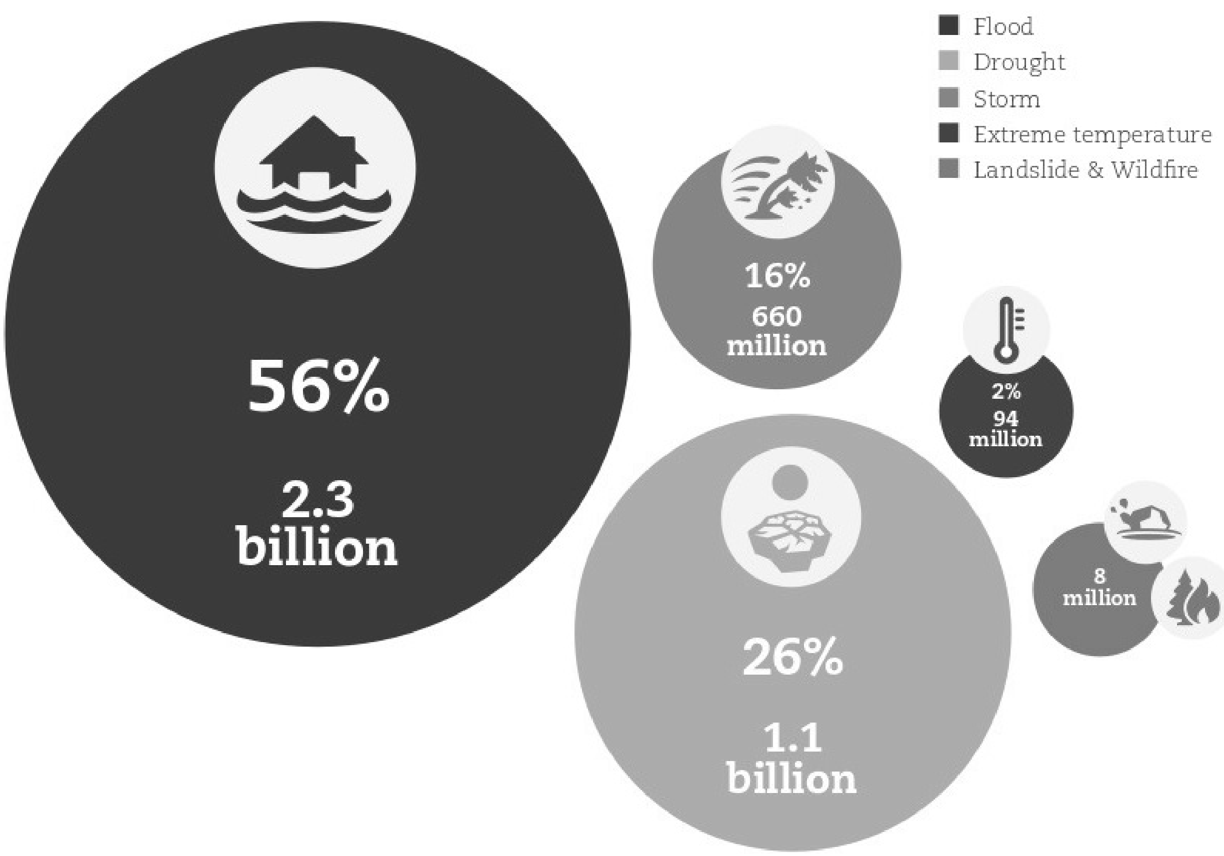


Figure 2: Number of people affected by weather-related disaster (1995–2015)
(NB: deaths are excluded from the total affected.)

Asia experienced in 2009 the largest share as reported in natural disaster occurrence (40.3%), which was accounted for 38.5% as reported in total economic damages (US$ 41.3 billion). Natural disasters took a turn in 2010, caused US$ 123.9 billion of economic damages. By 2050 average annual economic losses from Asian floods disasters could surge to 500 US billion dollars and 100 million people could be pushed into poverty by the next 15 years.

monsoon floods of July-august, 2017 claim 1200 lives and affect 41 million people in South Asia.

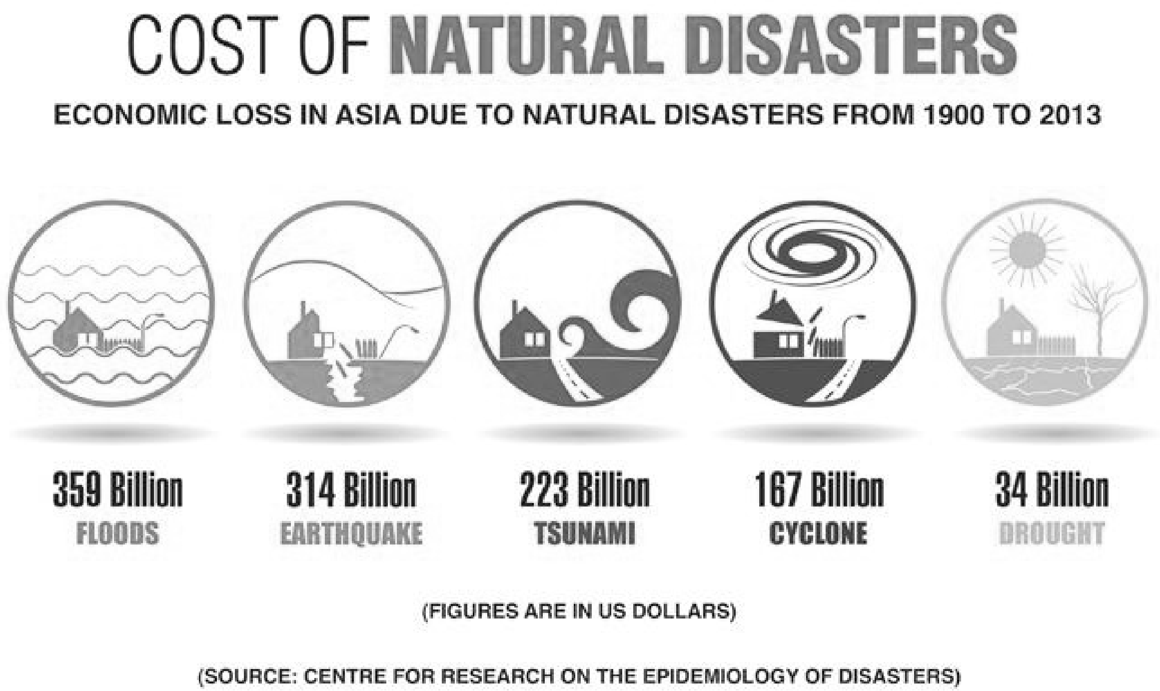


Figure 3

India has already lost more than US$ 40 billion in July- August to floods, deeply affected 6 States and partly affected 23 States in 2017, 2 billion US$ claims by West Bengal State. State Andhra Pradesh has 2 billion US$ average losses annually. The Economic vulnerabilities exacerbate the impact of a disaster and make the process of recovery and rehabilitation very high opportunity costs. Developing Countries in Asia start losses 2-15% GDP annually and up to 12 per cent of government revenues. Global risk investment required US$ 6 trillion yearly for 15 years, Asia and India to evaluate Information to disaster, Infrastructure to risk and Incentives to community for future disaster risk reduction, investment up to 2.4 US$ trillion average annually for 15 years (2015–2030).

If safeguards to mitigate its impact globally are not implemented, could reach to US$ 435 billion in 2060. On average 100,000 people are expected to lose their lives due to natural hazards each year and particularly to 97 % of deaths occurred in the least developed countries. Moreover, it is estimated that climatic disasters will cause effects to 375 million and up to a billion people will be forced out of their homes by 2050 due to climate change. Similarly on human Development Index Norway ranked 1, Switzerland 2, and India ranked 131 in 2016. According to Disaster Risk Resiliency Index Switzerland ranked 1, Honduras got 130 ranks in 2016 and in 2017 Haiti got 130 ranks and by Disaster Risk Index Vanuatu ranked 1, Bangladesh 5, and India ranked 77 out of 183 countries.

As the first major agreement of the post-2015 development agenda, the Sendai Framework and its implementation is an important catalyst to influence and complement the achievement of the goals and targets set forth in the 2030 Agenda for Sustainable Development, as well as in the Addis Ababa Action Agenda on financing for development, agreed, and in the COP21 climate agreement at the end of 2015 and COP22 at Marrakech.

The Sendai Framework outlines seven global targets to be achieved over the next 15 years: a substantial reduction in global disaster mortality; a substantial reduction in numbers of affected people; a reduction in economic losses in relation to global GDP; substantial reduction in disaster damage to critical infrastructure and disruption of basic services, including health and education facilities; an increase in the number of countries with national and local disaster risk reduction strategies by 2020; enhanced international cooperation; and increased access to multi-hazard early warning systems and disaster risk information and assessments. A key part of the success of the 2030 Agenda for Sustainable Development will be based on the progress made to implement disaster risk reduction and resilience building. As such, disaster risk reduction indicators will be one of the cornerstones to measure and monitor the progress of both public and private actions that aim to address the underlying risk drivers, reduce existing levels of risk and strengthen resilience towards the achievement of the SDGs to end poverty and zero hunger by 2030.

Photo 1.

Geographic isolation and lack of economies of scale pose a particular development challenge to small island developing states, where climate change threatens their existence, which is critical for these countries' future and their effective pursuit of the 2030 Agenda for Sustainable Development. The 2017 edition of the *Countries with Special Needs Development Report* highlights the importance of infrastructure in achieving inclusive growth and sustainable development and has been accorded a high priority among the goals and actions agreed upon in the global programmes of action for these countries; these actions include the Istanbul Programme of Action for least developed countries, the Vienna Programme of Action for landlocked developing countries, and the Small Island Developing States Accelerated Modalities of Action (SAMOA) Pathway.

The latest data show that about one in eight people still lived in extreme poverty, nearly 800 million (80 Cr.) people suffered from hunger, the births of nearly a quarter of children under 5 had not been recorded, 1.1 billion (110 Cr.) people were living without electricity, and water scarcity affected more than 2 billion (200 Cr.) people.

Sustainable Development Goals: Disaster Risk Reduction

On January 1, 2016 UN 17 Sustainable Development Goals implemented-The transformative plan of action based on 17 SDGs- poverty, hunger, health, education, gender, water, energy, jobs, infrastructure, inequalities, cities, consumption, climate, oceans, the environment, peace, institutions, and partnerships with 169 targets, 100 Global Monitoring Indicators to address urgent global challenges by 2030.

Disaster Risk Reduction cuts across different aspects and sectors of development. There are 25 targets related to disaster risk reduction in 10 of the 17 Sustainable Development Goals, firmly establishing the role of disaster risk reduction as a core development strategy for poverty reduction.

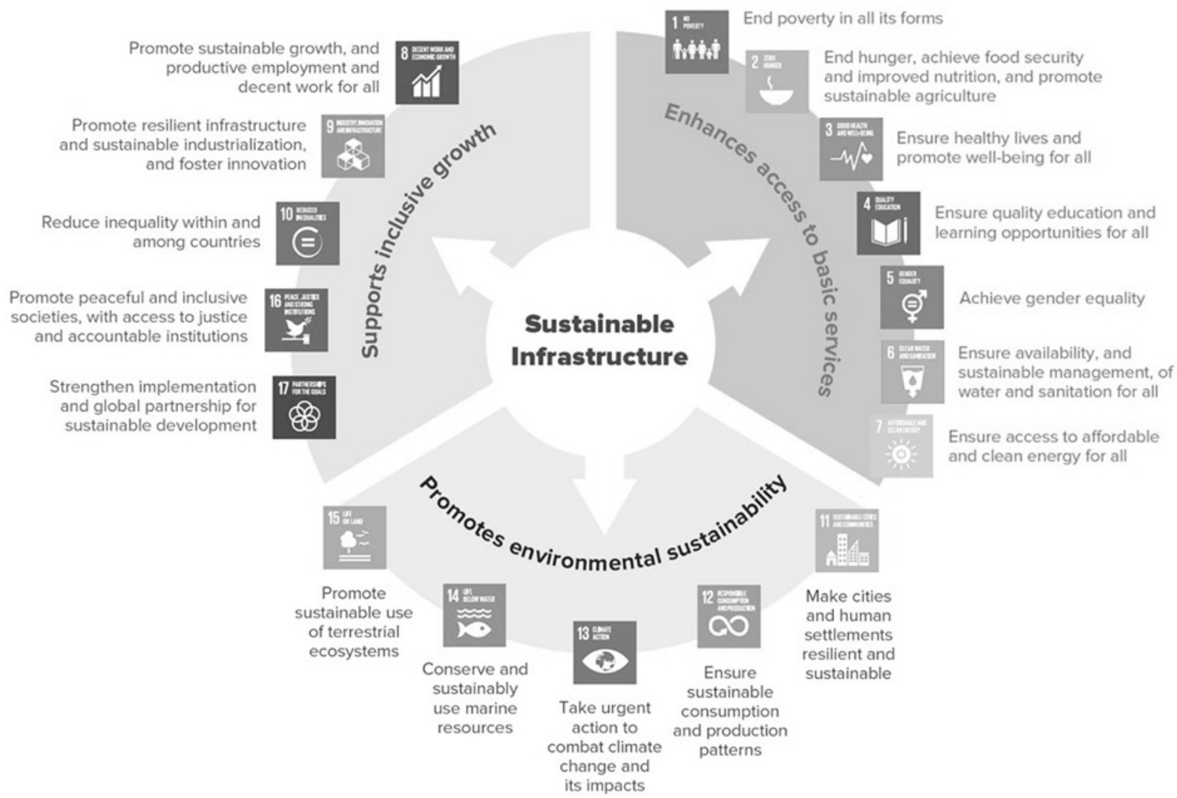


Figure 4

Goal 1: End Poverty in All its Forms Everywhere

Target 5 of goal 1 (1.5) calls for an end to poverty by building the resilience of the poor and those in vulnerable situations, and reduce their exposure and vulnerability to climate-related extreme events and other economic, social and environmental shocks and disasters by 2030 with losses from natural disasters, by climate and non-climate-related events in US dollar and lives lost.

Least Resilient Countries, 2017	**Least Resilient Countries, 2016**
121. Myanmar	121. Venezuela
122. Madagascar	122. Dominican Republic
123. Nigeria	123. Kyrgyzstan
124. Lebanon	124. Nicaragua
125. Pakistan	125. Mauritania
126. Chad	126. Ukraine
127. Ethiopia	127. Egypt
128. Nepal	128. Algeria
129. Venezuela	129. Jamaica
130. Haiti	130. Honduras

HDI rankings: How India compares with BRICS peers

The UN Human Development Report 2016 ranks India 131 out of 188 countries, based on 2015 data. Despite making major progress, India still ranks third among South Asian countries– behind Sri Lanka and the Maldives. Among the BRICS nations, India's improvement in HDI is the second-best after China which has recorded the highest at 48%

Gender Inequality Index

Rank		Seat share of women in Parliament (%)	Participation in the labour force: Woman*	Participation in the labour force: Men
52	Russia	14.5	56.6	71.7
92	Brazil	10.8	56.3	78.5
37	China	23.6	63.6	77.9
90	South Africa	41.2	46.2	60.2
125	India	12.2	26.8	79.1

*% of women 15 yrs and above

Multidimensional Poverty Index

	Population near multidimensional poverty (%)	Population in severe multidimensional poverty (%)	Intensity of deprivation
Brazil	6.7	0.3	40
China	22.7	1.0	43.3
India	18.2	27.8	51.1
South Africa	17.1	1.3	39.6
Russia	-	-	-

Inequality adjusted Human Development Index

	Human Development Index (HDI)	Inequality adjusted HDI	Overall loss (%)
Russia	0.804	0.725	9.8
Brazil	0.754	0.561	25.6
China	0.738	NA	NA
South Africa	0.666	0.435	34.7
India	0.624	0.454	27.2

Source: UN Human Development Report 2016

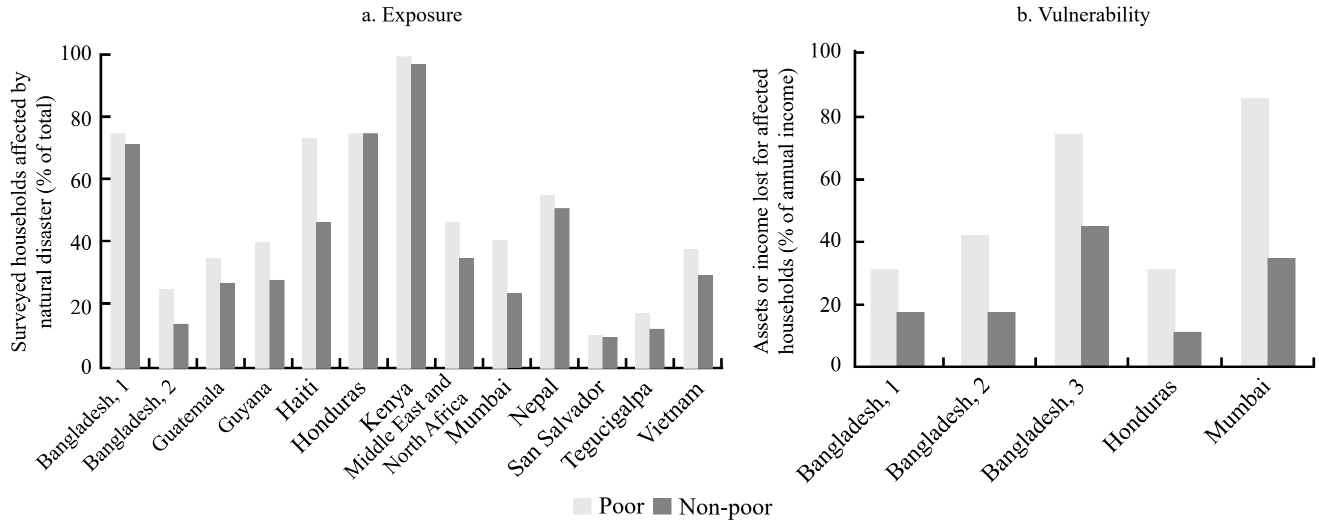
Figure 5.

Building disaster resilience is critical to achieving the goal of eradicating extreme poverty. As one of the key drivers of disaster risk, given the way it creates and aggravates economic and social vulnerability, poverty has significantly contributed to the growth in risk conditions which further limit the progress of sustainable development. By 2030, there could be 325 million people trapped in poverty and exposed to the full range of natural hazards and climate extremes particularly in sub-Saharan Africa and South Asia. This suggests an urgent need to build and strengthen the resilience of poor communities to prevent future disaster events from pulling more people into poverty and to protect their livelihoods and assets to help them recover.

Target 1.5, which relates to building the resilience of the poor, further strengthens the position of disaster risk reduction as a core development strategy for ending extreme poverty. To achieve this goal and target, Sendai Framework proposes the promotion and development of social safety nets linked with livelihood enhancement programmes in order to ensure resilience of households and communities to disasters.

India direct transfer of Rs 217,242.53 Cr (about 31 billion US dollars to poor people's account by 2014-17 and opted 3 targets out of 7 through Nationally Determined Contributions (NDCs).

Poor people and natural Disasters

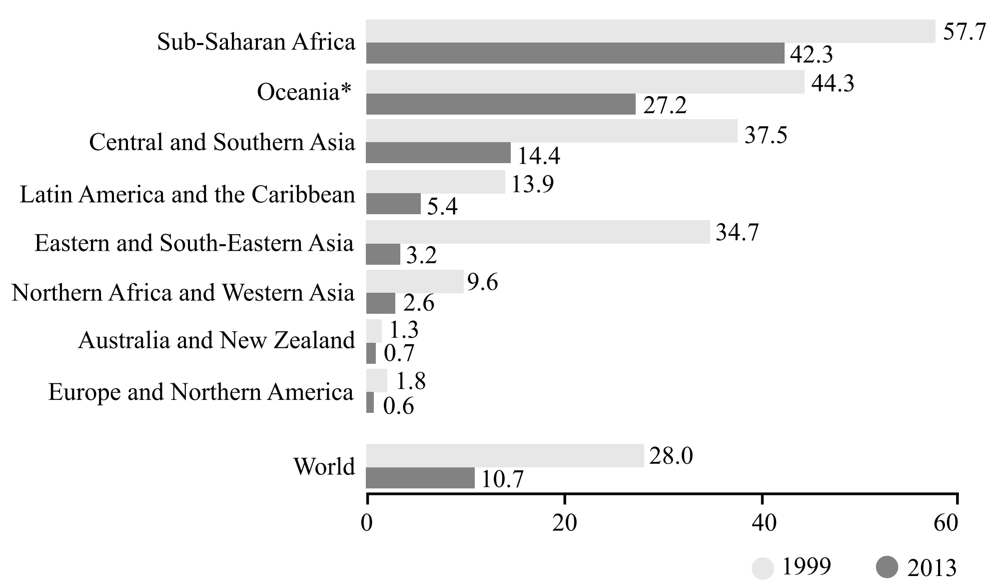


Source: World Bank, 2016

Goal: 2. End Hunger, Achieve Food Security and Improved Nutrition and Promote Sustainable Agriculture

Natural hazards are a cause of global food insecurity and hunger, particularly when they compound existing economic vulnerability. Large shocks and extensive risks destroy agricultural assets and infrastructure, causing serious damage to the livelihoods and food security of millions of small farmers, pastoralists and fishers in many developing countries. The high impact of disaster and climate risk on agriculture calls for enhanced mainstreaming of disaster risk reduction and climate adaptation strategies within the agriculture sector. Severe cyclonic Storm Aila in 2009 washed away 835 km embankments with all coastal houses and poisoned 2 lacs hectares of agriculture fields with saline water intrusion.

Proportion of the population living below 1.90 US dollars a day, 1999 and 2013 (percentage)



Note: Oceania* refers to Oceania excluding Australia and New Zealand throughout the publication

Figure 7.

Target 2.4 supports the immediate need to advance actions in mainstreaming disaster risk reduction and climate adaptation into agriculture sector planning and investments in order to promote resilient livelihoods, food production and ecosystems. Agricultural practices also need to be modified in order to adapt to the projected changes in climate conditions as well as the increasing disaster risk. Sustainable and productive agriculture systems, including farm technologies and practices such as crop diversification to adjust to new temperature and precipitation patterns, changing livestock breeding practices and shifting grazing patterns, developing and managing climate-resilient food production systems, developing and using drought and flood-tolerant crop varieties and adopting water and soil moisture conservation measures are just a few examples that could help prevent, mitigate and reduce disaster and climate risk.

Photo 2. Severe Cyclone Aila Impacted Coastal Belts of Sunderbans, 2009
Source: Mitigator, 2009

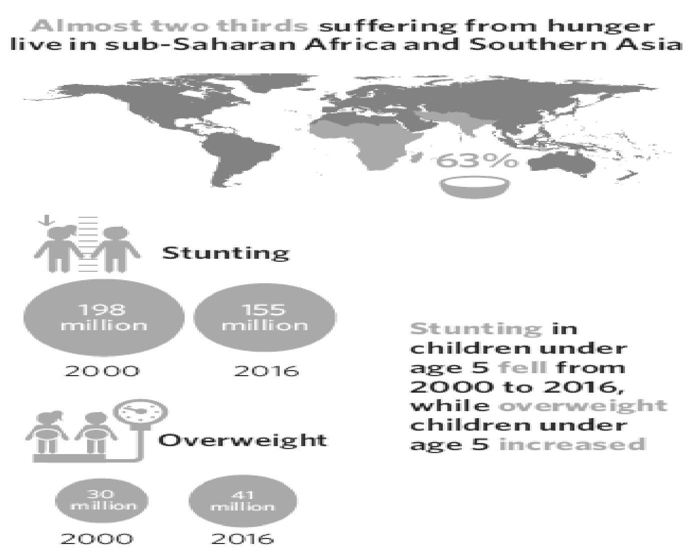


Figure 8.
Source: UN 17 SDGs Report, 2017

Goal 3: Ensure Healthy Lives and Promote Well-being for all at all Ages

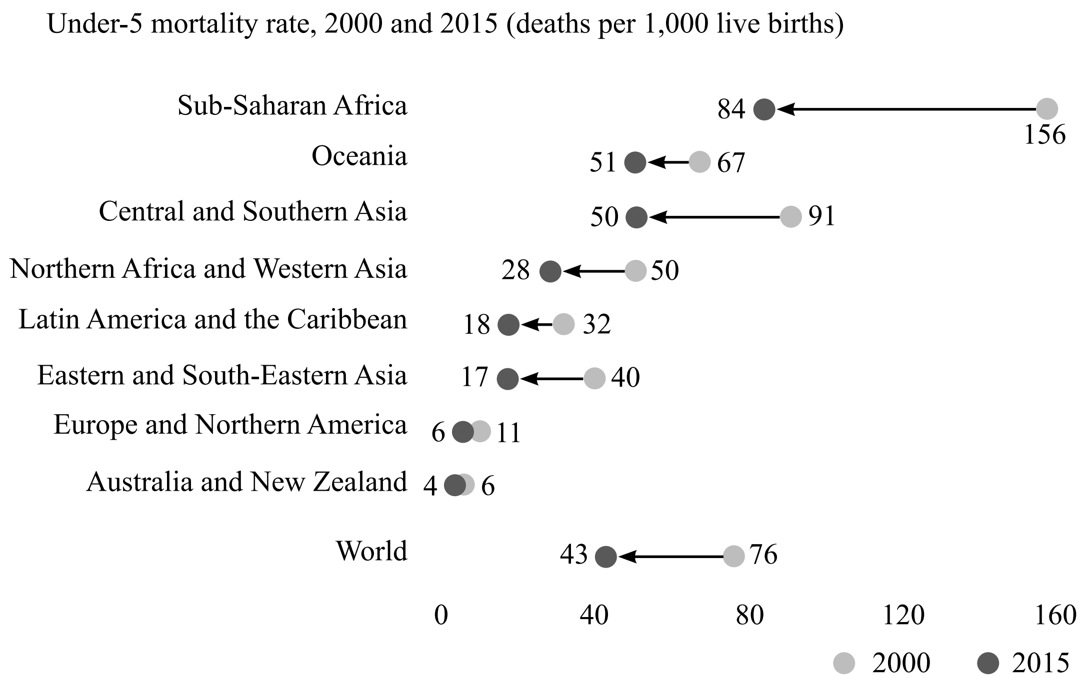


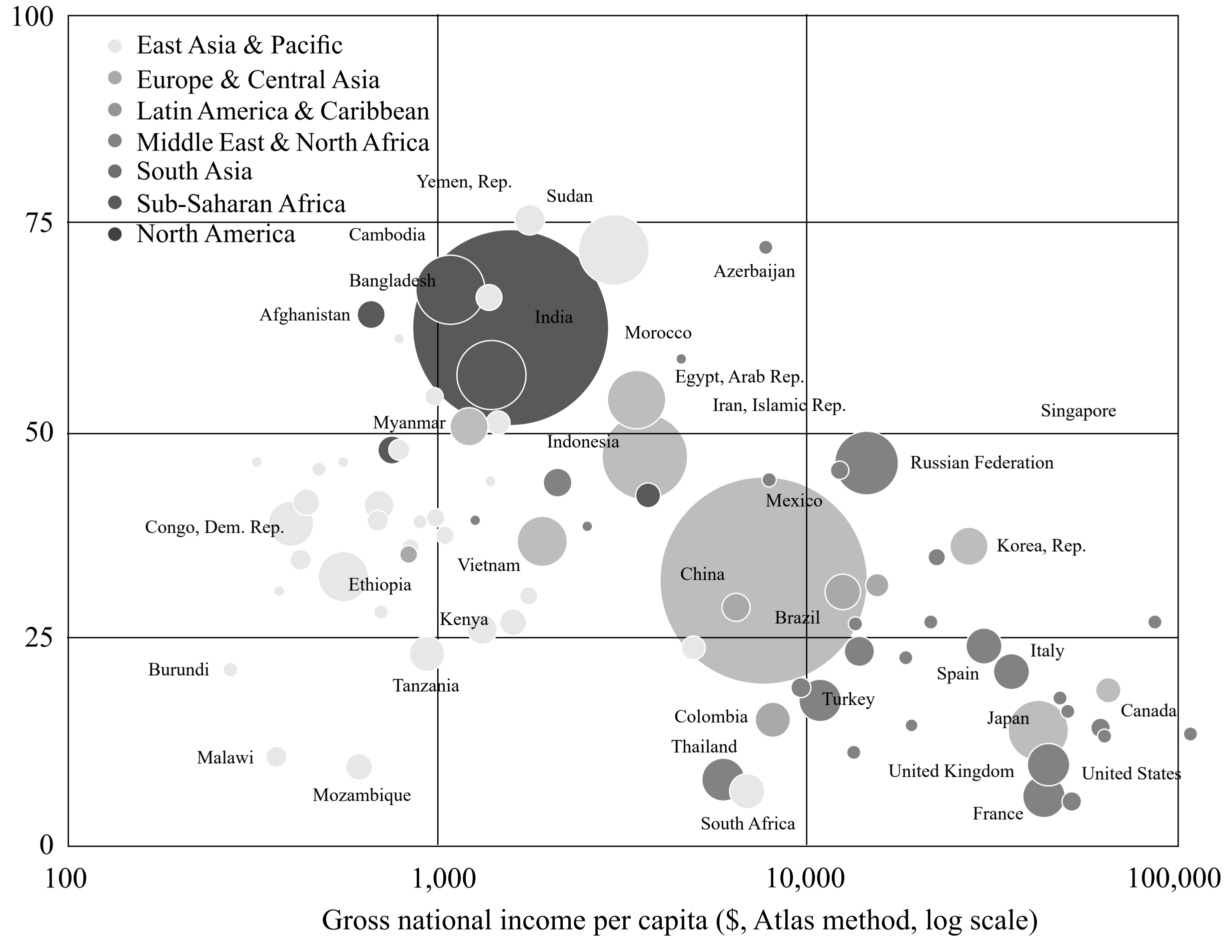
Figure 9: Global number of deaths in the first 28 days of life (neonatal deaths) and between the first month and age 5 (post-neonatal under-5 deaths), 2000-2015 (millions)

People's health and wellbeing are often affected as a result of disasters and other emergencies. Major risks to public health are raised by diseases, injuries, psychosocial effects and disabilities linked to extreme weather and climate-related hazardous events. Moreover, damages to health facilities not only cost lives but also disrupt health systems, facilities and services, leaving many without access to health care in times of emergency and longer-term implications through lost preventative care (such as vaccinations and prenatal). Promoting resilient health systems can significantly contribute to building the capacities and resilience of communities to cope and recover from the impacts of disasters.

Target 3.d, which relates to strengthening early warning and risk reduction of national and global health risks, presents an opportunity to further actions to promote resilient health systems. This target, in particular, is complemented by the outcome of Sendai Framework which has placed a strong emphasis on the resilience of health systems and integration of disaster risk reduction into health care provision at all levels. At least four of the seven targets in the Sendai Framework are directly linked to health, focusing on reducing mortality and injuries, improving people's well-being, early warning and promoting the safety of health facilities and hospitals. All these contribute to helping people lead more resilient lives.

India opted 4 targets out of 8 and currently launched a new mission on addressing climate impacts on health as a part of the NAPCC. Four out of 13 targets find synergies in the existing health concerns as well as integrating the climate lens into it.

Some of the implementation strategies highlighted in the Sendai Framework include enhancing the resilience of national health systems by integrating disaster risk management into primary, secondary and tertiary health care. The Sendai Framework also calls for the inclusion of people with life-threatening and chronic diseases in the design of policies and plans to manage risks before, during and after disasters.



Note: Circle size is proportional to population size.

Figure 10.

Source: WHO Global Health Expenditure database; World Bank National Accounts Database; OECD National Accounts database; WDI (SH.XPD.OOPC.TO.ZS, NY.GNP.PCAP.CD)

Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Education plays a crucial role in reducing vulnerability and building community resilience to disaster risks. Resilient schools not only provide space for learning and development but can also serve as centers to coordinate response and recovery efforts and as emergency shelters. Target actions 4.7 and 4.a, focusing on building and upgrading education facilities and promoting education for sustainable development; contribute significantly to resilience-building in the education sector.

India opted three out of 10 targets in NDC particularly to SDG targets 4.4 increase in technical and vocational skills, and target 4.5 addressing equal access to all levels of education and vocational training for the vulnerable, including disabilities, indigenous peoples and children in new skills with respect to adaptation, green technologies that support climate mitigation.

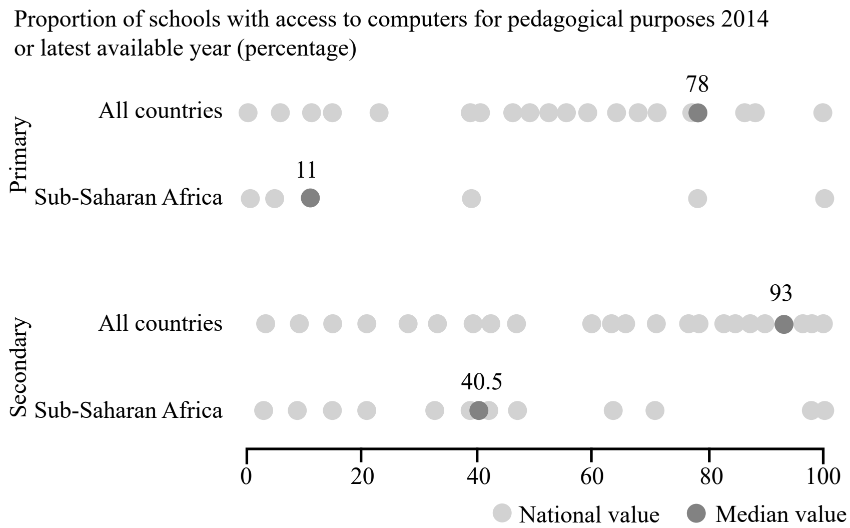


Figure 11

Goal 5: Achieve gender equality and empower all women and girls

Women and girls worldwide are more exposed than men and boys to disaster risk, suffering higher rates of mortality, morbidity and significant damage to their livelihoods. More than 100 million women and girls are affected by the impacts of disasters every year due to gender inequalities associated with socio-economic and cultural traditions as well as their limited access to information. However, women and girls also have much potential to reduce disaster risk and build community resilience. Women's active participation in disaster risk reduction has also proven effective, particularly in building leadership, sharing local knowledge and traditions as well as developing capacity for risk reduction.

Figure 12

Despite the absence of an action target that emphasises strengthening the role of women and girls in the context of disaster risk reduction, it is evident that this is critical to achieving the goal of gender equality and empowerment and building disaster resilience of communities. The Sendai Framework underlines women's participation is critical to effectively managing disaster risk and designing, resourcing and implementing gender-sensitive disaster risk reduction policies, plans and programmes.

Goal 6: Ensure availability and sustainable management of water and sanitation for all.

Proportion of population using different types of drinking water services, 2015 (percentage)

Proportion of population using different types of sanitation services, 2015 (percentage)

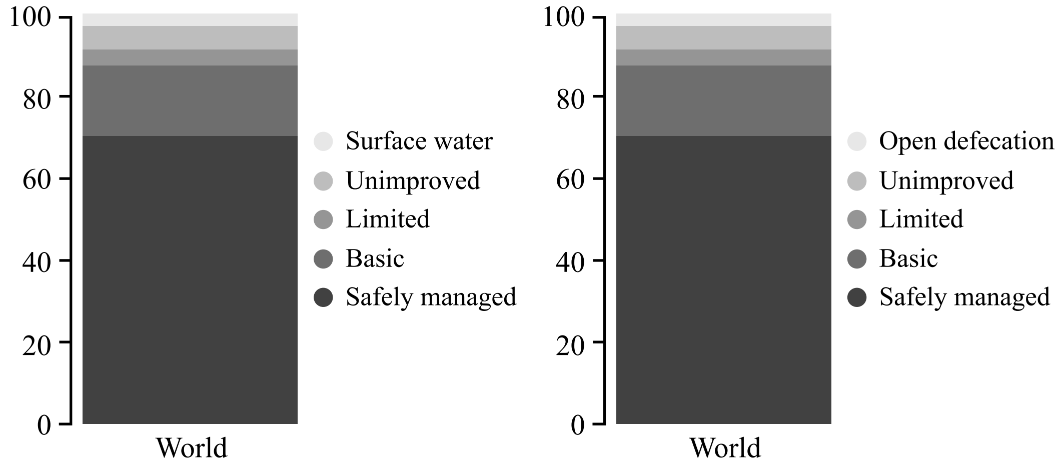


Figure 13

Sustainable water management is critical to addressing disaster vulnerability and strengthening the resilience of communities to water-related hazards. 90 countries of the world facing water-related disasters such as floods, droughts, hurricanes, storm surges and landslides account for approximately 90 per cent of disaster events worldwide. Ongoing population growth in flood-prone areas and increased agricultural development on marginal lands will further increase exposure and vulnerability to such risks. Robust and sustainable management of water resources will significantly contribute to reducing the impacts of water-related hazards and strengthen efforts to mainstream disaster risk reduction strategies into water management.

Target 6.6, which relates to protecting and restoring water-related ecosystems, will significantly contribute to strengthening the resilience of communities to water-related hazards. This target also indirectly provides an opportunity to mainstream ecosystem-based approaches for disaster risk reduction and further highlight their value as a win-win and no regret solution to the increasing disaster and climate risks underlined in the Sendai Framework. Some of the implementation strategies suggested by the Sendai Framework include mainstreaming disaster risk assessment, mapping and management into rural development planning and management of rivers, coastal flood plain areas, drylands, wetlands and all other areas prone to droughts and flooding, including through the identification of areas that are safe for human settlement and at the same time preserving ecosystem functions that help reduce risks.

Out of 8, six targets find alignment in Indian NDCs. The NDC misses out on transboundary water governance in South Asia this is of critical significance, given the sharing of waters, mountains and seas across the region. A major part of the South Asian river system like the GBM basin is vulnerable to climate change.

Goal 7: Ensure Access to Affordable, Reliable, Sustainable and Modern Energy for All

Billions of dollars invested in energy infrastructure are lost to disasters each year, causing significant social and economic disruptions. Over the years, there has been a significant increase in the number of energy infrastructure installed and growing incentives for clean energy development. Only Asia has 4.5 trillion US dollar opportunities for solar power and while this growth drives the progress of cities and economies around the world, the size of electricity networks has exposed more of this foundational infrastructure to hurricanes, earthquakes, droughts and floods.

