STRENGTHENING DISASTER RISK PREPAREDNESS FOR URBAN RISK REDUCTION – A CASE STUDY OF ASSAM STATE DISASTER MANAGEMENT AUTHORITY (ASDMA) AND GUWAHATI MUNICIPAL CORPORATION (GMC).

A Dissertation submitted to the Indian Institute of Public Administration for the award of Masters Diploma in Public Administration in partial fulfillment of the requirement for the Advanced Professional Programme in Public Administration (APPPA)

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CERTIFICATE

I have the pleasure to certify that Sh. T. Kabilan has pursued his research work and prepared the present dissertation titled **Strengthening Disaster Risk Preparedness for Urban Risk Reduction: A Case study of Assam State Disaster Management Authority and Guwahati Municipal Corporation** under my guidance and supervision. The dissertation is the result of its own research and to the best of my knowledge, no part of it has earlier comprised any other monograph dissertation or book. This is being submitted to the Indian Institute of Public Administration for the purpose of Masters Diploma in Public Administration in partial fulfillment of the requirement for the Advanced Professional Program of the Indian Institute of Public Administration (IIPA) New Delhi.

I recommend that the Dissertation of Sh T Kabilan is worthy of the award of Masters Diploma in Public Administration from IIPA, New Delhi.

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LIST OF ACRONYMS AND ABBREVIATIONS

ASDMA	Assam State Disaster Management Authority
BIS	Bureau of Indian Standards
CBDRR	Community Based Disaster Risk Reduction
DDMA	District Disaster Management Authority
EOC	Emergency Operations Centre
EMEX	Emergency Management Exercise
EMT	Emergency Management Team
GEMEX	Guwahati Emergency Management Exercise
GMC	Guwahati Municipal Corporation
GMDA	Guwahati Metropolitan Development Authority
HR	Human Resources
HVRA	Hazard Vulnerability Risk Assessment
IMD	Indian Meterological Department
ISRO	Indian Space Research Organization
MHEWS	Multi Hazard Early Warning Systems
NDMA	National Disaster Management Authority
NEADS	North East Affected Areas Development Society
NE	North East
NGO	Non Governmental Organization
PWD	Public Works Department
SDMA	State Disaster Management Authority
SOP	Standard Operating Procedure
WHO	World Health Organization

UNDP	United Nations Development Programme
UNISDR	United Nations International Strategy for Disaster Reduction
UNDRR	United Nations Office of Disaster Risk Reduction

EXECUTIVE SUMMARY

Disasters have a significant impact on urban areas, posing a significant challenge to the social, economic, and environmental sustainability of cities. In response, urban risk reduction has emerged as a critical area of concern for policymakers worldwide, with a focus on strengthening disaster risk preparedness. This case study examines the experience of the Assam State Disaster Management Authority (ASDMA) and Guwahati Municipal Corporation (GMC) in strengthening disaster risk preparedness in a multiple disaster scenario.

The study found that ASDMA and GMC have made significant progress in enhancing their disaster risk preparedness capabilities through a range of measures, including the development of contingency plans, early warning systems, and community-based disaster risk reduction initiatives. These efforts have been supported by the establishment of a robust institutional framework and strong collaboration between ASDMA and GMC, as well as other stakeholders such as civil society organizations and the private sector.

Despite these achievements, the study also identified several challenges that must be addressed to strengthen disaster risk preparedness further. These include insufficient resources and capacity, limited community participation, and inadequate integration of disaster risk reduction into urban planning and development processes. To address these challenges, the study recommends several strategies, such as increasing funding for disaster risk preparedness, enhancing community engagement, and promoting the mainstreaming of disaster risk reduction into urban planning.

The study highlights the critical role of local government in disaster risk preparedness and emphasizes the need for strong collaboration and partnerships between different stakeholders to enhance urban risk reduction. It also underscores the importance of a comprehensive and integrated approach to disaster risk reduction, which involves addressing both structural and non-structural measures, such as early warning systems, community preparedness, and capacity building.