Proportion of the population with primary reliance on clean cooking fuels and technologies, 2000 and 2014 (percentage)

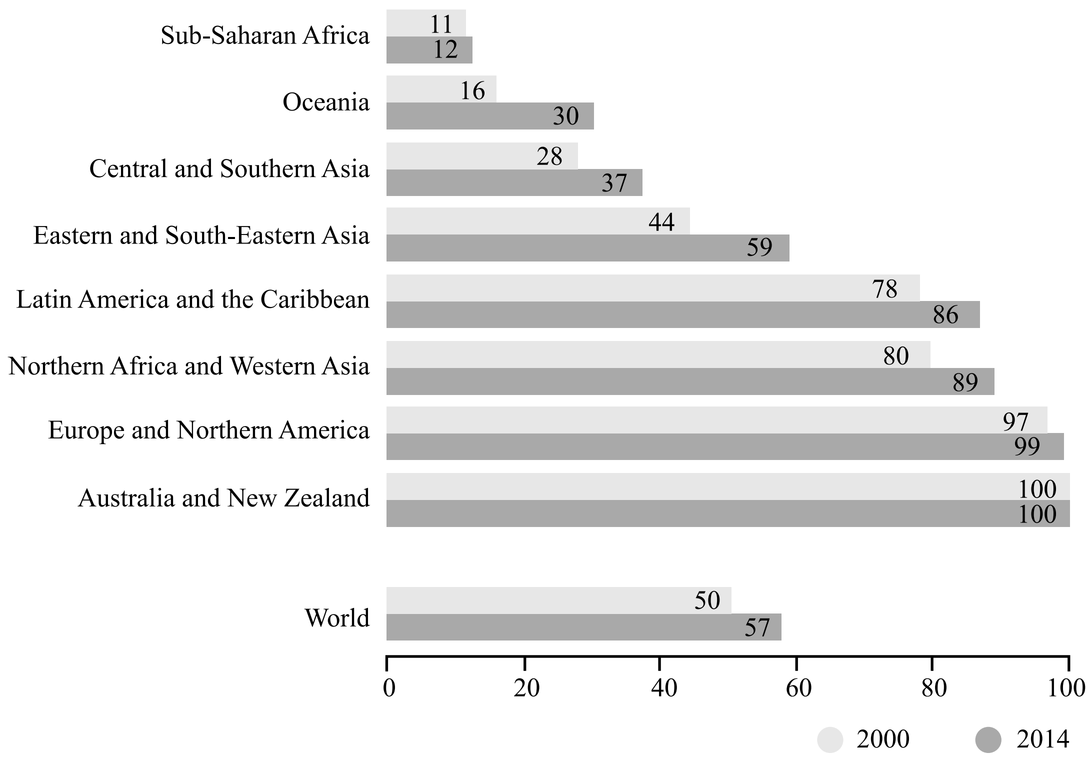


Figure 14

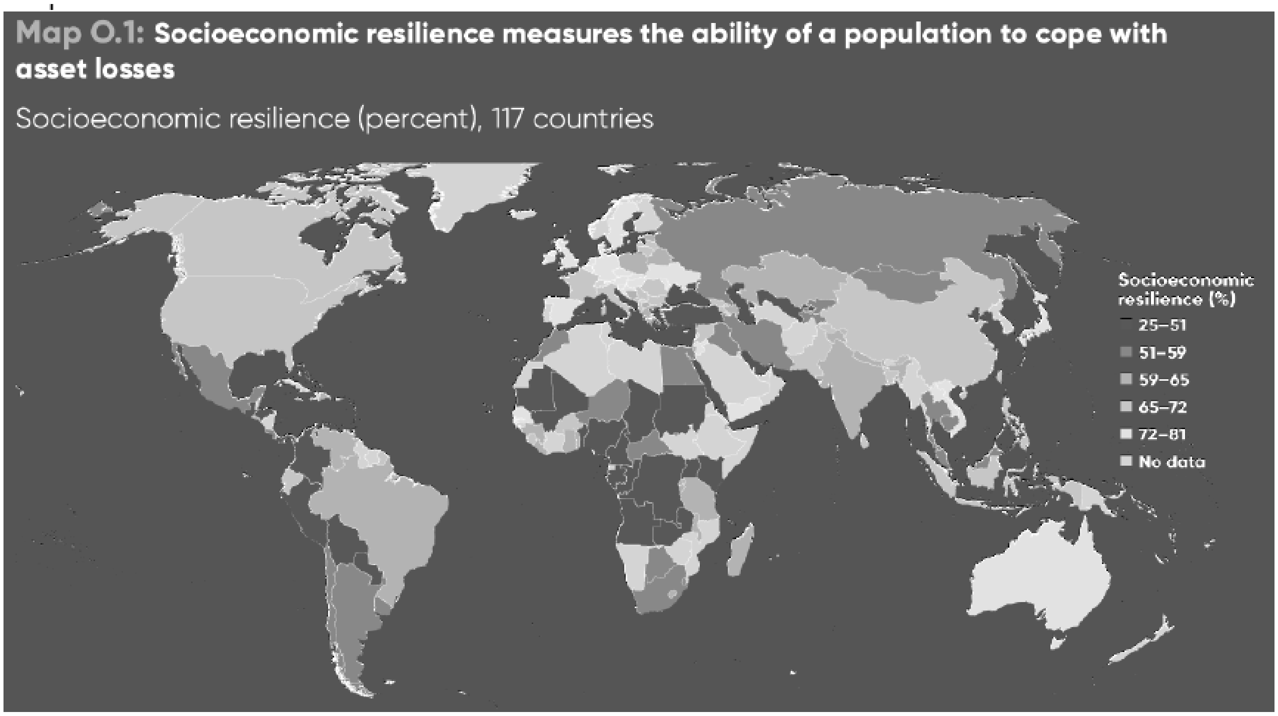
As in the case of building resilient infrastructure, measures to achieve the energy goal require strengthening and promoting the resilience of new and existing critical infrastructure to ensure they remain safe, effective and operational during and after disasters in order to provide life-saving and essential services. Some measures to consider include building better from the start to withstand hazards through proper design and construction; retrofitting and rebuilding; nurturing a culture of maintenance; and taking into account economic, social, structural, technological and environmental impact assessments.

From 2009 till 2015 the share of renewable grid capacity has increased by over 6 times by India (NDC, 2015).

Goal 8: Promote Sustained, Inclusive and Sustainable Economic Growth, Full and Productive Employment and Decent Work for all

The global average annual losses from disasters are forecast to increase from US$300 billion in 2015 to US$414 billion by 2030. Trillions of dollars of new business investment will also pour into hazard-exposed regions, largely determining the future of disaster risks.

Investing in disaster risk reduction and resilience is imperative to secure economic growth and development. The Global economic prospect 2017 stated that the current economic growth will strengthen to 2.7% as a pickup in manufacturing and trade, rising market confidence and stabilising commodity prices allow growth into the resume in commodity-exporting emerging market and developing economies.



Source: World Bank 2017

Photo 3.

Given the current trends in disaster impacts and increased exposure of economic assets to risk, the integration of disaster risk reduction and resilience into the economic and development strategies of both the public and private sectors should be a priority in order to achieve this goal. Measures to achieve this goal as outlined in the Sendai Framework include promoting mechanisms for disaster risk transfer and insurance, risk-sharing and retention and financial protection for both public and private investment.

The Sendai Framework also calls for the integration of disaster risk reduction considerations and measures into financial and fiscal instruments.

India opted 5 out of 12 SDG targets in the creation of greener jobs in energy, waste management, water, transport, tourism and construction, etc.

Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation.

Infrastructure, such as road, power, communications and water networks, and health and primary education facilities, is a basic requirement of a competitive economy. When infrastructure fails during a disaster event, it can interrupt vital services and threaten the sustainability of large and small businesses. For example, power failures may disrupt water supply and transport during hurricanes. Estimates suggest that by 2030, annual investment requirements for infrastructure development are likely to total about US$53 trillion, an average of 2.5 per cent of world GDP. Targets 9.1 and 9.a related to developing sustainable and resilient infrastructure development are vital not only to protect existing infrastructure but also future infrastructure investments. This includes structural and non-structural measures, such as flood control systems, protectiveembankments, seawall rehabilitation, building codes, retrofitting of buildings, risk-sensitive planning, hazard mapping and disaster risk financing.

India finds 2 out of 8 SDG targets on enhancing technology for Dams, Dykes, Ponds and other Water and Energy infrastructure to climate risk and resilience. India in the month of August, 2017 invested in risk and resilient infrastructure US 87 billion dollars in river-linking schemes and 8 billion US dollars (approx 56,000 thousand Cr.) in key infrastructure. A low-carbon and climate resilient development pathway for infrastructure will be the key to achieving countries social, economic, political and environmental goals (WRI, 2015).

In order to progress these targets and goal, UN ESCAP access to physical infrastructure Index the Sendai Framework recommends strengthening disaster resilient public and private investments through structural, nonstructural and functional disaster risk prevention and reduction measures in critical facilities, in particular schools and hospitals and other physical infrastructure.

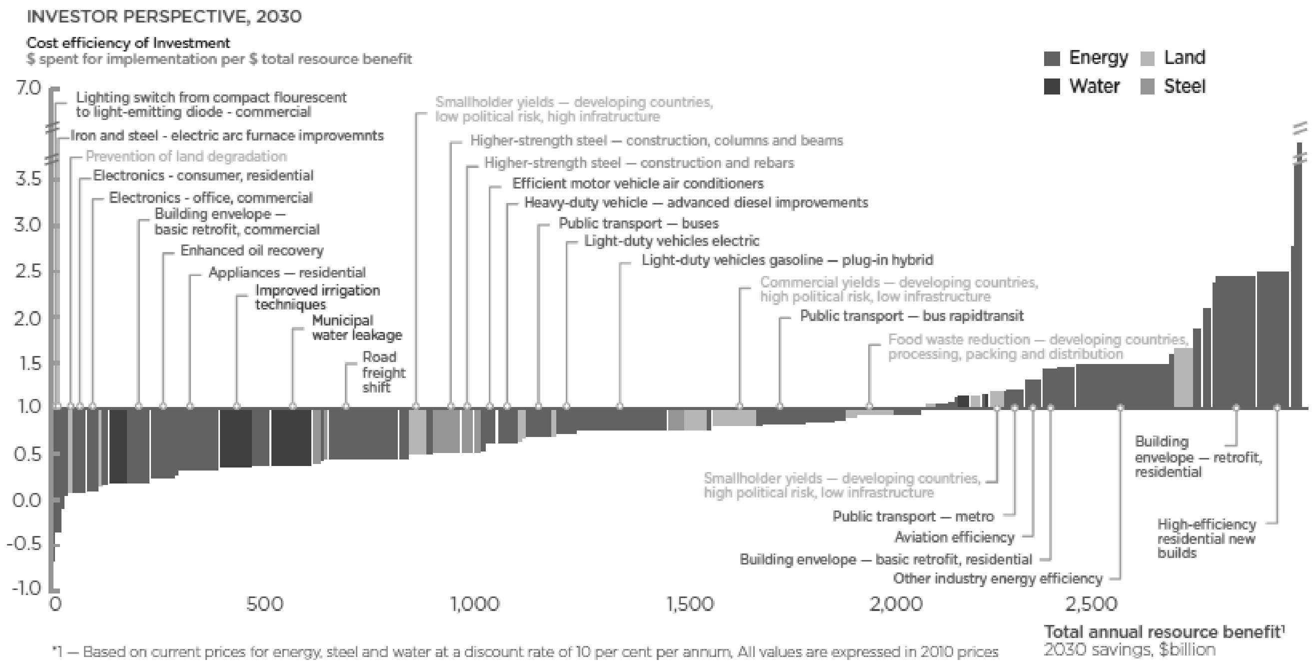


Figure 15.
Source: McKinsey Global Institute. Resource Revolution (2011)

Goal 10: Reduce Inequality Within and Among Countries

Disasters may exacerbate social inequalities. For example, they can widen the economic divide between men and women, as evident after Hurricane Katrina in 2005 where women's average income increased by 3.7 per cent from 2005 to 2007 while men's incomes increased by 19 per cent. The poorest populations are almost always the most vulnerable to disasters, with precarious livelihoods, lack of safety nets and economic buffers and living in high-risk environments where disasters occur frequently. Inequalities in the distribution of rights, resources and power which prevent equitable risk-sharing add to the increase in disaster risk.

Goal 11: Make Cities and Human Settlements Inclusive, Safe, Resilient and Sustainable

The world is increasingly becoming urban; population growth and urbansation are projected to reach more than two-thirds of the world's population. Increasing population density can lead to creation of risk, especially when urbanisation is rapid, poorly planned and occurring in a context of widespread poverty. Furthermore, the growing concentrations of people and economic activity in most cities are seen to overlap with areas of high-risk exposure. Estimates suggest that by 2050, the urban population exposed to cyclones will increase from 310 million to 680 million while exposure to major earthquake risks will increase from 370 million to 870 million. Urban development investment is also set to increase from US$7.2 trillion in 2011 to US$12 trillion by 2020. The exposure of urban assets to sea level rise and flooding could reach US$35,000 billion by the 2070s which is ten times more than the current levels. With 60 per cent of what will be urban in 2030 still to be built, urban growth presents an unparalleled opportunity to reduce disaster risk in cities by reflecting resilience and disaster risk reduction in policy, planning, design and investment decisions over future urban development, and to avoid past development mistakes.

Photo 4. Smart and Disaster Resilient City design

Action targets under this goal (11.1, 11.3, 11.4, 11.5, 11.b and 11.c) focusing on upgrading urban slums, integrated urban planning, reducing social and economic impacts of disaster risk, building the resilience of the urban poor, adopting and implementing urban policies in line with the Sendai Framework and building sustainable and resilient urban infrastructure are strategic opportunities to ensure increase capacity to support cities, protect current and future development prospects and build safer, more resilient cities throughout the world.

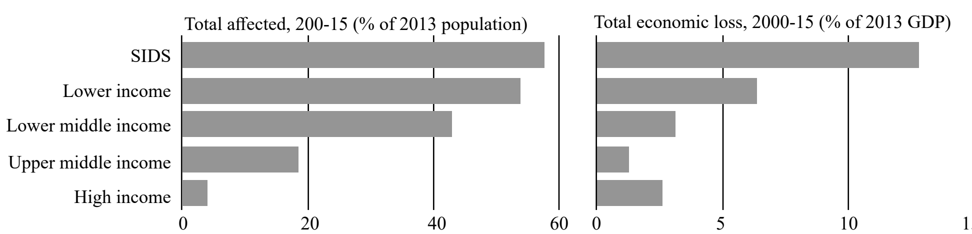
India opted 7 out of 10 SDG targets and clearly stated that Resilience to disasters, sustainable infrastructure, and risk-informed planning, disaster contingency plans should be made an important component of any smart city plan.

Goal 12: Ensure Sustainable Consumption and Production Patterns

The indiscriminate dumping of solid waste may cause flooding which could also damage critical infrastructure such as solid waste systems, triggering more sewage overflows. Inefficient disaster waste management also affects livelihoods and recovery efforts, with potentially far-reaching implications for the economy. However, more needs to be done to strengthen the integration of sustainable waste management into disaster response and recovery and building back better.

Goal 13: Take urgent action to combat Climate Change and its impacts

Natural disasters have a significant impact in low-income countries and small island developing states (SIDS), Effect of natural disasters on population and GDP.



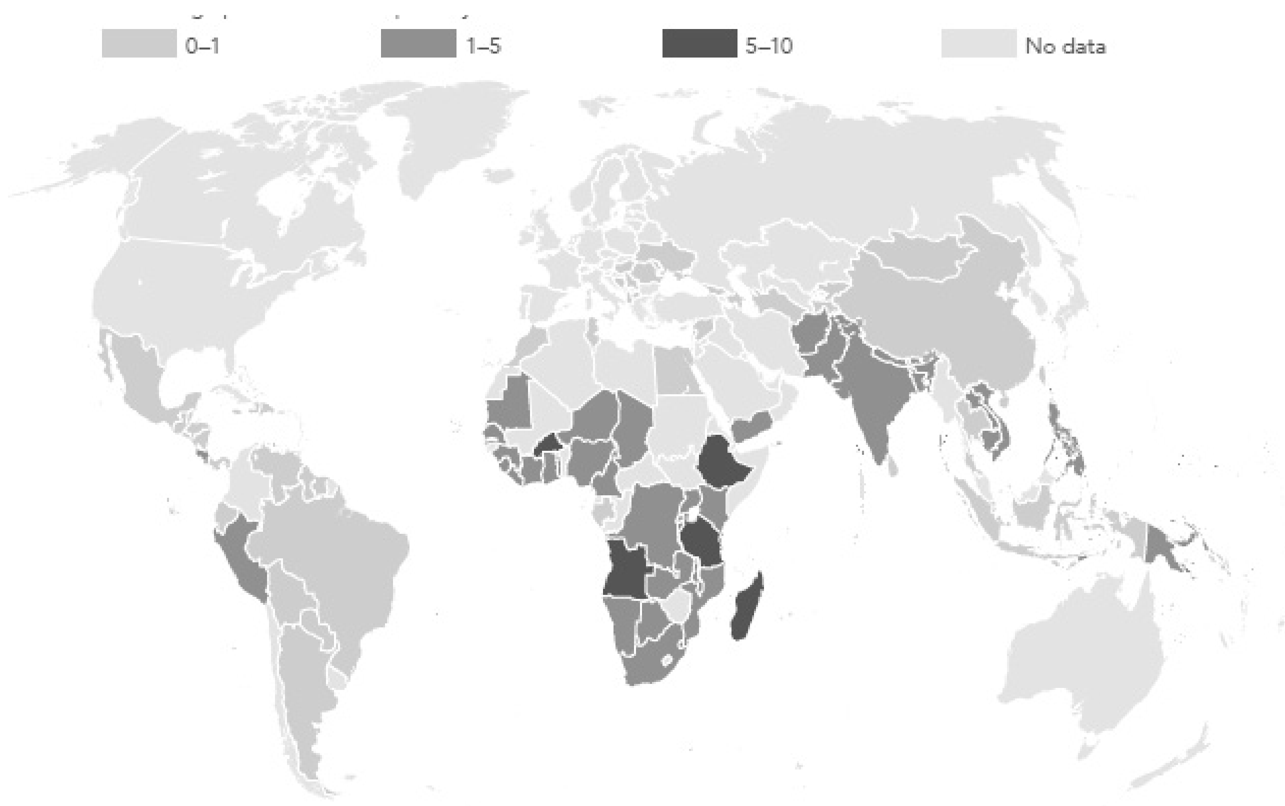
Source: EM-DAT, The International Disaster Database, School of Public Health, Universite catholique de Louvain, Brussels, http://www.emdat.be; WDI (SP.POP.TOTL, NY.GDP.MKTP.CD)

Atlas of Sustainable Development Goals 2017

Figure 16.

Climate change magnifies disaster risk and increases the cost of disasters. Through changing temperatures, precipitation and sea levels, amongst other factors, global climate change is modifying hazard levels and exacerbating disaster risks in different sectors and countries. Nearly 600 coastal cities of the world are vulnerable to sea-level rise. Since 1980, weather-related hazards have accounted for 74% (US$2.6 trillion) of total reported losses, 87% (18,200) of total disasters, and 61% (1.4 million) of total lives lost. The number of weather-related hazards has tripled, and the number of people living in flood-prone areas and cyclone-exposed coastlines doubled. The trend is expected to continue to increase. For example, in India, climate change will contribute an additional US$10-25 billion to expected annual losses by 2050.

Investing in disaster risk reduction is a precondition for developing sustainably in a changing climate. Target actions under this goal, focusing on strengthening resilience and adaptive capacity, capacity building and integrating climate change measures into policies and plans, awareness raising on climate adaptation and early warning (Targets 13.1 to 13.3 and 13.a to 13.b) provide opportunities to strengthen the integration between disaster and climate resilience to protect broader development paths at all levels. In order to achieve these targets and the overall goal, the Sendai Framework recommends strengthening disaster risk modeling, assessment, mapping, monitoring and multi-hazard early warning systems; promoting the conduct of comprehensive surveys on multi-hazard disaster risks and the development of regional disaster risk assessments and maps, including climate change scenarios; and maintain and strengthen in situ and remotely sensed earth and climate observation.



Source: S. Hallegatte, M. Bangalore, L. Bonzanigo, M. Fay, T. Kane, U. Narloch, J. Rozenberg, D. Treguer, and A. Vogt-Schilb, 2016, *Shock Waves: Managing the Impacts of Climate Change on Poverty*, Washington, DC: World Bank, https://openknowledge.worldbank.org/handle/10986/22787.

Photo 5. Climate change could raise extreme poverty rates substantially by 2030

India finds its suitability in all five out of five SDG targets; NDC includes both adaptation and mitigation into broader national policies and strategies. It does mention the need for developed countries to raise and provide the required finance.

Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development

The global ocean is fundamental to sustaining life on earth; it is a major carbon sink, absorbs heat and produces half the oxygen we breathe. Shipping, fisheries and aquaculture, energy, biotechnology, and mineral and biological extraction, generate USD 3-6 trillion, and are seen as a major avenue for achieving the UN Sustainable Development Goal (SDG) 14 on oceans and seas through Blue Economy.

Marine resources and associated coastal ecosystems contribute significantly to national economies and provide a wide range of services to communities, including food sources, livelihoods as well as shoreline protection against storm surges, floods, sea-level rise, tsunami and other coastal related hazards.

Target action 14.2, focusing on the sustainable management and protection as well as strengthening resilience of marine and coastal ecosystems, can contribute to reducing disaster risk and increase in demand for healthy marine and coastal ecosystems.

India aligned four out of 10 SDG targets in NDC to regulate the climate and act as a carbon sink. To control Ocean acidification and other impacts that threaten human livelihoods, continuity of mangroves across the Indian Sunderbans and Bangladesh coast even river management of Ganga, Brahmaputra and Meghna River Basin management.

The Sendai Framework explicitly seeks to account for the environmental damages caused by disasters – in many cases damages are attributable to the removal of disaster waste and to impacts associated with recovery and reconstruction planning that have by-passed existing environmental legislation.

Goal 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

Ecosystem degradation erodes the resilience of communities and nations and exposes them to increased risks of and impacts from disasters. A severe cyclonic storms (AILA) in 2009 at Sunder bans destroyed 15 % of the mangrove forests and desertification and degradation of dry lands to the destruction of coastal forests and wetlands, the loss of biodiversity and ecosystem services often translates into increased disaster risk, losses and slower recovery, in urban and rural areas alike.

India opted 6 out of 12 SDG targets to save the vulnerable forests because forest plays an important role in stabilising the climate and sustainable livelihoods.

Preliminary estimates put global annual losses to ecosystem services as high as US$190 billion. Protecting, restoring and sustainably using ecosystems are critical in this regard. Target actions 15.1 to 15.4 and 15.9, focusing on managing and restoring forests, combating land degradation and desertification, conserving mountain ecosystems and their biodiversity and integrating ecosystem and biodiversity values into national and local planning, development processes, poverty reduction strategies, all contribute to resilience building. These targets are also in line with the Sendai Frameworks focus on building environmental resilience through the inclusion of ecosystems in risk analysis and planning.

As per marine ecosystems, the Sendai Framework proposes similar priority actions for their terrestrial equivalents -- mountains, rivers, coastal flood plain areas, drylands and wetlands, among others.

Goal 16: Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

Disasters and conflict are mutually reinforcing. Weak state structures and social systems in conflict-affected countries are likely to affect the ability of people and communities to respond to disaster risks, as well as increase the likelihood of stresses and shocks turning into a disaster. Conflict and disasters damage and destroy livelihoods, safety nets, health and infrastructures, which perpetuate vulnerabilities that put people and communities at risk, further entrenching poverty and inequality.

In India, climate-related natural hazards could lead to interstate migration, interstate conflicts for resources, and social conflicts with communities and industry extending to transboundary issues.

Many developing countries experience the impacts of both disasters and conflict. Reports show that more than 50% of people affected by natural hazardous events, from 2005 to 2009, have lived in fragile and conflict-affected contexts. In order to progress this goal, it is imperative that disaster risk reduction and response is incorporated into target actions in order to strengthen the resilience of people and communities in conflict-affected countries and in the aftermath of disasters.

Goal 17: Strengthen the means of implementation and revitalise the global partnership for sustainable development

The success of the 2030 Agenda for Sustainable Development, particularly the SDGs, depends on its effective implementation. To be effective, the implementation must ensure wide participation of stakeholders including NGOs, Civil Society and the private sector, who have been instrumental in the progress achieved so far in sustainable development. This was seen at the Third UN World Conference on Disaster Risk Reduction in March 2015, where over 600 commitments were made by stakeholders as part of the implementation of the Sendai Framework.

Opportunities for partnership building are presented in the implementation of both the outcome document and the Sendai Framework. Successful partnerships can potentially bring out competence and experience-sharing as well as build synergies between different target actions which can be cost-effective in the long term. These partnerships can substantially contribute to or complement efforts to achieve the SDGs.

India's NDC highlights the need for international support on climate finance gap as US 2.5 trillion dollars (at 2014-15 prices). India's NDC is also committed to mobilising the resources necessary for adaptation and mitigation these include financial resources, technical cooperation and technology transfers.

Photo 6. United Nations Paris Agreement 2015, France

Photo 7. Asian Ministerial Conference 2016, New Delhi

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Disaster Management for Achieving Sustainable Development Goal in India

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Abstract

The paper deals with the present state of disaster caused by natural hazards in India. In this paper effort is made to study about existing Disaster management structure in India, Seismic vulnerability assessment, Techno-legal regime to promote disaster risk reduction, building construction regulations, stakeholder capacity building, training and salient features of disaster management plans, etc., for sustainable development and actual ground reality in execution/implementation of the same on ground. It has also been experienced that the country is not adequately prepared to deal with the consequences of these disasters. The experience suggests that there is an urgent need for a proper disaster management strategy that is focused, well cocoordinated and prepared for all obvious eventualities so that its impact is reduced. The paper deliberated on all these issues and has finally recommended various comprehensive measures to be taken, based on literature survey and practical experience on ground. The major reasons leading to failures of large number of structures have been analysed, their remedial measures discussed and deliberated to take preventive measures for reduction of its impact in future and thereby ensuring sustainable development. For resilience and sustainability of infrastructure in a changing environment and its impact in terms of various hazards, we have to develop our proper strategies to reduce the impact of any hazards.

Keywords: seismic vulnerability assessment, techno-legal regime, disaster risk reduction, construction regulations, stake holder, capacity building, training, disaster management plans, sustainable development, resilience

Introduction

A disaster is a "a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its resources." The Disaster Management Act, 2005 defines a disaster as "a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man-made causes, or by accident or negligence which results in substantial loss of human sufferings and damage, and destruction of property, or damage to, or degradation of, environment and is of such nature or magnitude as to be beyond the coping capacity of the affected area". A disaster is a result of the combination of hazard, vulnerability and insufficient capacity or measures to reduce the potential chances of risk. A disaster happens when a hazard impacts a vulnerable population and causes damage, casualties and disruption. Any hazard – flood, earthquake or cyclone which is a triggering event along with greater vulnerability would lead to disaster causing greater loss to life and property. For example; an earthquake in an uninhabited desert cannot be considered a disaster, no matter how strong the intensities produced. Civil engineering deals with construction of structures and their integration, stability and serviceability. Structures are exposed to various forces and loads which need to be resisted and withstand without failure.

Structural stability can be attained by laying out proper design and adhering to standard Codal provisions. But, often when a disaster strikes a catastrophic damage to various structures is witnessed as evident from past events. The structural failures at the time of disasters not always should be blamed for natural reasons but failure is fostered because of anthropogenic reasons too. Construction by faulty or poor structural design, poor workmanship, and use of sub-standard materials and avoidance of engineering ethos at work site leads to the building of vulnerable structures which magnifies the damage succumb to a disaster. India is a vast country with diverse geographical and climatic conditions and hence different parts are vulnerable to different types of disasters. As per National Disaster Management Policy, 58.6% of the landmass is prone to earthquakes of varying intensity whereas over 40 million hectares (12% of land) is prone to floods and river erosion. Out of the 7516 km long coastline, about 5700 km is prone to cyclones and tsunamis.

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Effects of Disasters

Each type of disaster can have several disruptive effects. These in turn cause generally predictable problems and needs of four kinds: environmental; health; social, economic, and political; and administrative and managerial.

Environmental Effects

Disasters can have any number or combination of four effects: destruction and damage to homes and buildings; decreased quantity or quality of water supplies; destruction of crops and/or food stocks; and the presence of unburied human bodies or animal carcasses.

Effects on Health

Sudden natural disasters are often believed to cause not only widespread death but also massive social disruption and outbreaks of epidemic disease and famine, leaving survivors entirely dependent on outside relief.

Economic, Social, and Political Effects

Disasters disrupt rather than destroy economies, during this period normal economic activities are severely curtailed, even if the sources of employment are unaffected by the disaster.

Administrative and Managerial Effects

Administrative problems in disaster are made more difficult by four factors, which increase in importance with the extent of the disaster.

i) Effects on community leadership.
ii) Disruption of formal organisations.
iii) Damage to critical facilities and lifelines.
iv) Disruption of transportation (and isolation of resources).

Types of Disasters

In 2015, 21 geophysical disasters (earthquakes/tsunamis, volcanic activities and mass movements of geological origin) were registered, representing a share of 7.7% of total disaster occurrence, near to their decade's annual average of 8.2%. The number of disasters from earthquakes (21) was the second lowest since 2005, 17 % below its 2005–2014 annual average, while, inversely, the number of disasters from volcanic activities (7) was 17% above its annual average. Disasters from mass movements of geophysical origin are rare events and only one occurred in 2015, which is in line with their 2005–2014 average occurrences. With 5 earthquake disasters, China was the country the most hit in 2015, as it was in the period 2005–2014, and this number was similar to the decadal annual average (5.1). Three disasters from earthquakes occurred in India, as much as the whole 2005–2014 period, and 2 in Nepal, for only one in this country between 2005 and 2014. Afghanistan and Pakistan experienced 2 earthquakes, each; such numbers being around three times their annual average. Among countries with high earthquakes frequencies, Indonesia experienced only one disaster, for an annual average of 3, while Iran wasn't hit in 2015 against an annual average of 2.3. Two disasters from volcanic activities occurred in, both, Ecuador and Chile, countries which, respectively, experienced 3 and 2 such disasters from 2005 to 2014. No such disasters occurred in 2015 in Indonesia, Colombia and the Philippines, three countries with, respectively, 13, 7 and 7 disasters from volcanic activities reported between 2005 to 2014.

Disaster – Global Trend

With the tropical climate and unstable landforms, coupled with high population density, poverty, illiteracy and lack of adequate infrastructure, India is one of the most vulnerable developing countries to suffer very often from various natural disasters, namely drought, flood, cyclone, earthquake, landslide, forest fire, hail storm, locust and pest attack, etc. Though it is almost impossible to fully recoup the damage caused by the disasters, it is possible to: (i) minimise the potential risks by developing early warning strategies (ii) prepare and implement developmental plans to provide resilience to such disasters (iii) mobilise resources including communication and tele-medicinal services, and (iv) to help in rehabilitation and post-disaster reconstruction. Indian space technologies are being effectively used in disaster warning, relief mobilisation and tele-medicinal support. The earth observation satellites have great potential to provide the required database for pre-disaster preparedness programmes, disaster response, monitoring activities and post-disaster damage assessment, reconstruction and rehabilitation.

Various disasters like earthquake, landslides, volcanic eruptions, flood and cyclones are natural hazards that kill thousands of people and destroy billions of dollars of habitat and property each year. The rapid growth of the world's population and its increased concentration often in hazardous environment has escalated both the frequency and severity of natural disasters. With the tropical climate and unstable landforms, coupled with deforestation, unplanned growth proliferation non-engineered constructions which make the disaster-prone areas mere vulnerable, tardy communication, poor or no budgetary allocation for disaster prevention, developing countries suffer more or less chronically by natural disasters. Asia tops the list of casualties due to natural disaster.

Among various natural hazards, earthquakes, landslides, floods and cyclones are the major disasters adversely affecting very large areas and population in the Indian sub-continent. These natural disasters are of (i) geophysical origin such as earthquakes, volcanic eruptions, landslides and (ii) climatic origin, such as drought, flood, cyclone, locust, forest fire. Though it may not be possible to control nature and to stop the development of natural phenomena but the efforts could be made to avoid disasters and alleviate their effects on human lives, infrastructure and property. Rising frequency, amplitude and number of natural disasters and attendant problems coupled with the loss of human lives prompted the General Assembly of the United Nations to proclaim 1990s as the International Decade for Natural Disaster Reduction (IDNDR) through a resolution 44/236 of December 22, 1989 to focus on all issues related to natural disaster reduction. Despite of IDNDR, there had been a string of major disasters throughout the decade. Nevertheless, by establishing the rich disaster management related traditions and by spreading public awareness the IDNDR provided required stimulus for disaster reduction. It is almost impossible to prevent the occurrence of natural disasters and their damages.

DM Structure In India

National Policy on Disaster Management-2009 was approved by GoI on October 22, 2009, based on Disaster Management Act, 2005. The NDMA was formed as the apex body for disaster management, headed by the Prime minister. It has the responsibility of laying down policies, plans and guidelines for Disaster Management (DM) in the country. The guidelines are to assist the central Ministries, Departments and States to formulate their respective DM plans. It approves the National Disaster Management plans and DM plans of the Central Ministries/Departments. NDMA takes such other measures, as it may consider necessary, for the prevention of disasters or mitigation or preparedness and capacity building, for dealing with a threatening disaster situation or disaster. Central ministries/ Deptartment and State is to extend necessary cooperation and assistance to NDMA for carrying out its mandate. NDMA oversee the provision & application of funds for mitigation and preparedness measures. NDMA has the power to authorise the Departments or Authorities concerned, to make emergency procurement of provisions or materials for rescue & Relief in disaster.

At the state level, the SDMA, headed by the Chief Minister, lay down policies and plans of DM in the state. It approves the state plan in accordance with the guidelines laid down by the NDMA. SDMA Coordinate the implementation of the state plan, recommend provision of funds for mitigation and preparedness measures and review the development plans of the different Departments of the state to ensure the integration of prevention; preparedness & mitigation measures. The State Govt. constitutes State Executive Committee (SEC) to assist SDMA. DDMA (District Disaster Management Authority) headed by District Collector act as planning, coordinating & implementing body at District level. DDMA ensures that the guidelines for prevention, mitigation, preparedness & response measures laid down by the NDMA and the SDMA are followed by all the Department's of the state government.

There are other institutional arrangements for disaster management in India Armed Forces – Called to assist Civil Administration, when the situation is beyond their coping capability. Central Para-military Forces (CPMFs), which are also the Armed Forces of the Union, play a key role at the time of immediate response to disasters. State Police Forces & Fire Services- are crucial immediate responders to disasters.

Other institutional Authorities in India are:

- Civil Defence & Home Guards
- State Disaster Response Force (SDRF)
- Role of NCC; NSS (National service Scheme); and NYKS (Nehru Yuva Kendra Sangathan) and other NGOs.
- International cooperation and coordination in all spheres of DM.

The functioning of all these Institutes' need to be evaluated and possible improvement needs to be suggested, to reducing the impact of disasters.

Existing Disaster Management Structure

The disaster management setup was structured at three levels viz. national, state and district. The NDMA was set up as the apex body at the national level, while at the state level State Disaster Management Authorities (SDMA) was set up. These were headed by the Chief Ministers. At the district level, District Disaster Management Authorities (DDMA) was set up. These were headed by the District Collectors and co-chaired by elected representatives of the local authorities. All these authorities were charged with the responsibility of formulating holistic and integrated plans for disaster management and ensuring the implementation of these plans when required. The executive committee of the NDMA is called National Executive Committee (NEC). It coordinates the response on behalf of the NDMA. It consists of 14 Secretaries of the Government of India as well as the Chief of the Integrated Defense Staff. To assist the NDMA two other bodies have been created called the National Institute of Disaster Management (NIDM) and the National Disaster Response Force (NDRF).

State Disaster Management Authority (SDMA)

The Disaster Management Act 2005 also provides for the setting up of Stage Disaster Management Authorities under the Chairperson ship of the Chief Minister. State Authority is to be assisted by a State Executive Committee under the Chairperson ship of the Chief Secretary of the State. The Committee shall prepare a State Plan which would include assessment of the vulnerability of different parts of the State to different forms of disasters; measures to be adopted for prevention and mitigation of disasters; capacity building; and role of departments of State Government, apart from the planning aspect it is also involved in taking up and supervising relief and rescue operations at the time of disaster and in disseminating information about any impending disaster.

District Disaster Management Authority (DDMA)

The structure of disaster management institutions goes down to the district level where the responsibility is given to DDMA which is headed by the Collector/District Magistrate with an elected representative of the local authority as co-chairperson. DDMA will act as the planning, coordinating and implementing body for disaster management at the district level. It will prepare the District Plan for disaster management in accordance with instructions by NDMA and SDMA. The DDMA will also ensure that the guidelines for prevention, mitigation, preparedness and response measures laid down by the NDMA and the SDMA are followed by all the Departments of the State Government at the District level and the local authorities in the District.

Local Authority

For disaster management, local authorities would include Panchayati Raj institutions and those agencies which control and manage civic services. These bodies are required to ensure the capacity building of their employees for managing disasters and carrying out relief and reconstruction activities in the affected areas.

National Institute of Disaster Management (NIDM)

Capacity building is an important aspect of disaster management. This requires developing human resources to handle disaster management work and undertake studies and research on the subject. The Disaster Management Act gives this mandate to the National Institute of Disaster Management. The institute was formed as National Centre for Disaster Management (NCDM) in 1995 but was re-designated as the National Institute of Disaster Management (NIDM) in 2005 after the enacting of the Disaster Management Act.

The institute is headed by the Union Home Minister and Vice-Chairman; NDMA also acts as the Vice-President of the Institute. Day-to-day works is looked after by the Executive Director. The institute has five divisions i.e. Geo-Hazard Division; Hydro-Met Hazard Division; Policy Planning and Cross Cutting Issues Division; Response Division; and Administrative and Finance Division.

National Disaster Response Force (NDRF)

NDRF was constituted in 2006 with 8 battalions drawn from the paramilitary forces. Presently it has the strength of 10 battalions. General superintendence of the force vests in NDMA and the force is headed by the Director General of NDRF and Civil Defense. These battalions are positioned at different locations to provide timely response to disaster situations and are available to State Governments at the time of need. The force provides specialised response during disasters, is pro-actively deployed in impending disaster situations, imparts training to state disaster response force personnel and conducts programmes for creating awareness and community capacity building.

Integrated Data Resource Network (IDRN)

Integrated Data Resource Network is a database in the electronic form maintained by the Ministry of Home Affairs. The data enlists the inventory of equipment and human resources relevant to disaster management. Organisations related to the work update the inventory of equipment, skilled human resources and critical supplies for emergency response. Idea is to make available the information on availability of equipment and human resources required to combat any emergency. This database also helps the policy makers to assess the level of preparedness for specific vulnerabilities.

NDMA (National Disaster Management Authority)

National Disaster Management Authority (NDMA) is an agency of the Ministry of Home Affairs whose primary purpose is to coordinate response to natural or man-made disasters and for capacity-building in disaster resiliency and crisis response. NDMA was established through the Disaster Management Act enacted by the Government of India in December 2005. The Prime Minister the de-facto chairperson of NDMA. The agency is responsible for framing policies, laying down guidelines and best-practices and coordinating with the State Disaster Management Authorities (SDMAs) to ensure a holistic and distributed approach to disaster management. In the view of the frequency of disasters striking India, there is a need for continued vigilance, preparedness and conscious efforts to reduce the occurrence and for mitigation of impact of natural disaster. What is required is a planned approach to disaster management; its management is a fundamental component of sustainable development because the reduction of disaster equivalent to increased development.

Suggestions/Recommendations

The following suggestions/recommendations can be offered for an effective disaster management system in India:

- There should be a proper multi-tier organisational structure in a focused and coordinated manner responsible for the overall management at national, state, districts and village levels.
- The basic design of disaster management should consist of planned coordinated efforts in following important areas:
  - Preparedness
  - Identification and prediction
  - Early warning system
  - Evacuation
  - Relief
  - Rescue
  - Rehabilitation
  - Compensation
  - Reconstruction

- There is a need to share expertise and experiences so that states can learn from each other. There is also a need for training personnel continually likely to face natural disasters and those who deal with the relief operations. Our implementation problem on ground is the major bottleneck, which has to be addressed at various levels by monitoring continuously.
- India in recent years has made significant development in the area of disaster management. A new culture of preparedness, quick response, strategic thinking and prevention is being ushered. The administrative framework is to be streamlined to deal with the various disasters. Effort are also to be made to make disaster management a community movement wherein there is greater participation of the people. Further, a lot more need to be done to make disaster management a mass movement in near future. Infect one major area where we are lacking is planned way how to reduce impact of hazards turning into a disaster, because of our Engineering failure. We are giving more importance to management part, whenever any hazards are happening. Major concern and thrust area should be for our all the Assets being created need to be planned/designed/executed properly & also maintained properly to withstand the various types of hazard likely to be there during the life span of structures. By doing this we can reduce the impact of any likely hazards in future. It is a fact that because of our unplanned development activities certain natural disasters are happening, which are man-made like effect due to floods. Despite of lot of Codal provisions being made now, we are constructing lot many structure now also, which will not withstand any major hazards like earthquake. Further lot many structures, which were constructed as per old Codal provision and not constructed properly require retrofitting immediately, but somehow it is not happening mainly because of lacking awareness about implications.
- Most of the cities in India are exposed to various risks due to very high population density, substandard habitat, disproportionate occupancy rate, poor design and construction qualities and lack of community preparedness and inadequate response and soil, which is liable to liquefaction. Therefore it is desirable to incorporate these risks elements into the development plan. The broad set of recommendations has been suggested on the basis of various reports of the major national/international agencies working in the field, literature survey, etc., which were found relevant for the implementation in DRR and which may help in integration of risk assessment in regional development.
- Mainstreaming Disaster Management into development planning may be ensured by regulating land use zonation according to the exposure of risks, updating and enforcement of building byelaws as per the disaster resistance codes and retrofitting of lifeline buildings and other important buildings. Such practice may help in reducing risk by improving the condition of existing building and new constructions.
- There is a need for an institutional setup at various level of administration to ensure the management of disasters during emergencies. The clear out responsibilities and reporting system of the various departments, such as Police, Fire, Transport, Communication, NGOs, Public Work Department, Municipal Corporation and Revenue department, etc. should be clearly demarcated within a well-defined structure so that response time may be reduced at the time of disasters.
- There is a need of generating public awareness by fostering community-based disaster management planning initiative in schools, hospitals, residential areas, villages, etc. to ensure community preparedness.
- Geographic Information System (GIS) and database focusing on the development of techniques and decision support tools, to integrate, manipulate and display a wide range of risk-related information, should be developed. Such a system may also include the techniques to assess the vulnerabilities of buildings, infrastructure and awareness of the people to the impact of hazard.
- Availability of quantified database at various administrative levels for various aspects is found to be very limited. A detailed database on disaster risk aspects should be developed so that specialised studies and assessment can be facilitated at all levels of planning. It may help in exploring and expanding means of indicators and parameters which will result in more relevant picture in front of us. Risk management is needed to embraces all administrative and operational programs that are designed to reduce the risk of emergencies involving acutely hazardous materials. Such programs ensuring the design safety of new and existing equipment, standard operating procedures, preventive maintenance, operator training, accident investigation procedures, risk assessment for unit operations, emergency planning, and internal and external procedures to ensure that these programs are being executed as planned.

- As per the Census data, natural materials like mud, stone, bricks, timber and bamboo form the major chunk of the buildings material (up to about 95%) in construction across India. There is a larger use of cement-based materials (up to about 95%) in construction across India. Further, the use of cement-based materials is in mainly in urban areas. Over the last two-three decades, there has been an increasing trend of use of RC slabs in roofs. On the other hand, the buildings with modern materials like reinforced concrete and structural steel still constitute only about 3.6% of the entire building stock though their absolute number is on the rise. The cumulative dominant materials of choice by 2011 are: (i) mud and un-burnt brick (about 22%), (ii) burnt brick (about 48%) and (iii) Stone (about 14%). These three material together account for 84% of housing material used in the country (Census 2011). But, civil engineering and architecture education imparted across India does not account this in the curriculum. On the one hand, the housing construction materials listed above are reflected in only 3% of the courses taught to undergraduate students. In particular, the course on masonry is almost extinct in the curriculum across the engineering colleges in the country. On the other hand, 97% of the curriculum is addressing the small minority of 3.6% of reinforced concrete houses in the country. Recognising the above skewed situation, clear understanding is required of this vulnerability of the building stock in the country: (i) by identifying measures that can retrofit the existing building stock to earthquake-resistant standard, (ii) by ensuring that new houses constructed are not vulnerable, and (iii) by making systemic changes as part of capacity building and preparedness initiatives of disaster management towards mitigating impending earthquake disasters. Hence, a systematic methodology is required for the following:
  – Documenting Housing Typologies in the Moderate Severe Seismic Zones of India, with a view to understand the extent of loss that is expected in each existing housing type, and developing guidelines for all new constructions; and
  – Retrofitting the vulnerable housing stock in the Moderate to Severe Seismic Zones of India.
- **National Retrofit Program-** Considering the gigantic number of buildings and structures to be retrofitted countrywide against seismic effects, a National Program on Seismic Retrofitting of Buildings and Structures in India should be launched with the central coordinating office to address the issues of seismic retrofitting, like disruption planning, availability of funding and technology, designing, implementing and monitoring. With the guidelines to
  – Seek mandatory seismic retrofitting in a phased manner of all existing government-owned constructions and select existing privately owned constructions and
  – Encourage seismic retrofitting of all existing privately owned constructions other than those identified under item (i) above. Appropriate incentive schemes are necessary to ensure that owners of private constructions take up seismic retrofitting of existing constructions, a key component of earthquake risk reduction in the country.
- **Looking Ahead -**Population pressure, environmental degradation and unplanned urbanisation are some of the major factors contributing to increased vulnerability in the country. As such, a need has been felt to accelerate the pace of disaster mitigation efforts. It is required to lay more emphasis on the following areas:
  – Linkage of disaster mitigation with development plans;
  – Effective communication system;
  – Use of latest information technology including latest Early Warning System
  – Insurance in all relevant sectors;
  – Extensive public awareness and education campaigns, particularly in the rural areas;
  – Legal and legislative support;
  – Greater involvement of NGOs/private sector.
- **Suggestions for Rapid Progress-** For rapid progress towards appreciable reduction in the disastrous impact of natural hazards, the policy of the government may include the following:
  – To invest in global observations and to give a boost to the science of observation and measurement on which the real progress depends.
  – To enhance the scientific content of prediction methodologies and reliability of forecast, if and when it becomes feasible.

- To map the earthquake hazards on a large scale and link the maps intimately with the process of development planning, to conduct micro zonation of urban areas at earthquake risk.
- To foster closer partnerships with financial and legal institutions, insurance companies, community-based organisations and industry.
- To create an All India Institutional Network, to involve in disaster preparedness, mitigation management and prevention.
- To invest more on public awareness, education, training and human resource development in the area of disaster mitigation.

• **Resiliency of infrastructure-**Strengthening the resiliency of critical infrastructure can be described as actions and programs that:
  - Identify risks to critical infrastructure and interdependencies.
  - Assess and prioritise risks.
  - Take mitigated or protective measures to reduce risks and the potential for disruptions.
  - Conduct exercises to assess measures and identify strengths and areas of improvement and then take corrective measures.
  - Refine and upgrade critical infrastructure plans in all sectors.
  - Result in swift and more effective response and recovery efforts when disruptions occur.

• **Road Ahead**-Given the inter-dependencies and connectedness among critical infrastructures, a disruption of any one service could have a cascading effect across essential services or systems. A "risk management" approach to critical infrastructure refers to the continuous, proactive and systematic process to understand, manage and communicate risks, threats, vulnerabilities and interdependencies across the critical infrastructure community, including the owners and operators of critical infrastructure. Having a strong situational awareness of the risks and interdependencies that confront critical infrastructure is the first step towards a comprehensive risk management process. Population living in urban areas will increase from 29 per cent in 2000 to 40 per cent by 2030. The escalating demand for basic services in urban centers is resulting in a serious deterioration of service quality across housing, transport, healthcare, power, water supply and sanitation, and education. Uncontrolled and unplanned development going beyond control by civic authorities has led cities to be more and more vulnerable to natural disasters and disease. The Mumbai floods of July 2005 that brought the city on its hold were flashed on television sets worldwide. The death and destruction that the floods brought in their wake reinforced India's image as a poor, under-developed country unable to care for its own. Infrastructure of all cities everywhere needs refurbishment and mega-investment. While the policy spotlight has thus far focused largely on Tier I cities—Mumbai, Delhi, Chennai, Kolkata, Bangalore, and Hyderabad; cities such as Nagpur, Surat, Vadodara, Ahmedabad, and Vijayawada, that is, Tier II cities with a population over 5 lakhs are also growing at much faster rate.

• In order to make built-infrastructures disaster-resilient it is recommended that:
  - All state governments and all local bodies (urban and rural), development authorities, special and new town development agencies, etc., need to modify, revise, revamp the existing building byelaws; development control rules; planning standards; town planning rules; special regulations for fire, structural, health, construction, electric and life safety, in line with the NBC-2017 by suitably adopting fully or adapting it with local variation as may be needed.
  - NBC-2016 to be adopted as the basis for all structural design, fire protection, building and plumbing services, building materials and construction practices (and construction safety) and for proper protection, upkeep and maintenance of water bodies by modifying the departmental construction codes/specifications/manuals of government construction departments' strengthening of all building development and regulating agencies with the right level of professional human resources (which has to upgrade knowledge periodically to keep pace with the latest in the field) to deal with proactive responses needed with the building professionals and builders. The professional human resource pooling for contiguously situated human settlements and the related regulating agencies should be attempted, considering the socio-economic and budgetary constraints of smaller level local bodies dealing with building regulation work.

– Over the last twenty years, the overwhelming majority (90%) of disasters have been caused by floods, storms, heatwaves and other weather-related events. In total, 6,457 weather-related disasters were recorded worldwide by EM-DAT. Over this period, weather-related disasters claimed 606,000 lives; an average of some 30,000 per annum, with an additional 4.1 billion people injured, left homeless or in need of emergency assistance. Weather-related disasters are becoming increasingly frequent, due largely to a sustained rise in the numbers of floods and storms. Flooding alone accounted for 47% of all weather-related disasters (1995-2015), affecting 2.3 billion people, the majority of whom (95%) live in Asia. While less frequent than flooding, storms were the most deadly type of weather-related disaster, killing more than 242,000 people in the past 21 years; that is 40% of the global total for all weather-related disasters. The vast majority of these deaths (89%) occurred in lower-income countries, even though they experienced just 26% of all storms.

Conclusion

The life and property were both effected very badly during various hazards. Thereby our main concern is to plan, build and maintain all the infrastructures in such a way that they are less vulnerable to possible hazards converting into disaster. The architect, planner and Engineers involvement in ensuring safe structure has to be ensured, for which accountability part of all stakeholders including builders is a must. The Engineers bill may give some impetus on this direction. The skilling of workers (who is one of the mission of present Govt), who are involved in quality construction, requires special attention. The mechanisation of construction Industry is a must for ensuring good quality construction, so that the effect of any disaster is reduced. Our engineers role, responsibility and accountability at various levels of decision making and implementation on ground should increase to minimise the impact of any future disaster. The builders/contractors involved in construction business also have to upgrade themselves technically and to be made more accountable for giving proper quality on ground. The persons involved in various activities related to construction is to be identified and their role and responsibility to be defined properly so the in case of any failure happened due to any negligence, etc., at any level to be identified and punished, similarly performer should be rewarded properly for proper motivation of doing a good job. For resilience and sustainability of infrastructure in a changing environment and its impact in terms of various hazards we have to develop our proper strategies to reduce the impact of any hazards converting into disaster as brought out. As deliberated in the paper, if we take proper preventive measures for reduction of the impact of disasters in future, we can ensure saving of scared resources and for achieving sustainable development goal in India, thereby ensuring sustainable development also.

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Bangladesh Media: A Strategic Player in DRR

Akbaruddin Ahmad[a] and Mujtoba Ahmed Murshed[b]

Abstract

Natural and man-made disasters have received a huge range of intensity in the last couple of decades on the earth and consequently, a new realisation is taking place for a synchronised and strategic media role in the contemporary world to reduce disaster risks.

Amidst of this state, as we know, Bangladesh being the world's eighth-most populous country is highly vulnerable to recurrent natural hazards due to its geographic location and topography. Historically it regularly experiences floods, droughts, tornadoes and cyclones, but all these have been intensified these days, too. In addition, being located in a tectonically active zone, Bangladesh has a long history of seismic tremors as well. Henceforth, Bangladesh's modern media map could help the Disaster Risk Reduction (DRR) methods by channeling out information during disasters to reduce human sufferings.

True, a system of devoted international cooperation, human sufferings caused by catastrophic impacts of disasters could be reduced significantly. This cooperation revolves around public information and education; improved warning systems; disaster preparedness; and mitigation.

If we observe closely, indeed, the media role is the most important means for achieving all of the above-stated objectives by curbing disaster risks.

Keywords: disaster, strategic, Bangladesh, media role, risk reduction

Objectives/Research Question: The research objectives of the paper are: a) to look into strength of the Bangladesh media; b) to highlight the media role in DRR; and c) to suggest measures on how to overcome shortfalls.

Research Argument: Against the backdrop of existing situation, the paper would argue that the strategic approaches of media in DRR.

Methodology: The paper would mainly use research book, articles, and secondary sources of evaluation reports available in print media on governance in Bangladesh.

Key Findings/Discussion: Based on the discussion on the existing ground reality, the special focus is on to see a coordinated approach of media for improving the DRR in terms of paving the ways to meet multiple disaster challenges in Bangladesh.

Introduction

People of Bangladesh are carrying the fate of facing some disasters like floods, cyclones and droughts. Indeed, several decades back it was the brand of Bangladesh and still, it remains the same along with the modernisation and economic growth to receive the middle-income positioning country in the world economic map. No wonder even a philosophically tuned person who used to deny the fate-driven life, but to accept the force of the disaster in own ruins as the nature designed fate! The ground reality tells us to accept that all these have become a periodic feature of our national life.

Across the coastal belt, every single locality is spotted vulnerable and the sections of the populace also stand identified in danger over the years. Almost always, the weaker sections of the society are the worst sufferers because their livable structures are not strong to resist the magnitude of any disaster. Their house cannot keep head high above the tidal waves under the hoisting of a red flag for great danger. They are unable to shift from these places because there lay their sources of livelihood and all that they have in life to preserve and protect for survival.

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Play of mass media and the dissemination of disaster information by the media has huge importance. On the individual level and for the affected population, information provided by mass media can be crucial in motivating and enabling them to prepare for the disaster, to act reasonably during the disaster and to recover after the disaster. Mass media can stimulate a public debate, before and after the disaster, in the affected communities on how to prepare for the disaster and which steps are to be taken from the experiences during disasters to minimise the damage.

In addition, beyond question in many disaster situation, mass media has a bigger function to portrait the damage to draw attention for help from own community's non-affected audience and also international groups.

Relating to the whole parameter, media of Bangladesh is playing a highly significant role in reducing the disaster risk as we all see the field has got a huge leap of modernisation in these days.

Disaster Risk Reduction (DRR) Theory

DRR is a systematic approach to identifying, assessing and reducing the risks of disaster. It aims to reduce socio-economic vulnerabilities to disaster as well as deal with the environmental and other hazards that trigger them. Here it has been strongly influenced by the mass of research on vulnerability that has appeared in print since the mid-1970s.

It is the responsibility of development and relief agencies alike. It should be an integral part of the way such organisations do their work, not an add-on or one-off action. DRR is very wide-ranging: Its scope is much broader and deeper than conventional emergency management. There is potential for DRR initiatives in just about every sector of development and humanitarian work.

The most commonly cited definition of DRR is one used by UN agencies such as UNISDR, also known as the UN Office for Disaster Risk Reduction, and UNDP: "The conceptual framework of elements considered with the possibilities to minimise vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development."

Disaster Risk Management: Concepts and Policy Framework

Basic Terminology

Capacity - A combination of all the strengths and resources available within a community, society, or organisation that can reduce the level of risk or the effects of a disaster.

Disaster - A serious disruption of the functioning of a community or a society causing widespread human, material, economic, or environmental losses, which exceed the ability of the affected community or society to cope using its own resources. Disasters are a result of the combination of exposure to a hazard; the conditions of vulnerability that are present; and insufficient capacity or measures to reduce or cope with the potential negative consequences.

Disaster risk - The potential disaster losses in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period.

Vulnerability - The conditions determined by physical, social, economic, and environmental factors or processes which increase the susceptibility of a community to the impact of hazards. Located right on the coast of Bangladesh, this family's house is regularly washed away by tidal surges.

Hazard - A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.

Resilience - The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. It is determined by the degree to which the social system is capable of organising itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures.

Disaster Risk Reduction - The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, pragmatic management of land and the environment, and improved preparedness for adverse events.

Disaster Risk Management - The systematic process of using administrative directives, organisations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster. Disaster risk management aims to avoid, lessen or transfer the adverse effects of hazards through activities and measures for prevention, mitigation and preparedness.

Climate change - The climate of a place or region is changed if over an extended period there is a statistically the significant change in measurements of either the mean state or variability of the climate for that place or region.

Ideal Role of Media in DRR

Communication is an important part of disaster prevention and management. Many channels are used before and during a disaster - for example, visible or audible signals, leaflets, announcements by speaker cars and public events. Newspapers, television, radio and increasingly important the internet, all together the Mass Media have certain characteristics that make them advantageous for disaster communication as they provide easy access to large public audience and some of them constitute a robust communication system which remains working even in cases of a partial breakdown of the infrastructure. On the other hand, sources dealing with the media know that media can be difficult channels. There is no direct control over the content and form of information transmitted. Sources who want to communicate with the public have to deal with journalists who do not form a passive "information channel" but act as gatekeepers, interpreters and commentators.

The primary goal of disaster managers of informing an audience reliably and credibly about risks and adequate protection behaviour will often be hindered by the information preferences of the audiences themselves as well as by the "public arena" and "watchdog" function of the media.

That means that there are goal conflicts among the different functions of mass media and between them and the goals of disaster management.

Media Strength of Bangladesh

In the disaster-prone area or disaster threatened zone, media has a bigger role to play to reduce the disaster risk. Hence, one needs to know the strength of operational media in a country. One must understand the favorable democratic factors are must for the growth of free press in a country. Democratisation and freedom of press are hand in hand and reinforce one another. Freedom of the press is a powerful agent in a democratic society. Having this theoretical frame, we must admit Bangladesh is a democratic country after reviving back of its parliamentary democracy in 1991 and this has brought considerable freedom for the press with a great democratic order after the downfall of the autocratic military regime of two decades. Indeed, the successive democratic regime generally respected the freedom of the press, although the tasks of upholding this freedom by the journalists have not been easy in Bangladesh.

The Bangladesh media is ranked at 136th out of 178 countries of the world on the Reporters without Border Press Freedom Index. The media market in Bangladesh has mushroomed over the past 10 years, with a large range of highly profitable newspapers and satellite TV channels springing up. At the national level, the media has become dominated by a few large corporations along with business interests. Brand new web-based initiatives, which go right down to the village level, are now being driven by a few energetic individuals. Bangladesh has one of the highest mobile phone penetration rates in the world and these services have massive potential to stimulate public debate and generate change. On the same line, legislative changes, such as the Right to Information Act (RTI) in 2009, seem to demonstrate the commitment of the current Awami League Government to media freedom.

Legal Environment

Although the constitution provides for freedom of expression, yet the press is facing constraints over national security aspects and following some of the journalists were arrested and prosecuted. The 2009 Right to Information (RTI) Act, which applies to all information held by public bodies, has improved government transparency and accountability. It simplified the fees required to access information, overrode existing secrecy legislation, and granted greater independence to the Information Commission, tasked with overseeing and promoting the law. The Ministry of Information controls broadcast licensing for both commercial and community outlets. In 2014, the cabinet approved a draft broadcast policy that contained a range of potentially restrictive provisions, including a prohibition on programming deemed excessively critical of state priorities or threatening to national security and sovereignty. In November 2015, the government announced that all online news portals would be required to register with the authorities and the process is moving still on to be finalised.

Political Environment

Collectively Bangladeshi media present an array of views. However, political coverage can highly be partisan to a higher degree as many owners and editors of many private outlets have their political affiliations. Private broadcast outlets are required to air selected government-produced news segments and official speeches. Internet-based content has experienced censorship also in Bangladesh, with periodic blocking of YouTube, Facebook, other social media and messaging applications in the recent past.

Economic Environment

There is a wide variety of privately owned daily and weekly print publications. Private broadcasting continues to expand, with more than 40 television and two dozen radio stations—including three commercial FM outlets and 14 community stations. The state directly owns or influences several broadcast outlets, including the public BTV, which remains the sole terrestrial television broadcaster with national reach. During the past few years, the number of online news outlets, including news websites and Internet-based radio stations has increased dramatically.

Private broadcast and print media in Bangladesh are often owned by business conglomerates controlled by politically influential individuals or families with extensive assets in other industries. Some such outlets allow the interests of their owners to influence their news coverage. Political considerations influence the distribution of government advertising revenue and subsidised newsprint, on which many publications depend. Private media owners and corporate interests are also able to influence content through the allocation of advertising.

Press Laws

Article 39(1) of the Constitution provides for freedom of speech, expression. The Press Council Act of 1974 ostensibly entrusted the Press Council (PC) with preserving the freedom of the press. Its responsibilities included responsibility for devising a code of conduct for maintaining high professional standards. In practice, the PC would help the press to avoid a conflict with the government through self-censorship. Despite such scenarios and self-censorship, the press, numbering hundreds of daily and weekly publications, provides a lively forum for a wide range of views. The free spirit of the Bengalis prevails. While most publications support the overall policies of the government, several newspapers report critically on government policies and activities.

Strength of Broadcast Media

The then East Pakistan, which is presently Bangladesh, had very poor telecommunications. Between 1959 and 1963, the first 100 KW medium wave and short wave transmitters were installed in Dhaka in order to improve communication between the two wings of Pakistan separated from each other by over 1,200 miles. There were relaying regional stations in Chittagong, Sylhet, Rangpur, Rajshahi and Khulna. The 1971 war for the liberation of Bangladesh destroyed most of the facilities particularly in Khulna. Immediately after liberation, the government established the Bangla Betar Radio (BBR) with eight regional stations. In June 1975, Bangladesh opened its first earth satellite radio station at Betbunia, 140 miles south-west of Dhaka.

The Betar Radio (BR) has eight radio stations in Dhaka, including one for overseas service. There are FM facilities in Dhaka, Sylhet, Chittagong, Rajshahi, Rang-pur and Khulna. As for television, there were 15 broadcast stations in 1999 with an estimated 1.5 million sets in 2001. Programs are aired nationwide and to the other countries of South Asia, South and Southeast Asia, Middle East, Europe and the US. The BTV covers 95 per cent of the population with relay stations in Dhaka, Rangpur, Mymensingh, Noakhali, Satkhira, Sylhet, Khulna, Natore, Rangamal, Chittagong, Cox's Bazar, Jenaidah, Thakurgaon and Patunkhali. In the early 1990s, Cable TV was introduced. It became quickly popular and was availed of in more than one million homes mostly in Dhaka and Chittagong. On July 12, 2001, Parliament approved two bills granting autonomy to state-run Bangladesh Television (BTV) and Bangladesh Betar (Bangladesh Radio). Even with passage of these laws, the public still believes that there is no real autonomy for BTV and Bangladesh Radio.

Different Cyclones Hitting

Media s the strategic partner in DRR, one can have a better understanding seeing the destruction magnitude of different cyclone hitting Bangladesh. Thirty-five per cent of the area of Bangladesh is less than 6 m (20 ft) above sea level, and over 20% of the entire country is submerged beneath annual river floods in an average year. The 575 km (360 mi)-long coastline is contoured in such a way that it funnels cyclones from the warm waters of the Bay of Bengal into the area. And most importantly Bangladesh is a densely-populated delta country that sits on sediments eroded from the Himalayan Mountains. About five tropical cyclones per year enter the Bay of Bengal both before (April-May) and after (October-November) the southwest monsoon season.

1970 Bhola Cyclone

The 1970 Bhola cyclone was the world's worst modem natural disaster, and may remain so to this day. It struck East Pakistan (present-day Bangladesh) and India's West Bengal on November 12, 1970. The powerful cyclone formed over the central Bay of Bengal on November 8 and moved to north with an intensified capacity. Although there were no direct measurements of the winds of pressure in the storm, satellite imagery suggests that the storm intensified rapidly, becoming a well-defined cyclone with sustained winds between 137-145 km/h (85-90 mph) by 11 November. The system traveled north and intensified, driving into the low-lying delta area overnight on 12 November, during an above-average lunar high tide. The cyclone carried a 6 m (20 ft)-storm surge and average winds in excess of 225.3 km/h (140 mph).

Impact

Although meteorologists knew of the approaching storm, there was no way to communicate to most of those living in the coastal plain and on the islands of the Ganges River delta. The storm surge devastated many of the offshore islands, wiping out villages and destroying crops throughout the region. West Bengal and Assam in India saw heavy rainfall and high winds that damaged housing and crops, as did the Andaman and Nicobar Islands, but the coast of East Pakistan suffered the most traumatic consequences.

But the impact was shocking in this region. Bhola Island and Hatia Island were completely devastated, along with neighboring islands and the adjacent mainland coast. Up to 500,000 people lost their lives along with 45,000 on-shore fishermen, 85 per cent of homes destroyed along with crops and 300,000 valuable cattle. Around fishing boats were destroyed and were killed, subsequently creating a severe food shortage. Numerous larger vessels were sunk or damaged by the cyclone, but the major cost was measured in human lives, with hundreds of thousands killed.

Role of media

Media was very in the then East Pakistan and consequently the people of that region was in dark about the scale and magnitude of the cyclone.

Cyclone Sidr

Cyclone Sidr 2007 was a tropical cyclone that resulted in one of the worst natural disasters in Bangladesh. The fourth named storm of the 2007 North Indian Ocean cyclone season, Sidr formed in the central Bay of Bengal, and quickly strengthened to reach peak 1-minute sustained winds of 260 km/h (160 mph), making it a Category-5 equivalent tropical cyclone on the Saffir-Simpson Scale. On November 9, an area of disturbed weather developed southeast of the Andaman Islands, with a weak low-level circulation near the Nicobar Islands. The IMD upgraded the system to Cyclonic Storm Sidr early on November 12. The system then began to intensify quickly as it moved slowly northwestward. The storm eventually made landfall in Bangladesh on November 15, 2007.

Impact

Thirty costal districts were classified as “severely affected” and a further eight were classified as “moderately affected”. Of the 2.3 million households affected to some degree by the effects of Cyclone Sidr, about one million were seriously affected. The number of deaths caused by Sidr is estimated at 3,406, with 1,001 still missing, and over 55,000 people sustaining physical injuries. Improved disaster prevention measures, including an improved forecasting and warning system, coastal afforestation projects, cyclone shelters, and embankments are credited with lower casualty rates than what would have been expected, given the severity of the storm. Most of the destruction and related social and economic losses resulted from the harsh storm conditions and the subsequent failure of an extensive embankment system.

Figure 1: November 2007, Cyclone Sidr in Bangladesh. Source: Google.

In the wake of Cyclone Sidr, the Government of Bangladesh, together with international experts, undertook comprehensive damage and loss, and needs assessments to ascertain the extent of the damage caused by the storm, and to define a comprehensive and feasible recovery plan. The Joint Damage, Loss, and Needs Assessment (JDNLA) estimated the total damage and losses caused by the cyclone to be Bangladesh Taka (BDT) 115.6 billion (US$ 1.7 billion).

Figure 2: November 2007, Cyclone Sidr in Bangladesh. Source: Google.

Role of Media

Media played a very strong role during the Sidr. Every single development was channeled through the print and electronic coastal belt. A Tropical Cyclone was issued on November 11 while located a short distance south of the Andaman Islands. Around the same time, the India Meteorological Department (IMD) designated the system as Depression BOB 09. Later that day, it intensified into a deep depression as it moved slowly north-westward.

On the morning of November 15, the cyclone intensified to reach peak winds of 215 km/h (135 mph) according to the IMD, and a peak of 260 km/h (160 mph) according to the JTWC best track. Sidr officially made landfall later that day, with sustained winds of 215 km/h (135 mph). It weakened quickly after landfall and the final advisories were issued early on November 16.

Forecast heights of the storm surge predicted by a numerical model developed by Dr Hassan Mashriqui (Louisiana State University) was communicated to the emergency response authorities in Bangladesh, prompting massive evacuations of low-lying coastal areas through the administration and media. A total of 2 million people in Bangladesh were evacuated to emergency shelters. The Indian Metrological Department (IMD) also issued a cyclone alert for Orissa and West Bengal on November 14. Over 40,000 Red Crescent volunteers were deployed to order residents in the 15 affected provinces into a special cyclone and flood shelters. The main ports had been closed.

Cyclone Aila

Late on May 21, 2009, the Joint Typhoon Warning Center (JTWC) reported that a Tropical Disturbance had persisted about 950 kilometers (590 mi) to the south of Kolkata, in India and had developed within the Southwest Monsoon. The disturbance at this time had a broad and poorly organised area of deep convection, which was located to the southeast of the low level circulation center, which had consolidated into a single circulation during the previous 12 hours. During May 22, 2009, the disturbance developed further with a Tropical Cyclone Formation Alert being issued early the next day by the JTWC as the low-level circulation center had become stronger and more defined.

During the day, depression continued to slowly intensify until early the next day when it was upgraded to a Deep Depression by RSMC New Delhi, and designated as Tropical Cyclone 02B by the JTWC. Later that day, RSMC New Delhi reported that the deep depression had intensified into a Cyclonic storm and had been named as Aila whilst located about 350 kilometers (220 mi) to the southeast of Sagar Island. Aila became a severe cyclonic storm on May 25 and made landfall at its peak intensity (60kt, 967h).

Impact

The cyclone Aila caused 190 immediate deaths, injuries to 7,103 people, damage to 6,000 kilometers of roads, more than 1,700 kilometers of embankments to collapse, more than 500,000 people to become homeless and complete destruction of 275 primary schools and damage to 1,942 schools. The cyclone has had a devastating long-term impact, particularly because embankments, which were breached during the storm remain unrepaired. Livelihood options were also severely affected by the cyclone as livestock, shrimp ponds and cropland were washed away or destroyed.

Figure 3: May 2009, Cyclone Aila, Bangladesh, 26 May2009. Source: Google.

Role of Media

While the cyclone was not as strong as Sidr, and the initial death toll was considerably lower, it is estimated that about 4 million people have been affected during and after Cyclone Aila. In the Bhola District of Bangladesh, an estimated 500,000 people evacuated to higher areas and shelters as Aila neared landfall. Tourists were advised to stay in their hotels due to the short amount of time to prepare for the storm. Officials in India evacuated thousands of residents from coastal areas ahead of Cyclone Aila. In addition, several warning alerts were issued before the cyclone hit Kolkata; however, no alarm bells were rung.

Cyclone Mora

In late May 2017, an area of convection began to organise in the Bay of Bengal under favorable conditions characterised by low wind shear and warm sea surface temperatures. On May 27, the Indian Meteorological Department (IMD) noted the high likelihood of the low-pressure area organising into a tropical depression. Similarly, the Joint Typhoon Warning Center issued a tropical cyclone formation alert on the disturbance. The JTWC classified the disturbance as a tropical cyclone roughly six hours later as it continued to intensify. At the time, the storm's motion was influenced primarily by a nearby subtropical ridge, forcing the system to take a north-northeasterly track.

Impact

Cyclone Mora has hit the south-eastern coast of Bangladesh, killing at least six people. Most of them were killed by falling trees in the districts of Cox's Bazar and Rangamati. Hundreds of houses were fully or partly damaged, the officials said. Significant damage is reported in refugee camps housing Rohingya Muslims from neighboring Myanmar. The authorities have moved hundreds of thousands of people to shelters.

Figure 4: May 2017, Cyclone Mora in Bangladesh. Source: REUTERS

Role of Media

With Mora's relatively rapid intensification, Bangladeshi authorities were hard-pressed to carry out evacuations and prepare for the storm. Maritime weather alerts were issued for the Bangladeshi ports of Chittagong, Cox's Bazar, Mongla and Payra, under the anticipation of a 1.2 to 1.5 m (4 to 5 ft) storm surge. All flights out of the Shah Amanat International Airport of Chittagong were suspended. City-wide, 500 shelters were opened. Authorities attempted to evacuate 1 million people prior to landfall, though as of May 29, only 300,000 had done so. Fishing boats and trawlers have been advised to remain in shelters until the late evening. Flights in the area have been cancelled.

Different Floods

Bangladesh's geographical location in the Ganges Delta and many distributaries flowing into the Bay of Bengal have made the country flood-prone. Coastal flooding, combined with the bursting of river banks is common, and severely affects the landscape and society of Bangladesh. Around 80% of Bangladesh is floodplain, and it has an extensive sea coastline, rendering the nation very much at risk of periodic widespread damage. Many embankments are composed purely of soil and turf. Flooding normally occurs during the monsoon season from June to September. The convectional rainfall of the monsoon is added to by relief rainfall caused by the Himalayas. Melted water from the Himalayas is also a significant input. Each year in Bangladesh about 26,000 km^2 (around 18% of the country) is flooded, killing over 5,000 people and destroying more than seven million homes. During severe floods, the affected area may exceed 75% of the country, as was seen in 1998. This volume is 95% of the total annual inflow. By comparison, only about 187,000 million m^3, of stream-flow is generated by rainfall inside the country during the same period. The floods have caused devastation in Bangladesh throughout history, especially during the years 1966, 1987, 1988 and 1998. The 2007 South Asian floods also affected a large portion of Bangladesh.

Figure 5: Bangladesh flood 1998
Source: Google.

The catastrophic floods of 1987 occurred throughout July and August and affected 57,300 km^2 of land, (about 40% of the total area of the country) and were estimated as a once in 30-70 year event. The seriously affected regions were on the western side of the Brahmaputra, the area below the confluence of the Ganges and the Brahmaputra and considerable areas north of Khulna.

The flood of 1988 was also of catastrophic consequences that occurred throughout August and September. The waters inundated about 82,000 km^2 of land, (about 60% of the area) and its return period was estimated at 50–100 years.

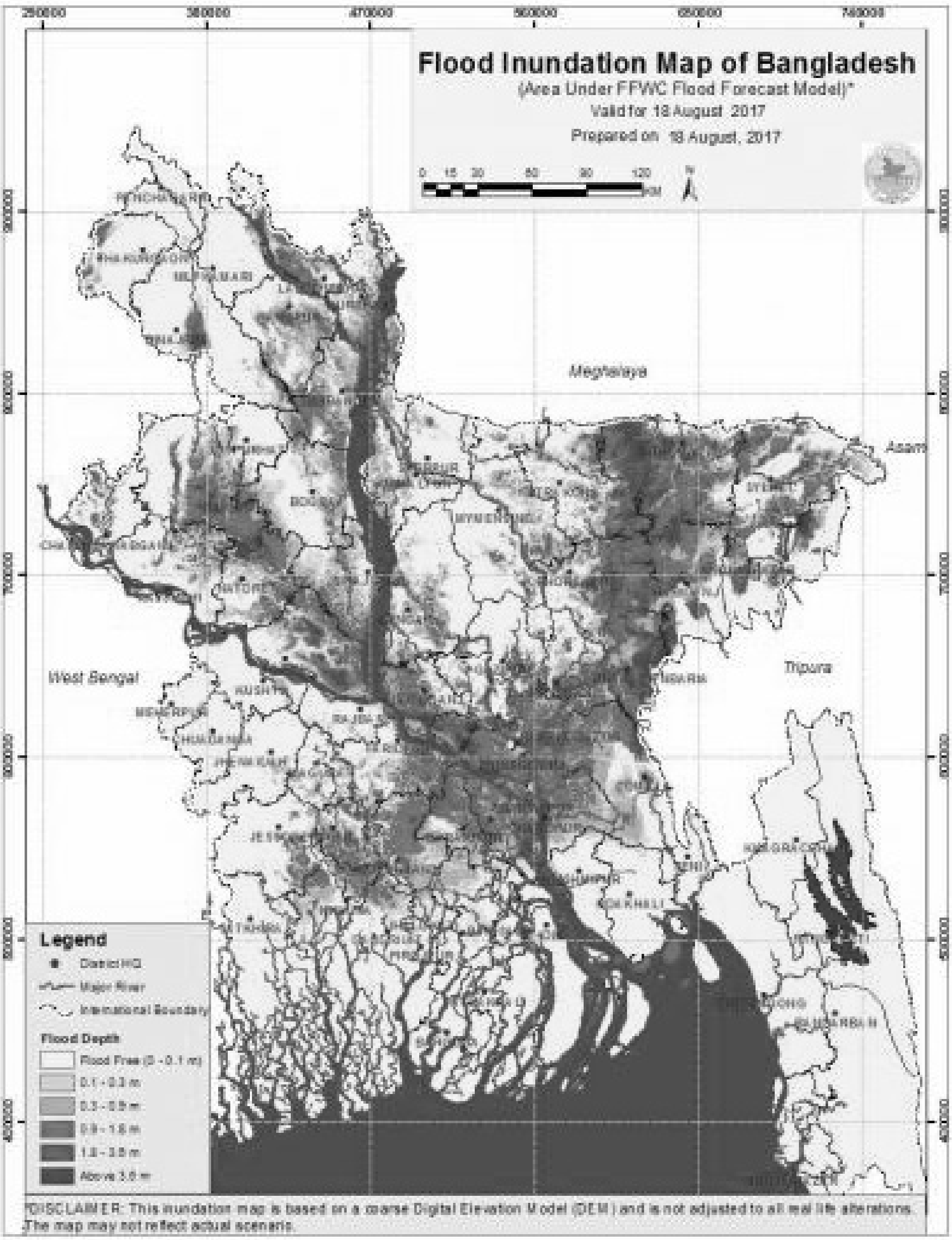
Figure 6: August 2017, Flood in Bangladesh.
Source: Google.

Rainfall together with synchronisation of very high flows of all the three major rivers of the country in only three days aggravated the flood. Dhaka, the capital of Bangladesh, was severely affected. The flood lasted 15 to 20 days.

Figure 7: 1998, Flood in Bangladesh

Flood in 2017

About 35 per cent of Bangladesh has been inundated by the flood caused by the onrush of water from upstream and incessant rainfall, affecting over four million people. So far, 138 upazilas of 25 districts have been flooded. Around 32 per cent of the country was flooded in 2015. But now, it may have submerged a wider region. The death toll following the flood stood over 100, including a few cases of lightning strikes. The total number of people marooned up until now was figured at 4,126,540.



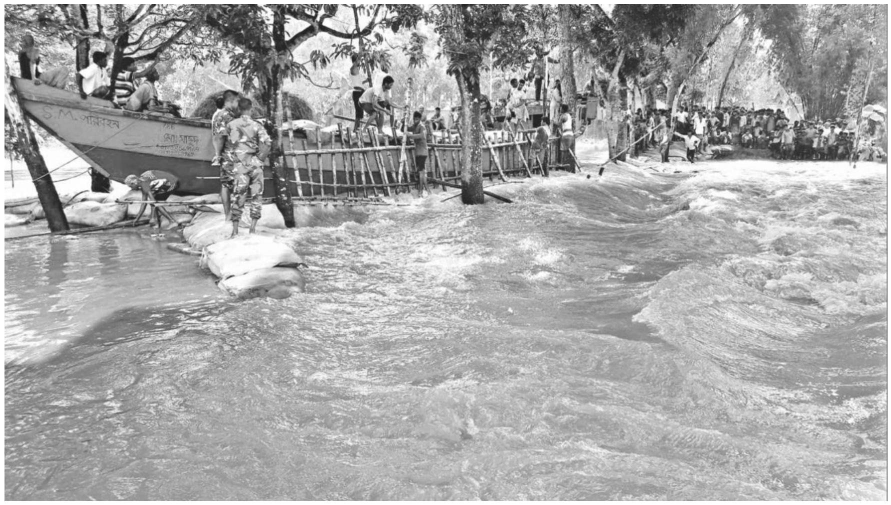


Figure 8: August 2017, Flood, Sirajganj, Bangladesh.
Source: Google.

Earthquake Risk in Bangladesh

Only recently have scientists come to recognise that Bangladesh is positioned at the juncture of several active tectonic plate boundaries. Moreover, it sits atop the world's largest river delta at close to sea level, facing both the risk posed by a quake and secondary risks of tsunamis and flooding in the quake's aftermath. These teaching case materials show the fieldwork of an international team of scientists working to provide Bangladeshi leaders the tools they need to understand and minimise geologic risks. Using both seismic and sedimentary data, scientists are attempting to model the interactions between past earthquakes and river-course shifts–an invaluable aid in predicting future quakes and how they could impact this unique terrain.

The potential destruction from the earthquake warned about in this study would be much worse than in Haiti. An 8.0 magnitude earthquake (which is slightly lower than the potential 8.2-9.0 max that this fault could trigger) is 32 times stronger than a 7.0 earthquake. If that quake was to strike under Dhaka, which has a population of around 7 million, compared to Port-au-Prince, which has a population of about 1 million, the resulting death toll could be staggering. The strain is building up that will sometime be released by an earthquake, but the timing is unknown. It could happen tomorrow or it could happen in 500 years. The fault is entirely in the sub-surface. Data collected since 2004 by Professor Michael Steckler, a geophysicist at Columbia University's Lamont-Doherty Earth Observatory and his team has found that a juncture between major tectonic plates in the region is locked and loading up with stress. Measurements found convergence of tectonic plates at the rate of 13-17 mm per year "on an active, shallowly dipping and locked mega-thrust fault. That build-up has the potential to trigger major shifts in land and also an earthquake with a magnitude of between 8.2 and 9.