This study has incorporated valuable insights and lessons learned for policymakers and practitioners in the field of disaster risk reduction, particularly those working in urban contexts. It demonstrates that strengthening disaster risk preparedness requires sustained efforts, political will, and the involvement of multiple stakeholders. Furthermore, the study underscores the need for an inclusive and participatory approach to multiple disaster risk reduction that empowers communities to take an active role in mitigating and responding to disasters.

Chapter I

INTRODUCTION

Disasters are sudden, destructive events that can cause immense damage to communities, including loss of life, property damage, and economic disruption. They can be natural, such as hurricanes, earthquakes, and floods, or human-caused, such as terrorism or industrial accidents. In order to minimize the impact of disasters, communities need to be prepared with disaster preparedness plans.

Disaster preparedness involves having a plan in place for responding to disasters. This includes identifying potential hazards, assessing risk, developing emergency procedures, and training community members in how to respond in the event of a disaster. The goal of disaster preparedness is to reduce the impact of disasters on communities by preventing or mitigating their effects.

One of the key reasons why disaster preparedness is important for communities is because disasters can happen at any time and without warning. Even if a community has never experienced a disaster in the past, it is still at risk. By being prepared, communities can minimize the impact of a disaster and save lives.

Another reason why disaster preparedness is important is that disasters can cause long-term damage to a community's infrastructure and economy. For example, a major hurricane can destroy homes and businesses, disrupt transportation networks, and cause power outages that can last for weeks or even months. By having a disaster preparedness plan in place, communities can reduce the amount of damage that is done and recover more quickly.

In addition to reducing the impact of disasters, disaster preparedness can also help to build resilience within communities. By working together to prepare for disasters, communities can develop stronger relationships and a greater sense of cohesion. This can help to improve community morale and make it easier for people to cope with the aftermath of a disaster.

In summary, disaster preparedness is essential for communities to minimize the impact of disasters, protect lives and property, and build resilience. By developing a disaster preparedness plan and working together to implement it, communities can be better prepared to face the unexpected and recover more quickly from disasters.

Statement of the Problem:

The North East Region of India is ecologically sensitive and a biological hotspot. Guwahati is the largest city of the North East region and the commercial hub of Assam which is the entry point through railway, roadway and flight hub for the region. Further, it is the most populous city of the region close to eleven million people. The city falls in the BIS Zone – V classification of seismic mapping. The river Brahmaputra flows right across the city. Though multiple disasters in the form of earthquake and flood has never happened at Guwahati, Guwahati has seen landslides, floods and rains happen all at the same time.

This study would attempt to understand the preparedness mechanism in the event of a Multiple Disaster scenario due to "extreme weather events" along with a seismic event which could be catastrophic to Guwahati. This study aims to assess the present disaster preparedness mechanism of two critical institutions ASDMA and GMC in the event of such a disaster. This study would try to study the present systems/ processes/SOP's in place for such multiple hazards and attempt to provide a SOP based on available literature, interaction with stakeholders to improve the resource distribution (financial and technical manpower) so that in the event of a multiple disaster, the systems and processes are robust, simulated and event ready to respond to the event in the "golden hour".

Aims and Objectives of Research:

Aim: To study the Multiple Disaster preparedness mechanism in terms of SOP's of ASDMA and recommend measures/processes to improve these processes during a multi disaster scenario. The study will focus to strengthen the disaster preparedness mechanism

in terms of technically adequate manpower and financial resources at the district level to include:

(a) Separate SOP's for Multiple Disaster preparedness at District/ Urban areas

(b) Dedicated technical manpower deployment in ASDMA and GMC.

(c) Community sensitization about Multiple Disaster preparedness and response.

Objectives : The objectives of the research work are :-

a) To study the institutional framework of ASDMA in terms of availability of SOP's for multiple disasters at Assam based on vulnerability mapping.

b) To assess the present HR deployment in ASDMA and GMC and recommend adequately trained technical manpower for coordination in a Multiple Disaster event.

c) To formulate a "Multi Hazard Community Preventive Resilience Strategy" and create a mass awareness and sensitization program through traditional media and social media to infuse a sense of community preparedness in case of a multi hazard event.