But hopefully, with increased knowledge of the risk, the governments of India and Bangladesh can focus efforts on building more earthquake-resistant structures as well as improve planning to cope up with relief and supplies for the people after an earthquake. A quake measuring seven or more on the Richter scale with its epicentre inside Bangladesh could lead to the collapse of 75,000 hazardous buildings, he told bdnews24.com, giving an idea of the extent of the damage such a disaster could cause.

Conclusion

The paper has projected the media responsibility in reducing the risk factor of any disaster in Bangladesh and their contributions to the system to reduce losses for people. Bangladesh is consistently ranked one of the most vulnerable countries to natural disasters, but this is primarily because of the frequent occurrence of tropical cyclones, floods, heatwaves and other weather-related disasters, combined with the massive population living in vulnerable conditions. The massive amounts of sand and sediment in the soil of the delta region have placed Bangladesh in danger and in addition, a potential devastating mega-thrust fault is on the offing. In an earthquake, the shaking will cause the sandy ground to behave like a liquid in a process known as liquefaction. This makes the shaking even more devastating to buildings built on this sandy ground. People would face the disaster in the absence of any means to predict, develop awareness and preparations for any cyclone, flood and earthquakes.

The opposite scenario could be minimising losses and thus it clearly demands a more functional press along with a modern strength in a true democracy practicing atmosphere to enjoy freedom. The whole system requires a close collaboration with the government instruments as well. Their access to information has to be ensured at a full scale, too, to bring disaster information to the key audience in time. The media forges a direct link between the public and emergency organisations and plays a very important role in disseminating vital information to the public before, during and after disasters. The media assists in the management of disasters by educating the public about disasters, warning of hazards, gathering and transmitting information about affected areas, alerting government officials, relief organisations and the public to specific needs and facilitating discussions about disaster preparedness and response for continuous improvement. In the frame of DRR, people need to receive warnings ahead of the disaster and following the aftermath, data on casualties, damage, the relief supplies, too. The best way to bring this information to the respective audience is through the mass media.

Through this paper, we found that widespread dissemination of early warnings saved thousands of lives and properties whether in cyclone or flood situations. Bhola cylone in 1970, for example, struck southeastern Bangladesh with its devastating capacity had trailed a more than 300,000 people dead and 1.3 million homeless. At that time mass media was very fragile in then East Pakistan, presently Bangladesh. We have started seeing a marked difference after the independence when gradually media of Bangladesh got reorganised. In May 1985, a comparable cyclone and storm surge hit the same area and having better local dissemination of disaster warnings and the people were better prepared to respond to them. The loss of life, although still high, was 10,000 or about 3 per cent of that in 1970. When a devastating cyclone struck the same area of Bangladesh in May 1994, fewer than 1,000 people died. Only six people were dead in late May 2017 during the cyclone Mora! The dramatic difference has happened due to the fact that early warning systems connected through TV channels, newspapers, radio stations and community radio have contributed as the strategic players in DRR to make people alert in low-lying areas where substantial lives and properties were saved. The paper has highlighted for more modern capacities of mass media along with its every instrument in the whole costal belt and also in the Brahmaputra and Ganges delta to make people alert over any natural disaster.

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Gender Mainstreaming for Efficient Sustainable Disaster Risk Reduction

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Abstract

Gender mainstreaming is a concept that is easy to agree but difficult to implement or follow and same happens when it comes to mainstreaming gender perspective in disaster risk reduction legislation, policies, plans, programmes and actions. Thus, in order to achieve efficient sustainable development, appropriate disaster management capacities and resilience may be built equally in both men and women. It is important to institutionalise gender-sensitive risk assessments, implement gender sensitive early warning system and use gender-sensitive indicators to monitor gender mainstreaming in disaster-risk reduction. Gender mainstreaming emphasised un developing increased understanding of gender concerns and developing governance capacity for its regulation, promotion and development of monitoring mechanisms. The paper attempts to address gender issues and integrate gender perspectives into DRR legislations, policies, plans, programmes missions, projects and actions for enhancing efficient sustainable community resilience.

Keywords: gender mainstreaming, sustainable development, disaster risk reduction

Introduction

Women and men live in a society that does not provide them with equitable opportunities for personal growth and empowerment as human beings. Often power structure creates imbalances between the two sexes leading to inequitable control on resources and opportunities including exclusion of one gender from decision/policy making process or leadership. Gender equity recognises that different approaches may be required to foster a justified society for all human being based on individual aptitudes, abilities and interests, regardless of gender.

Disasters destroyed decades of human efforts and investment towards development thereby placing heavy demand on society for reconstruction and rehabilitation and repetition recurrence of such disasters threaten sustainable development. Gender is a key dimension of the social difference and yet it has been absent as one of the factors/ parameters in disaster research and analysis (Fordham, 1998). Even till the 1990s, most books on hazards and disasters failed to recognise the significance of analytical categories, such as –gender –women or –feminism to the extent that such terms did not warrant inclusion in their respective indexes, or even sometimes in the text as a whole. Thus, disaster research, somewhat more so than development research, has been broadly gender insensitive.

Gender mainstreaming calls upon the attention to be paid to existing social structures based on gender relations, which result in the unequal status of women or men. Gender discrimination is a systematic discrimination against women men that limits their capabilities and renders them vulnerable to exploitation and abuse of all forms. It calls for a specific emphasis on the equal participation of women and men in all processes which design and build programmes and policies for disaster prevention, mitigation and preparedness as well as for disaster relief, response rehabilitation, reconstruction, relocation, resettlement, recovery and redevelopment. There has recently been a critical shift in the mainstreaming of gender perspectives into DRR from women focus to gender focus approach, based on the premise that the roles and relationships of women and men in DRR should be analysed within the overall gendered socio-economic and cultural context. On-top of this shift, the strategic focus of disaster management has changed from reactive disaster response to long-term proactive disaster vulnerability and risk reduction, where gender and DRR are considered necessary to achieve efficient sustainable development. Successful gender mainstreaming in disaster management as well as in post-disaster programmes also calls for reforms in legislation, policies, plans, programmes and actions that would transform gender relations in order to make them more equitable, justifiable and rights based, to offer women guarantees for equality in dignity and in rights.

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Current Status of the Literature

Chew and Ramdas (2005) found that the social and economic breakdown that follow natural disasters cause women to become more vulnerable to sexual abuse and domestic violence. Women are usually put up in shelters that lack security and privacy, which further threaten their survival. Most disaster-relief efforts fail to write policies that cater to the unique needs of females.

Pregnant women may lack obstetrical care and young women may lack access to contraception or sanitary supplies. Often, supplies in relief programmes are distributed by men and displaced female victims feel uncomfortable obtaining them from the males (as cited by Hines, 2007).

Anthropologist Raymond Weist (1998) studied the relationship between domestic arrangements, women‘s vulnerability, and their coping capacity during a disaster. Data from his work in Bangladesh, supplemented by examples from rural Mexico, illustrated that global capitalism in many parts of the world has reduced the capabilities of individuals and families to cope with crisis, and typically, women bear the brunt of the economic changes. The number of households headed by women are likely to increase after a disaster and the situation for these women and their dependents is especially precarious. The primary approach to disaster relief has been to assume the nuclear or conjugal family household as normal. According to Hines (2007), women who survived the tsunami in South Asia underwent serious structural changes in the family. Women started assuming family leadership roles, which they had not previously done. The role of single parenting in a patriarchal society is presented with other cultural and societal challenges. For example, after the tsunami, many women became first-time boat owners, which traditionally had been a male occupation, and it became a challenge for these women to undergo such a transition because in the eyes of their culture, they are violating societal norms.

According to Oxfam International (2005), fisherwomen in the fishing community of Nagapattinam, India, did not own boats. Their contribution to the labor market came in the form of performing tasks, such as cleaning, drying, and selling the catch. After the tsunami, relief programs were set up to provide funding to boat owners who had lost their boats to the tsunami. Women who were widowed as a result of the tsunami, were not given such financial relief since they did not own the boats themselves. The relief programmess did not take into consideration that the death of the husbands would cause these women to face a domino-effect of economic burdens.

The study on fatalities due to disasters reveal that more women died in the 2004 tsunami than men. According to the reports by the Asian Development Bank, United Nations, World Bank, and Oxfam (2005) found that in areas where data could be obtained, three times as many of the victims were women. The reasons for this disparity vary from a lack of relevant knowledge to cope during the disaster to cultural practices that increase women‘s vulnerability with regards to the avoidance of accidents (as cited by Dimitrijevics, 2007). According to Beinin (1981), Schwoebel and Menon (2004), and Oxfam International (2005), in many countries, women‘s roles are to look after and protect the children and the elderly, as well as the family‘s domestic property, which hampers their self-rescue efforts in almost any type of natural disaster (as cited by Neumayer et al., 2007). Cultural practices may also hamper the ease of escaping disasters. According to Ikeda (1995), dress codes can restrict women‘s ability to move quickly and societal restrictions, which requires the consent of the male members of the family (husband, father, brother), can hinder their ability to relocate. As an example, in rural Bangladesh women are expected to wear a sari (traditional clothing that hampers running and swimming) and to remain in the *bari* (typically in the houses of the family and near kin). These requirements can impede women‘s movements and their access to information about impending disasters, such as cyclone-induced floods (as cited by Neumayer et al., 2007). Cannon (1995) found that social prejudice against women learning to swim drastically reduces their survival in flooding.

Gender differences in society make women more vulnerable to disasters through their socially constructed roles. Women are highly represented in the agriculture and informal economies. Both of these industries are often seriously impacted by natural disasters, as a result of which women comprise the majority of the unemployed after disasters. In addition, they are often underpaid and have little access to benefits.

According to Byrne and Baden (1995), if gender is not considered there is a danger that women may become invisible in relief programmes, with men receiving most resources and participating in the planning and implementation of programmes. This leads to increased gender inequality and reduces the effectiveness of relief programmes, resulting in women‘s capacities remaining underutilised and their needs not met. Conversely, a focus on women alone (rather than gender relations) may lead to women being seen as the primary victims of emergencies, arising in failure to recognise men‘s and women‘s different needs and capacities, contributing to increased gender conflict.

Hence, it is important to have a clear understanding of the difference between the ―Women in Development (WID) approach and the ―Gender and Development (GAD) approach in the analysis of emergencies. The WID approach is reflected to some extent in relief practice through the recognition of some of the needs of women in food distribution, health care, and the importance of their role as mothers. But GAD approaches and the associated analysis of the distribution of power and resources as well as the process of change in relations between men and women are poorly articulated in emergency policy and practice.

A review of the literature and discussions on vulnerability suggests the need for integrating the GAD approach in data management and analysis. This approach could help relief workers ensure that there is no gender discrimination.

Why Gender Mainstreaming in DRR Programme

A natural hazard in itself is not a disaster but turn into a disaster when individual/ community does not have adequate capacity to respond in a way that saves life and property. The lack of capacities is not predetermined to the sex of the person but they are the result of prevailing social, economic and political inequalities. Prevailing gender role and power relations determine to a great degree the nature and extent of capacities present in any community or society. Gender role and power relations directly influence how resources and opportunities are distributed and controlled and who make the decisions. Thus, gender inequality is often considered a root cause of social vulnerability during disaster and recovery process in most of the countries. It mainly, attributed to their subordinate position, patriarchy and culture. When gender issues are not addressed fully or sufficiently, in both development and disaster context, they perpetuate gender-based inequities. These make the women or men more vulnerable to various hazards as their specific needs are not met especially when it is compounded with other social inequalities or problems. Like poverty which is known to be a key factor in the vulnerability of both men and women during hazard events, but there can be gender differences among the poor that further compound the risk. For instance, poor women may have heightened vulnerability to hazard events that occur during the daytime, as many live in unsafe areas and houses and tend to spend more time indoor or near the house than their male relations. As men usually form the majority of poor migrant laborers, their wives and children as well as older people remaining in the family home may be more exposed to the impacts of local disaster.

Understanding gender differences can save lives

There is considerable evidence that lack of physical skills, such as the ability to climb tree or to swim, has been a major contributing factor to disaster fatalities among women. In India, upto three times as many women as men died in 2004 Tsunami, while in Indonesia this figure rose to up to four times the number of male causalities. While not all of this disparity is due to differences in physical skills, in case where women has ability to swim, the overall mortality rate was reduced by more than 60 per cent. Teaching women and girl to swim when it is not traditional to do so have saved lives in flood prone areas.

Source: Guha-Sapir et al, 2004 and I Smyth, 2005

Major disasters that have occurred over the past decade, such as the Indian Ocean Tsunami, Hurricane Katrina and the Kashmir Earthquake, have highlighted the gendered aspects of disaster risk and vulnerability. For example, response and recovery programmes encountered heavy criticism for gender insensitive practices that often made the situation for women worse. As a result the issue now receives greater attention from researchers, academics, relief and recovery agencies.

Gender Mainstreaming for Ensuring Sustainable Community Resilience

At the global level, available information shows that efforts to promote gender equality in DRR have focused on advocacy and awareness generation, along with support for policy changes and gender mainstreaming in inter-governmental processes. Some regional inter-governmental level policies and strategies focusing on disaster management and DRR also come into place over a decade. Unfortunately, the commitment to gender issues is rarely stated explicitly.

However, the Hyogo Framework of Action (2005-2015) contained the most explicit reference to gender than any other international plan policy framework for Disaster Risk Reduction. It stated that gender perspective should be integrated into all disaster risk management policies, plan and decision making processes, including those related to risk assessment, early warning, information management, education and training. Mainstreaming gender in disaster preparedness, response and recovery process involves assessing and analysing the situation through gender lens to understand the total impact of disaster on young mothers, single mothers, child headed households by girls or boys, grandmothers headed households (in the face of HIV AIDS). It is, therefore, important to incorporate gender-sensitive strategies and initiatives in disaster management processes to address both the basic (practical) and strategic gender need of adult women/men, boys/girls, older women and older men. Gender mainstreaming emphasised upon formulation of gender-sensitive budget for disaster-prone area and gender budgeting of all the developmental programme and scheme. Mainstreaming is, thus, a process of achieving balance in relationship between men and women.

Gender Analysis and Mapping in DRR

The lack of gender-segregated information in disaster relief work is a major impediment for research. Therefore, participatory approach may be adopted for vulnerability analysis. For gender mainstreaming to occur it is necessary to always use a gender analysis framework (sometime also mentioned as Gender lens). Gender lens support in making women and men concerns visible in disaster policies, programmes and implementation. It helps in carrying out gender responsive mapping before designing programme interventions. Gender mapping thus involves looking at the relative spaces and resource entitlements to women and men in various institutions like family, community, market and States, etc. Through gender mapping it is possible to:

- identify the stumbling blocks (threats, weaknesses, strengths and opportunities for addressing various gender-based vulnerabilities.
- predict strategies that reduce rather than increase vulnerabilities.
- contextualise underlying factors affecting women and men, such as socio-culture values, myths and prejudices, legal framework, policy, educational level, access and control of resources and women economic power.

It helps in identifying **Strategic Gender Needs (SGNs) like position, equitable power relations, justice and Practical Gender Needs (PGNs) like addressing basic needs as rights**. When policies and programmes either exclusively address SGNs of women or address them through programmes, which meet their PGNs, they bring gender into the mainstream of development and disaster management objectives. Gender analysis also provides us with the data on the quality of daily realities of women, girl, boys and men as well as quality of their participation indifferent sectors. All the decisions must be based on gender aware specific need of men and women and they must be treated differently. Thus, gender analysis should be integrated into disaster need assessment in all sectors to ensure that gender-based injustices and inequalities are not exacerbated by humanitarian interventions and that where possible greater equality and justice in gender relation are promoted.

Gender Mainstreaming during Various Phases of Disaster Risk Reduction

Disaster Preparedness and Mitigation

Community based disaster risk reduction and preparedness starts working with community for vulnerability and capacity assessment. It also tries to understand the various local hazards and characteristics of community in terms of demography, male-female ratio their strength and weaknesses. Preparedness may include spreading awareness of a "culture of safety" and developing community capacities for promoting that attitude. The issues faced and processes require ensuring that CBDRM activities should be sensitive to and inclusion of gender and diversity. Like men women may also get trained in other lifesaving skills–search and rescue techniques like climbing or swimming along with training in first aid.

As a part of preparedness activity women may also get trained in **Early Warning System** as trained women task force may support in ensuring that vital information reaching all the segments of the community.

Mason Training Programme in Delhi

During five days training programme 35 masons including five women masons and 1 Assistant Engineer from Municipal Commissioner of Delhi got trained in Earthquake Resistant Construction.

One Technology Demonstration Unit has got constructed in the premises of Office of Deputy Commissioner (West).

- **Information Education and Communication**
  A gender analysis of the situation of both men and women can help in developing interventions that better meet their different roles, needs and are mutually reinforcing in increasing the overall safety and resilience of the household and community. The gender-related issues involved in the development of physical mitigation works be it the building check dams or health clinic. Women may also get involved or trained in other non-traditional areas such as cyclone resistance roof construction, which may contribute to both family income and community safety.

> In part of India's Tamilnadu state that were affected by the 2004 Indian Ocean tsunami, it was found that both elderly women and men were excluded from some assistance when relief was mediated through communities traditional local authority. This was due to mistaken assumption that they required little food for their survival
>
> Source: C. Pincha, 2008

Disaster Response

Disasters impact men and women differently (even within the same household) because of social, economic, physical and biological differences. Having information about their situations is essential when developing responses that better meet their specific needs. Consulting with a socially and economically representative cross-section of affected men and women is essential for effective targeting as is their participation in decision making during response process.

- **Immediate Need Assessment**
  In a quick onset of disaster, rapid assessment normally takes place within the first 24 to 72 hours of the emergency. At the minimum, sex disaggregated data should be collected at this time. It is possible to supplement this data with any available information on the pre-existing gender and socio-economic context and on the impact previous disaster may have had on different group.
- **Emergency Response Teams**
  Assessment and response team should include an equal number of male and female members in order to facilitate accessing women and men separately during need assessments. If these teams are kept in the same balance throughout the operation they will also be better able to address the respective needs of women and men.

Task Force of School Disaster Management Team representing girls students getting trained in search and rescue a lifesaving skills.

- **Beneficiaries Registration and Relief Distribution System**
  Procedures for relief registration and distribution should recognise the need for, and ensure access to assistance by all types of vulnerable and needy households as well as individual households. There have been many instances of women and other vulnerable groups missing out on relief assistance particularly when government and relief agencies have registered households based on their male heads.

> In Thailand followed by Indian Ocean Tsunami, female household members who needed to become the main breadwinners due to the illness or injury of the male head of household, had difficulty getting their situation recognised by authorities (Asia Pacific Forum on Women, Law and Development, 2006)

- **Appropriateness of Relief Items**
  Gender and culture-specific needs should be taken into consideration when designing relief packages. Women and men of the communities should be consulted while designing the relief packages. Like sanitary needs of women and older girls may be taken into consideration. Similarly, pregnant and lactating women have special needs for crucial nutrients and vitamins supplements that can be incorporated into family or mother or baby assistance package. Specific health issues of pregnant women may be addressed. During the Uttarakhand flash flood and landslide disaster, 2013 in absence of any female gynaecologist women delivered babies in unhygienic and unsafe conditions.
- **Ensuring Appropriate Safety in Relief Centers**
  After any disaster, relief camps and shelters plan to take into account the socio-cultural needs and preferences of both men and women in consideration with safety. It should provide enough privacy to female members of affected population. Bathing and toilet arrangement needs to be adequately and culturally safe and appropriate.

Disaster Recovery

During the recovery process if the gender issues are to be addressed with sensitivity to local contexts, it can contributed to boosting the economy and promoting safety, prosperity and the decision-making power of the women. A careful planning and analysis is to be done for recovery process that contributes to address the existing gender and social inequalities.

- **Housing, Human Settlement and Water and Sanitation**
  It is vital that women and men from all social and economic grouping in disaster-affected communities actively participate in the design and location of new housing and communal infrastructure, such as water and sanitation facilities and community halls, as well as repair of existing structures. Many reconstruction programmes have resulted in nearly empty settlements or the re-creation of unsafe living conditions, because of a lack of understanding of the livelihood and social need of the inhabitants.

Gender inclusion in Post-disaster Recovery work of Maharashtra and Gujarat Earthquake

After 1993 earthquake in Latur, Maharastra and 2001 earthquake in Kutch Gujarat State Government tried to ensure gender equity in post disaster reconstruction and rehabilitation work by women contributing in actual construction/ repairs of their own hoses as part of "Owner Driven Constriction". Other initiatives taken by the government were the training of women masons' and formation of Self Help Groups.

Women who were widowed in this earthquake and otherwise not entitled to plot and house because land holdings were not in their name were provided with separate plots. The ownership of the land and houses was on name of widow women. In all other cases, the plots and houses were provided in joint ownership of the husband and wife except when the beneficiary was a widower.

Challenges for Gender Mainstreaming in DRR

- **Poor understanding of gender in DRR linkages at the policy and practitioner levels**: Gender equality in DRR does not mean merely addressing women's issues - it means addressing concerns of both men and women, the relations between them and the root causes of imbalances.
- **Gender issues are often institutionally marginalised within organisations**: The vogue for Gender Focal Points or Gender Desks results in easily marginalised positions with not enough authority to advance the issue organisation-wide in a multi-disciplinary way. This, in effect, is the opposite of mainstreaming. Gender issues become perfunctorily treated as 'just women's issues, there is a notable absence of male champions, and gender 'expertise' is applied in isolation from development processes like DRR.
- **Gender continues to be identified as an 'add on' aspect, rather than an integral component**: The development and DRR fields are now addressing relatively new priority programming issues such as climate change that compete with other programmes for donors. This means that gender and DRR can be de-prioritised when they are not understood to be cross-cutting issues.
- **There is a lack of genuine political accountability and financial resources** for global advocacy and action on gender and DRR. Commitment **to** the issue largely remains in the documentation alone. There have **been** no significant moves to translate words into actions in terms of **concrete** policies, finances, substantive programmes or accountability **measures**. Gender mainstreaming in DRR remains a free choice with **no** accountability, no checks and balances, no ownership, and no **medium** or long-term commitment.
- **Gender events have not been adequately linked with inter-governmental DRR processes**. Recommendations on mainstreaming gender into DRR that are being produced have a limited impact because they are not being considered or implemented by national governments and UN agencies.
- **Lack of institutional and individual capacities and tools for mainstreaming gender in DRR**. Gender and DRR knowledge and capacity are still possessed by only a relatively small group of professionals and practitioners working in these two areas. The majority of disaster professionals often lack the knowledge required to address gender issues in DRR.

Conclusion

To address a gender perspective in DRR requires change in the mindsets and attitude of policy makers and implementers. Every citizen has a role to play in reducing disaster risk, but government is best positioned to create an enabling environment for gender equality in DRR. Successful implementation of any development programme requires the full and active and balanced participation of men and women. Governments play an important role in promoting gender equality and building disaster resilience at community and national levels. Thus, serious action needs to be taken and more efforts need to be made for promoting gender inclusive disaster risk reduction. Each action is an effort to shift the identity of women from beneficiaries to key actors in building, shaping and sustaining resilient communities.

Ethical Declaration

The authors have not received any funding from any source(s) for this study.

Both the authors have written it jointly and the communication of the paper has been done after obtaining consent from the co-author. There are no conflicts between the authors.

This article does not contain any studies with animals performed by any of the authors.

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Scope and Potential of Engendered Disaster Risk Reduction Initiatives in Chellanam Panchayat

Neena Joseph[a]

Abstract

Disaster Risk Reduction is the crucial aspect of Disaster Management. Pertinent literature evidences that hazards are disproportionally more disastrous for women. Higher vulnerability and lesser coping capacity arising out of subordinate social status lends partial explanation. Hence gender inclusively designed and implemented risk reduction initiatives cover the risk reduction requirements of the general population as well. The objectives of this study are to map out the vulnerabilities of the women; to delineate the required risk reduction measures for vulnerability reduction and enhancement of coping capacity and to assess the scope and potential to implement the initiatives. The study area selected is Chellanam, a coastal village in Ernakulam district, Kerala, India which is being considered for the implementation of disaster management initiatives by the District Disaster Management Cell. The village is plagued by the problems of sea incursion, water logging, drinking water shortage and was also affected by the Tsunami (2004). The methodology would be interviews with District Disaster Management Cell officials and elected representatives of the village and FGDs with the citizens. Global practices will be customised and the implementationviability will be assessed applying SWOT analysis.

Keywords: disaster risk reduction, initiatives, vulnerabilities, social status, capacity, scope, potential

Introduction

Disaster Risk Reduction (DRR) is the crucial aspect of Disaster Management. Global experience and research evince that hazards have disproportionally more disastrous impact on women. Higher vulnerability and lesser coping capacity arising out of societally ordained lower position in the gender hierarchy lends partial explanation for this disparity. Hence, risk reduction initiatives which are gender inclusively designed and implemented would be inherently covering the risk reduction requirements of the general population. While planning DRR projects, vulnerabilities of women need to be mapped out. Further, the ingredients required to reduce their vulnerabilities and to enhance their capabilities and coping capacities need to be incorporated. When projects are chosen, it is necessary to assess their implementational viability. Although financial, economic, social and ecological viablities are assessed, when it comes to implementation, a comprehensive strategy taking into account the ground realities of politics, ethics, civic sense of the community, participation of vulnerable groups including women and children, etc., are not adopted.

Chellanam grama panchayat[1] is selected for study because it is a disaster prone coastal panchayat and is perennially subjected to the fury of sea which makes its disastrous inroads into the terrain for more than three months a year. Water logging is another issue. It was also affected by South Asian Tsunami (2004). The authorities too have acknowledged the fact of its vulnerability. Ernakulam district is one of the nine districts in Kerala (out of 14 districts) selected by District Disaster Management Authority (DDMA) for implementing National Cyclone Risk Mitigation Project of World Bank. Again, Chellanam is one of the four panchayats in Ernakulam District which is being proposed for putting up a cyclone shelter by World Bank. Funds are being planned for capacity development in this panchayat by DDMA.

In their endeavour for disaster risk reduction, currently the panchayat is seriously considering to put up geotextile protection walls (GTPW) in the gaps where the rubble mounted protection walls are damaged. Attention needs to be paid not only for disasters by the strict definition of the term but also on perennial vexatious natural phenomenon. Wards 13 and 18 are plagued with sea incursion problems. Ward 18 is selected, because it is the worst affected.

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In GTPW technology intended to be tried out in the study area, geo bags (2mx1mx.4m) made of geo synthetic unwoven uv susceptible material (with petroleum base) are filled with water and sand from the work site itself. The capacity of the bags is .8m^3 when full and if filled to full capacity would weigh 1600 kg. The bags filling can be done effectively only through mechanised labour. As it is being filled, the content has to be densified. Usually it is mechanically filled up to weigh 1100 kg. If filled manually, adequate densification will not happen and a bag could be filled up to weigh say only 800 kg. Hence, manual filling would not be cost effective and technologically efficient. Given the weight of the bags, for stacking up also machines have to be used. Initially, geo textile which is a synthetic material is spread out and the bags are stacked up to a height of say 3.6 metres which would be decided exactly after assessing the specific requirement at the respective spots. Once the bags are stacked up to the required height the 'wall' is wrapped with geotextile and securely sewed up. The sand deposited by sea itself along the shore are scooped up and piled behind the GTPW. Adambu[2] which is a type of creeper is planted in the sand. As it grows it crawls up, the GTPW and into the front side of the wall, it becomes a bio fence. Adambu consolidates the sand pile and bolster up the GTPW. The approximate cost of this work is about Rs 15 to 16 lakh per 100 metres. The wall is supposed to last from four to five years. The same technology had been applied (but without geo textile wrapping) in Purakkad beach for nearly 100 metres length in Alappuzha district and there the GTPW has been put up since the last one year.

The objective of this paper is to map out the vulnerabilities of the area with specific reference to the differential vulnerabilities of women and also to delineate and explore the specific components in the DRR initiatives to reduce the vulnerabilities of women and to enhance their coping capacity. Governance matters are looked into. The approach to implementation of this DRR initiative is also studied. Both primary and secondary data are collected.

Background Study

Traditionally, in disaster management, the focus is on response rather than prevention/mitigation, on large catastrophes rather than small and medium scale disasters (even though these disasters may have larger cumulative impact than the spectacular but occasional large catastrophes) and on national and international disasters rather than local ones (IWID). In India's national policy on disasters, in preamble itself, mention is made about the paradigm shift from relief centric response to proactive prevention, mitigation and preparedness driven approach (NDMA, National Policy on Disaster Management, 2009). At international level, the major shift from Hyogo Framework for Action (2005-2015) to Sendai Framework for Disaster Risk Reduction (2015-2030) is the shift from disaster management to disaster risk management (UNISDR, Sendai Framework for Disaster Risk Reduction, 2015). Sustainable Development Goals (SDGs), officially known as Transforming our World: the 2030 Agenda for sustainable development include good health and well being (goal 3), gender equality (goal 5), clean water and sanitation (goal 6), decent work and economic growth(goal 8), sustainable cities and communities (goal 11), climate action (goal 13) and life below water (goal 14). out of the 17 SDGs. Goal 11, stands for making cities and communities inclusive safe, resilient and sustainable. One of the key ingredient in acheiving SDGs is the vulnerabilty of the poor and marginalised population and the multi sectoral participation. National Policy on Disaster Management 2009 by National Disaster Management Authority (NDMA) of India aligns perfectly with the disaster risk paradigm. The policy spells out wholistic and integrated approach. In risk reduction, policy is for utilizing Corporate Social Responsibility(CSR), Public Private Participation (PPP) and to utilise the resources of National Cadent Corps (NCC), Nehru Yuva Kendra, coordination with civil society, etc. Tchno legal and techno financial regimes, R&D, capacity developemtn, training of communities, Knowledge management through sharing and dissemination of good practices are spelt out (NDMA, 2009). The Disaster Management Act 2005, has made it statutory to institute NDMA, SDMA and DDMA and also to rope in the local authorities as well. The institution of National Insitute of Disaster Management is a progressive legislation (India, 2005) The link between natural hazards, people's vulnerability and disasters is explicated by Wisner (Wisner, 2004). Wagner also underlines the link between children and sustainable development. Wagner highlights the relevance of content awareness and critical thinking skills (Wagner, 2016). The role of decentralised governance system is amply illustrated in UN literature (UNDP, 2010). Women's roles in the society are ordained as primary resource users and managers and they are vested with the responsibility of their dependents. Therefore, they have comparatively higher sensitivity to hazardous conditions that put their families, homes and neighbourhoods at risk (Elaine Emerson). The capacities of women and girls are to be assessed and at all levels of disaster management including disaster risk reduction and the requisite capacity building has to be undertaken (Fordham).

Research Methodology

Secondary data was collected from the records and publications of Chellanam panchayat office. Key informants were interviewed, which included the Panchayat presidents[3] (current and previous), Vice President, CDS (Community Development Society) Chairperson[4],Ward members, ADS chairpersons, Neighbourhood Group members of Kudumbasree, Study was conducted in ward 18, which is the worst affected by sea incursion. (Focus Group Discussion) was conducted with NHG members. Previous and current ward members and ADS Chairperson were interviewed. The contemplated GTPW technology initiatives are then subjected to Strength Weakness Opportunity Threat analysis (SWOT analysis) to arrive at a strategy for implementation. identify and evaluate the factors related to viability of implementation and also to assess the scope and potential of this DRR technology to reduce the vulnerability of women to disasters.

Conceptual Framework

Disaster Risk Reduction

In general "risk is defined as the combination of the probability of an event and its negative conseqences" (UNISDR, 2009). Risk is usually associated with the degree to which humans cannot cope (lack of capacity) with a particular situation eg natural hazard. The term disaster therefore refers to the potential (not actual and realised) disaster losses, in lives, health status, livelihoods, assets and services which could occur in a particular community or society over some specified future time period. Disaster risk is the product of the possible damage caused by a hazard due to the vulnerabilty within a community (African Centre for Disaster Studies, 2011).

A hazard is defined as "a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and ecomomic disrtuption, or environmental damage" (UNISDR, 2009) Hazards can be sequential or combined in their origin and effect. Hazards can be created by humans (anthropogenic) or environment (natural) (African Centre for Disaster Studies, 2011).

The UNISDR (2009) defines disaster as "A serious disruption of the functioning of a community or a society involving widespread human, material, or environmental losses and impacts which exceeds the ability of the affected community to cope using only its own resources. UNISDR goes on to indicate that "Disasters are the combination of the exposure to a hazard; the conditions of vulnerability that are present; and insufficient capacity or measures to reduce or cope with the potential negative effects on human, physical, mental and social well - being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation." Hazard is the cause and /or trigger. A disaster is the result of a hazard's impact on society.

Coming to vulnerabilities, effects of a disaster are determined by the extent of a community's vulnerability to the hazard. This vulnerabilty is not natural, but the result of an entire range of constantly changing physical, social, economic, cultural, political and even psychological factors that shape people's lives and create the environments in which they live" (Twigg, 2001).

Disaster Risk Reduction is defined as the concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disaster, including through reduced exposure to hazards, lessened vulnerabilty of people and property, wise management of land environment and improved preparedness for adverse effects.

Hazards per se do not constitute disasters. Disaster occurs due to the interplay of hazard, vulnerability and coping capacity (UNISDR, ISDR Background paper for WSSD, 2002). This interaction is depicted as

Disaster risk (R)= Vulnerability (V)x Hazard (H)/ Capacity (C).

SWOT Analysis

SWOT is the acronym for Strength, Weakness, Oportunity and Threat. SWOT analysis is a process which generates information that is helpful in matching the goal of an organisation to its capacities and to the respective social environment (Morrison, 2016). SWOT Analysis can be used in community organisation as a tool to identify the successful implementation of social services (Wikipedia). First, the objectives of the entity (organisation, community, project, programme, etc) for which SWOT is being conducted is to be identified or fixed. Based on this, the internal and external attributes of the entity are explored based on whether they are helpful in achieving the objectives (strengths and opportunities) or harmful for this (weaknesses and threats). Strengths and weaknesses are the factors internal to the entity whereas weaknesses and threats are the external ones (Morrison 2016), (RAPIDBI, 2007). Strengths and weaknesses are the present realities while opportunities and threats have a future orientation as well (RAPIDBI,2007). The external factors include macro economic matters, technological changes, legislative changes, socio-cultural changes, changes in market or competitive environments(Wikipedia. Strategies are to be devised to use/build/leverage the strengths; stop/remedy/overcome the weaknesses; exploit/prioritise/capture/build on the opportunities and to defend/plan/manage the threats (Morrison, 2016; RAPIDBI,2017; (Fine, 2009). Weaknesses can be converted to strengths using opportunities. Threats can be converted to opportunities using strengths. Threats and weaknesses can be converted to strengths and opportunities (FME). Thus conversion is a strategy. Matching is another strategy where strength is matched to opportunities to gain competitive advantage. SWOT is a data capture process and is only the first step towards the more in depth analysis. SWOT is a simple and versatile tool. But it is subjective. What is classified as strength and weakness depends on the judgement (FME) of the person concerned. SWOT cannot be done effectively by just one person. It requires team effort (Morrison, 2016). Although it is simple, oversimplification is to be aavoided. Ideas are generated using brainstorming.(FME). The objective of SWOT analysis is to use the knowledge an organisation has about its environment and to formulate its strategy accordingly (Tanya Sammut -Bonnici, 2015).

Discussion and Findings on Issues Related to Sea Incursion

Sea incursion and water logging throw formidable challenges in the spheres of addy cultivation, shrimp cultivation, vegetable cultivation and also on health and sanitation. It is women who bear the brunt of all these impacts given their socially ordained roles of cooking, cleaning and caring. Geographical factors make the panchayat ecologically fragile. This paper focuses on sea incursion.

Chellanam panchayat is situated in the south western part of Ernakulam district with Arabian sea on the west and backwaters running from north to south on the eastern part. It is only 19.6 km long and one km wide. The fact that the area is only one km wide makes it more susceptible to the perils of sea incursion. The panchayt is on average of 30 cms below sea level, seawards and 30 cms above sea level landwards. The entire panchayat is protected along the coast with sea walls made of granite rubbles. In wards18, the sea wall is damaged for a stretch of 100 metres. In those areas, during high tides, episodes of sea incursion occur starting from the middle of May and lasts till the end of August. The phenomenon of sea incursion is unpredictable and during these months this is a daily happening. It happens during high tides which could commence at any time, say starting from 11a.m. Sometimes, the incursion may stretch up to any time, as late as even up to 10 p.m. There could be intermittent episodes also. In ward 18, the houses are situated as close as 3-12 metres from the sea. During high tides, the sea water rushes into the land through the stretch of land where the rubble mounted protection walls have been damaged, thus flooding the already infirm terrain of loose soil and rushes into the courtyards and backyards of the houses bringing along with it sand and clay. Many of the houses and latrines happen to 'sit' because the inundating waters carries away with it the sand under the floor. The entire water, clay and waste flood into these low floored houses. This creates perpetual cleaning challenges to women because cooking and cleaning are the roles set apart exclusively for them. The sea sometimes take away in its sweep the utensils, coconut and anything which lies in their yards. The sea water damages the houses and there is the never ending perpetual maintenance work consuming time, energy and money of the citizens. The maximum amount obtained from Revenue department is only 5000 and that too with inordinate delay of one year. Everything together makes house management a nightmare for women.

In the houses where there are no septic tanks, but only ring type latrines, as the water inundates the yards, the latrine waste seeps up. This generates an abominable health threatening environment, posing the risk of waterborne diseases such as cholera, Hepatitis A, typhoid, acute diarrhoeal diseases. Vijayam canal is a major canal constructed along the length of the panchayat. Inadequate depth and lack of maintenance decreases its efficacy to contain the water which enters from the western part of the panchayat. The ducts and canals which are constructed to carry the flooded sea water from the western part of the panchayat to the backwaters in the eastern part get silted up eventually. A glance at the canals evidences the callous disregard for the maintenance of the canals and the indiscriminate dumping of canals with all sorts of waste. If the canals were clear, the Culex is a genus of mosquitoes which breeds in dirty water and several species of this serve as vectors of *Japanese encephalitis*, *filariasis* etc. When there is any illness for anyone in the family, going by the socially constructed caring role of women, it is on the shoulders of women that the entire burden of nursing of all family members falls. When the treatment expenses increase and shrink the non health component of the family budget, it is predominantly on the women's needs that the cut happens.

This situation was prevailing for the last ten years and the situation has exacerbated since the last 6 years.

Drinking water shortage is a perennial issue in the panchayat. The incursion of the sea and seepage of toilet waste together contaminate the quality of water in the well. Drinking water is brought in tanker lorries and from there it is pumped through pipes directly into the households. Water reaches every week or fortnight into the households and each family gets about 350 to 400 litres. The persons at the upper end get more water and as the the lower ends are approached the flow decreases progressively.

The amount spent for preventing sea incursion in Chellanam village[5] is Rs 3,60,805 during the financial year 2016-17. From the village aid is given to the flood affected persons. The maximum amount paid is only Rs 5000 and the average amount paid is Rs 2500 to Rs 3500. The system is so slow that none out of the 99 applicants had received compensation during the previous year.

Discussion on the Factors Pertinent to the Implementation Strategy of GTPW: SWOT Analysis Along With an Enquiry into the Scope and Potential of GTPW

SWOT analysis, or more precisely fact finding is done from the perspective on the GTPW project which will be implemented immediately in ward 18. The analysis revolves around the objective of having a situation based solution to the sea incursion problem with the partnership of women who are the worst affected. The scanning of economic- technological- social-ethical - legal-administrative ecosystem is done. The micro dynamics of the pertinent community behaviour was looked into. Strengths and weakness of the project are examined mainly in the light of the realities of ground level implementation.. Missed opportunities are also looked into and not only the tangible and direct aspects of costs and benefits / strengths and weaknesses. An enquiry is made into the prevailing socio legal administrative ecosystem. Matching and conversion of the four SWOT ingredients are done. Here the entity under discussion is GTPW technology applied for 100 metres of sea coast in ward 18 of Chellanam panchayat.

SWOT Analysis of GBPW project

Strength	Weakness
• Free availability of the filler material at site • Comaprative inexpensiveness vis s vis rubble wall and geo tubes • Heaviness of bags prevents stealing • Speed of implementation and suitability as a quick solution • Avoidance of material scarce and, procedurally cumbersome rubble technology plagued with ground level petty goondaism	• New technology and hence not tried and tested • Non biodegradable material and hence inherent environmental issues • Non uv resistant and hence not long lasting • Temporary solution only vis a vis rubble and geo tube technology. • Labour content is less. Hence missed opportunity to bring NREGS to the local economy and employment, mainly for women • Not women friendly technology • Coir or jute bag alternatives are labour intensive, women friendly and eco friendly

Opportunity	Threat
Favourable global thinking, national policy and national statute pivoted on community participation; roles of local governance and administration; gender equality and capacity building • TIINA situation of rubble mounted technology • Conscientisation and training against vandalism • Training and R&D around DRR activities • Offering leadership to inculcate civic sense and ethical operations • Community mobilisation for vigilance • Organised and strong network of Kudumbasree and Balasabhas which facilitate formation of vigilance groups and captive trainees • Robust NREGS set up • Exploration of opportunities for repair work • R&D to consolidate indigeneous knowledge and to promote innovativeness • Presence of uemployed labour force among women	• Vandalism • Stealing of the material • Habitual trouble makers who impede local development • Inefficient governance • Lack of civic sense

Strength

The filling material for GTPW is costless ie sand and water are local and freely available. Hence hassles of transportation, uploading, downloading etc are not involved. The total cost per 100 metres is Rs 15 to 20 lakhs for GBPW whereas, it is Rs 57 lakhs and 60-62 lakhs, respectively, for geotubes and rubble mounted walls. The ease of implementation is comparatively less for GBPW while rubble technology is plagued with raw material scarcity, transportation hurdles, gawking charges and extortion. GTPW is a temporary but quick solution to the problem of sea incursion. The heaviness of bags (1100kg) prevents stealing of sand as in the jute bag alternative.

Weakness

This is a comparatively a new technology introduced one year back at Purakkad beach, Alappuzha district and hence there is no experience regarding efficacy and longevity. Till date it is not needing maintenance. uv non resistant quality of the material of the bag poses the risk of damage. The predicted life is 4 to 5 years against 10 years that of geo tubes. This is a temporary set up. This is a machine-based technology unlike that of jute or coir bags. Choice of this alternative is a missed opportunity for inflow of NREGS funds into the panchayat and also for the employment generation especially for women who are in turn are the worst affected and hence could legitimately be expected to have turned out quality work to solve their own problem of sea incursion. Bags require mechanised filling and densification[6] on the go. The material of the bag and covering material is petroleum based and not biodegradable. Hence this choice entails a missed opportunity for using the alternative biodegradable coir or jute materials for the bags and instead of geo textile, bhoovastra made of coir for the covering material. The jute/coir alternatives could have generated additional labour by way of maintenance as well. The technology is not women friendly due to the heaviness[7] of the bags. Due to non uv-resistant nature of the bags and harm from granites, repair and replacement is to be expected. This might require periodic checking and repairs and the related scope for women's employment for this is yet to be explored.

Threat

Vandalising of the walls cannot be ruled out. So also stealing of the covering materials. The miscrenats are usually those who own houses in the eastern parts or cities and who encroach the sea shore and put up houses with the sole objective of getting government aid. In short, the efficacy is dependent on good governance related to timely repairs and prevention of vandalism and theft and containing the miscreants. The efficacy also depends on the civic sense of the community including children.

Opportunity

The global thinking and international documents, national legilstion and the national policy align with the concepts of disaster risk reduction, women's partnership, community participation, involvement of local bodies and government. R&D, documentation of best practices, knowledge sharing and dissemination, Public Private Participation, capacity building, banking on corporate philanthropy etc. Evaluation of alternative technologies, triggering the innovativeness of the citizens to come up with novel solutions of DRR ((Disaster Risk Reduction) and to consolidate their folk knowledge have ample scope. A hertrogeneous team consisting of local body, leaders, academicians, community leaders, engineers can visit sites where a range of technologies are used against sea incursion and an interested team can engage in R&D activities. District Disaster Management Authority has an allotment of 5.9 lakhs rupees for training activities within the district. Training on technical aspects such as repair of bags and consciousness raising to promote civic sense and against vandalism and stealing can be undertaken.

Scope can be explored for labour mobilisation for repair work. There is scope for mobilising labour. The already existing Kudumbasree and Balasabhas can be mobilised for disaster risk reduction activities. In the 18th ward there is unexploited opportunity for mobilising the labour of women. In ward 18, there are 265 registered NREGS[8] job card holders. 210 of are active out of which 200 are women (95 per cent). For the district, the figure is only 93 per cent. But the average number of days of employment is only 30 days as against the district figure of 44. Many women go to cities for domestic work and the daily earnings is about Rs 231 whereas NREGS work would fetch them Rs 258 per day. A very few work in more than one home and earn more. Preference is for NREGS work available near to home. Engagement in labour related to DRR would be gratifying indeed for the women who would be able contribute their labour to solve their own pressing perennial problem. NREGS work available in their own locality would enable them to participate more in household and community activities.

The situation has reached a sort of TINA point (There Is No Other Alternative) except going in for the non rubble mounted ones. The rubble mounted wall work is undertaken by contractors. They often collude with the contractors and profiteer compromising on the quality of the work and pacifying the local formal and informal leaders with money. Even when honest work is done the extortion persists. The restrictions against quarrying, unavailability of granite rubbles, exhaustion of material of currently licenced quarries, the multi-layered licence procedures[9], nokkukoolie[10] at the quarry and work sites, speed money to the police during transportation, extortion of money by local leaders' and 'activists' under the threat of reporting to the vigilance authorities, lack of good roads to take the rubble to the work spot, denial of permission by private parties to drive through their compound to download the rubbles together make the rubble mounted protection wall a very unattractive work for the contractor especially when the work is small in magnitude and cannot contain the 'unaccountable' expenses. If the money is not paid the extorters can 'scrupulously' inspect the rubbles and raise inconvenient questions about the conformity of the stipulated size of the rubbles[11] and land up the contractor in heavy loss and could even prevent the very execution of the work. Hence, contractors are reluctant to take up contracts for rubble mounted protection wall built as a repair mechanism.

There are two Balasabhas[12] in ward 18. The children could also incorporated as adjuncts in the awareness generation on the need and relevance of the Protection Wall, vigilance, reporting and repair works. Training could be imparted on civic sense and responsible citizenship. Instances of drug abuse by children are being reported and in response training sessions for children are being organised. Inspite of the positivity of these good initiatives, children need alternate engagement in meaningful activities for maintaining them as individauals with good mental health. There is opportunity to do this by partnering them in DRR activities.

Conclusion

Weigh Against Alternatives

The study of a mere 100 metre repair work in a single ward alone, sheds light on the dynamics in the larger scenario.In the case of the GBPW technology, when the study was made, the project was already decided upon and the work had just commenced. Even at this stage, a comprehensive environment scanning done through SWOT yielded useful information regarding the technological alternatives at the end of the life of the geobags. A thorough analysis is to be made on various alternatives and complementary activities such as deepening the canals to contain the onrush of water from sea incursion, the labour intensive coir bag and mangrove cultivation, geo tubes etc. The opportunities opened up for Knowledge Management, R&D, dissemination etc has to be utilised to make in depth study on alternatives by the technical teams. The concepts on community participation spelt out in the Policy and Act can be operationalised through site visit and consultation on alternatives by a heterogeneous group of technical, administrative and local body leaders along with sociologists who can assess the social viability of the alternatives. The nuances of the micro dynamics at the ground level is of utmost significance While participation is planned, necessary technical training for the upkeep of the facilities for prevention of sea incursion has to be included.. The element of social engineering is critical. Attitudinal engineering regarding the ethical standards and protection of public property has to be incorporated in the planning and children are to be included.. Involvement of women who are the worst affected has to be ensured. Leadership of the local self government and the creative potential of Kudumbasree network can be leveraged. The local innovativeness can be encouraged and indigenous solutions can be subjected to R&D, documented and disseminated after testing. Thus, we can match the strengths with the opportunities. Weaknesses and threats can be converted to strengths utilising the opportunities. It is for us to explore.

Notes

[1] Grama panchayts are the local bodies in rural area which are endowed with powers of local self government through the 73rd Constituton l Amendment Act 1992.

[2] Adambu: is a type of creeper on which rabbits usually feed.

[3] Panchayat president heads each panchayat samithy (committee) which in turn is constituted by ward members. A panchayat is divided into wards and from each ward, a representative is elected to the panchayat samith as ward member. In Kerala there are 941 panchayats. Chellanam panchayat has 22 wards.

[4] CDS Chairperson heads CDS which is the local body level institution of Kudumbasree (literal meaning is pprosperity of the family) launched in 1998 to eradicate poverty through community action under the leadership of local bodies. This is a three tier network with Area Society (ADS) at ward level and Neighbourhood Groups (NHG)s at grassroots level. In Kerala, grassroots democracy is facilitated through functional linkages with panchayats. As on March 2017, the system has 2,77,175 NHGs affiliated to 19,854 ADSs and 1073 CDSs with a total membership of 43,06,976 women. Chellanam panchayat has 22 ADSs NHGs with ---- women as members.

[5] Village is the basic unit of division of land by Revenue department, whereas panchayat is the basic unit for the department of local self government. Three villages lie within the boundary of Chellanam panchayt. They are Chellanam, Kumbalangi and Rameswaram villages. Only Chellanam village is plagued by sea incursion.

[6] Densification: With mechanised filling, a bag could be filled up to a weight of 1100 kg, with manual filling it could be filled up to only, say 800 kg. For the efficacy of the geo bags, compressed packing is required.

[7] Each bag weighs about 1100kg, approximating the weight of 22 cement filled sacks.

[8] This is a national level programme in India, which guarantees 100 days of employment to all the eligible members of each family registered at the rate of Rs 258 per day. The panchayat is expected to maintain a shelf of projects and employment is to be provided within 15 days after the person places a request. If the panchayat is not able to provide employment within 15 days odf demanding the job, unemployment wages have to be provided. Panchayat will have to pay compensation for delay of wages. Out of the total amount spent by the panchayat per year, 60 per cent need to be labour component and this would be reimbursed by central government. Out of the material cost ie 40 per cent of the total, three fourths would be met by central government and one fourth by sate government. Although, when the scheme was lodged, the idea was to spend the entire budget on soil and water conservation, land development, eco restoration etc, in subsequent years, there was permission to include works related to asset formation as well.

[9] Clearance is required through DEAC (District Expert Appraisal Committee) and DEIAA (District Level Environment Impact Assessment Authority) and if required to be taken up to SPEIA (State Environment Impact Assessment Committee)

[10] a phenomenon found particularly in the state of Kerala where the organised labour force extort labour charges even if they do not do any work in the location, in the eventuality of some other agency undertaking the work at the behest of the person who wants to get the work done for wages. The term gawking wages also is being used to denote the same

[11] The stipulated size is $1^{m}3$ (metre cubed) for regular rubbles and below I m3 for irregular rubbles

[12] The Balasabhas are the network of children in a ward. Each Sabha consist of 15 – 30 children in the age group of 6 – 18 years, constituted with the purpose of preventing the intergenerational poverty transmission and the intended route towards this is capability enhancement of children. Study groups are constituted for experimental and systematic learning, for understanding democratic process, participation in conserving environment etc. This help children to understand the intricacies of collectivisation. At present, 66,743 Balasabhas, covering 10,59,283 children, creating glorious dimensions to the endeavour.Balasabha is set as the three tier system as NHG, ADS and CDS level.


Coir bags
Mangrove in coir bagsCoir bags
Geo tubes
Callous waste disposal

Figure 1

Applying the Concept of Business Continuity Management for Resilience of Critical Infrastructure with a Focus on Health Facilities

Eilia Jafar[a]

Abstract

Business continuity management essentially involves identification of risks, threats and vulnerabilities that could impact continued operations (Disaster Recovery Institute, 2017). It focuses on restoration of key functions within a targeted duration. This article proposes an approach towards resilience of critical infrastructure drawing on the concepts of business continuity planning. Critical infrastructure is essential for functioning of a society and there is a strong interdependency between different critical infrastructures like power, communication, transport, healthcare facilities, administrative centres. There is a growing dependence of communities on critical infrastructure. In the event of a disaster, one of the most critical infrastructure is healthcare, functioning of which is also dependent on other infrastructures. Every year, disasters result in closure and functional disruption of many health facilities for months. It is difficult to quantify the impact of such disruptions on the lives of those dependent on such facilities. Lack of timely treatment and disruption in treatment services can complicate medical cases and even result in loss of lives. Identification of key functions, elements and systems that are critical for continuity of operations and planning for their continuity can significantly reduce future losses.

Keywords: critical infrastructure, functional disruptions, risk identification, business continuity planning, business continuity management, resilience, restoration

Introduction

"Critical facilities are the primary physical structures, technical facilities and systems which are socially, economically or operationally essential to the functioning of a society or community, both in routine circumstances and in the extreme circumstances of an emergency"(UNISDR, 2009). There is a direct linkage between sustainability and resiliency of critical infrastructures and existent interdependencies(Nguyen T, Cai X, 2016). Business continuity management (BCM) is the development and implementation of a step-by-step plan for recovery and restoration of critical functions of any business establishment within a predetermined time after a disaster or an extended disruption.

The term built environment refers to the physical parts of where we live and work (CDC, 2011). It is the manmade surroundings in which we spend our lives for work, education, business, etc., as well as recreational activities. Within this built environment are lifeline buildings like hospitals, schools, administrative centres, fire service and police stations that serve critical functions in our society.

Concept of Business Continuity Management

Crisis management view of business continuity as a concept acknowledges that any organisation/institute or public facility is part of a larger environment characterised by uncertainty, risks and threats for external and internal environment. For the public, however, the critical functions played by institutions like hospitals, and other lifeline institutions should continue regardless of the situation and any disturbance or gap in service can result in serious implications.

A larger percentage of businesses that suffer large data losses go out of business and never recover. Some that do recover continue to bear the brunt of disaster for years due to loss of key information, contacts and contracts.

Healthcare Facilities as Critical Infrastructure

Hospitals symbolise saving lives and in the event of a casualty people rush to hospital for treatment. It is important for such a facility to be safe so that people get timely treatment. According to PAHO/WHO "a safe hospital is one

[a] CARE, India

which will not collapse in disasters, killing patients and staff; continue to function and provide services as a critical community facility when most needed; and is organised with contingency plans in place and health workforce trained to keep the network operational.”

Impact of Disasters on Hospitals

A hospital can be impacted by disasters in many ways:

A- Fully Internal and external: Whole facility fully affected-community also affected

B- Fully Internal: Whole facility fully affected-community not affected

C- Partially Internal and external: Partial facility affected-community also affected

D- Partial Internal: Facility partially affected-community not affected

E- Fully External: Facility safe but increased flow of patients due to mass casualty

F- Non-structural damage: Facility safe but non-structural damage

Disaster preparedness planning of hospitals needs to consider all the above scenario. The collapse of Jubilee hospital in Bhuj (2001) was an example of Fully Internal and external where community was badly affected and the hospital building had fully collapsed.

There is ample data on lessons learnt from disasters in hospitals in India, for example, collapse of civil hospital in Bhuj (2001) killing more than 200 persons including doctors, patients, nurses, technician’s attendants and visitors, terrorist Attack at the Ahmedabad Civil Hospital (2008), collapse of Leh Civil Hospital during Leh Cloudburst (2010), and fire at AMRI Hospital Kolkata (2011). Similarly, there are lessons from around the world including Evacuation of Dresden Heart Centre during flood in Germany (2002), evacuation of hospitals in Tohoku during Great East Japan Earthquake (2011) and experiences of Virginia Hospital Centre- Arlington post September 11 attacks etc. All indicate the need for preparation for disasters and conducting drills to test the plans. After the Great East Japan earthquake in March 2011, during the first 72 hours after the disaster, out of the 14 base hospitals in Miyagi Prefecture, 64.3 per cent of hospitals requested supplies related to electricity and medical supplies. 42.9% requested for blankets/sheets; food and drinking water. Another area that needs focus and planning is triage, diagnosis and preliminary treatment (Kudo 2013).

During the floods in New York (2011), water entered Lourdes Hospital building affecting access to certain sections of hospital and impacting health care functioning (refer to Figure 1).

Figure 1: Lourdes hospital during floods 2011, New York

When a fire broke out at Sum Hospital in Bhubaneswar, Odisha on October 17, 2016, the hospital administration was taken by a shock. Despite prompt response and efforts by all concerned, the fire resulted in 23 deaths and many more injuries. This was second such incident in the state within six months when a fire broke out in a hospital. The horrific incidents that took place at MIOT hospital, Chennai during the floods in December 2015 are still fresh in our memories. Lives were lost as the flood resulted in disruption of power supply, collapse of communication lines, and lack of food supply. Road access was also impacted. It was a yet another reminder that disaster preparedness planning for hospitals needs to be taken seriously.

If the hospital building is not prepared for disasters, the structure, systems and critical functions of hospitals can potentially get affected and will not be able to perform their key role of saving lives. The safety of such lifeline buildings is very critical.

National Disaster Management Authority (NDMA), Government of India has brought out National Disaster Management Guidelines on Hospital safety in February 2016 with an objective of addressing hospital safety through a multi-hazard and inter-disciplinary approach and to ensure structural sustainability

It is important to recognise that hospitals not only respond to disasters but can also be affected by disasters. Guidelines for disaster preparedness planning are available. The challenges are: (i) lack of understanding of risks; (ii) lack of trained manpower who can conduct an assessment and develop as well as implement realistic disaster preparedness plans and (iii) lack of resources to implement such plans.

Business Continuity Planning for Health Care Facilities

Business continuity planning aims at keeping facilities operational by planning for recovery and restoration of partially or fully interrupted critical functions. It involves identification of risks, planning for recovery and restoration, dissemination of plan, testing and maintenance of plan. The concept can be successfully applied to health care facilities to ensure functioning of hospitals during disasters. Once the critical and support functions have been identified for a heath care facility by conducting business impact analysis, and all interdependencies are understood, planning is done for worst possible scenarios.

It is important to understand and mitigate factors that contribute to vulnerability. Steps like anchoring of equipment, planning for backup of power supply and data, continuity of water supply and establishing proper mechanisms for waste treatment and disposal of medical wastes need to be taken.

Post the flood (2011) in Lourdes hospital that resulted in inundation of building, flood walls were constructed which protected the facility from inundation and disruption of functions. As shown in Figure 2, there was complete water logging in areas outside the hospital but flood walls could protect the hospital from internal impact. Mitigation efforts need to consider both structural as well as non-structural damage that could take place.

Figure 2: Flood Wall, Lourdes Hospital
Photo Credit: FEMA News Photo

Another key step in business continuity is understanding the training needs of human resource in the health facilities. Certain positions having key roles in disaster response need to go through specialised training courses. It is important that everyone is familiar with protocols and standard operating procedures that get activated during emergencies. Health facilities should test their preparedness to respond to disasters by conducting mock drills and testing business continuity plans.

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Resilience to Disasters and Climatic Changes: A Case for a Smart Village

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Abstract

A Nation and a Location (Area) could be durably built on sustainable developmental initiatives-economic and social-. Development, paradoxically, is disaster-prone- but adaptable to the realm of systemic and climatic influences when driven by techniques, technology and talent (skills) and with the support of durable resources-local and global. This would usually require, in-building of Disaster Mitigation(DM) techniques within and imposition of Climate Management(CM) needs over the developmental framework. Planning for such a framework and with an area-specific /bottom-up approach would put the effort at ease in terms of implementation advantage(s) and visibility of outcome(s). Considering the geography and demography of the country, " Smart Village" vehicle powered by a tri-sectional engine components of Skill-India', Digital India and 'Make in India ' is considered one of the durable means to reaching the composite goals.

"Smart Village" entails a structured system of (i) identification of a village cluster(s)- one in the midst of ten villages with about 40-50 thousand habitations; (ii) an institutional mechanism, captioned as 'Poly Skill- Material-Technology, (Poly-SKIMAT) Growth Centre- with its remit to organise a cyclical and two-year training course- to advance skills suited to transformation of local resources into modelled and value-added products and with an additional one-year extended curriculum (iii) tapping of young skills (of 14-18 yrs. age- ten per village- and once in two years) for such a training - to lend to a 'trained Skill-Pool', in diverse micro/mini/small enterprise(s)areas, for product development using local material- to benefit to its value addition at the source before product-transport in finished form; and (iv) rendering the skill-pool- trained in tandem, in front-line DM areas-to provide on-line and first-tier/ DM-support at the onset of disaster(s) and in addition to extending an organised climate education off-line to locals- a planned and cost-effective DM and CM support).

The scheme is premised on three 'T's, viz: Technology (support system), Training (for village youth) and Transformation(T-T-T) of material to value-added products for direct transport to demand centers in a structured institutional framework with identified responsibility for and participation by the local Governments(s).The implementation programme involves Panchayat Raj Institutions(PRIs)and is overseen by District and State Governments. The scheme entails additional and other indirect benefits in the form of:-

- knowledge connectivity and improvements in quality of life of citizens leading to reduction in stratification;
- opportunity and visibility for a 'bright future' to the local young;
- Extension of a platform for locals to upscale the value of their material wealth with the 'lending technology and talent' at their door step;
- Facilitations for enhanced partnerships (in public and private / Small & big industries realms) in tapping talent and resources.
- Capability to assess local vulnerabilities with respect to climate, natural disasters and material security;
- Support to get insight into strategies for climate change adaptation and mitigation;
- Support for better appreciation of the potential of environmental valuation; thus rendering the 'smart village' the capability to 'designing its own SMART-action plans'.

Keywords: sustainable developmental, initiative, smart villages, 'Poly Skill- Material-Technology, (Poly-SKIMAT), Technology (support system), training, village youth, Transformation (T-T-T), SMART-action plans

Introduction

Planning Strategies for development in the post independence era, hitherto, have been, by and large, sector-specific or area-centric. At the first stage of 'post-independence' planning for the economy, the focus was on the service sector to start with- for creation of more jobs-; then to industrial development- for self reliance; further to agriculture- to

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bring in the green revolution; and back to service sector- to adopt and sustain the global electronic/digital age, and now again to industry- to prop the 'make in India'- but with a difference viz: to integrate the expanding national/ domestic skills with the value-added produce.

In Area Development, the same was first 'Urban-centric'–with emphasis on education, transport, health and industrial infrastructure-; shifted to Rural- rural roads & rural housing, micro-industrial infra and micro finance to promote local area development; and back now to Urban- Smart cities for Digital India. Incidentally, NREGA was not a development prop in the sense that it was conceived as a stand-alone and (primarily) as a non-skill and non-machinery instrument to sustain the livelihood needs of the 'last man' on demand.

While development progressed with modest results, **stratification (economic and social)**-primarily **urban-rural** and also urban-urban and intra-urban-continued to increase in qualitative and spatial terms, albeit with shifting origins. The Scheme 'PURA'-(Provision of Urban amenities in Rural Areas), conceived by President Abdul Kalam; accepted and started by the government in 2003 which was primarily meant for correcting the imbalances in **development and hence the social stratification(s)**, but has been relegated to lesser focus in the subsequent five year plan. Increases in the frequency of Disasters, temporal needs of 'resilience to Climatic changes and influences' is expected to lend further dimensions to the stratification gaps[1].

Development, paradoxically, entails element(s) of disasters and their multiple risks, but can be made adaptable to the realm of systemic and climatic influences when driven by techniques, technology and talent (skills) and with the support of durable resources-local and global. This would, more often than not, require, in-building of Disaster Mitigation (DM) and Disaster Risk Reduction (DRR) techniques within and imposition of Climate Management (CM) tools over the developmental framework. Planning for such a framework and with a structured and bottom-up approach would put the effort at ease in terms of implementation advantage(s) and visibility of outcome(s). Tapping youth power for accomplishing skillsand energizing the local resources for the cause of 'development' is considered as one of the viable routes in that direction.

Of the three basic infrastructure requirements for development,- viz: men, material and technology- extension of human resource support (HRS) stands in sharp contrast in as much as that while the other two elements could have alternatives,- in the form of imports- but scarcity of (HRS) (in the indigenous form) with the required skills to handle the technology and material would lead to adverse impacts on development, many a time influencing quality and subscribing to delays and cost escalations. Needless to say that in the DM area, the same leads to multiplicity of losses- material and life. Earlier attempts on expanding skilled HRS while provided results, the same has been effectively influenced by HR exports and demand mismatches. These and other externalities (of economic and social nature), such as lack of incentives for movement of skills within the country. subscribed to scarcities mismatches and diminishing percentages of skill work force in the overall HR assets. The imperatives of lead times in the development HR skills would invariably contribute and actually contributed to mismatches.

Thus taking due cognizance of current stress by the government, on skill Development, ”smart Village” proposal aims at universalisation of skills across the states- in the ultimate stage, with a minimum of one skill and material (SKILL-MAT) growth centre per district in the identified rural hub(s)- in an organised form with a T-T-T (Technology, Training and Transfer of skills to growth formation) approach, the scheme aims at uniformity in the tapping the potential of '*development and supply'* of skills and with close-end provisions for job/ career opportunities for talent and acumen (see Box-A) and with the focus for channelisation of *youth power* into the mainstream of development leading to creation of a vibrant and inherently-skilled and visible youth-power-infrastructure' at the rural clusters and with their organised supply chains with the demand centres.

"Smart Village" pilot proposal aims at organised intervention(s) for creation and expansion of- skilled-youth power infrastructure for propping developmental framework;

- rural knowledge/industrial hubs with urban-connectivity
- provisioning of DM and DRR support base nearer to the site at the onset of disasters; and
- off-line local-knowledge-base for the climate and environmental management.

Thus making the focus of the ”Smart-village” multi-facetted.

Box-A

Training and Employment sustenance

MSEs do promote employment generation. Needless to mention that its sustenance would greatly depend upon continuous skill up-gradation and access to technology adaptability, with cost effectiveness with a view to balancing the technology absorption without limiting the capacity to employment generation. **The skill center would be an effective platform for such facilitation** with easy access (to MSEs) to technology at acceptable costs.

MSEs linkages with large industries can be effectively propped and sustained with an organised support from the skill centres in terms of quality improvements in the MSE produce and its extension and spread into diverse areas that are of interest for the large industries. An organised attempt to improvement the depth in quality (in the MSE produce) and its extension and spread into diverse areas would attract and lead to a willing cooperation and support of the large industry.

Thus given the content and quality spread of MSEs and its two-way and possible close-end linkages with large industries, would impact employment opportunity for the skilled trained at the centre in a tri-directional canvass as outlined below.

- Conventional employment opportunity for a third of the annual outgo of the skilled from the centre with MSEs and and large industries (The PPP approach outlined in the scheme, after the pilot stage, would facilitate the same;
- The second and bright third (in the annual outgo after the third year,) could be facilitated with higher career opportunities, with organised financial support from RRBs and other governmental sources; this could go upto entry into 'Indian Skill Development Service'.
- The remaining can have be provided with avenues for/access to self employment and as start-UPs with technology (from the centre) and financial support from RRBs and other such windows.
- Training in DM areas at the centre would provide addl. Facilitations for entry into State / central DM organisations.

Considering the geography and demography of the country, " Smart Village" vehicle powered by a tri-sectional engine components of 'Skill-India', 'Digital India' and 'Make in India ' and with focus on:

- catching the young(local) talent and train and equip them for their organised partnership in the planned activity to promote and sustain value addition to local resources and upscale the value of their material wealth; and
- Familiarising the youth, and the elite locals on the vulnerabilities with respect to climate, natural disasters and material security and making them as front-line partners in DRR activities at the onset of disasters and post disaster management efforts; and
- Enlisting the support and involvement of the local elite and the Panchayat Raj Institutions (PRIs) to get insight into strategies for climate change adaptation(s) and mitigation; and better appreciation of the potential of environmental valuation is considered one of the durable means to reaching the above and composite goals. In short, the "Smart Village" vehicle emphasises augmenting the local development of skills (man-power) to suit and foster promotion, qualitative uplift of the value of the material resources available at a given place and time and obviate the risks for the developmental outputs insulate them from the periodical climatic disorders and other environmental impediments.

Smart Village" (proposal), at the pilot stage, entails establishment of Sixty Poly Skill-Material-Technology, (Poly-SKIMAT) Growth centers /Poly-SKIMAT Centers- **ten centers per state (two centers per district per state) in six identified states, with a combination of coastal (to cover cyclone-prone areas) and inland annual flood, drought and other disaster-prone areas (in the ratio of 3:2) with a view to integrating Disaster Risk Reduction(DRR) and Climate Resilience efforts with developmental initiatives / programmes**,- and equip them / gainfully woven them with Technology, Training (of local youth) and Transformation(T-T-T) of local resources / material to value-added products and with simultaneous facility / with facilities for direct transport to nearby / urbandemand centers.

The proposal, at the outset, confines itself to focusing on Micro-Industrial sector to gradually expand to cover small/ Medium- Industrial areas (**see Box B**) and with the ultimate objective of establishment of **six-hundred such centers** in the country over a period.

Box B

The complimentary character of the MSEs as ancillary and cost-effective support systems for the large industries is well established. The same has a large canvass starting from making a 'uniform' for workers (in large industries) up to and above the making of important support systems such as the T&P infrastructure items and extending into contract management areas, such as networking of tool-Room infrastructure. Efforts for extending such a ancillary support, have been largely bilateral in nature and promotional in character. An organised attempt to improve the depth in quality (in the MSE produce) and its extension and spread into diverse areas would attract and lead to a willing cooperation and support of the large industry. While the results are obvious, the skilled youth would be at the centre of advantage with sustainable openings. Emphasis for the above is inherent in the scheme.

- In the above context, It is viewed that the growth centres could play the role of a *functional inter-phase/ facilitator* for extended cooperation thereby benefitting the youth.
- The Corporate Social Responsibility (CSR) for employment generation is expected to get an attractive boost in the scheme in tapping of youth skills by large Industries.
- The informal sector in India has a large absorption capacity for self-employment and income generation, but its productive and social potential remains limitedly tapped. Improving market access for large parts of the population, especially small and marginal farmers, micro entrepreneurs, women and youth. in the informal sector particularly rural and/or deprived groups, would improve their grasp for opportunities embedded in the expanding areas of development. The scheme can effectively subscribe for the same,
- MSEs can promote employment generation. Its sustenance would greatly depend upon continuous skill up-gradation through technology adaptability. The scheme can lend support / organise for such adaptations. Together with attracting small and tiny ancillaries around, the scheme can pave the way for promotion of 'decentralised Rural Hubs' together with knowledge connectivity in and around the centre and thus leading the cluster to graduate to a 'Smart Village'.
- Villages are worst hit with disasters. Trained youth in DM areas and DRR efforts would be a handy and extendable asset to the local administration at the onset of disasters.

Starting with Sixty centers, at the pilot stage and with organised training and technology inceptions and quality improvements, to add to value addition on-line, during the pilot stage, the scheme is expected to lead to:

1. provision of and progressive expansion in the development infrastructure- machine and technology- at the centre(s) and at the cluster point covering a group of ten villages to suit and promote value-addition to local material;
2. improvisation of appropriate 'skill-infra' to benefit the identified local youth; and
3. further to gradually bridge the knowledge and social gaps and hence stratification, over time.

In physical terms, the scheme, at the pilot stage itself, is expected to benefit six thousand young per year, after the third year, with diverse skills and to support transportation of value-added in finished form to the demand Centers.

The Proposal (details of)

The pilot scheme would have the following two physical components:

- **Training Centre:** Housing of one Skill (Training) Centre in a cluster of ten villages, for imparting training to one-hundred students in ten groups. Each village will subscribe to make available ten person/students per year in the age group of 12-18 yrs. of age, (with five in the 12-15 and five in 16-18 age group)- with the choice of the group made by identified experts/trainers in association with local Panchayat Raj Institution (PRI) officials and Self-Help Groups and their associations in the area; and
- **Product Development Centre:** The centre will also have the treatment facility for the local raw material and instrumentation system for conversion of raw and semi-finished material in to final useful product(s). The center would provide the experimental ground for the 'trained' in the skill center in structuring and shaping the finished products, with the support of trained personnel, and helpers under the supervision of the trainers.[2]

Physical facilitations for the above including the infrastructure arrangements for the same could be under the aegis of the Panchayat Raj Institutions (PRIs) under the supervision / advice and approval of the District Administration.

Choice of centre(s) will be made with the following considerations:

- The centre will be housed in a village-cluster –**to start with** in the existing local school premises and with the village already endowed with infrastructure connectivity such as road (and with possibility for access to Rail), water & sanitation, electricity and communication, finance (Bank-RRBs)) institution and more importantly the availability of material resources, in and around the ten village group(s) to lend easy and ready primary raw-material support for conversion to useful form- one of the ultimate outcomes from the centre.
- The centre will have land facility around and under its ownership enough for storing and for treatment of the raw material.
- The centre will also have facility to fetching the raw material and for transport of finished products to demand centres.
- The centre(s) will be established in a place having the total population of the village(ten) group to be in the range of 40-50 thousand in order to have the benefit of
  - wider choice of youth with inherent talent- one in fiftyof population/persons (boy or girl) for the group of hundred per year; and
  - to also facilitate uniformity in the comparative brightness and sharpness of the chosen.

The centre will organise a two-year course on skill development suited to promotion of local resources and to develop model products. An additional one-year course would be conceived for facilitating the gateway for the brightest among the students for higher academic and skill persuits.

Functional components of the scheme, thus, entail the following aspects separately for each centre notwithstanding the commonality in some of the areas/subjects:

- Assessment of raw material support for development of diverse products;
- Identification of different finished products using the local raw material- This should also include use of material waste from one product as input to alternate / additional product(s);
- Broad assessment of the demand for different finished products in the vicinity of the centre and at accessible nearby places;
- Assessment by experts trainers for facilitating quality product development and training and including the costing of finished products;
- Assessment of training needs-quality and period of training for product development starting from proto-type development and upto quality control management;
- Assessment of instrumentation needs including (a) that for treatment for the raw material; (b) ancillary and supporting instrumentation; (iii) training-hardware tools; tools for product development and quality control;
- Identification of a training module (with software and hard ware) for trainers relating the product development; including that for lab-training for the trainers;
- A mobile technology bus with the in-built hard and software facility for special training and with facility for inter-center connectivity;
- A detailed curriculum for 2-yr. training with identification of study period for related subjects.
- An additional course curriculum for the third year with academic content to promote capturing the brighter skills among the trained for higher academic pursuits and functional excellence.

In short, the scheme is conceived for establishing primarily a multifaceted skill centre for tapping youth power latent at the country side and with a structured and close-ended objective- with a regenerative character- for empowerment, assured employment (both entrepreneurial and conventional) generation, facilitations for absorption of talent to local area development (economic and social) and with knowledge and technology connectivity to sustain area uplift with insulation from frequenting natural calamities (primarily annual floods and cyclones) using the local skill-potential as front line mitigation prop and above all augmenting the support of PRIs for better appreciation of the potential of environmental valuation for their reflections in the area development and action planning. In this context, it is reiterated here that the establishment of the centre is premised on identifying and attracting talent available at the country-side at a very young level and capture and tap the inherent skill for encouraging self promotion for rising to better heights and not to create per se skilled labour force. To that extent the centre ipsofacto lends itself as a physical interface for the progress of the skilled individual and in meeting the larger objective of bridging the knowledge gaps thus subscribing to mitigating the stratification gaps. The other objective that has to be given weight while making the DPR and shaping the subject content and apportionment of the study period of the subjects in the curriculum has been that the centre has to act as an easily approachable platform for the value addition of the local material resources and with inherent economic and environmental benefits.

Governance of the Scheme

With a view to deriving benefits of organisational and functional nature by drawing upon their experience and expertise also tapping cost benefits on running costs, the centre can maintin functional linkages primarily with the organisations, such as the and Industrial Training institutes under MSME and in the private sector, NDRF etc. While the details of the nature of linkages can be delineated in the DPR, it is emphasised that the linkages are primarily to benefit the youth for exposure to diverse knowledge areas and for improving their absorbing capacity and widening the knowledge horizon thus rendering the 'smart village' the capability to 'designing its own SMART-action plans'.

Financial Implications

The cost and financial implication of the scheme is center-specific and product related (covering group of products) and hence requires detailed assessment with a Detailed Project Report (DPR). The cost involvement would have to be estimated in two parts viz: (i) the training and the product-prototype development (the skill development portion) and (ii) product development by the 'Trained' in the final and finished form. However for making an overall estimation of the average total cost per centre, the following assumptions can be considered.

- The land availability for the centre does not attract any financial implication while building cost and other infrastructure civil costs at the centre do involve;
- Other capital costs to be considered include those relating to:
  - preparation of detailed project report (DPR) for each centre;
  - preparation of training modules;
  - Basic infrastructure/ instrumentation support at the centre;
  - the Technology Bus with hard and soft ware facility for the trainers;
  - the training facilities for the first two-years; and
  - structural support for academic/course for the third year;
- The running costs include those relating to:
  - engagement of expertise for selection of incumbents for training (once in a year);
  - periodical movement of trainers with modules during the training period;
  - hostel facility for the students and permanent staff members-including uniforms, books and other training material besides associated running costs;
  - cost of raw material support and material preparation costs; and finally
  - facilitation costs at the centre that include a core organisation and a staff structure.

Given the proper initial and infrastructure shaping of the centre, the running costs, after the initial two-year period, can be made safely recoverable and with proper administrative, management and externally-monitored set-up for quality monitoring.The centre can be made progressively regenerative, with the finished products subscribing actively with their competitive cost-structure in the market.

On a rough estimate the capital cost component per centre is not expected to exceed ₹ 4.0 crores and the running costs at around 1.5 Crore per centre. This does not include the cost of preparation of DPR per centre for the scheme which can be in the vicinity of Rs. 3.00 crores depending upon the ToR. Thus the total capital cost for sixty centres would be about Rs. 240 crores. Adding the recurring cost of Rs.90. crores per year, the total cost of the scheme would be about Rs. 500 crores for the sixty centres for the pilot stage.(see Box-C)

Box-C- details of outlay required for implementation of the scheme

Item	Pilot stage	Ultimate Stage*
No. of Poly Skill-Material-Technology, (Poly-SKIMAT) Growth centres	60	3000
Participants per Centre/year	100	100
Total Participants (60x100) -annual	6000/year	3,00,000/yr
Participants setting up enterprises (50% success rate) after 3rd yr. (recurring/yr.	3000	1,50,000
No. of Employment per enterprise (average)(after the third year)	10	10
Total Employment to be created (30000x4)	30,000**	5,00,000/yr.
Cost per Centre (capital cost 4cr. + running cost 1.5 cr.) INR	INR 5.5 cr.	INR 5.5 cr
Total Cost for 60 Centres (Pilot phase) including DPR cost	**INR 500. cr**	

**in addition to conventional employment for the rest counted at 3000/yr. * 600 districts in the country

Given the socio-economic advantages involved in the implementation of the scheme, it is proposed that the scheme (with 60 centres) be funded by the Centre under the DFID/UNDP support with a one-time grant to the concerned PRIs with State Government holding responsibility for effective financial and physical monitoring at the district level in order to render the scheme regenerative and self supporting on a sustained basis and ultimately lead to the expansion with quality improvements of the scheme to reach to the target of six hundred centres and with a P-P-P-arrangement. In addition, the involvement of RRBs (Regional Rural Banks) for financial involvement in the scheme can also be considered. The same could be in the form of assistance to procurement of capital infrastructure at the Technology Bus etc,. In addition, the RRB involvement to providing financial assistance to students from the Centre for higher academic pursuits could also be part of the scheme.