Hypothesis :

The hypothesis of this dissertation is that Assam's disaster preparedness though has improved over a period of time, the need to strengthen the Standard Operating Procedures at the District level and a dedicated team at the district level is very critical to provide a robust preparedness strategy. Further, the deployment of financial resources at the district level along with training and capacity building is integral in improving their awareness of a multi hazard/disaster response mechanism through exposure to organizations and countries who have done it prior. Further, empowering the community as "first responders" for a multi hazard event is very critical, as most of them must be aware of flood, landslides and earthquakes as separate events. The unison of multi hazard and the importance of the community response is critical for the "golden hour". A robust

community sensitization strategy through “multi hazard simulation/ mock drills” would help the preparedness mechanism at the local level.

Rationale and Justification:

With the creation of the National Disaster Management Authority (NDMA) as the nodal agency for national level risk apex body which is headed by the Prime Minister created in 2005 the larger thrust and need for a single agency for a national disaster management institution has been resolved. With climate change already in action across various parts of the country being victim of “ extreme weather events”, it becomes pertinent that the North east part of India especially the city of Guwahati which is the gateway of the North East state is adequately prepared for a multi disaster event.

The need for “localising the Sendai Framework” at the District Disaster Management Authority and to the panchayat level is integral for a robust preparedness mechanism for a multi disaster scenario. The two agencies in Guwahati for the disaster risk preparedness are Assam State Disaster Management Authority (ASDMA) and Guwahati Municipal Corporation (GMC). This study would emphasise on the readiness of these agencies in terms of SOP for a multi disaster scenario as well as the communication strategy to the community and sensitization measures in place to make the preparedness machinery robust and effective before the event.

Research Questions:

The research questions are as follows:

a) What is the present status of SOP management at ASDMA for Multiple Disaster preparedness?

b) What are the HR challenges in ASDMA and GMC in implementing a common disaster preparedness strategy for the Kamrup district?

c) What are the financial resource challenges faced by ASDMA and GMC for disaster risk preparedness?

d) What are the problems faced by ASDMA in localizing disaster preparedness strategy at the district level?

e) How has the community responded to disaster risk preparedness awareness campaigns by ASDMA as a first responder?

Methodology :

The study intends to constructively engage with ASDMA, GMC and the District Emergency Operations Centre of Kamrup district to analyse and understand the present system of disaster risk response for a multi disaster. Apart from these institutional studies, it is proposed to obtain primary data through questionnaires from all the relevant stakeholders mainly health and emergency service authorities like water, electricity and public works department about their sense of awareness and preparedness for a multi disaster scenario. The citizens living in select disaster prone areas of Kamrup metro shall also be interviewed through a random sampling method so that elderly, physically challenged and the vulnerable are mapped during data collection.

Review of Literature:

a) Books:

i. Professor Vinod Kumar Sharma in his book Disaster Management has put forth various perspectives of disaster management which are context specific. The book has documented various disasters in India in detail and provides a birds eye view of disaster management in India and the lessons learnt in those disasters. (Sharma, 2013).

ii. David Alexander in his book “Natural Disasters” has described the causes and extent of natural disasters giving facts and figures. Some of the best and precise definitions of natural disasters are mentioned in this book. (David, 1993).

iii. Indu Prakash in his book “Disaster Management” has provided an elaborate scheme of the natural disasters and the issues involved. The author has delved in detail about the lessons learnt in the Uttar Kashi earthquake of 1991 and the

importance of NGO's in relief work in disaster mitigation works. (Prakash, Indu , 1994)

iv. Gupta M.C et al in their "Manual on Natural Disaster Management in India" had dealt in detail about the disaster management systems, nature of relief operations and details of funding mechanisms for disaster relief available in India. (Gupta, M.C. 2001)

v. In their book, "Development and Disaster Management: A Study of the North East States of India" - Amita Singh, et al have shown the fragility of the region coming under the forces of development. There are state specific case studies and disaster documentation which helps the reader understand the dynamics of development in the NE states. (Amita Singh, et.al 2011)

vi. Rajib Shaw et al (2013) in their work on the multiple disasters at Tohoku region of Japan, Tohoku Recovery refers to the efforts made to rebuild and recover the Tohoku region of Japan, which was devastated by a massive earthquake and subsequent tsunami on March 11, 2011. The earthquake, which had a magnitude of 9.0, was one of the largest ever recorded and caused widespread destruction, with the tsunami causing further damage and loss of life.

The Tohoku region, which includes the prefectures of Miyagi, Iwate, and Fukushima, was particularly hard hit by the disaster, with entire towns and villages being destroyed and thousands of people losing their lives. In the aftermath of the disaster, there was a massive effort to provide emergency aid and assistance to those affected, with international organizations and volunteers from around the world coming to the region to provide support.

The recovery effort in Tohoku has been ongoing since the disaster, with a focus on rebuilding infrastructure, homes, and businesses, as well as supporting those who were affected by the disaster. The Japanese government has allocated significant resources to the recovery effort, and there has been a concerted effort to involve local communities in the planning and implementation of the recovery.

The recovery effort in Tohoku has faced numerous challenges, including logistical and financial difficulties, as well as the ongoing impact of the disaster on the physical and mental health of those affected. However, there have been significant successes in the recovery effort, with many areas of the region being rebuilt and new infrastructure being developed to support the local communities.

Overall, Tohoku Recovery is a long-term effort to rebuild and recover the Tohoku region of Japan following the devastating earthquake and tsunami of 2011. While there are ongoing challenges, the recovery effort has made significant progress in supporting those affected by the disaster and rebuilding the region is a model of learning for all Multiple Disaster scenarios around the world.

(b) **Policy and Acts:**

i. Disaster Management Act, published by Ministry of Home Affairs, December 26, 2005.

ii. Assam State Disaster Management Policy, Revenue and Disaster Management Department, December 10, 2010.

iii. Assam Disaster Management Rules, Revenue and Disaster Management Department, December 8, 2010.

iv. National Policy on Disaster Management, Ministry of Home Affairs, 2009.

v. Guwahati Emergency Management Exercise , GEMEX, 2012, published by Assam State Disaster Management Authority, 2012.

vi. Hyogo Framework for Action 2005- 2015, UNIDSR, 2005.

vii. Sendai Framework for Disaster Risk Reduction, UNIDSR, 2015.

Research Methods and Data Sources:

Study will be based both on primary and secondary sources.

(a) Primary research would include:

i. Online meeting of officials of ASDMA and GMC at Guwahati and interacting with them and officials at the District Emergency Operations Centre about the level of disaster response preparedness for Multiple Disaster event. A questionnaire shall be prepared and circulated so as to get input from potential disaster areas based on risk mapping done by ASDMA.

ii. Online interaction with all line departments like fire service, PWD, water and sanitation about the SOP's available in their departments and their preparedness for such an event.

(b) Secondary research would include:

i. Books, research papers, reports, articles on disaster preparedness available at IIPA Library and online.

Chapterisation Scheme:

The layout of the dissertation will be as under:

a) **Chapter I: Introduction** (Research Methodology)

b) **Chapter II: Multi Disaster Risk Profile of Assam**. This chapter will discuss in detail the details of disasters in Assam and the lessons learnt on disaster preparedness.

c) **Chapter III: Role of ASDMA and GMC in Disaster Preparedness for Guwahati**. This chapter shall discuss the structure and functions of ASDMA and GMC in disaster preparedness in Assam. This chapter also shall delve into the manpower and financial resources needed for a multi hazard event.

d) **Chapter IV: Standard Operating Procedure-key for Disaster Preparedness**. This chapter shall analyse the present mechanisms /SOPs available for multi hazard/ disaster and coordination of these agencies in executing the SOP's like the GEMEX exercise of 2012.

e) **Chapter V: Role of Community leadership in a multi hazard event at Guwahati**. The local community is always the "first responder" in a disaster event. This chapter shall study the details of trainings given to the community by ASDMA and the sensitization of community leadership in identifying the vulnerable to evacuate them on priority and provide food, water and shelter to the most vulnerable in the population.

f) **Chapter VI: Conclusion and Recommendations for a robust SOP for Multi disaster for Guwahati**. Based on the interactions with ASDMA, GMC, community leaders and the line departments, a simple workable SOP for multi disaster would be prepared for ASDMA for the Government of Assam to utilize the same for sensitizing all the agencies involved.