Outcome

The scheme is premised on three important objectives as below:

- Tapping of young and dormant skills in an orderly way and to encourage confidence building and facilitate self-promotion;
- Provision of a ‘Skill-Pool’ of 6,000 young per year in diverse micro/mini/small enterprise(s); and climate (resilience) management;
- Extending a platform for locals at the country-side to upscale the value of their material wealth with ‘**lending technology and talent**’ at their door step.

Thus the Scheme could support a farmer, a mason, a carpenter and other material owners besides projecting ‘visibility for a bright future’ to the young.

Following would bethe indirect outcome(s) that the can flow from scheme:

Functional

- Structural/entrepreneurial ambience for growth of small/micro enterprises (around the cluster and over a period of time) to render the cluster an industrial hub with a *semi urban* look and as a Facilitation Centre;
- Reduction in Knowledge /Cultural imbalance and bridging functional gaps with ease;
- **Structured *knowledge-connectivity* measures for building a climate for self-promotion for the youth**

Environmental Mitigation of a hazard and arresting a possible disaster and preparing a society for facing a disaster(s) with progressive minimisation of disturbance (to society) is to be considered entailing avoidable/indirect but visible social and economic costs. In addition, the scheme:

- supports discouraging, to start with, and over a period time could mitigate/arrest transport of raw material to urban centres;
- subscribes to reduction in accumulation of 'waste material' at urban centres;
- Provide assured front line support to DRR efforts with an array of trained/skilled manpower;

Social

- Promote and support 'Knowledge connectivity' to the multitude in the clustered village groups and thereby bridging the stratification gaps.;
- Mitigation of urbanisation

Programme Implementation

Given the character of the scheme, the pilot programme would have be taken forward in consultation with the Ministry of Skill Development supported by the Ministry of Rural Development/Micro, Small and Medium Enterprises.

Captioning of the Scheme

Given the emphasis for a scientific mechanism for coordination among the entities the success of the pilot scheme can lead to a flag-ship programme covering 600 cluster-centres that can be suitably captioned as **Prime Minister's Smart Village Yojana (PMSVY), /Pradhanamanthri 'Kaushal Gram' Yojana** under the aegis of Ministry of Skill Development.

Notes

[1] With emphasis on'Digital India' and 'Smart Cities', the gaps are expected to get widened.

[2] *Training personal and helpers* form part of the skeleton permanent staff of the center, who receive initial/ periodical training from external/visiting trainers in product development at the centre. Details will be given in the Detailed project Report (DPR).

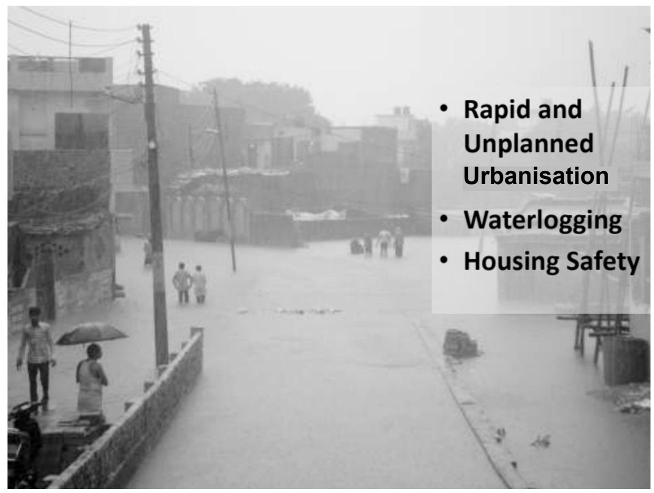
Flood Resiliency Plan for the City of Patna

Pallavi Mukhopadhyay

Urban areas are not disaster-prone by nature, rather the socio-economic structural process that accelerates rapid urbanization, population movement and population concentration, substantially increase disaster vulnerability.
- Hari Srinivas (2009)

Abstract

Patna being a saucer-shaped receptacle bounded by four interlinked rivers that is trusted to turn turbulent - Ganga, Gandak, Sone and Punpun. Overburdened by its populace of two million and recklessly urbanised, it sits atop an ill-planned drainage system. Subjected to a downpour such as Chennai's, without alarming the city of Patna would capsize. Nature has rigged it to recurrently drown, so efforts for its reversals should be started earliest. Within city's municipal boundaries, arrangements for preventing or fighting off a deluge are in disrepair. The Storm water drainage systems are almost absent; existing sewage network that is meant to double as drainage lies overburdened with unrelieved human effluence. The city corporation reveals that it has no estimates about its installed capacity to drain out rain or flood water from the city. With current stature of non-preparedness, civic authorities in Patna will take much time to flush out the effects of even 65mm downpour. The resiliency program aims to advance knowledge, develop expertise, and design strategies to help improve ability to deal with recurring floods shifting from conventional forms of flood management to possible adaptations & mitigation, analysing through flood risk assessment, cost benefit analysis and other relevant networking techniques.



Keywords: water logging, storm-water drainage, vulnerability, behavioural aspect, resilient framework.

Introduction

In the context of disaster risk management, the definition of resilience increasingly focuses on community resilience and is shifting towards terminology borrowed from ecology and social sciences. Adger (2000) for example defines social resilience specifically as relating to a community's ability to withstand external social, economic, and political shocks. Whilst Zhou et al (2010) more narrowly refers to "the capacity of hazard-affected bodies (HABs) to resist loss during disaster and to regenerate and reorganise after disaster in a specific area in a given period". This implies risk reduction approaches that are people centred and react to local knowledge, and therefore research on resilience needs to understand how communities and individuals survive and cope with disasters.

Increased resilience is also linked to vulnerability reduction although the relationship between vulnerability and resilience is not easy to specify (Adger, 2006). Using the broader definitions of resilience implies that many measures that reduce vulnerability can also be said to increase resilience and this may be reflected in the strengthening of four capacities within the built environment namely: *threshold, coping, recovery and adaptive capacity*. In the context of managing flood risk, *threshold capacity* is the level to which flood hazard must reach before damage and disruption is widespread. *Coping capacity* reflects the ability of cities to continue to function despite the threshold capacity being exceeded. *Recovery capacity* is related to the speed and effectiveness of the return to normal operations of the city after a flood; while *adaptive capacity* denotes an ability to use the recovery period and the time between events to enhance the other three capacities (De Graaf, 2008). Adaptive capacity is central to the broad concept of resilience adopted in this paper. However, while increased resilience results from decreased vulnerability of people and assets it may also result from a general adaptability or coping ability and underlying socio-economic and political factors quite divorced from the flood hazard.

A Brief Introduction to the City

Patna city has experienced a continuous growth in past few decades in terms of population. Patna being surrounded by three rivers has a constraint of growth on the northern side due to river Ganga, southern side due to river Punpun and eastern side due to river Sone. Moreover the topography of Patna is like a saucer due to the surrounding three rivers. Thus drainage poses a major problem and pumping out of water seems to be the only solution at present. The city is also otherwise prone to flooding. The natural growth of Patna City has been towards the west till date, with the older part of Patna being in the East side of the city. This core area of Patna faces problems of overcrowding, which has led to enormous pressure on the physical infrastructure and traffic congestion. The newer development areas lying in the central and western part of Patna comprises of both plotted developments and apartment houses. The apartments in the newly developed area are again straining on the existing infrastructure, as the up gradation of the physical infrastructure has not been done in proportion to the increase in population being accommodated in the apartments. This has lead to problems of water supply, sewerage, drainage, solid waste management, parking etc. In the southern part of Patna city there are low-lying areas lined along the bypass road, which again cause a constraint to the development of the area. These areas are being presently used for dumping of solid waste. In fact, almost the entire stretch of the bypass road is being used for dumping of city waste. After understanding the existing land use map of Patna city it has been observed that the linear city of Patna has a core at near its eastern extremity and a denser mixed use core near Patna Railway Junction. Expansion eastwards and southwards has been limited due to water logging. Therefore, new developments have formed westwards between the Ganges and on either side of the Delhi Howrah trunk rail line. Expansion would still be in these directions in the UA and in the south-west upto Patna-Gaya rail line. Currently daytime floating population to Patna Municipal Corporation is primarily from within the PRDA and where market gardens and orchards flourish in lieu of grains and pulses.

Patna is the Capital of the Bihar and is one of the oldest continuously inhabited cities in the world. In terms of population it the second largest city in Eastern India. The modern city of Patna is located in the Patna district on the southern bank of River Ganga.

Location of Patna District in Bihar

The total geographical area of the study area is 297 Sq. km. It is situated between latitude 25 30'- 25 40' E and longitude 85-85 20'' N. The city has the longest river- line.

Stress and Perturbations

Stress in risk management represents a risk to the well-being and the normal continuation of the human society, the consequences of which are profoundly negative. The urban centre of Patna faces various forms of stress- geological, topographical, climatic and socio-economic.

Climatic Stress

Though Patna has a humid sub-tropical climate, the recent decades have witnessed significant impact of climate changes. The climate is getting extreme. Highest temperature ever recorded is 44.7 °C (In 2006), lowest ever is 1.1 °C (In 2013) and highest rainfall was 1531 mm (In 2007). Every year heat waves and cold waves cause numerous deaths.

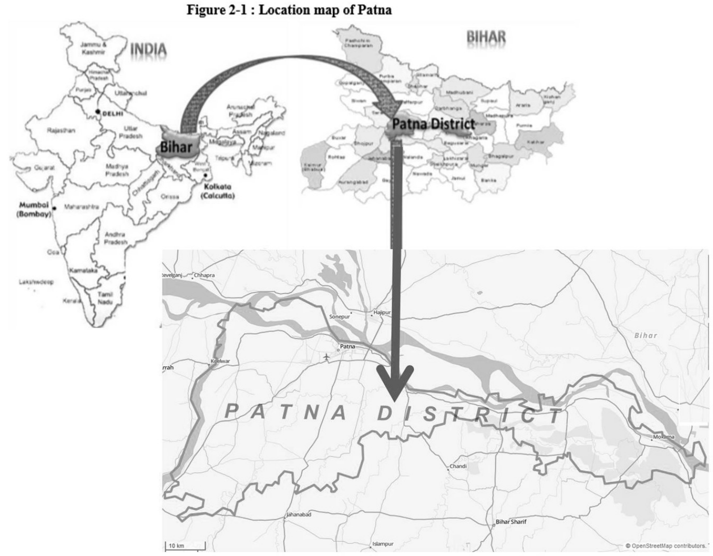
Socio-Economic Stress

Patna is a million plus city. Its total population according to 2011 census was 16.84 lakhs. It is the most populous city of Bihar and ranks 14th among the most populous cities of India. The decennial population growth rate is very high and it has exceeded 77% during past decade.

In 2001, there were total 23% people below 15 years i.e. children and 4% people above the age of 65 years. Thus, a total of 27% of people were dependents while a total of 73% people came in working age-group. Thus, the dependency ratio is also very high.

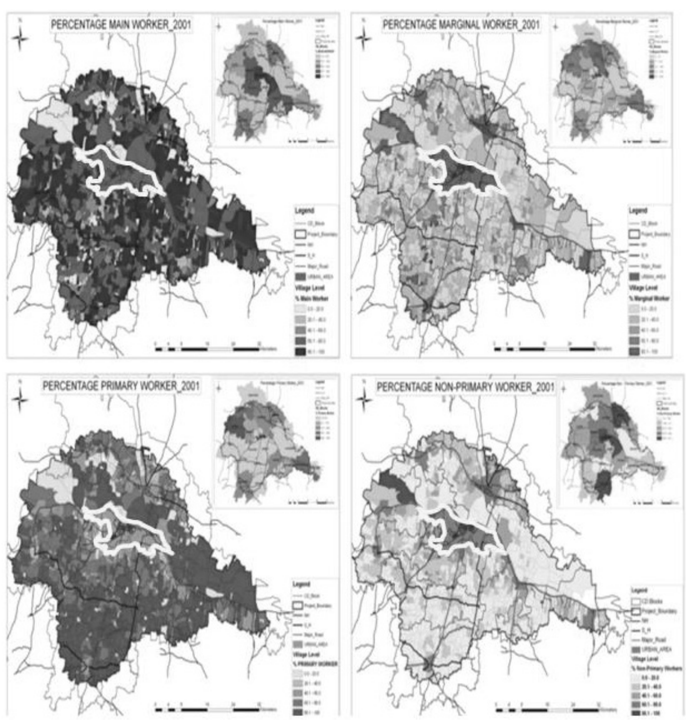
The city is witnessing vertical growth due to Multi-Story Apartment culture. There is more vertical growth in the city compared to lateral growth. This leads to very high density which increases the vulnerability.

Figure 2-1 : Location map of Patna

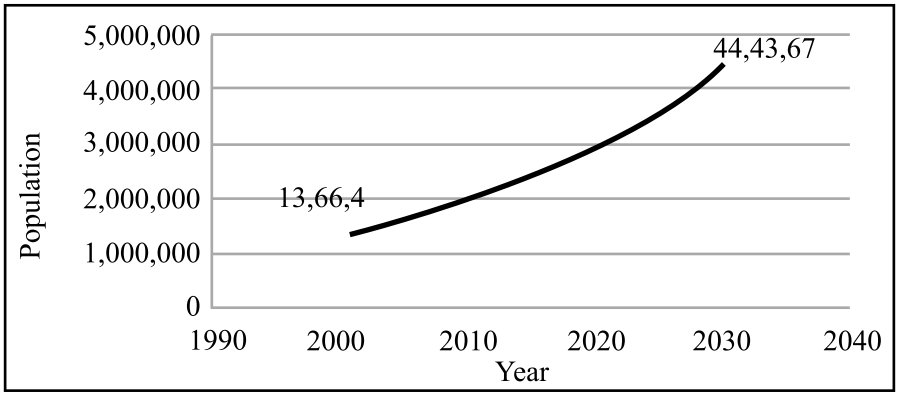


Location Map of Patna

(**Source:** http://udhd.bihar.gov.in/PMP2031/data/pmp-2031-report.pdf)



Map of showing demographic and socio-economic profile of the projected area



Proposed population of projected area

(**Source:** http://udhd.bihar.gov.in/PMP2031/data/pmp-2031-report.pdf)

City's Vulnerability to Climate Change

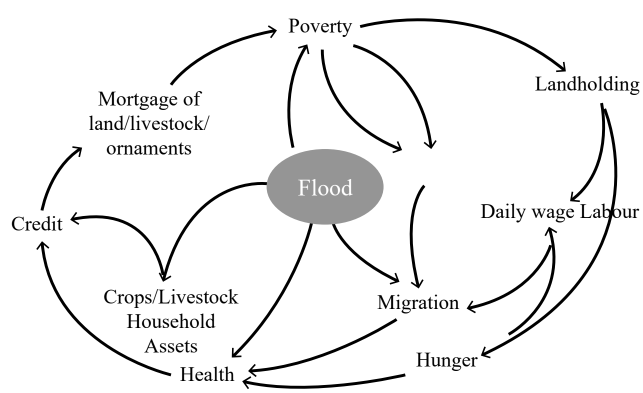
The causal factors of the vulnerability are:

a) Natural/Topographical:
The city is naturally vulnerable due to its location in the Gangetic belt of the Eastern India. Low lying areas, large number of water bodies, low slope gradients, high groundwater table and an infrastructure based on such natural conditions accentuate the vulnerability.

b) Behavioural:
The city has strong links with rural livelihoods and a floating population, comprising mainly of the lower middle income group with a low literacy level. There is a general lack of responsible behaviour towards the upkeep of city's services.

c) Policies/Governance:
A faulty master plan, poor governance and administration of basic services are some of the key issues influencing the city.

The three causal factors are interdependent and interrelated in influencing the vulnerability of the city.



Vicious circle of livelihoods & poverty arising from the damage

Methodology of Calculating Vulnerability Index based on Behavioural Aspect

Twelve elements have been chosen in the present study as the indicators of the vulnerability of an individual. These elements chosen cover the various physical, socio-economic factors and also their level of awareness and preparedness.

- Age- Extreme age-group people have difficulty in moving out of the danger zone. The children and the elderly both are dependent upon others for their needs which further increase their vulnerability. The elderly also require greater time for recovery from any physical setback.
- Gender- Women are physically comparatively tender, have the extra burden of child-bearing and rearing and as such, often have a more difficult and a longer period of recovery than the men and thus, are more vulnerable.
- Educational level- Education is related to socio-economic status as higher education results in greater earnings while lower education not only hampers economic growth but also constraints the ability to understand warning information and access to recovery information. Thus, the illiterate or the less educated ones are obviously more vulnerable.
- Nature of employment- Permanently employed professionals apart from having job security are also often covered by safety nets like insurances, provident funds etc. which makes their recover fast and smooth and thus, less vulnerable. Temporarily employed workers (e.g. as in construction work, domestic helpers etc.) suffer more after a calamity as need of their services decline. Self-employed farmers, traders etc. also suffer as they might not have the requisite capital to resume their work in a timely fashion and need to seek alternative employment.
- Income- Higher income enhances the ability of individuals to absorb and recover from losses more quickly and thus reduce Higher socio-economic status enhances the ability of communities to absorb and recover from losses more quickly.
- Number of working members- Families with large number of dependents and only a single working member or single parent households often have limited source of finance. Thus, they find it harder to cope up in case the main earning member is affected.
- Insurances- Having insurance of any kind (life, health, property etc.) helps the individual to transfer any risk faced by them and thus, reduces their vulnerability.
- Distance from hospital- Medical facility is an important post-event source of relief. Proximity of medical services ensures immediate relief at the time of disaster and reduces vulnerability and vice-versa.
- Personal mode of Transport- Having a personal mode of transport (excluding bicycle as it is a much slower mode of transport) plays a significant role at the time of any emergency (e.g. getting to hospital etc.) and thus, reduces vulnerability.
- Holding Bank deposits- Bank deposits act as a fall-back cushion at the time of any disaster which can be used to address any emergency needs. People without it generally have to suffer its lack.

Risks

- **Water logging**
  Unplanned developments, poor infrastructure, localised underground sewerage, lack of solid waste management contribute to the city's water logging. During the last few decades, water logging has become chronic in many parts of the city. If the present development situation continues the people of Patna will have to face serious consequences in terms of livelihood, health and infrastructure in the future. In these areas, water stagnates for more than three to four months, deteriorating health conditions and increasing health hazards.
- **Sewerage and Sanitation**
  The coverage of sewerage network in Patna is very poor. The existing sewer networks cater primarily to the old city area. There is no sewage treatment plant in the city. The sullage is directly ejected either into the river or into the water reservoirs, leading to further pollution and increasing siltation of the river bed. Due to improper maintenance, most of the open drains are badly ruined and packed with silt and garbage. The gray water of the city generally flows through open drains, reducing their carrying capacity drastically.
- **Solid Waste**
  Another important concern of the city is poor solid waste management; especially plastics. The municipality has no solid waste management plans presently. Collection of garbage from streets is not regular. Due to the lack of formal dumping sites, the entire solid waste generated in the city is disposed either along the roads or used as land-filling material for low lying areas. From the vulnerability analysis it was deduced that the prevalent use of plastics is one of the important causes of water stagnation in the city.

- **Vulnerabilities of the Poor**
  Resilience of the community depends on the infrastructure that supplies them essential services like roads, housing, drinking water, waste management, electricity, transportation and telecommunication. The risk of water-logging in Patna is increasing every year, damaging the infrastructure and affecting society as a whole; particularly the unprivileged people, who neither have the capacity to respond nor do they have the option of moving to safer places. They are the most vulnerable and suffer the most. Table 1 depicts the vulnerable groups/ sectors and their vulnerabilities.

The Urban Scenario

Despite some progress in the infrastructural developments of the city, it is not at par with the population growth; the latter far outstripping the former. Consequently, this exerts a pressure on the infrastructure and affects the service delivery system.

Most vulnerable points based on vulnerability index

Slums - According to the draft final report of the city development Plan for Patna by the Bihar Urban Development Agency (BUDA) 16.8% of the population of Patna resides in slums.

The distribution of slums shows that most of them are located along the R. Ganga and also concentrated near the railway station and Kankarbagh residential area which is a low-lying area. This makes the already poor slum dwellers of Patna even more vulnerable to floods and water-logging and related hazards. The other factors like 60% illiteracy and 31.6% of unemployment etc. further increases their vulnerability.

Table 1 – Characteristics of Slum Population in Patna Urban area

1. Total population – 16.8 % (2.86 lakhs)
2. No. of households – 17,128
3. Illiteracy – 59%
4. Unemployment – 31.6%
5. Municipal supply of water – 52.5%
6. Open ground defecation – 52%

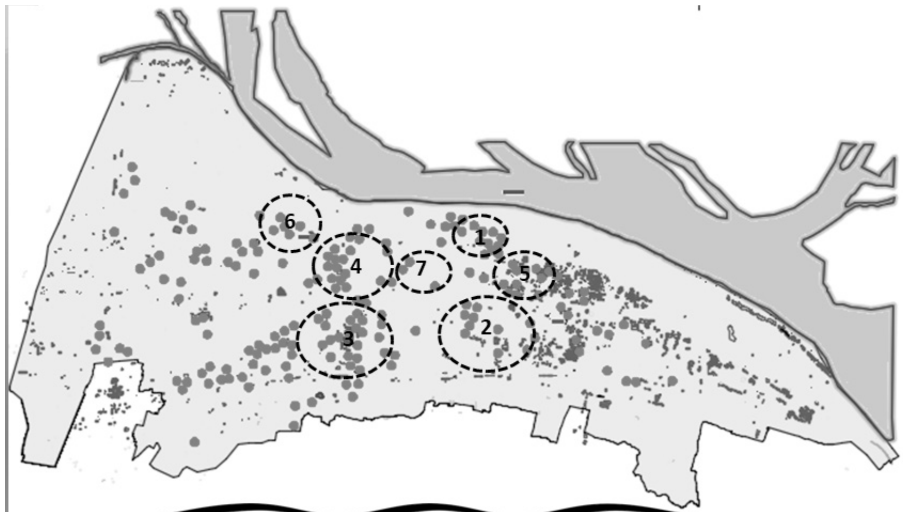
(Source- City Development plan, Draft final report (BUDA))

Map no. 1: Ward division of the city

Map no. 2: Slum distribution of the city

Map no. 3: Contour lines of the city

Map no. 4: Water-body distribution of the city



Map no. 5: Vulnerability representation of the city

Most vulnerable areas in the city based on topographical constraints, behavioural patterns, ill-planned urbanisation:

1. Rajendra Nagar
2. Kankarbagh
3. Anisabaad
4. Bari path
5. Bikhna pahari
6. Gandhani bargh
7. Govind Mitra Road

Based on primary survey on the residents & secondary sources(ward counsellors & concerned municipal authorities)

Major issues related to the chaos

- **Storm water drainage isssues**
- **Flood water from river Ganga intruding to the city**

Present Drainage Situation of the City

As discussed in earlier Patna City is situated on an up level strip of land along south bank of river Ganga between Danapur in the west and Fatuah in the east and having an average width of 1.5 km in east and 3 km in the west. The strip slopes towards south and also towards east. This sort of topography has given a saucer like shape to Patna. The railway line virtually divides the topographic conditions of the town. Area in the south of railway line is almost flat and rain water often remains accumulated on a vast span of urban land for the major part of the year. The problems of city become more acute when the water level of Ganga, Punpun and Sone rises, which in turn leads to flood. Storm water drainage is expressed in terms of its coverage with respect to the total road length. Ideally, the length of the storm water drain should be twice that of the total road length. There is about 460 km pucca drain, 340 km kutcha drain, 1200 km underground drain. The unserved area is around 8%

Major Water Bodies

This district falls in the Ganga Basin. The river Ganga passing through the northern border of district in NW-SE direction drains the district. However, there are irrigation canals running parallel and horizontal to the river. Apart from this there are a few small ponds/ditch but its size is negligible and water is very less.

Existing Drainage System

The storm water drainage system of Patna and its outgrowths have been divided into four distinct zones.

Eastern Zone

The Eastern zone is primarily the old Patna city comprising the area falling on north of new bye-pass road, east of Nalanda Medical college Hospital and Ganga Bridge and up to Deedarganj on the east and Paschim Darwaja in the west. There is no well-defined drainage system in this area. The streets and lanes are so narrow that underground conduits for sewerage and drainage could not be laid due to non-availability of space. Major portion of human settlement has grown at higher level in this area.

There are two Nos. of very old drainage outfalls one at Paschim Darwaja and the other for the city area which is called "City Moat". In fact, the area drainage in the northern part of this zone takes place through Agamkuan Nullah which leads to Pahari pumping station and the storm water from the southern part of this zone drains out in low lying areas where from it discharges into the river „Poon Poon‟. The area in the south of main Railway line remains water-logged for months together, since there is no pumping station in between Pahari and Deedarganj, the major drains being east city moat and west city moat connected by several open surface drains. The pumping capacities at Pahari mitigates the problem of water logging in NMCH area, Tulsi Mandi and road from Agamknan to Gulzarbagh Railway Station.

Southern Zone

The Southern zone is encompassed by main Eastern Railway line in the North, Patna new Bye -pass in the South, Ganga Bridge in the East and Patna Gaya Railway line in the west. At present a drainage system exists at Jogipur in Kankarbagh serving Lohianagar housing colony only, having a pumping station of total capacity of 780 hp, whereas about 2600 hp capacity pumping station is required to cater the areas chirayatand and Karbigahiya with adjoining localities. As yet, these two areas do not have proper drainage system. On completion of construction of Patna new Bye-pass the natural drainage was obstructed and as such there is accumulation of storm water in the colony areas between old and new Bye-Pass roads. The drainage problem is further aggravated due to haphazard growth of private colonies even without having any surface water drains. The Housing Board colony of Kankarbag, Bahadurpur and Hanuman Nagar also has drainage congestion. The pumping station located at Jogipur (Kankarbagh) pumps out storm water to Kankarbagh outfall which leads to pahari at a distance of 4 Km. during non-monsoon period the storm water flows by gravity to the river „Poon Poon‟. During flooding situation the storm water is discharged to the river „Poon Poon‟ by pumping at Pahari. An additional set up of pumping storm water has been built for Bahadurpur area near the T.V. tower, where from storm water is pumped to Kankarbagh outfall. It may be mentioned here that the Kankarbagh outfall is in a dilapidated condition and the stretch of outfall channel from Nandlal chhapra to the Ganga Bridge is still kutcha. This stretch should immediately be desalted, re-sectioned and lined. The lining may be done by using indigenous material. In addition to this, the pumping capacities at Jogipur and Pumping stations must be increased. With a view to eradicate severe flooding situation in the east of chirayatand area up to the Ganga bridge, Bahadurpur Rajendra Nagar and Nalanda Medical college area, Bihar Rajya Jal Parshad (earlier BISWAS Board) prepared especially a separate drainage scheme for Kankarbagh. This scheme speaks of construction of open drainage network and renovation of pump houses at Jogipurand Pahari. It may be opined that open drains become the receptacles of solid wastes and as such these drains will have blockage due to formation of slush mucks and filthy matters. Thus, the flow through open drains gets interrupted. It is recommended to lay R.C.C. N.P2 pipe drains of required diameter by following the standard design norms.

Central Zone

This zone is bounded by Patna-Gaya Road in the west, Nalanda Medical college Hospital Road in the east, Ganga Bridge Approach Road on the north and the main Eastern Railway line in the south. Ashok Raj Path acts as a ridge line. The strip of land lying between Ashok Raj Path and the river Ganges slopes towards the north i.e., towards the Ganges. This area is prone to flooding. There was an embankment along the Kankarbagh road to prevent entry of flood water from the river „Pun Pun‟. After wards, this embankment has been shifted further east and north along the river „Pun Pun. The new Bye-Pass road is the boundary for Patna urban area apart from „Pun Pun" bundh. The major three nullahs leading to outfall of this zone are Bakerganj nullah, Agamkuan nullah and the underground drain up to Krishna Ghat. The storm water during worst situation in monsoon is pumped from Antaght outfall, Krishanaghat outfall and Pahari outfall. The storm water from areas of Kadamkuan, Langertoli, Machutoli, Machutoli, Baripath and Khazanchi road is pumped out from R.K.Avenue Pumping station and discharged to Agamkuan mullah. The storm water of Rajendra Nagar area is pumped to the Agamkuan nullah which flows to Pahari.

Western Zone

This zone is bounded by Patna-Gaya road on the east, Danapur-Khagaul road on the west, the river Ganges on the north and main railway line on the south. Although on the south the main railway line is a barrier, the storm water from areas like Mithapur, Jakkanpur, Purandarpur and Gardanibagh comes under gravity to the sump located at Mithapur wherefrom it is pumped. The areas to the west of Patna canal up to Danapur-Khagaul road are quite high and free from flood. The Government house, Secretariat, Patna High court, officers" quarter, etc formed new capital area in western zone of Patna. Serpentine channel, the old bed of the river Sone was only out let in the western zone. At a later date, a drainage canal now known as Boring canal was excavated to intercept the flow reaching serpentine channel discharges storm water into the river Ganges at Rajapur outfall. When the level of the river Ganges reaches highest high flood level (H.H.F.L), the storm water is pumped from Rajapur Pumping station. S.K. Puri drain connected to Rajapur pumping station receives storm water from Punaichak, Patel Nagar, Anandpuri, New Pataliputra colony, A.N. Colllege area, Nehru Nagar, etc. The storm water of Punaichak and Patel Nagar area is pumped into S.K.Puri Drain at Punaichak pumping station. The storm water of Jakkanpur area (at north of Patna-Gaya Railway line) and south of Patna Phulwari Road is pumped to the serpentine mullah which ultimately discharges to the river Ganges through Mandir outfall. The other major drain in this zone is Kurjee drain which drains out the storm water from veterinary college area, Ashokpuri, samanpura, Rajabazar, Asana Nagar, western Patel Nagar, S.K. Nagar, A.G. Colony, New Pataliputra Colony, Rajiv Nagar and Kurjee. The drainage water is discharged into the river Ganges by pumping at Kurjee pumping station and outfall. At present, the area lying on the west of the Kurjee Nullah has no drainage system at all. Therefore, the storm water flows over the land by following the natural ground slopes and gets stored in depressed pockets and low-lying areas forming ponds in vast tracts of land. The area on south of railway line and from Anishabad turning upto Phulwari sharif have no drainage system obviously, the low-lying areas and roads remain water-logged. It has been observed that residential and institutional growth are very fast in the locality between Saguna more and Patna canal without giving any thought of draining out the storm water. The areas which are having sporadic growth must be provided with suitable underground drainage network with catch pits and street inlets as and where as well as and when required. The Pataliputra Colony has its storm drainage system and the storm water is pumped into the river Ganges. But, the areas where Sadaquat Ashram, Brajkishore Memorial, Polytechnic, Layala School and other establishments are located, have no storm water drainage system. The major drainage out falls to the river Ganges are from Patna canal, at Kurjee Pump house, Rajapur Pump house, Mandiri P.H., Anta Ghat P.H., Krishna Ghjat P.H. and Gai Ghat P.H. There is only one drainage outfall drain leading to the river Pun Pun (from southern zone and partly from central zone). Some more outlets to Pun Pun are required. The existing drainage system has again been divided into several drainage districts on the basis of the areas catered by the drainage channel/canal/Nikashi drain and draining out the storm water to the outfall. These are Baker Ganj channel district, Kadamkuan Nullh/Agamkuan Nullah district, Mithapur drainage district, Serpentine channel district, Boring canal District. etc. These are the five channel districts delineated for storm water drainage.

Issues

As a result of unplanned development in the city, certain severe problems have cropped up for drainage of storm water even during rainy season. The few identified issues are:

- Even though separate sewerage system has been adopted in Patna, the same does not function in reality. Storm water drains; open drains and storm outfall carry sullage, septic tank effluent and even untreated sewage.
- When Sewerage network get choked the household usually connects it to the storm drainage system. Therefore open drains get silted.

- The Agamkaun nala is heavily silted, therefore during rainy season the drain overflows and water partially accumulates in its catchments areas and partially finds its way back to the pump house at Saidpur.
- The existing drainage pumping plants at Pahari, Jogipur (Kankarbagh), Rajendra Nagar, Antaghat, Kishanghat, Mandiri, Mithapur, Rajapur, Punaichak, SP Verma Road and Kurjee are old and not working at the designed capacity. The construction of unplanned colonies further aggravating the water logging and is source off health hazards
- The Siadpur Pumping station is catering to total central zone drainage system leading to breaching of Agamkaun Nala, which is heavily silted. The water circulates in the catchments of Saidpur pump house.
- 10 out of 15 drainage pumping plants are not working to its designed capacity due to poor maintenance & completion of life-cycle.
- The encroachments; solid waste dumping and silt deposition cover the drainage channel and RCC drains in Central Zone. This lead to water logging in the central zone area
- Drains on the both side of bypass is not properly developed, they are kuchha nala and encroached and blocked at many places causes not proper draining of water resulting to water logging in surrounding area.
- Drains along the railway line is not properly developed which causes flooding in area south of railway line.
- The multilateral agencies involved in planning, implementation and operation & maintenance has led to mismanagement.

Reasons for Water Logging

- Indiscriminate disposal of waste by the residents.
- The spacing between the dustbins are more than 1.5km leading to litter of waste on the local and cluster level streets.
- Absence of Modern Waste Collection Technique and instruments.
- Low water absorption capacity of the soil in the area.
- The encroachments; solid waste dumping and silt deposition cover the drainage channel and RCC drains in Central Zone. This lead to water logging in the central and eastern zone area.
  Presently the slum pockets are in poor habitable conditions and integrated development is required for all the physical infrastructure including water supply, drainage, sewerage, SWM and housing

Proposals

- Improvements in Storm Water Drainage System: de-silting of 70km of Drains,
- After de-silting is done the wet garage to be collected & disposed elsewhere to be incinerated & minimised quantification.
- Covering 50km of Open Drains,
- Construction of New Drains (50km),
- Construction of Road over Drain from Gaighat to Mohinlark Stadium.

The proposed resilience strategy is based on:

1. Targeted physical and institutional action to improve drainage, housing, health and communication systems in selected areas of the city.
2. Information, data and knowledge focused activities to build the evidence base required for long-term planning, emergency response and social advocacy among diverse groups of residents, city authorities, NGOs, academics, politicians and other actors.
3. Analytical and advocacy activities designed to raise public and political awareness of emerging problems thereby generating the social pressure required at the behavioural, organisational and political levels for solutions to emerge and be implemented.

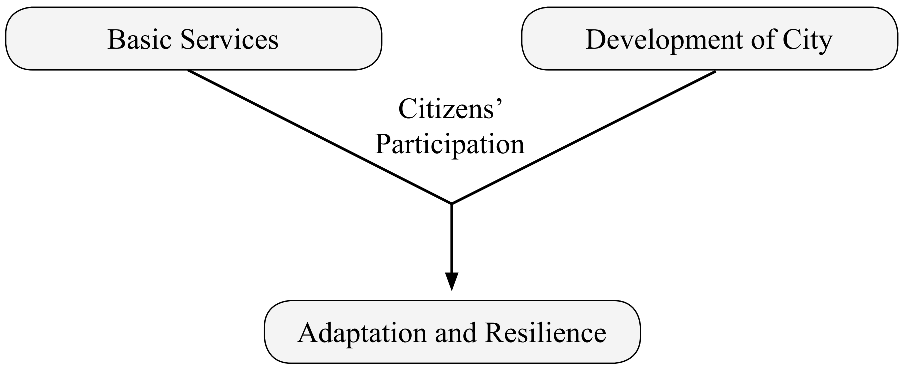
Underlying all of these will be a focus on developing the institutions and governance mechanisms required to implement activities and strengthening the critical systems that contribute to resilience and enable adaptation.

More specifically, to address multiple challenges at a local level, building on existing consensus regarding the importance of flooding, solid waste management and resilient housing, detailed micro-resilience plans will be completed and implemented in a few wards. This will demonstrate what can actually be achieved by community institutions established at the ward level.

Another proposed action is to develop a Resource Centre that will help in maintaining a database of information related to generic (physical, infrastructural)

The Resilience Framework and Strategy

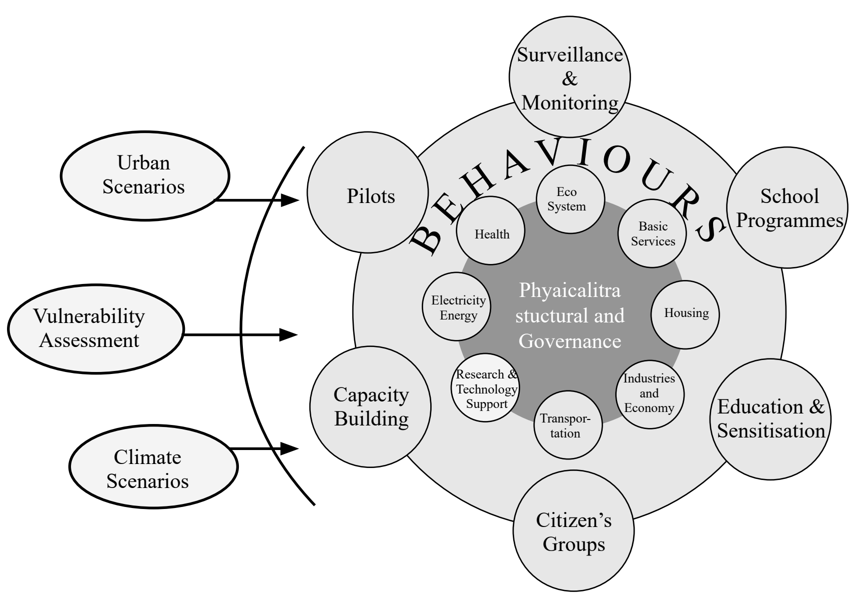
The resilience framework is based on the core components of developing the city by developing the basic services through citizens' participation to build up resilience and adaptation to climate change



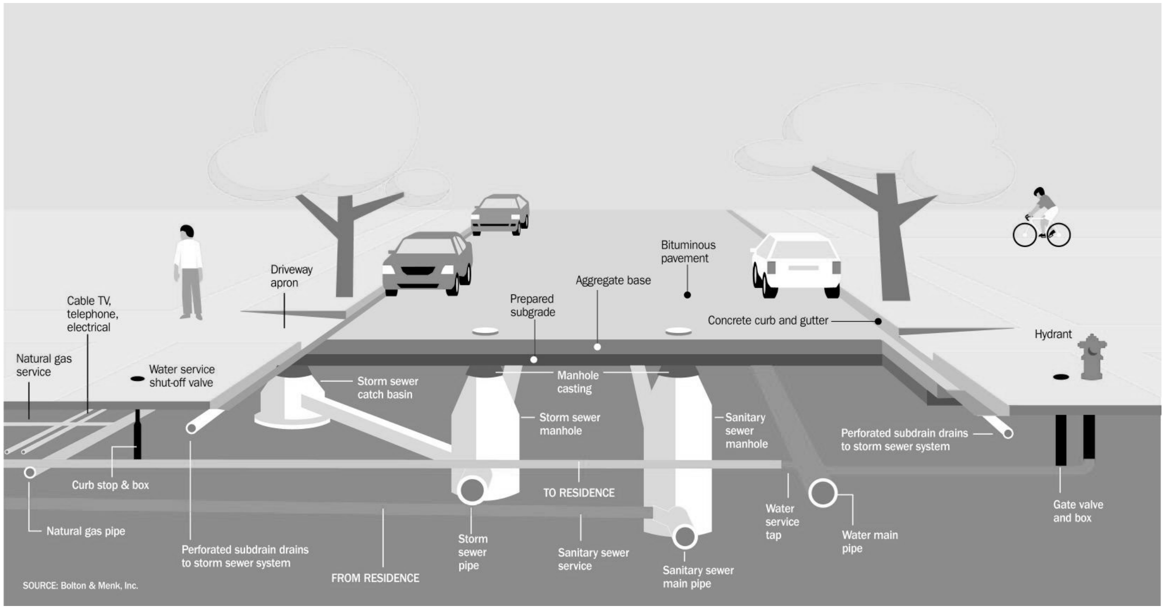
Resilient framework

Based on this framework, a preliminary resilience strategy was developed. This strategy is dynamic, with built-in feedback mechanisms for continuous responses to changes as they occur.