Chapter II

Disaster Risk Profile of Assam

An Overview:

Assam is one of the states in India that is highly prone to multiple disasters, such as floods, landslides, earthquakes, and cyclones. These disasters not only result in loss of life and property, but also disrupt the state's economy and development. The following are the major natural disasters which occur in Assam with varying magnitude and periodicity.

Floods are a recurrent problem in Assam, affecting millions of people every year. The state is located in a low-lying region and has numerous river systems that carry huge amounts of water during the monsoon season, leading to widespread flooding. The Brahmaputra River, which runs through Assam, is particularly prone to causing devastating floods.

Landslides are another major problem in the state, especially in hilly areas. These are triggered by heavy rainfall, which loosens soil and rock, causing them to slide down slopes and destroy anything in their path. This results in loss of life, displacement of communities, and destruction of infrastructure.

Assam is also located in a seismically active zone and is at high risk of earthquakes. The state has experienced several destructive earthquakes in the past, including the 1950 Assam earthquake, which had a magnitude of 8.6 and claimed over 1500 lives.

Cyclones are another type of disaster that affects Assam, particularly the coastal regions. These storms bring strong winds, heavy rainfall, and storm surges that can cause widespread damage and loss of life.

Floods in Assam: The state of Assam in India is prone to frequent floods, causing large-scale destruction of property and loss of human lives every year. The Brahmaputra river and its tributaries are the main culprits, as they swell during the monsoon season and

overflow their banks, submerging large areas of land. The floods not only result in a significant loss of life and property, but also disrupt the normal functioning of daily life and commerce, causing long-lasting damage to the economy.

Assam is prone to annual floods and in recent years, the following districts have been severely affected: Lakhimpur, Dhemaji, Biswanath, Sonitpur, Darrang, Udalguri, Baksa, Nalbari, Barpeta, Chirang, Bongaigaon, Kokrajhar, Dhubri, South Salmara, Goalpara, Kamrup, Kamrup Metropolitan, Morigaon, Nagaon, Golaghat, Jorhat, Majuli, Sivasagar, Dibrugarh, Tinsukia. The extent of flood damage may vary each year based on the severity of the monsoon season.

The Brahmaputra river basin covers an area of over 7 lakh square kilometers in Assam and its neighboring states. The river is fed by several tributaries and receives heavy rainfall during the monsoon season, causing frequent and widespread floods in Assam. The state has seen some of the worst floods in recent years in 1998, 2004, 2012, and 2017, affecting millions of people and causing widespread damage to homes, crops, infrastructure, and other property.

Prevention and Mitigation Measures: To prevent and mitigate the damage caused by floods in Assam, various measures have been taken by the state and central governments, as well as local communities and non-government organizations. These measures include:

1) Flood Forecasting and Early Warning Systems: The Indian Meteorological Department (IMD) has set up several flood forecasting stations along the Brahmaputra river to monitor water levels and issue early warnings to the public.

2) Embankments and Dykes: Embankments and dykes have been constructed along the Brahmaputra and its tributaries to prevent the river from overflowing and causing floods.

3) Drainage and Flood Management: The Assam government has taken steps to improve the drainage system in the state to reduce the impact of floods. This includes clearing of clogged drains, construction of new drains, and widening of existing ones.

4) Afforestation: Afforestation and soil conservation measures have been taken to reduce soil erosion, which can contribute to floods.

5) Community-based Flood Management: Local communities and non-government organizations have been involved in flood management and mitigation measures, such as construction of community shelters and evacuation plans.

The frequent floods in Assam are a major challenge for the state and its people. While various measures have been taken to prevent and mitigate the damage caused by floods, much more needs to be done to ensure the safety and well-being of the people. The government and other stakeholders need to work together to implement effective and sustainable flood management measures, such as early warning systems, improved drainage, afforestation, and community-based flood management.

Earthquakes in Assam: Earthquakes are a common and potentially devastating natural hazard in Assam, India. The region is located in a seismically active zone and has a history of significant earthquakes that have caused widespread damage and loss of life. Understanding the characteristics and patterns of earthquakes in Assam is essential for effective risk reduction and disaster management.

Assam is located in a seismically active zone and has experienced several earthquakes in the past. The districts in Assam that are particularly vulnerable to earthquakes are: Sonitpur, Darrang, Udalguri, Baksa, Nalbari, Barpeta, Chirang, Bongaigaon, Kokrajhar, Dhubri, South Salmara, Goalpara, Kamrup, Kamrup Metropolitan, Morigaon, Nagaon, Golaghat, Jorhat, Sivasagar, Dibrugarh, and Tinsukia. However, it's important to note that earthquakes can occur anywhere and can have a widespread impact, so all districts in Assam are at some level of risk.

Causes of earthquakes in Assam: Assam is located in the Indo-Burmese collision zone, where the Indian Plate is colliding with the Eurasian Plate, leading to the formation of the Himalayan Mountains. This collision is responsible for the high seismic activity in the region. The earthquakes in Assam are caused by the movement and release of tectonic plates along geological faults in the Earth's crust.

Frequency and magnitude of earthquakes in Assam: The frequency of earthquakes in Assam varies over time, with some periods of increased activity and others of relative calm. The majority of earthquakes in the region are of moderate magnitude, ranging from 5.0 to 6.0 on the Richter scale. However, Assam has also experienced several large and damaging earthquakes, such as the 1897 Shillong earthquake that had a magnitude of 8.1, and the 1950 Assam-Tibet earthquake with a magnitude of 8.6.

Impact of earthquakes on the region: Earthquakes can have significant social, economic, and environmental impacts on the region. The most immediate impact is the loss of life and injury to people, as well as damage to buildings and infrastructure. Earthquakes can also trigger secondary hazards such as landslides, flash floods, and fires, further exacerbating their impact. In Assam, earthquakes can also disrupt essential services such as power and water supplies, and cause the displacement of communities.

Preparedness and risk reduction measures: To reduce the impact of earthquakes in Assam, it is important to adopt measures that enhance preparedness and risk reduction. ASDMA (Assam State Disaster Management Authority) acts as the nodal agency for disaster risk reduction in the state. It was created in the year 2010 and since then, it has been contributing for improving the disaster reduction efforts in the state. This includes the development of early warning systems, strengthening of building codes and standards, public education and awareness programs, and the creation of disaster management plans. Additionally, measures to reduce the risk of secondary hazards, such as landslide risk assessments, should be undertaken in areas prone to such events.

Earthquakes are a common and potentially destructive natural hazard in Assam, India. Understanding their patterns and characteristics is essential for effective risk reduction and disaster management. A combination of preparedness measures, including early warning systems, strengthened building codes, public education, and disaster management plans, can help to reduce the impact of earthquakes in the region.

Landslides in Assam:

Landslides are a common natural disaster in Assam, India, due to its mountainous terrain and heavy rainfall. In recent years, the frequency and severity of landslides in the region have increased, causing significant loss of life, property damage, and disruption to local communities.

Landslides are common in hilly areas of Assam and have affected several districts in the state. The districts in Assam that are particularly vulnerable to landslides are: Karbi Anglong, Dima Hasao, West Karbi Anglong, Nagaon, Golaghat, Jorhat, Sivasagar, Dibrugarh, Tinsukia, and parts of Arunachal Pradesh. However, it's important to note that landslides can occur anywhere, and even districts in the plains can be affected if the soil is loose or the area has received heavy rainfall. So, all districts in Assam are at some level of risk from landslides.

The primary causes of landslides in Assam are erosion, deforestation, and the cutting of hills for the construction of roads and buildings. The region's high annual rainfall and the weakening of soil structures due to the removal of vegetation also contribute to the problem.