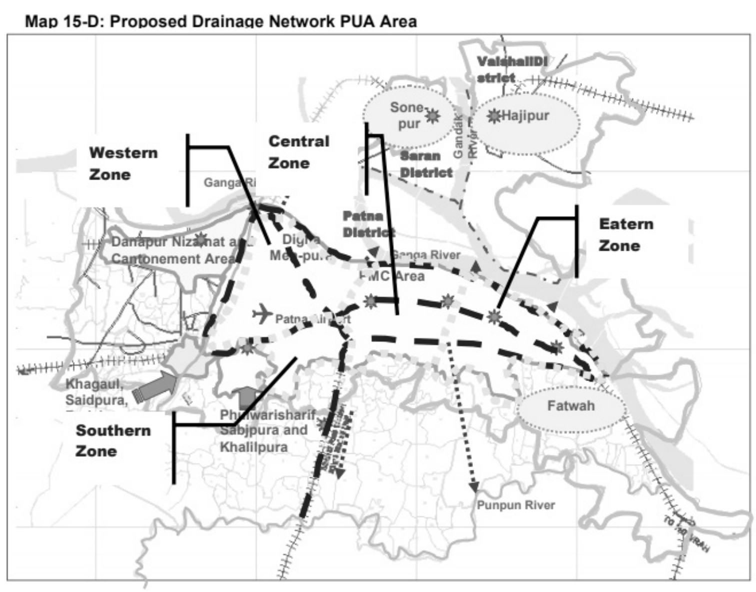
The strategy needs to be detailed for the various identified sectors and groups vulnerable to climate change (inner, smaller circles in Figure 2). It is crucial that the city government plays a pro-active role in developing the resilience of the city. The citizens too need to be organised and sensitised for ownership and partnership in the city's development. Though technical assistance and capacity building of government institutions are important for evolving local solutions and resource mobilisation, the role of responsible citizenry will be crucial too. The development of the city's basic services for the citizens (especially vulnerable groups) will strengthen the resilience of the city and its population.



Resillence strategy



Design ideology that can be proposed



Proposed drainage network 'PUA' area in Patna master plan 2030

LEGEND
District Boundary
PRDA Boundary
PUAA Boundary
Urban Areas other than PUAA
Railway Stations
Airport

Drainage Network
Zone Boundaries

Conclusion

With the selection of Patna Bihar managed to push three of its cities, including Bhagalpur, under the mission. Each city is entitled to get Rs 1000 crore over a period of five years from the Centre as well as the state government in equal share for redevelopment of selected areas with smart civic facilities. Stage is now set for makeover of Patna and Muzaffarpur following their selection under the ambitious smart city mission of the Union government. Though the areas to be renovated under the mission are limited to pockets, it might set a benchmark for planning agencies to reorient cities' master plans to facilitate similar development in the rest of the areas.

Three types of development have been proposed for Patna under the smart city mission, which include area based development, pan city development and pan city smart solutions. The mission concept envisages redevelopment of areas between Patna junction and Gandhi Maidan to add components of smart cities without disturbing the existing structures (known as retrofitting). It also includes renovation of areas around Patna junction.

Retrofitting for localities around Boring Road and Mainpura are proposed, besides developing public parks, public buildings, government and private offices, commercial zone and river front. Information technology based intelligent water supply management, storm water management, transport and traffic management, smart municipal governance, solid waste management and power outage management have been proposed under the pan city solution for Patna.

The purpose of this paper is to highlight the vulnerability of the city in respect to chaos created by even minimal downpour leave alone the monsoons, being capital of the state the impact due to its vulnerability towards water logging pertaining to its topographical & man-made influences in certain areas becomes a real negative for the development spree the country is looking forward to.

When the cities are competing for smart city's approval but according to my perception the administrative units should first focus on much pressing immediate infrastructural issues which might not only hinder the process of development but also create more permanent solution towards the issues.

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Disaster Risk Reduction through Community Training

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Abstract

It is a matter of great concern that nothing much has been done in the area of disaster management at the community level and normally all the critical work is left to the defense and paramilitary forces who are summoned on all such occasions. It is strongly felt that if a community based disaster management plan is in place, much can be achieved in the area of prevention, mitigation and preparedness of all natural and manmade disasters.

The main aim of the present programme is to put in place a trained team of local volunteers who by immediately responding to the disaster situation in their vicinity will provide maximum possible relief and minimise losses. The pioneering batch of such volunteers will be local youth having experience of adventure activities either through NCC/ NSS or Mountaineering. The services of highly qualified and willing persons of the locality from the fields of defense, medicine, fire safety, police and mountaineering will be used to orient and train these youths into disaster managers. Frequent mock drills and refresher courses will help raise the general awareness of the community as a whole and prompt them to work for prevention and mitigation of all kinds of disaster. A community self-equipped to help it when faced with disasters certainly is a safer community.

In the tourist & disaster prone state of Himachal, these trained youths with minor modifications in the training module can become successful adventure entrepreneurs. The success of the programme can be a source of income to the state also. The state can become the hub for the training of disaster managers throughout the country. In due course of time, the state can come up with a state-of-the-art institute of community based disaster management which will train the trainers for further dissemination of disaster management techniques to the remotest corners of the country.

Keywords: mainstreaming, disaster, DRR, community-based disaster management plan, training

Introduction

Disasters don’t believe in caste, creed, religion, ideology and race boundaries. When, why and where a disaster strikes cannot be predicted with certainty. In order to minimise its losses, therefore, we have to start this community training programme of mass awareness at the earliest. It is a duty not only of the govt. but also the people to take part in such exercises and trainings which strengthens the community, the state and the country. Certainly it will have to be a people - govt. joint venture. We are already lagging behind in this field. Let us immediately kick start this programme without waiting any further.

Our aim is to train and equip people with necessary expertise to successfully handle all type of disaster situations in and around the state/country. In this module, main focus is on a community training programme to save time, money and loss of property and more thrust on improvised methods and techniques are proposed to be imparted for making it cost-effective and ensuring speedy response. Trained community teams will be equipped with practical knowledge of covering all types of obstacles during disaster such as landslides, flooded rivers, streams, avalanches cloud bursts, earthquakes.

Our basic aim is to train the community in self-rescue and rescue of others during and after disaster. These trained people can further train and educate other people in different parts of the district and state to increase the strength of available trained volunteers. N.G.Os, school and college students in particular will form the bulk of the training programme in future. The programme also aims to train people from different departments of the govt. to increase their preparedness for disaster.

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Priority

Our priority is to start this type of community training as early as possible with help of government and the public at large. In this training, co-ordination of various departments that play a key role during and after disaster is crucial. In the first phase, we have to prepare a team of trained persons (Master Trainers) who can further train the community in the area through various NGOs, Panchayats and other organisations, etc., already working in the area. The training will be made cost effective by organising demonstrations under one roof as well as to convey the message effectively. Pamphlets and other literature will also be distributed to the participants so that they comprehend the subject in a lucid manner. This training will definitely lead to improvement of local, regional and national capacity to respond to disaster and public health emergencies.

Our Goals

a. To reduce the number of deaths, injuries and other loses due to Impact of disaster.
b. To train maximum people of the community of different locations in the state to raise their awareness and equip them in self rescue and rescue of others.
c. To increase local community's civic participation through formation of associations, NGOs etc.
d. To bring attitudinal changes in the community to ignore their narrow personal prejudices and to promote general respect for diversity and human dignity.

Community Disaster Preparedness Module

Disaster preparedness Well in advance	Preparedness planning on particular disaster	Risk reduction during and After disaster
Increasing community Disaster awareness	Disaster emergences needs	Disaster programme and information reporting
Improve co-ordination in various departments	Improving basic training and Refresher course/ advance Techniques from abroad	Project planning Of Disasters in the area

About disasters, no one can predict. But our experts they can inform and alert community timely. In this community module, we prepare ourselves and other persons for rescue during and after disaster. These trained people know how they can reduce the loss of the property and people. They are already mentally and physically prepared for this (living with disasters). A strong team of young Pharmacist and other professional rescuers who are trained in self rescue and rescue of others can save precious lives whenever any area in the State faces any type of disaster. These persons will be trained to rescue the people in below mentioned types of disasters:-

1. Avalanche
2. Cloud burst
3. Earthquake
4. Flood
5. Heavy rain
6. Heavy snowfall
7. Land slide
8. Major road accidents
9. Multistory complex

In our community training programme, we will provide all type of technical skill to help community in worst conditions in minimum time. (Golden hours)

Increase Community Disaster Awareness

In this community training module, we are interested in training maximum number of people - students and N.G.Os in the state. They will be trained and equipped to impart further training amongst NGOs and other organisations at district and block level.

This programme is perfect to conceive and generate more & more people in this field. These persons can help local NGOs and other associations/organisations with their comprehensive theoretical and practical knowledge. NGOs can organise practical demonstrations and seminars for the awareness in the community. This community awareness programme can minimise the risk and loss of property tremendously.

Improving Coordination

This type of training will succeed only with the joint efforts and the help of government departments. After training, these trained personnel's can organise such type of training programmes to further increase the trained manpower of young professional youths of the district and the state. We can subsequently share the experiences of individuals with those who are experts in different fields. All this require great coordination. Without sincere coordination, we will not be able to run such types of community training programme which is the need of the hour and favourable for the society, the state and the nation. Proper coordination will enable us to start timely and result in saving time, money and energy. The community involved in the disaster can be served in the best possible way.

Preparedness Planning

Our aim is to train well in advance and minimise the risk, casualties and loss of property**. (A minor mistake creates a major accident)**. In this training, our aim is not confined to a particular type of disaster but to prepare trace to manage all kinds of disaster in mountains, landslides, floods, fire, heavy rain, earth quakes, cloud bursts and avalanches also. These teams can preplan without wasting their time to start. They are local and they know the area and how to approach and what to carry. If our plan is well coordinated and properly executed, it can save many lives and losses also.

Refresher Courses

After this community training, those already trained can be called for refresher courses and some other selected persons can be recalled for higher courses. These courses will be organised by existing N.G.Os, Societies and Clubs. We will provide them latest information and latest skills and equipment for risk reduction. This training will help people and society in general. Where there are no possibilities of sending fire vehicles and other mechanical aid, these trained persons can play a vital role in case of any disaster. Trained NGOs/volunteers can take some precautionary measures timely.

Risk Reduction

This community training Module of disaster management programme has been specifically prepared to establish trained rescue teams with all types of technical training to avoid unnecessary delay and loss of property. They are perfect to timely lead the whole team to midst of disaster.

Disaster Management Information

This community training programme covers in depth the theoretical and practical aspects of disaster management in the maximum thrust areas of practical component. (Innovated/Improvised Methods) From time to time, disaster management authority can provide maximum authentic material and latest information about dos and donts about particular disasters in the state. These technically trained persons can convey tips to the common man in the society by delivering lectures and practical demonstrations through pictures, plays and videos. By organizing practical demonstrations, people can be made to understand more consequences of disasters and how to mitigate them. This way, we can attract more people in the community. This awareness programme can help us to minimise the risk and loss of property. Without this type of training, it is difficult to convey the message to the community on a large scale. These trained people can help the Govt. to lead the team with confidence and for favorable results.

Project Planning

In our training programme, trainees will be taught the planning and execution of rescue for any of the following disasters due to:

- Flood
- Heavy Rain
- Cloud Burst
- Fire
- Heavy Snow
- Earthquake
- Avalanche
- Water hazards
- High Rise buildings
- Major road Accidents

Trained teams will successfully organise the rescue operations for above mentioned hazards. What to carry, how to cross obstacles on the way, from where the lay man comes back, all would be a part of our training. As these are all local people, they know the area and the geographical topography and configuration. They have complete knowledge about local weather and local assistance available in the area.This training targets key staff of development, relief and government departments with the need to sharpen their skills so as to prepare the community, NGOs, school and college students to mainstream disaster risk reduction and to know ongoing development strategies.

Results

This training program can train educated and unemployed professional and non professional youths. Only these youths of Himachal Pradesh can be a success with this particular kind of training. These technical and professional rescuers can help their own district and state as well as generate self employment for them. In this way, Himachal Pradesh will be a first state in the country to start such types of exercise. This training can attract maximum people from the other parts of the country because of the Himalayas which are famous for its beauty and rich environment. Govt. of Himachal Pradesh can start such type of state-of-the-art institute (community based disaster management institute) in the future. It will generate additional income as well as well as trained persons for the society. These trained and technically sound youth can participate during or after disaster in the region to which they belong for saving the budget of the ministry of defense. As it is now, mostly our army/paramilitary forces are engaged during disaster and their involvement is a very costly affair.

In the metros and other plain areas, army can approach fast because of technical knowledge and skilled manpower and having all type of latest equipment and heavy machinery. In the hilly states during disaster like heavy rain, landslides, etc. it is difficult to manage. We are having the solution for particular disaster in hill states by providing trained people within the area. With minimum budget (use off improvised techniques and technical skill to lead) one can make self-help groups to help the govt. during or after disaster. In our state the villages don't have roads and not even basic rescue facilities. That's why this particular subject has been focused which is the need of the society and time. We will organise such type of professionals in every district of Himachal Pradesh. In second phase, these trained teams will increase the number of trained people for the welfare of the community and also further training programs with help of other NGOs and associations.

Stages of training			
A	**B**	**C**	**D**
First Aid L/D/P	**Rock craft** **River rescue, still & white water.** L/D/P	**Improvised methods & techniques.** L/D/P	**Snow & Ice Craft** L/D/P
Community Based training programme			

Selecting Team for Exercises during Disaster

There is a need to the start as early as possible for many reasons. Early selection of team (trained in community disaster mitigation) will make possible distribution of definite duties and decentralisation of authority. Another fact is that the scope of exercise may have to be modified if it is found that sufficient number of trained and experienced persons (for umpiring) is not available.

Our Requirement for Recruitment for Trainees

For first batch of 2012

- Young doctors and pharmacists (regular employees/ unemployed)
- Police, home guard, fire department and ex- service man.
- Engineers and technical staff from P.W.D and I&P.H.
- Revenue, forest, transport and industry department officials.
- N.G.Os and other associations.
- School and college students in large numbers. (Future of the country).
- Trained swimmers, climbers, rafting guides and skiers.
- Retired people from above mentioned departments.
- River guide, Mountain Guide, Plumber, Electrician, Gas welder and other professional in the community.

These peoples are vital to the success of our aim and objectives. By doing away with the need to engage more paid employees, we can save our time and budget also. Government may not have sufficient funds to provide for disaster management force in each and every state of India. But community disaster management is the need of the state and country. The training program is to be organised in such a way that trained persons can immediately start rescue without wastage of any time. Schools, colleges, and other NGOs are the main sources of man power for the programme. People from other organisations mentioned above can also be associated if they fulfill the required parameters.

Disaster Team Means

D :- Disciplined
I :- Intelligent
S :- Social
A :- Active
S :- Service
T :- Technical
E :- Experienced
R :- Responsible
T :- Trained
E :- Effective
A :- Accountable
M :- Man power

General Principle for Training

- The standard of training will be kept high in order to ensure efficiency amongst the trainees and infuse confidence among the general public.
- Suitable machinery, on a uniform basis has been devised for the provision of personal accommodation, equipment, syllabus and instruction.
- The methods of training will be uniform and the training organisation, establishment, pamphlets and equipment will be standardised.
- Experience in organising and imparting training can be shared with NGOs, disaster management authorities in different states.

- Mutual aid by these trained persons with in state and outside, if required, will be facilitated.
- Training will be of a type which helps to maintain interest and discipline among trained rescuers so that they become useful to the community in peace and during and after disaster. This is an important factor in maintaining the morale and spirit of the volunteers.
- Training has to be progressive and planned in a distinct way to organise systematic progress throughout the training programme.

Panic Causes

Panic during a disaster is instrumental in increasing the losses manifold. Drills for overcoming panic will be conducting during the training keeping the following panic causing factors in mind:

- Absence of safety outlets.
- Poor leadership
- Suspense
- Fear
- Sense of insecurity
- Element of surprise
- Rumors
- Lack of technical skill
- Lack of information about disaster area
- Anti- social element

Preventive Control Measures

- Power of information
- Keeping people occupied
- Development of sense of physical security
- Development of sense of emotional security
- Proper training
- Counter acting rumors
- Authentic information
- Authoritative advice
- Quick mobilisation of disaster teams

Basic First-aid Training

This course is intended to give the rescue trainees sufficient knowledge to take necessary action as a matter of urgencies in the absence of doctor. It includes first aid treatment for shock, bleeding, suffocation, burns, artificial respiration, insensibility and training in stretcher handling in different conditions. Besides there will be thorough practice in the use of bandages. Every volunteer will be given training in the course along approved lines. Such type of course may be called basic first aid course.

Rock Craft

Climbing is taken to mean the ascent of rocks which generally require the use of the hands for progress and for safety. Skill, as defined in the dictionary, is the knowledge of any art or science and the dexterity in the practice of it. Climbing is neither an art nor a science, but an activity which is a combination of both and climbing skill are a reflection of this there are few hard and fast rules; there are general principles which are usually followed, but sometimes even these may have to be abandoned. In many climbing situation the unusual or unexpected may arise, though it can often be anticipated. Experience allows you to foresee or deal successfully of these situations; a technical repertoire should enable you to solve individual problems in a safe, quick and efficient manner.

This is true throughout climbing from the usual moves to the most complex of rope maneuvers. In the course of a climb, while approaching towards disaster area in Himalayas, whether it is on rock, snow, or ice there are number of parts which are linked together to provide a safe system.

Rock climbing is a very natural activity and, to begin with, few specialised techniques are required. Using the legs is basic too much of rock climbing. For more difficult climbs less natural techniques have to be learned. If our teams are trained in rock climbing they can cross these types of obstacles on the way to disaster area. We will provide rock climbing training (natural & Artificial) in our camp.

River Rescue

We will train our trainees in river rescue at our camp. River rescue training includes the following subjects:-

- Use of ropes
- Use of knots
- Type of boats handling & operation.
- Anchor preparedness
- Swimming & swimming aids (improvised).
- Safety
- Buoyancy.
- Construction of emergency bridges.
- Aerial rope way preparation (flying fox)
- captive ferrying
- Recovery of survivors from water.
- Helicopter rescue from water if possible
- Treatment of survivors.
- Communication system and system of warning. (Flag Signals)
- Rope rescue is one of the best successful practices in the international level.

This particular technical training will be provided at our training camp. After this training these trainees will be perfect in self rescue and perfect in river rescue during disaster.

Improvised Methods and Techniques

The main aim is to train each and every person in maximum use of improvised methods and techniques during different types of hazards in the area or Himalayas. 85% of our population lives in villages. Some of the villages don't have basic rescue facilities for which focus is on improvisation in the training programme. In the training programme, we make maximum use of stuff available locally in a particular area. Another reason to promote such type of training for disaster is that it can be started easily with minimum budget to train maximum people in community based disaster course at a time. These techniques, in fact, were used by our ancestor's right from early days. These methods and techniques are easy in use during climbing and during all type of rescue operations as they need not carry much load on back. Because of heavy rain, cloud burst, heavy snow fall, avalanche and landslide it's important to have trained people to lead the rescue teams.

Conclusion

Through this training, the administration, NGOs, other organisations / associations will be fully geared to respond to disaster management in their area and thus help minimise all kind of damage. This training will prepare the community not only to handle all kinds of disaster like earth quakes, floods, landslides, heavy rain/snowfall, fire in the multistory buildings and major road accidents, etc., in a systematic way but also will increase preparedness to mitigate loss of property and life besides preparing ourselves and other persons for rescue during and after disaster. This training programme is specifically designed to keep in readiness established trained rescue teams with all types of technical training to avoid unnecessary delay and loss of property.

Urban Governance and Access to Civic Services: A Case Study of South Delhi Municipal Corporation

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Abstract

India's urban population with 377 million (2011 Census) constituting 31.6% of our total population is projected to cross 50% by 2050 (UN Population Fund estimates). However, the pace of urbanization in India is posing challenges related to service delivery and infrastructure, housing, environment, and transportation. Infrastructure is often deficient and service delivery standards are sub-optimal specially for the urban poor. If the urban challenges are not tackled appropriately, India's cities will only get increasingly chaotic and rural poverty will be converted into urban poverty. A Brief Summary of Pilot Survey of South Delhi Municipal Corporation is divided into four zones i.e. The Master Plans have failed to plan for this growth and the concomitant pressure on civic services. Recently the MCD has been trifurcated into 3 smaller Municipal Corporations – North Delhi Municipal Corporation, South Delhi Municipal Corporation and the East Delhi Municipal Corporation. The elections have been a game changer for Delhi's municipal governance. They enjoy a de-facto security of tenure and privately "buy" municipal services. There are key drawbacks of Delhi's Master Plans, which were never prepared for the "population explosion", that actually happened in the period they were planning for. Also landowning agencies (public or private) can now relocate and rehabilitate slum dwellers themselves instead of mandatorily entrusting the job to the Delhi Urban Shelter Improvement Board (DUSIB). The "majority" of Delhi's urban dwellers are floating migrants with no clearly defined rights to its urban city space or its civic services. These are the grim present realities of Delhi's demographic changes in the last three decades, in the backdrop of which Delhi's urban development seems extremely problematic. Therefore, the Delhi municipal elections of 2017 did offer 2 models in terms of rights to urban residents-one universal (AAP manifesto) and the other differentiated (BJP manifesto). We can see the emergence of an urban welfare regime that defines rights and entitlements for urban residents specially the poor. Delhi Municipal Elections, 2017 This election evinced more public interest than any one municipal election one can remember in the last 3 decades. Their manifesto had nothing to say about "unauthorised colonies" and "JJ clusters" or "uniform civic services" at all. The BJP - AAP war continues with each blaming the other for Delhi's unsanitary condition, relentless road digging, water-logging, unhygienic condition of slums and MCD workers again complaining of lack of payment of salaries. Delhi is indeed a city of paradoxes. It has a potential SMART CITY within it, ably governed by a non-elected municipal council without any notion of "participatory" urban governance

Keywords: urbanisation, housing, urban governance, civic services, SDMC, smart city, models

Introduction

India's urban population with 377 million (2011 Census) constituting 31.6% of our total population is projected to cross 50% by 2050 (UN Population Fund estimates). The number of statutory and census towns increased from 3799 and 5161 to 4041 and 7935 from 2001 to 2011 respectively. India's 8000 cities together contributed 63% of the GDP in 2007, and this is expected to go upto 75% by 2021 (2011 census). However the pace of urbanisation in India is posing challenges related to service delivery and infrastructure, housing, environment, and transportation. Infrastructure is often deficient and service delivery standards are sub-optimal specially for the urban poor. If the urban challenges are not tackled appropriately, India's cities will only get increasingly chaotic and rural poverty will be converted into urban poverty.

Delhi is the most populous city in India and the second largest in the world with 18 million people and its projected population growth will make it among the first three by 2025. New Delhi's planned landscape, government complexes, foreign missions, aesthetically designed enclaves covering only 2% of Delhi's population is governed by a non-elected municipal body.

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New Delhi Municipal Council (NDMC) is the local body of the city of New Delhi. The area under its administration is referred to as the NDMC area. NDMC, covering an area of 43.7 km is governed by a council with a chairperson appointed by the central government and includes the Chief Minister of Delhi. The state of Delhi is divided into three statutory urban regions: the NDMC, the Municipal Corporation of Delhi (MCD) and the Delhi Cantonment Board region. The MCD governed part of Delhi covers the largest area – 1397.3 km. It has the onerous task of providing civic services to urban villages, resettlement colonies, "regularised" as well as "unauthorised" colonies besides slum settlements. MCD is an autonomous body that governs 8 of the 11 Districts of Delhi. It is among the largest municipal bodies in the world providing civic services to more than an estimated population of 11 million citizens in the capital city. Recently the MCD has been trifurcated into 3 smaller Municipal Corporations – North Delhi Municipal Corporation, South Delhi Municipal Corporation and the East Delhi Municipal Corporation.

The Delhi Cantonment Board works under the Cantonments Act 2006 governing an area of 10,791.88 acres with a population of 110351 (census 2011). The Delhi Cantonment houses the Delhi Cantonment Area and other defence related installations in the city.

Under MCD jurisdiction, posh planned colonies like Vasant Vihar and Defence Colony coexist with middle income level housing complexes (massive townships like Dwarka and Rohini) where MCD provides basic services – road maintenance, garbage removal, street lighting, community parks, primary schools and health clinics. Water and electricity is the responsibility of Delhi Jal Board and Delhi Vidyut Board working directly under the State Government of Delhi. Since 2015, the Aam Aadmi Party (AAP) government slashed the power tariff to half and provided 20,000 litres of free water for all residents.

The "unplanned" part of the city under MCD jurisdiction has the "majority" of city votes. That is the reason why the seven members of Parliament, 70 members of Delhi legislative assembly and 272 municipal councilors – (elected representatives) indulge existing voters with their own brand of "appeasement politics" by routinely promising them clean drinking water, 24 hour electricity, clean sewerage and "regularisation".

The unplanned part of the city – constitute three unorganised clusters living in close proximity to one another. These include some 675 slums and resettlement colonies, over 1000 unauthorised colonies and 135 urban villages. Political parties have seen to it that the slum settlements receive immunity from demolition except through judicial orders, get supply of drinking water, a modicum of sewage disposal, food subsidies and an election voting card. The second group consists of over 1000 unauthorised colonies. The occupants bought agricultural land privately, (an illegal transaction) since converting or subdividing agricultural land required approvals that were never obtained. Without sale deeds or building plans, shoddy structures, deficient sewerage systems and insubstantial basic amenities, these housing areas have been shunned by the municipal system but many such colonies get "regularised" from time-to-time.

The third large group comprises 135 urban villages. Dotted all over Delhi and interspersed among planned residential and commercial complexes, these villages are precariously built structures standing amidst electric wires, shoddy hutments and garbage. Ironically the elected Municipal Corporation of Delhi which is the custodian of public health and safety, exempted all urban villages from paying property tax or following any building regulations.

These are the grim present realities of Delhi's demographic changes in the last three decades, in the backdrop of which Delhi's urban development seems extremely problematic. **Both Delhi's frenzied expansion or the politics of "appeasement" practiced by successive elected governments leaves the task of the Municipal Corporations (MCDs) of Delhi extremely challenging in providing uniform civic services.**

There are key drawbacks of Delhi's Master Plans, which were never prepared for the "population explosion", that actually happened in the period they were planning for. Furthermore Delhi is governed by multiple agencies- water, power, roads, public transport and land are controlled by other parastatals of line departments of Central and State governments making coordination difficult. MCD is responsible only for solid waste management, maintenance of public spaces and some basic repairs and maintenance of other services such as roads, street lighting and drainage systems while many other functions have been outsourced to other bodies.

The launch of the Jawaharlal Nehru National Urban Renewal-Mission (JNNURM) towards the end of 2005 significantly enhanced both the local governance and urban planning systems in India's largest cities. One of the prerequisites for any city to access funds from Central government was to prepare a City Development Plan. The Community Participation Law under the 74^{th} constitutional amendment provides for going further down and reaching the people which has never been implemented in any city. It makes provisions for constituting Area Sabhas/ Mohalla Samitis within a “ward” for taking municipal administration nearer to the people. In Delhi, the mohalla sabhas, the referendums on mobile apps and massive advertisement campaigns led by the AAP government regarding public services since 2015 have probably led to renewed debates on citizens’ right to uniform civic services than ever before.

Housing Typologies in Delhi: How do they Impact Municipal Services?

Delhi has had three Master plans, made by the Delhi Development Authority (DDA), a para-statal, technocratic body, appointed (not elected) by and reporting to the Central Ministry of Urban Development. The three Master Plans of Delhi (MPDs) have been prepared for 1962, 2001 and 2021. Each is a twenty year plan, intended to capture growth in the city and mark detailed land use categories and divide the National Capital Territory of Delhi into an “urban development area” and “rural” zones. From the 2021 Master Plan, a third category of “urbanisable area” was added, presumably to mark areas for future expansion. If we look at the table, “planned colonies” is only one of the eight categories of housing in the city, inhabited by only 23.7% of the population in 2000. **Planned colonies** are those that are built on plots marked in the “development area” of the Master Plan, in concordance with the use allocated to that plot in the Master plan or the zonal plan and that are presumably laid out according to norms and standards defined in the master plan for design, infrastructure and civic amenities. A “planned colony” supposedly fulfilled all these conditions at the time that it was built. Therefore they can be termed “planned, legal and legitimate” colonies. Over time, two types of changes have come about in planned colonies-the extension of individual housing units beyond permissible limits of covered and built area (including extensions into public land, areas and roads) as well as widespread violations of permitted use, particularly the commercial use of residential premises. In other words, even within the planned colonies, there are layers of unplanned activities and informal uses and successive plans have created layers of “exemptions” to handle these non-conforming uses.

Table 1: Settlements in Delhi

Types of Settlement	Estimated Population in 2000 (100,000s)	Percentage of Total Population of City
JJ Clusters	20.72	14.8
Slum Designated Areas	26.64	19.1
Unauthorised Colonies	7.40	5.3
JJ Resettlement colonies	17.76	12.7
Rural Villages	7.40	5.3
Regularised-Unauthorised Colonies	17.76	12.7
Urban Villages	8.88	6.4
Planned Colonies	33.08	23.7
Total	139.64	100

Source: Drawn based on data from Government of Delhi sources

(This table clearly shows that 75% of the city lives in housing that is apparently unplanned. Even in 2017 the position remains roughly the same.)

Unauthorised Colonies

The population of Delhi increased by six million between 1962 to 2007 when the MPD’21 was notified-yet no new land was notified as an urban “development area” by the DDA from 1962 to 1990. MPD’01 added 4000 hectares and MPD'21 20,000 hectares as "development area" notified as "residential". For colonies built in between plans, it was impossible to get the tag of a "planned colony" as they had no way to meet the basic classificatory principle of the table: i.e. the building of the colony on land marked and zoned "residential" within the "development area". Residents therefore were forced to build shelter in what became, by implication, a range of unplanned colonies. This is partly a result of DDA's inadequate housing protection but in equal part the result of its refusal to include already built up areas within the "development area" of the Master Plan. This illegal inhabitation, interestingly has defined the processes of habitation for the poor and the rich alike, though the consequences of these "illegalities" are different for each. An unauthorised colony gets created when land is bought by an individual aggregator-from either individual farmers or the gram sabha and aggregated into the size of a colony. Though the purchase from this aggregator by individual buyers is formal, it is not legal since "agricultural land" cannot be used for non-agricultural purposes. Though all house owners have formal documents, none of these can be registered with the local authorities as recognised legal property titles because the colony does not exist on the Plan. However there is no recorded case of an eviction from an unauthorised colony. They enjoy a de-facto security of tenure and privately "buy" municipal services. Periodically, an unauthorised colony is "recognised" through a process-the property titles get recognised by law and can be registered. The process involves an attempt to align the unauthorised colony as closely with planned norms of the settlement layout (including building codes) as well as the payment of a onetime "conversion charge". There have been three major waves of regularisation in Delhi-1962(102 colonies), the second wave in 1975(567 regularised) in the third wave in 1993 applications were again invited for regularisations. In 2009, 733(out of 1639 applications) of these colonies were regularised. In the absence of objective criteria by which the regularisation process functions, it is indeed the discretion of the DDA to decide who will become legal and at what time. Once again, it is the Plans, which determine, through their discretionary ability to notify or not notify parts of the city within the "development area", as well as through waves of "regularisation" that decide which colonies will be "legal" or not legal.

Urban villages are settlements, located throughout the city and largely consist of ex rural villages that have been incorporated into urban areas as the city expanded. Urban villages are planned since they are included explicitly within the Master Plan. In order to be able to "retain" their character, urban villages are exempt from any building norms, mixed use or single use owning classifications. In other words, urban villages may build to any height, mix commercial and residential activities and violate developmental controls for parking and street widths. Urban villages today range from income poor neighbourhoods still practising village trades to neighbourhoods housed in some of the city's most fashionable districts (e.g Hauz Khas Village). The villages are "legitimate"; residents enjoy security of tenure and cannot be evicted.

Jhuggi Jhopri (JJ) Clusters and Resettlement Colonies

Slums are settlements identified or "notified" under the Delhi Slum Areas Act, 1956. Slums were considered "any area unfit for human habitation due to dilapidation, overcrowding or lack of sanitation". The primary principle of classification of the category, remains that residents are perceived as squatters on land they neither own nor paid for. In Delhi, 95%of JJ clusters are on "public" land, the large majority (83%) of them on land owned by DDA (GOI 2009).Unlike in the case of unauthorised colonies where residents did not have the right to buy rural or private land for urban use but the sale is a formal valid transaction, the efforts by some residents of slums to buy their plots is seen clearly as "illegal". The Slum Lords who supposedly own slums: occupy land, parcel it and allow tenants to settle for rent and are all engaged in informal activities in unplanned illegal sites on public land. The only way for residents of JJ clusters to become "legitimate" is to be evicted from the Slum cluster and resettled into an alternative site, called a "resettlement" colony. What is it that separates slum designated areas, JJ clusters and "resettlement" colonies? The major point of difference is their tenurial status and their relationship to the Master plan. Slum designated areas are protected from arbitrary eviction without resettlement (they exist only in the Old City and on Private Land) in Delhi today. JJ clusters have no security of tenure (exist mostly on public land), resettlement colonies are authorised by the Master Plan. Families allocated plots in these colonies are owner-occupiers, given licenses rather than titles that are non-transferable, cannot be sold. Tenants living in JJ colonies are excluded. In evictions from 1990 to 2007, estimates of the number of families resettled averaged only about 25-40% of the total families at any given site. Activists claim that recent resettlement colonies because of the diminishing size of the plots, the distance from employment centres and the abysmal state of infrastructural services remain slum-like even today[1].

An important point to note is the unevenness of civic services provided by MCD in the different categories of colonies, other than “planned”. In the rest of the colonies, municipal services are provided formally since most of the residents are the urban rich/middle class who are tax payers and claim benefits individually or through RWAs. It is only the residents of JJ clusters who are completely at the mercy of their landlords who “arrange” for civic services through illegal payment to municipal authorities.

Delhi Municipal Elections, 2017

This election evinced more public interest than any one municipal election one can remember in the last 3 decades. Virtually all categories of residents (75%) living in all colonies other than “planned”, were being promised good and uniform civic services by the 3 major contenders-Bhartiya Janta Party(BJP), Aam Aadmi Party(AAP) and the Congress[2]. Of all the parties, AAP promised the maximum freebies to the urban middle class and the poor. They declared a moratorium on “evictions”, in-situ development of slums, abolition of property tax and a cleaner and greener Delhi with existing MCD funds. AAP was firmly of the opinion that MCD under BJP rule (last 10 years) had become a corrupt and inefficient body and all “illegalities” in all unauthorised colonies had become “regularised” through corrupt practices. AAP promised radical MCD reforms to end corruption and increased participatory urban governance through Mohalla Sabhas[3], better run corporation schools and efficiently run mohalla clinics[4]. In short AAP promised radical urban governance without increasing taxes. Despite having a more radical agenda, AAP lost the elections to BJP, who did not have any new ideas to run MCD except the promise that there will be greater coordination with the Central Urban Development Ministry and of course they will clean up the “mess” in Delhi with more “central funds”. They had already been in power for the last 10 years and their track record had been so poor that to pre-empt an election failure, they had to sack their entire old councillors and bring in fresh faces, with a promise of doing everything better in municipal governance if they were to win the elections.

BJP managed to make voters look beyond MCD’s shoddy record and focus on Modi, and turned it into a referendum on the AAP government. AAP’S vote share was 26%, BJP romped home with 36.1%. If we look at the BJP manifesto, they have promised to do everything they hadn’t done in Delhi in the last 10 years-ensure 100% doorstep garbage collection at all colonies and a good service in unauthorised colonies and urban villages. They have promised to acquire compacter units, waste management plants and waste-to-energy plants at landfills. They promised to construct more public toilets under Swachh Bharat Abhiyan (a complete failure in Delhi) and ensure basic sanitation around slum clusters. BJP said Colony roads would be regularly maintained except in unauthorised colonies where “public money” cannot be invested. They wished to improve municipal schools and health clinics, but have not spelt out any new modus operandi. They accused the Delhi government of not giving them the Fourth Delhi Finance Commission Funds, and promised to ensure collection of property tax on time. Their manifesto had nothing to say about “unauthorised colonies” and “JJ clusters” or “uniform civic services” at all. They therefore stand for a notion of “differentiated” civic services based on the housing status of different urban residents in Delhi and have no clear agenda on how to improve “participatory” urban governance.

What Delhi Expects from the New Corporators

To the authors, the only real possibility of a Smart City Project being implemented is in the NDMC Area and work towards it has already started. So a small portion of Delhi (42.7 sq. km.) may become a smart city in the next decade. The entire NDMC area is the legal planned part of the city devoid of unauthorised colonies and JJ clusters where the majority of Delhi’s population is currently housed.

Enforcing this plan is entirely possible in the NDMC area-which has been declared the cleanest city in the North Zone and finished seventh among 434 cities in the Swacch Sarvekshan 2017[5].

The elections have been a game changer for Delhi’s municipal governance. Media coverage of urban issues has been relentless with Times of India leading the coverage to raise citizen consciousness of municipal neglect of their duties. BJP‘s manifesto was full of pious promises, none of which had been pursued in the last 10 years. AAP’s manifesto had many new ideas, in-situ rehabilitation of JJ residents being one of the most radical ones. It is amazing despite all these promises people voted the BJP to power once again. AAP had been reminding urban residents during the election period that MCD has no problem of funds-it is sheer lack of a work culture and corruption that makes it unable and unwilling to fulfil its mandate. *The BJP - AAP war continues with each blaming the other for Delhi's unsanitary condition, relentless road digging, water-logging, unhygienic condition of slums and MCD workers again complaining of lack of payment of salaries*.

Results of Pilot survey undertaken by Jamia Political Science Department

- Under the Special Assistance Programme, the Political Science Department of Jamia Millia Islamia initiated a Research Project titled "Urban governance, citizenship and access to civic services: A study of South Delhi Municipal Corporation 2017"
- A pilot survey was conducted by a group of our students after the Delhi Municipal Elections in April 2017 in five categories of housing colonies in Delhi. The results of our survey will be presented

Table 2: Housing Settlements in Delhi (2001)

Category (In order of degree of security of tenure)	Population (in Million)	% of total population
Planned Colonies	3.31	23.71
Resettlement colonies	1.78	12.75
Designated Slum Areas	2.66	19.05
Urban Villages	0.89	6.37
Rural Villages	0.74	5.30
Regularised-unauthorised colonies	1.78	12.75
Unauthorised Settlements	0.74	5.30
Jhuggi Jhopri Clusters/Squatters	2.07	14.82

Source: Report of a Convention, Sajha Manch, June 1999 and Delhi Fact File, National Capital Region Planning Board, 1999.

A Brief Summary of Pilot Survey

- South Delhi Municipal Corporation is divided into four zones i.e. Central, South, West and Najafgarh.
- For the pilot survey, we randomly selected south zone and within that R.K.Puram ward was selected.
- Through purposive sampling, five categories of colonies were chosen
- Data was collected using a structured questionnaire
- In each category of colony, twenty respondents were interviewed.
- A total of 100 samples were interviewed for the pilot survey.

Basic Research Question

- The research hopes to look at both models:
  (a) **"universal"** or (b) **"differentiated"**
  in terms of citizen access to basic urban civic services and offer a rationale for choosing one or the other for the city of Delhi.
- The "majority" of Delhi's urban dwellers are floating migrants with no clearly defined rights to its urban city space or its civic services.

- **Therefore should there be a universal entitlement policy with regard to basic civic services (bench marks universally defined) for all city dwellers, or should all basic amenities be given access on the basis of "private capacity to pay" or the "ability to pay" mandatory taxes? This is the basic research question this paper sets to address.**

ANAND/SHANTI NIKETAN

- A planned colony-Houses built on privately owned plots
- Residents pay taxes but do not avail of the school and health facilities provided by SDMC
- 40 % voted for BJP, 20 % for Congress and remaining said their voting preferences keep changing depending on the performance of the Candidate
- Satisfied with civic amenities provided by SDMC which includes door to door collection of garbage, inner colony road maintenance and parks. Water and electricity are provided by Delhi Jal Board and BSES under the State government.