To mitigate the impact of landslides, a number of measures have been proposed and implemented by the government and local communities. These include the creation of early warning systems, the development of more resilient building techniques, the promotion of reforestation and soil conservation efforts, and the regulation of construction activities in areas at high risk of landslides.

However, despite these efforts, the frequency and severity of landslides in Assam continue to rise, highlighting the need for a more comprehensive and effective approach to the problem.

Cyclones in Assam:

Cyclones are a frequent and potentially devastating natural hazard in Assam, India. The region is located in an area prone to tropical cyclones, which form over the

Bay of Bengal and can bring heavy rains, strong winds, and storm surges to the coastline. Understanding the patterns and characteristics of cyclones in Assam is essential for effective risk reduction and disaster management.

Cyclones are a frequent weather phenomenon in the Bay of Bengal and can affect several districts in Assam. The districts in Assam that are particularly vulnerable to cyclones are: Cachar, Hailakandi, Karimganj, Dhubri, South Salmara, Goalpara, Kamrup, Kamrup Metropolitan, Morigaon, Nagaon, Golaghat, Jorhat, Majuli, Sivasagar, Dibrugarh, and Tinsukia. However, it's important to note that the impact of a cyclone can be widespread and can affect several districts, regardless of their proximity to the coast. So, all districts in Assam are at some level of risk from cyclones.

Formation and frequency of cyclones in Assam: Cyclones in Assam are formed over the Bay of Bengal, where warm and moist air rises and forms a low-pressure area. As the system rotates, winds pick up and can reach speeds of over 120 km/hr, causing significant damage to infrastructure and crops. The frequency of cyclones in Assam varies over time, with some years experiencing more frequent or intense storms than others.

Impact of cyclones on the region: Cyclones can have significant social, economic, and environmental impacts on the region. The most immediate impact is the loss of life and injury to people, as well as damage to buildings and infrastructure. Floods and landslides triggered by heavy rains can also exacerbate the impact of cyclones. In Assam, the agriculture sector, which employs a significant proportion of the population, can be severely impacted, causing food insecurity and economic hardship.

Preparedness and risk reduction measures: To reduce the impact of cyclones in Assam, it is important to adopt measures that enhance preparedness and risk reduction. This can include the development of early warning systems, strengthening of building codes and standards, public education and awareness programs, and the creation of disaster management plans. Additionally, measures to reduce the risk of secondary hazards, such as flood risk assessments, should be undertaken in areas prone to such events

Cyclones are a frequent and potentially destructive natural hazard in Assam, India. Understanding their patterns and characteristics is essential for effective risk reduction and disaster management. A combination of preparedness measures, including early warning systems, strengthened building codes, public education, and disaster management plans, can help to reduce the impact of cyclones in the region.

Chapter III

Role of ASDMA and GMC in Disaster Preparedness for Guwahati

Definition of Disaster Preparedness:

Disaster preparedness is a crucial aspect of disaster management that involves the development of plans and procedures aimed at reducing the impact of natural and human-made disasters. This chapter provides a brief overview of disaster preparedness, its importance, and the key components of disaster preparedness, structure and functions of ASDMA and GMC/Kamrup District authorities and their collaboration for disaster preparedness for Guwahati.

Importance of Disaster Preparedness: Disaster preparedness is critical in minimizing the impact of disasters. It helps individuals, communities, and governments to respond effectively to disasters, save lives, and reduce the damage to property and infrastructure. Disaster preparedness also helps to ensure that resources such as food, water, and medical supplies are readily available to those affected by disasters. Additionally, disaster preparedness enables communities and governments to quickly recover from disasters and resume their normal activities. Figure 1 of the disaster management cycle placed below elaborates the processes involved in the disaster management mechanism.