MOTI BAGH-Planned residential government colony

- Households live in government flats of different types
- Pay income tax
- 80% of the households send their children to private schools since they are not satisfied with SDMC schools
- Only 30% of the residents avail health facilities provided by SDMC
- 60% of the household members prefer to vote for BJP; 20% preferred to vote for AAP and remaining keep changing their party preferences
- Satisfied with water, electricity by State Government and waste management and street light facilities provided by SDMC
- Not satisfied with park facilities, Community toilets in the area are not well maintained.

Satya Niketan- A resettlement colony

- 90% of residents have bought from original allottees who got the land free. Now housed by students, private sector employees and other professionals.
- 90% of the residents in the area pay taxes
- None of the respondents are sending their children to MCD schools. Only 30% of the households avail health facilities provided by SDMC
- 40% of the households prefer to vote for BJP; 60% do not vote on the basis of party but according to the performance of the candidates
- Not satisfied with any of the civic amenities. No regular water or electricity supply
- Major civic issues are that of waste management and sewage disposal.

MOCHI BAGH ARAKPUR-Unauthorised colony

- An urban village located adjacent to Satya Niketan.
- It is not an authorised colony.
- 70% are not paying any tax;20% paying only income tax and 10% paying property tax
- 30% of them are sending their children to SDMC school but they are not satisfied
- 70% of them are availing health facilities since they don't have much option in the area
- Health facilities are substandard and the attitude of the staff including doctors towards them is not very pleasant
- 40% prefer AAP,10% prefer BJP,10 % to Congress and 40% keep changing their preference on the basis of work done by the candidate in the area
- People complained about irregular water supply and electricity, waste disposal,no park and community halls, etc.

NANAKPURA-J J colony

- A slum where slum dwellers have constructed *Jhuggis* in an area of 6-12sq.ft(approx.)
- 80% of the respondents own a *Jhuggi*
- None of the respondents pay any taxes
- A majority of 70% respondents send their children to SDMC school
- 100% avail health facilities provided by SDMC.

Water and electricity are supplied by private service providers. No waste management or sewage system. Community toilets and open defecation are both seen

Unevenness of Civic Services

- An important point to note is **the unevenness or differentiated access to civic services provided** by MCD in the different categories of colonies.
- In planned colonies municipal services are provided formally since most of the residents are the urban rich/ middle class who are tax payers and claim benefits individually or through RWAs.
- **It is only the residents of unauthorised colonies and JJ clusters who are completely at the mercy of their landlords who "arrange" for civic services through illegal payment to municipal authorities or through private service providers.**

Makings of an Urban Welfare State

Historically the Indian welfare state was largely imagined for rural areas. Most social security programmes focussed on rural poverty and destitution - government flagship programmes like National Rural Employment Guarantee Scheme, the National Rural Health Mission are just some examples.

Recently we do witness some seminal changes in government policies towards the urban poor - from the Urban Livelihood Mission to the Right to Education, Social Security for Unorganised Sector Workers Act, to growing debates on Urban Housing for the poor and Universal Health coverage proposals are all meant for urban coverage. We can see the emergence of an urban welfare regime that defines rights and entitlements for urban residents specially the poor. This is truly needed in the context of an urban renaissance-most Indians will be urban residents by 2050 and any notion of "differentiated" citizenship rights is morally wrong and this is what urban activists have been fighting for in the last 3 decades in Delhi.

Urban residents are beneficiaries of livelihood promotions through the National Urban Livelihood Mission or the recently passed National Street Vendors Act 2014. Therefore people employed in the unorganised sector are not "encroachers" or "squatters" but have been recognised as "workers" and all urban residents should therefore possess "the right to services" like water and sanitation as well as education and health services. These policies enable at least a partial claim of a "right to the city" because they are urban policies-*premised on residence within the city*. Unlike previous regimes of poverty alleviation, they do not identify beneficiaries as targeted groups marked by their relationship to the "poverty line" or imagine the urban poor as simply "floating migrants" who deserve no facilities as permanent tax paying urban citizens do. They use a language of universal rights and entitlements-they do not separate the urban slum from the urban rich colonies, from the income poor to the elite urban citizen.

The Delhi Slum and JJ Relocation and Rehabilitation Policy, 2015 is now a reality after recent amendments in 2017. The policy allows land owning agencies to be charged for dwelling units at institutional rates instead of circle rates. The institutional rate is Rs 12000 per sq. km while the circle rate is Rs 46200 per sq. km on average. Also landowning agencies (public or private) can now relocate and rehabilitate slum dwellers themselves instead of mandatorily entrusting the job to the Delhi Urban Shelter Improvement Board (DUSIB). The thrust of the policy is in-situ rehabilitation and relocation[6] by either the DDA or *private developers*.

Judicial Interventions

The commissioners of the 3 municipal corporations have often come to be indicted after the Municipal Elections of 2017. They recently came under fire in the Delhi High Court (HC) for reducing Swachh Bharat campaign to a "complete naught" in the capital. HC termed as "shocking" that despite repeated concerns raised by the court on solid waste collection and disposal, the corporations have not moved a single step resulting in a situation where Delhi, which once had the largest per capita forests, has been converted into a slum. The court said the corporations are in complete breach of rights of the citizens under the Constitution apart from the provisions of the DMC Act, civil laws and constitutional duties. Apart from the concerns of health, environment and right to life of the citizens of Delhi, the corporations have been hauled for the violation and contempt of court orders. The bench said the corporations have ruthlessly and callously permitted compounding and regularisation of unplanned and unauthorised colonies without first ensuring increase or improvement in civic amenities, such as bigger or greater number of sewage and water lines. It lamented that conversion of residential property for commercial activity was being permitted without first ensuring there was enough space for parking[7].

HC observed that there seemed to be more garbage than land for people in the capital. The bench lamented the lack of will in the corporation to work towards removing garbage and combating diseases, *saying funds were not the problem but the absence of will was.*

Referring to the claim by the corporations that they were short of funds due to failure of the Delhi Government to release money, the court wondered why the civic bodies had not filed any contempt plea to ensure implementation of the 4th Finance Commission recommendations. It also sought details from the corporation regarding their functioning in the past 5 years. "All municipal corporations shall inform us in tabulated format, five yearly progression with regard to the demographic variations, variance /increase in staff strength as well as infrastructure development in the nature of availability and increase in procurements" were the observations of the judges[8].

The bench also asked the government and corporations to inform it about the fate of the sewage treatment plants in the city. *8000 metric tons of garbage everyday accumulates in Delhi* - why they don't reach landfill sites was the query. The High Court chastised the Public Works Department and the Delhi Jal Board (under AAP government) for not cleaning drains annually and only resorting to knee jerk measures before the onset of the monsoon. *The court said another problem faced by the city was the multiplicity of civic agencies with each blaming the other instead of having a citizen oriented approach.* Delhi does not seem to have any plan for migrants, 2 lakh move into the city every year. In India every planning model is overturned by an excess of population - housing and public transport for example cannot keep up with rising numbers.

Resident Welfare Associations (RWAs) in Delhi

The RWAs in Delhi under the Bhagidari Scheme established partnership between residents/citizens and the municipal authorities to improve the urban services delivery system. However, these associations were found to be dominated by the members of the middle classes who identify the urban poor and squatter settlements as threatening to any future urban development.

Elite RWAs subscribe to the idea of "responsible" citizenship and are concerned with citizens as consumers. Apart from only paying taxes, these RWAs are interested in "constructive engagement" through, for example, private-provisioning of some services. Emphasis was placed on eliminating citizen benefits for "unauthorised" or "illegal" colonies. These RWAs took the judicial route to address the problem of "illegality". They preferred to access state officials directly with their problems. The scope of resident participation was limited in the sense that important decisions were often taken by a small core group of RWA members. On the contrary, non-elite RWAs (mostly in unauthorised colonies) were not found to be driven by the notion of citizenship but were directly concerned with the non-availability of civic amenities in their colonies and sometimes employed confrontationist strategies, (for example, street demonstrations) for aggressively pushing their demands. They preferred to contact the lower level government officials and discussed their problems with these representatives. Instead of bypassing the democratically elected municipal bodies, they cooperated with the elected representatives. In some cases, members of non-elite RWAs campaigned for councilors and offered issue-based support. This rapport between the non-elite RWAs and councilors had serious implications for poor people's access to services since the councilors sought to solve the problems of the poor through their "political" influence which they exercised to get work done by the officials in favour of their constituencies.

Conclusion

Barring the NDMC area, Delhi has truly become a city of floating migrants (estimated to be 2 lakh per year). The Master Plans have failed to plan for this growth and the concomitant pressure on civic services. Technocrats devise plans without necessarily understanding the realities of this relentless rural-urban migration which is an unstoppable process. People will go where jobs take them. Citizenship, in the world's largest democracy has to be morally defined in terms of an universal set of entitlements irrespective of where citizens live or what they own. Therefore the Delhi municipal elections of 2017 did offer 2 models in terms of rights to urban residents-one universal (AAP manifesto) and the other differentiated (BJP manifesto). Though BJP has won, it will also perhaps come to understand that years of pro-poor activism, politicisation of the urban poor and the logic of numbers (in terms of votes) in a democracy inevitably lead to the "universal" model in terms of providing a minimum package of civic entitlements to all urban residents irrespective of their housing status.

More and more unauthorised colonies are being regularised and slum dwellers "evicted" to resettle them as per the vision of the state to build "smart cities" everywhere. The city of Delhi now truly belongs to all-the rich, the middle and even the poor have "survived" with their different agendas through some sort of activism-the rich and the middle classes usually resort to "judicial activism" focusing on their rights as taxpayers to keep the city clean and "green" with the best civic amenities possible by civic agencies. The poor have asserted "politically" their right to "housing" and a common minimum of municipal services for their right to live in the city.

In essence, the purpose of inclusive urban development in Delhi gets defeated as the participatory practices failed to put the idea of "governing from below" into practice (MCD has been converted to a service provider only); instead they facilitated the idea of "governing by political capacity". However what followed is a growing perception that "the city needs to survive"(judicial activism) as much as its citizens. For this first, the legal and regulatory framework needs to be strengthened to empower local democratic institutions to act effectively and a strong national mandate for pro-poor service delivery is necessary for encouraging local government and service providers to intervene in favour of all categories of urban citizens. Given the widespread prevalence of patronage and clientelism in Indian democracy, leaders can make city governments truly effective especially for the poor if they are committed to provide benefits to the people not as charity, but as entitlements. This has often been termed as politics of "appeasement" but the authors feel very strongly that this kind of politics has truly been "empowering" and "entitling" for the poor.

Delhi is indeed a city of paradoxes. It has a potential SMART CITY within it, ably governed by a non-elected municipal council without any notion of "participatory" urban governance. This NDMC area is truly a model for other Indian cities to emulate for smart urban governance indicators have been put in place. On the other, the elected Municipal Corporation governed part of the city now is one of the worst examples of urban governance-the city is congested, polluted(it has the largest number of energy consumers and vehicle owners in India),overpopulated with 75% of its people living in unplanned and illegal colonies/slums and witnessing a pathetic condition of roads with 8000 metric tons of garbage accumulated daily but not disposed regularly. However it it is the nation's capital and citizens (specially students and job seekers) come from all over India. It has become a city of migrants and all residents therefore need to establish their "right to housing and municipal services" as part of their universal "right to the city" as urban residents.

Acknowledgements

The author would like to thank the students of M.A. Public Administration in the Department of Political Science, Jamia for their pilot survey in each of the 4 categories of housing colonies in South Delhi-planned, unauthorised, urban villages and JJ settlements recently after the municipal elections of 2017. This was my primary source of data for writing this article besides secondary sources cited.

Notes

1. Read Gautam Bhan's "In the Public's Interest: Evictions, Citizenship and Inequality in contemporary Delhi", Orient Blackswan, Delhi, 2016 which has the results of authentic research done in Delhi's slums and resettlement colonies

[2] BJP won in 181 wards which went to polls on April 23, 2017. AAP bagged 48 seats and Congress won 30 seats.

[3] In order to achieve the objectives of self-rule, 2972 Mohalla Sabhas were digitally mapped out across the 70 Assembly Constituencies of Delhi. Each Mohalla was formed by combining 3-4 electoral parts with all the registered voters living within. To avoid administrative multiplicity, all public assets (e.g roads, streetlights, drains) were digitally mapped to the asset owning civic agency like the MCDs PWD etc (ASICS Survey, 2016)

[4] Mobile health clinics for the urban poor have become functional in Delhi, again an AAP initiative.

[5] The award parameters:

Municipal solid waste collection and transportation

Solid waste processing and disposal

No open defecation

Capacity building efforts

Municipal Documentation

Citizen engagement and observations

[6] In today's neo-liberal era, slum clearance and rehabilitation is being done mostly by private developers e.g. Mumbai and Bangalore by giving a variety of incentives to slum landlords and tenants to get the land "vacated" first. Then "low income" group housing flats are raised on the vacated land (usually public land) and sold at subsidised rates to the slum residents. The same process may start in Delhi.

[7] HC's directions came after it took cognizance of a TV channel's news video showing that garbage was not being collected and disposed of from several Delhi colonies for days on end. Two recent deaths in the city have also caught the attention of the Delhi High Court, which took suo-moto cognizance of them. A bench of acting Chief Justice Gita Mittal and Justice C. Hari Shankar took note of Times of India reports on the death of a ragpicker while removing garbage due to electrocution and a nine year old boy's death in a compost pit.

[8] These Delhi High Court judgments were all delivered between May and July, 2017 after the Delhi municipal elections in April 2017.

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Disaster Management in the North Eastern State of India with Special Reference to Mizoram

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Abstract

Disaster management is the action taken by an organisation in response to unexpected events that are adversely affecting people or resources and threatening the continued operation of the organisation. Disaster management includes the development of disaster recovery plans, for minimising the risk of disasters and for handling them when they do occur, and the implementation of such plans. Disaster management usually refers to the management of natural catastrophes such as fire, flooding, or earthquakes. Therefore, the Government of India introduced a paradigm shift in the approach on Disaster Management. It stated that Disaster Management is a cycle of activities which are broadly described as Disaster Risk Management and Crisis Management. Due to its geo-climatic condition, the entire state of Mizoram is also one of the most hazard prone states in the country. To make matters worse, the State falls under Seismic Zone V, and thus liable to be hit by strong earthquakes. We, therefore, can see that natives of Mizoram are aware of the necessity of preventive and mitigation measures since long time past. Although the State is enjoying abundance of rainfall during monsoon period, the dry spell during non-monsoon period is really hard for the people. However, with the escalation of development works, the need to stress on mitigation, prevention and preparedness were almost left behind. The habit of felling trees and foliages of forests and burning them really destroy natural vegetation, thus causing ecological imbalances. Small tremors are felt every now and then in and around the state. Due to the steepness of the hillsides, underground water retention is minimal, causing perennial water sources to dry up during this period. The Mizo Society preserves forests above their water holes to retain the moisture and to attract more rain in the vicinity. A Mizo jhum cultivator will make a clearing or path around his jhum before burning to prevent spreading of fire to adjacent forest. The state is annually swept by cyclonic storms, cloudbursts, hailstorms and landslides. This structure is actually a strainer-like wall made of split bamboos, with very strong wooden posts. This had been aggravated by the tradition custom of jhum cultivation, commonly known as slash and burn. The people of Mizoram had been suffering the above calamities from time immemorial.

Keywords: hazard, ecological imbalances, preparedness, paradigm shift, mitigation, prevention, disaster management

Due to its geo-climatic condition, the entire state of Mizoram is also one of the most hazard prone states in the country. The state is annually swept by cyclonic storms, cloudbursts, hailstorms and landslides. To make matters worse, the State falls under Seismic Zone V, and thus liable to be hit by strong earthquakes. Small tremors are felt every now and then in and around the state. Although the State is enjoying abundance of rainfall during monsoon period, the dry spell during non-monsoon period is really hard for the people. Due to the steepness of the hillsides, underground water retention is minimal, causing perennial water sources to dry up during this period. This had been aggravated by the tradition custom of jhum cultivation, commonly known as slash and burn. The habit of felling trees and foliages of forests and burning them really destroy natural vegetation, thus causing ecological imbalances. Moreover, this usually led to unwanted spread of fire to forests.

The people of Mizoram had been suffering the above calamities from time immemorial. It is, therefore, natural that like all other human beings, the inhabitants of Mizoram had adapted themselves to these calamities and hardships by practicing certain traditional preventive and mitigation measures to save themselves from the fury of such disastrous calamities. For example, normal Mizo will construct his house with strong wooden posts or logs which are deeply imbedded into the ground to prevent his house from being blown away by cyclonic storms. (This writer finds that a normal rural Mizo is ready to invest all his earnings to build a strong house without a thought on savings and this must have been imbedded in his mentality as a priority due to necessity caused by natural hazards prevalent in Mizoram.) If the house site is facing the wind, then he will construct a windshield next to his house.

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This structure is actually a strainer-like wall made of split bamboos, with very strong wooden posts. In order to prevent his thatched roof blown off, he will also construct a separate frame work with thick bamboos, the ends of which are strongly fixed to the ground. A Mizo jhum cultivator will make a clearing or path around his jhum before burning to prevent spreading of fire to adjacent forest. The Mizo Society preserves forests above their water holes to retain the moisture and to attract more rain in the vicinity.

We, therefore, can see that natives of Mizoram are aware of the necessity of preventive and mitigation measures since long time past. However, with the escalation of development works, the need to stress on mitigation, prevention and preparedness were almost left behind. Even the government machineries are focusing mainly on relief and rehabilitation. Therefore, the Government of India introduced a paradigm shift in the approach on Disaster Management. It stated that Disaster Management is a cycle of activities which are broadly described as Disaster Risk Management and Crisis Management. The illustration below can best describe the cycle.

Profile of Mizoram

Mizoram is the southernmost state of the seven sisters' states of the North East India. The whole state is made up of monotonous rugged terrain of long, sharp ridges with deep gorges and narrow ravines. The rock formations are generally soft to moderate hard with loose, relatively thick cover. The entire state is covered by south-west monsoon and therefore receives heavy rainfall during the months of May upto September every year. Due to its geographical location, nature of rock formations, climatic condition, land use pattern and land cover etc., the state has witnessed massive landslides every year besides cyclone, floods, cloudburst, hailstorms, drought etc. Further, the state is classified as Seismic Zone-V area as per Seismic Zoning Map of India.

The effect of landslides which is phenomena in every part of the State is destructive in nature and causes a lot of miseries to the public as it results in loss of life and property, disruption of communication network and adversely affects development of the area, infrastructure, the community and the country as a whole. Mizoram is a hilly terrain. Geologically speaking, Mizoram is young and immature Sedimentary formation. This young and immature hill area receive good amount of rainfall every year for a period of six months starting from May upto October. Due to these natural and topographic circumstances, the developmental activities and settlement cannot avoid steep slope and loose topography.

As developmental activities become more and more, the equilibrium of stability in hill area are pose to disaster at any onset of heavy rain. Development Works like hill side cutting for road construction and building, over excavation of rock for construction materials, unscientific handling and cutting of hill slope cause landslide, rock fall and mass movement of land. Natural disasters do happen largely because of interference in the natural equilibrium triggered by heavy rainfall.

Landslides and its related natural disaster are one of the commonest disasters in Mizoram. In recent year, landslide and landslide related disaster claims number of lives; destroy huge amount of valuable properties and disrupt many development works.

The state of Mizoram lies in the Seismic Zone-V. This sensitivity of natural disaster and hazard could be largely due to its geographical and tectonic location. Geographically speaking, Mizoram lies within the south-west monsoon covers area. Due to this geographical location, Mizoram has received heavy rainfall for a period of not less than six months starting from May upto October every year. During this six months period, Mizoram in general and eight district headquarters, in particular are the most risk town due to heavy rain and rapid developmental activities.

Seismic activities may also trigger landslides, mudslide, rock slide, hill slope instability because ground rupture and/or land subsidence. Natural hazard and disaster in Mizoram could be attributed not only to the geographical and tectonic position, but also the morphological features of the area. More than 75% of the area is steep hill-slope forming deep gully and repeated intervening stream running almost parallel to each other in a north-south direction.

Another important factor that may consider is improper settlement and build-up structures in the hill-slope. There is few enough flat land for settlement and most of the civil structure including road, building are constructed at a steep hill slope in a haphazard manner. This kind of random settlement without proper planning in a hilly area could have maximised the degree risk and trigger the danger at any incidence.

Owing to this prevailing condition and situation, it is most urgently required details and systematic evaluation and studies with respect to natural hazard and disaster such as Landslide, mudslide, earthquake and even hill-slope instability so as to regulate and formulate proper town planning and mitigation measures. Therefore, the project called Landslide Risk Assessment covering eight (8) district headquarters of Mizoram is project is formulated.

Rainfall is a recognised trigger of landslides, and investigators have long attempted to determine the amount of precipitation needed to trigger slope failures, a problem of scientific and societal interest. In an area like Mizoram where heavy rainfall are a seasonal phenomena, landslides and its related natural disaster do happened every year. Most of the landslides related natural disasters are attributed to the influence of heavy rainfall and cloudburst in a hill-slope particularly in a build-up area and road-side where extensive slope cutting are taking place. Such frequent activities do invite hill-slope instability and result into disaster.

An area like Mizoram covered by south-west monsoon receives heavy rain every year. This seasonal phenomenon of heavy rain needs proper and systematic studies to decipher the contribution in bringing hill-slope instability, landslide and its related disaster and evolves the threshold values of rainfall in which any kind of disaster can predict or develop a warning system to minimise or avoid natural disaster and its related disaster is one of the most natural hazardous events in Mizoram. Proper understanding and characterisation of the very nature of landslide, the triggering factors and threshold point is one of the most important basic structure to establish for developing any kind of warning system so as to avoid or minimises lost of properties and human life and check any kind of developmental activities disrupted by such kind of disaster.

Department of Disaster and Rehabilitation, Government of Mizoram

In the beginning, the Department of Relief and Rehabilitation Department (Now renamed as the Disaster Management & Rehabilitation) is functioning only with few officers and staff at Directorate Level. Having no District offices all the Deputy Commissioner in the Districts are entrusted with the responsibility of immediate relief payments to the victims of Natural Calamities as per the Norms of CRF. Disaster Management Committees are formed at the State, Districts, Blocks and Village levels to extend immediate relief to the victims of various natural disasters like earthquake, cyclone, hailstorm, cloudburst, landslide, flood, Fire etc. Cyclone and Landslide being the main disaster in Mizoram a number of Silpaulin. are distributed free of cost every year to needy victims of Landslide and Cyclone, for saving dwelling houses from landslide, hailstorm, etc and for prevention of further landslide itself. Initially, the function of the R & R Department was confined to giving immediate relief to the victims of Natural calamities and rehabilitation of MNF Returnees. When Mizoram U.T became a full-fledged State a new allocation of business was notified by the Government of Mizoram vide No.J.12011/11/87-POL dt. 23.3.87. The purview of the Department has been widened even to the Pre-Disaster Management besides giving immediate relief and rehabilitation.

As such, the R & R Department had been renamed as "Disaster Management & Rehabilitation Department" to shoulder wider responsibility of Disaster Management comprising the following subject vide Government Notification No.A.46013/2/2006-GADDt.24.8.2006.

(a) Natural Calamity/Drought and Flood Relief
(b) Gratuitous Relief
(c) Disaster Management:-
  (i) Pre-disaster management as pro-active strategy including preparedness, prevention and mitigation, wherein every Department has important roles.
  (ii) Post-disaster management as re-active strategy including relief, rehabilitation andreconstruction.

In pursuance of the direction of the Ministry of Home Affairs, the nodal department for Disaster Management, formerly known as Relief & Rehabilitation Department, is changed to Disaster Management & Rehabilitation Department. The following is a glimpse of the various activities taken up under Disaster Risk Management by the Government of Mizoram:

- National Disaster Management Act, 2005 is adopted by the State Government.
- As envisaged in this Act, State Disaster Management Authority, State Executive Committee, and District Disaster Management Authorities are formed and notified.
- State Disaster Management Rules is drafted.
- Draft State Disaster Management Plan is being reviewed.

- All Districts have their own District DM Plans and are now under process of revision. All the 26 RD Blocks are also preparing their Block DM Plans. Around 30% of the 789 villages identified had completed their Village DM Plans.
- State ATI is identified as Training Institute for DM and had taken up training of district trainers for activities like School Safety Planning, Disaster Management Planning, First Aid, Search & Rescue, Office DM Contingency Planning, etc. They had taken up training of engineers on Earthquake Resistant Construction under NPCBEERM, and also conducted district level training of engineers and masons on Earthquake Resistant Construction.
- Hazard Safety Cell is formed in the State PWD under the leadership of the Chief Engineer, Building. This Cell had conducted Rapid Visual Assessment on Lifeline Buildings on their safety.
- Nodal Officers are appointed in all the District Administrations to implement the Programme at the District, Block and village levels under the overall guidance of the Deputy Commissioners who head the District DM Committees.
- Control Room-cum- Information Centre known as Emergency Operation Centres are established in the State headquarters and in all the District Deputy Commissioners' offices. These EOCs are being equipped with IT equipment.
- Awareness is created through Talk Shows, Seminars, Posters & Stickers, Essay Competitions, Painting Competition, TV spots & ads, handouts, hoardings and above all Mock Drills.
- First Aid training is imparted to 5612 DMT volunteers at village level, 127 at block level and 571 at the district level.
- Search & Rescue training is given to 4611 DMT volunteers at village level, 188 at block level and 700 at the district level.
- 2400 teachers are trained in School Safety Plan and Evacuation Drill.

Mizoram State Policy on Disaster Management

The state of Mizoram is prone to various kinds of disasters of recurrent nature. These disasters result in loss of life and property- public and private- and disrupt economic activity, besides causing immense misery and hardship to the affected population. A time has come to look at the disasters occurring in one or more parts of the state regularly, at more frequent intervals and to evolve a strategy for reducing their impact, and for giving assistance to the affected population. A timely and well-prepared action plan can save many lives and lots of property even at the time of sudden occurrence of a disaster, as the entire administrative machinery, and the community can be geared to the execution of a well laid out plan of action.

Each disaster has a different character and therefore requires a different plan of action for prevention and mitigation. The management plan similarly, calls for an event specific plan for preparedness response and recovery, though there may be some commonalities.

- Mitigation and management of disasters require a multi-disciplinary approach. Institutions, organisations and government agencies, at the state and district level, will be identified and involved in working out the strategy for prevention, mitigation and response and rehabilitation.
- At the state level, there shall be a Cabinet Committee under the chairmanship of the Chief Minister to approve all proposals on Disaster Management and review the status of prevention, mitigation and management of each identified disaster, annually during normal times and will meet as frequently as situation demands.
- A State Steering Committee at the Official level shall be constituted under the chairmanship of the Chief Secretary, Commissioner Secretary, Relief & Rehabilitation will be the Vice-Chairman.
- There will be Committees of similar nature at the District level and the Village level. The District level will be under the chairmanship of the Deputy Commissioner and the Village level will be headed by the President of the Village Council.
- The membership of the Block level, if established, will consist of representatives of similar line Departments and NGOs.
- The district plan will spell out the role of the media. Adequate warning systems will be established. All communications facilities existing and improvement plan thereof should be included.

- Prevention and mitigation strategy has to be different for various types of disasters and requires to be indicated as specific points of action at the State and district level for each one of them.

The Government of India, with support from United Nations Development Programme, introduced a novel programme known as GoI-UNDP Disaster Risk Management Programme. The main objective of the programme is to create awareness of the dangers faced by the state and the public at large and to prepare them to meet any eventuality with minimal loss. The programme emphasis sensitisation from the top officials to the lowest community members and make the government prepare itself and the community in the best possible way to prevent or mitigate the impact of any disaster or calamity.

Government of Mizoram had signed a MoU with UNDP in 2003 to implement the GoI-UNDP DRM Programme in the State. State Steering Committee under the chairmanship of the Chief Secretary is formed to monitor the various activities taken up under this programme. This committee is meeting at regular intervals. Disaster Committees are formed at the entire District, Block, and the village levels with the chairmanship of Deputy Commissioner at the District level, BDO at the Block, and VCP at the village levels.

Task Forces known as Disaster Management Teams (DMTs) are formed in all the District, Blocks and Village levels. These teams are created for activities like Search & Rescue, First Aid, Shelter Management, Relief Coordination, Information & Damage Assessment, Food & Civil Supplies, Water & Sanitation, Trauma Counseling, Patrolling, and Carcass Disposal.

Conclusion

In the state of Mizoram, it is clear that the works and functions of the Department of Disaster and Rehabilitation results in a better and improved preventive and mitigation measures to the inhabitants of Mizoram. The natives of Mizoram are now aware of efficient and proper disaster plans and management through the programmes or projects of awareness of disaster and public information which are mostly organised by the Department of Disaster and Rehabilitation, Government of Mizoram. The facilities of broadcasting useful/crucial information also play a significant role in changing the situation radically and this also results in decreasing the number of victims of the disasters in the prone area. This also gives better ideas to the people for the preparation and prevention before and after the disaster occurs.

As far as the State of Mizoram is concerned, population pressure, environmental degradation and unplanned urbanisation are some of the major factors contributing to increased vulnerability of the communities. As such, to mitigate the impact of disasters, there is a need to work collectively to solve the problems through multidimensional channels combining the efforts, resources and expertise of Government, NGOs and Civil Societies. In Mizoram, a proper disaster management and response system are institutional and organisational. A single organisational structure focuses on disaster management, including all disaster management aspects.

Disaster management is an all-comprehensive area where everyone has a duty to perform. The eternal preparedness has to start at individual, family, community, district, and state, regional and national levels. The challenges before us today are to have an effective response in the speediest possible way to save lives and properties. The knowledge of science and technology and people's wisdom should be incorporated in mitigating the impact of disasters. The right information and awareness creation has to be produced at all level, especially in the vulnerable areas. Public awareness is the key point to sustain a coordination and cooperation in the system and to make the best use of resources. It is an effective instrument in the prevention of the occurrence and lessens the effect of disasters in the area.

Disaster Management is a very specialised and highly skilled job. This cannot be undertaken unprofessionally with an adhoc approach. There is a wide gap in the knowledge, skills and attitude of the 'Disaster Managers' to cater to the need of disaster prevention, mitigation, preparedness and response. Disaster Management consists of multi-sectoral issues and most of the community sectors have not visualised their role as disaster managers and develop their human resources accordingly. Training and capacity building are very important to achieve the goals at various levels in disaster management. Training is a planned process, which directs learning towards achieving specific outcomes, leading towards achieving performance objective. Thus, the objectives of the study have been fulfilled and also the hypothesis has been proved.

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Building Resilience of Single Women in Ganjam, Odisha

Debabrata Patra[a]

Abstract

With the regular phenomenon of disasters, ActionAid realised the need to work towards resilience building of communities especially vulnerable groups apart from relief and rehabilitation work. Based on this need, ActionAid initiated women leadership program in Ganjam district – one of the most disaster prone districts in the state. Objectives of this intervention was to reduce the impact of disaster on women and other vulnerable groups by building women leadership on disaster prevention and management so as to respond to any future disaster with better preparedness and resilience. During the process, it was identified that SINGLE WOMEN are the most vulnerable among the vulnerable groups. ActionAid targeted resilience building of SINGLE WOMEN by ensuring their ownership over assets such as homestead land, linking them to housing schemes so that they can build houses on the land with DRR components, linking them to social security schemes and enabling them to earn their own livelihood thus preparing them better to face any future disasters.

Keywords: vulnerable groups, women leadership program, disaster prevention, disaster management, resilience building

Interventions

In order to achieve these objectives, first of all in each village ActionAid identified widows, women who are staying separately from their husband, divorcee women and unmarried women above 30 years of age. They were identified as single women. A database of 37,289 single women was developed on status of their land ownership and status of linkage to social security schemes. Then ActionAid liasioned with district administration for issue of homestead land to single women who do not have land in their name. At the same time ActionAid liasioned with block administration for linking the single women with social security schemes especially to Indira Awas Yojana-IAY and housing under Odisha Disaster Rehabilitation Project.

Leaders from single women groups were identified and their capacity was built to lead community processes along with other women, to have dialogue with government and PRIs for better access to different entitlements and built their knowledge and capacity on disaster prevention, preparedness and response. They were imparted training on different components of a house construction that are essential for Disaster Risk Reduction-DRR. ActionAid facilitated emergence of single women collectives/forums at block levels. 19 single women forums are now active in Ganjam district.

In addition to this, ActionAid facilitated Community Based Disaster Preparedness processes in 21 villages that included preparing disaster preparedness plan, approval of plans by gram sabha, identification of vulnerable persons/groups and preparing action plan for reducing their vulnerabilities, linking vulnerable to government programs, organising mock drills, formation of village level task forces and ensuring that women and girls become the members of the task forces and capacity building of task force members.

Impact, Lessons Learnt and Challenges

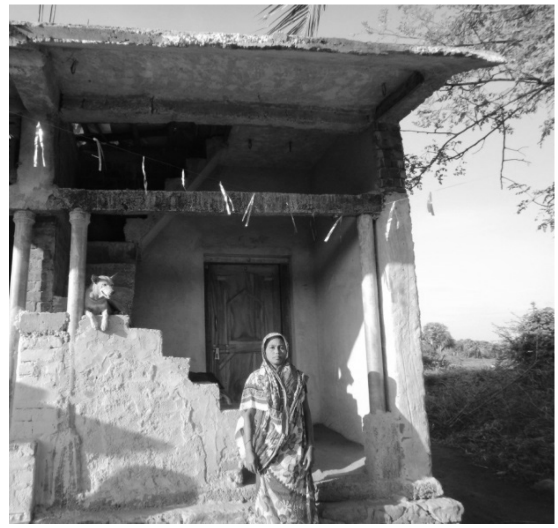
The most remarkable impact has been linking the single women to land and housing. 4029 single women have been distributed homestead land patta and also 2687 single women have been linked to the housing scheme under Odisha Disaster Rehabilitation Project. The schemes provide entitlement of Rs. 3.00 lakhs for construction of house, and Rs. 12,000/- for construction of toilet. Hence Rs. 80,61,00000/- and Rs. 3,22,44000/- has been mobilised towards construction of house and toilet respectively. Besides, 431 single women have been granted with housing under IAY of the state Government. 1463 single women have been linked with Old Age Pension (OAP), 1026 with Widow

[a,b] ActionAid

Pension, 59 with disability pension, 3019 with piped water facility of RWSS programme, 3569 with the National Food Security Schemes, 2026 with job card under MGNREGS, 2312 with LPG under Ujjala Jyoti Yojana. 440 single women have grown vegetables in their kitchen garden for additional nutrition. Besides, 3 single women collective have been cultivating vegetables collectively leasing out land.

This has boosted the confidence of women and now even without any project; these groups are running on their own and carrying forward their work.

One of the major lessons learnt from this intervention was that if we are able to dovetail our efforts with that of government we can generate huge benefits for the most marginalised communities. One of the major challenges was to make government and community realise that single women are the most vulnerable in the community.



With New Hope and House: A Case Study of Jayanti

Jayanti Das lives in Tarinipali village of Poirasi Panchyat, Ganjam Block. She is 32 years old and a widow. She has two kids, elder one is a boy and the younger one is a girl child. Her husband who was the sole bread earner of the house expired before PHAILIN.

The project team identified her as a single woman. She was not got linked to widow pension and other benefits. Her house was also got damaged in PHAILIN. The project team and women leaders of the village took her to the Panchayat and block office and dialogued with the block administration about her situation. As a result Jayanti was linked to widow pension. She was given Rs75000/- under Indira Awas Yojana. Initially she got two instalments for construction of house- Rs15000/- and Rs 35000/- with which she completed construction of the roof of the house. She has now completed the house in February 2016 after getting last instalment.

Jayanti works in a cashew factory near the village and earns Rs120/- per day. In addition to that she gets Rs300/- as widow pension. The project and women leaders have helped her in accessing these entitlements that has built her resilience.

Revisiting the Community Contingency Plans and Learnings

In 2017 we revisited the CCPs in 12 villages of Ganjam district of Odisha in India. These CCPs were originally developed in 2015 as part of the disaster risk reduction (DRR) intervention in the aftermath of Cyclone Phailin that had hit Ganjam coast in 2013. Women leaders of the community were capacitated to lead the CCP processes so as to reduce their vulnerability and face any future disaster with preparedness and resilience.

Objectives of revisiting these CCPs were to have a fresh look into the community needs, reflect on the progress made against the previous plan and find out the areas and opportunities for collaboration with private sector apart from the government.

Major findings of revisiting CCPs

- In the earlier plan, a list of families having thatched house had been made. The women leaders had advocated with PRI and emergency unit of the district administration for linking the vulnerable families with the housing schemes. Now, there is a change in the house types of the vulnerable groups of the village. It was found that 50% families from the list had been linked to the housing scheme and concrete houses constructed for them. Single women within the vulnerable groups have been given the priority while linking to housing schemes.

Figure 2: Cyclone shelter at Biripur

- In Biripur village, the need for construction of cyclone shelter was identified during the initial plan. The task force members, women leaders and PRI members had a discussion with the district administration and as a result the cyclone shelter been constructed. The Dalit community had demanded construction of the shelter near their hamlet as that was the worst affected area during the flood and cyclone.
- Vulnerable groups have been linked to social security schemes. Single women within the vulnerable groups have been given priority for linking to social security schemes.
- Confidence of task force members has increased due to their success in implementation of few plans by having dialogue with government. Revisiting of CCP gave the scope to the task forces of the villages to reflect on the roles they performed since their formation. They looked into the list of works they were supposed to do as part of preparedness. Task forces were restructured based on the views of the members and women leaders.

Challenges

- It is difficult for the women leaders and task force members to approach big corporates for collaboration for technical and deployment support. There is a lack of information about corporates.
- The private companies situated in local areas do not have dedicated corporate social responsibility (CSR) teams for which they are not interested in deployment of their personnel in the community processes. Therefore they did not contribute any time in the processes of revisiting CCPs. They also showed no interest on larger collaborations such as providing technical support or for construction of big infrastructure such as cyclone shelter.
- Development of CCP is not complete without capacity building of task forces and women leaders for understanding their role and responsibilities.
- Sustainable interventions to address climate change are highly essential but neither the government nor the private sector has any concrete agenda for this. Community can take small steps for this but there is a need for larger interventions.
- For the women leaders of the community, reaching out to big corporate is difficult. It needs time and resources for the CBOs. NGO definitely can play the role but they too need time for contacting and convincing the corporate especially to intervene in the disaster preparedness phase.
- Local government is not much interested for involving the private sector in the resilience building work rather they see their support more in disaster response. Local government does not pursue with the corporate to use their resources more in DRR and resilience building.

Learnings and Conclusion

- Approval of CCP in local governance forum (gram sabha) and linking the CCP with district administration has yielded result. Single women have been linked to housing.
- Regular revisiting of CCP gave is necessary to understand the emerging issues related to WASH and how to address it so that better preparedness can be ensured. In Badapali village, drinking water scarcity emerged this year but till the revisiting of CCPs not much attention was given. The community discussed about this when the role of WASH task force of the village was examined. Once it was identified the task force members contacted the PRI and block administration. Based on their demand the block administration has initiated the work for supplying drinking water to the village through pipelines from a government water tank.
- The community need for more and more programme on climate resilient and sustainable agriculture has come up. As there is not much mention of alternate livelihood option in CCPs, we have to give importance on practice of climate resilient and sustainable agriculture.
- The need for training of task forces came up strongly. The task force members opined that there is a need for building their understanding on disaster, climate change, DRR and resilience building.
- Newly elected PRI members are showing interest in implementing disaster preparedness plans through PRI.
- Revisiting of CCP has strengthened the resilience building and preparedness of community for future disaster.

- There is a scope for convincing and involving private sector in DRR especially disaster preparedness programs.
- Let us treat community as co-partners and not beneficiaries and partner with government for sustainability with the leadership of women and other marginalised groups in the area and focus on work for disaster Preparedness and resilience building along with response so that any disaster cannot cause so much damage so as to wipe years of development gains.