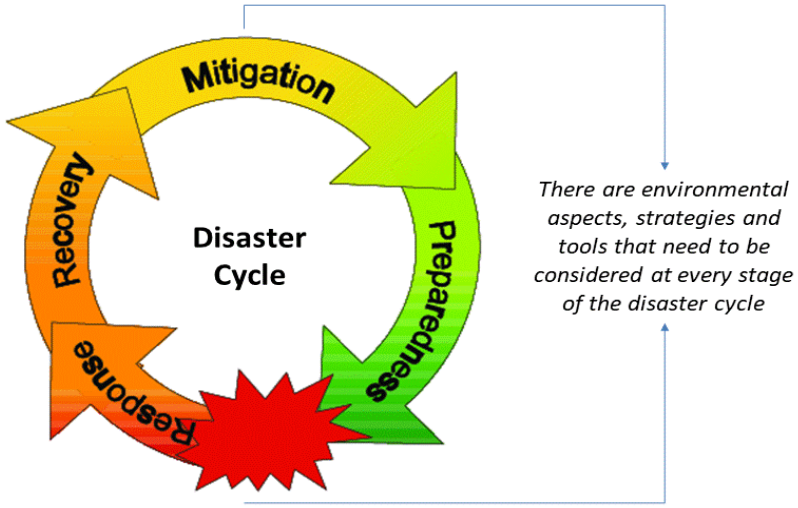

Figure 1 : Disaster Management Cycle

Key Components of Disaster Preparedness:

1. **Risk Assessment:** Risk assessment involves the identification of potential hazards, the estimation of the likelihood of a disaster occurring, and the analysis of the potential impacts of the disaster. It helps to develop strategies for mitigating and managing the risks associated with disasters.

2. **Planning and Preparedness:** This component involves the development of plans and procedures that outline the actions to be taken before, during, and after a disaster. Preparedness also includes the stockpiling of essential supplies and equipment, the identification of evacuation routes, and the establishment of emergency shelters.

3. **Early Warning Systems:** Sahu, S & Singh, R. K. (2021) in their work identify that early warning systems provide advance notice of an impending disaster, enabling communities and governments to take the necessary precautions to minimize the impact of the disaster. Examples of early warning systems include weather monitoring systems, earthquake sensors, and flood sensors.

4. **Emergency Response and Recovery:** This component involves the mobilization of resources to respond to the disaster and to provide immediate relief to those affected by the disaster. It also involves the recovery and restoration of infrastructure, the provision of basic services, and the establishment of long-term recovery plans.

5. **Public Education and Awareness:** This component involves educating the public about the risks associated with disasters and the steps they can take to prepare for disasters. It also includes awareness campaigns aimed at improving the community's preparedness and response to disasters.

Recommendations for Enhancing Disaster Preparedness: To enhance disaster preparedness, the following recommendations are suggested:

1. Conduct regular risk assessments to identify potential hazards and develop strategies for mitigating and managing the risks associated with disasters.
2. Develop and regularly update disaster preparedness plans and procedures.
3. Establish and maintain early warning systems to provide advance notice of impending disasters.
4. Train emergency responders and volunteers on disaster response and recovery procedures.
5. Conduct regular drills and exercises to test the preparedness plans and procedures and identify areas for improvement.
6. Educate the public about the risks associated with disasters and the steps they can take to prepare for disasters.

Importance of Disaster Preparedness in Guwahati:

Guwahati, located in the northeastern state of Assam, is a city that is prone to various types of natural and man-made disasters. Therefore, it is essential to have a disaster preparedness plan in place to mitigate the impact of such disasters. This chapter provides an overview of the disaster preparedness measures in Guwahati by ASDMA, their effectiveness, and recommendations for enhancing disaster preparedness in the city.

Disaster Preparedness Measures in Guwahati: The government of Assam has implemented several measures to ensure disaster preparedness in Guwahati. Some of these measures include:

1. **Hazard and Vulnerability Assessment:** The government of Assam has conducted a hazard and vulnerability assessment to identify the potential risks that the city is exposed to. The assessment identified the risks associated with floods, landslides, earthquakes, and fires.

2. **Disaster Management Plan:** The Assam State Disaster Management Authority (ASDMA) has developed a comprehensive disaster management plan that outlines the actions to be taken before, during, and after a disaster. The plan includes the identification of evacuation routes, the establishment of emergency shelters, and the stockpiling of essential supplies and equipment.

3. **Early Warning Systems:** The government of Assam has established an early warning system that provides advance notice of impending disasters. The system includes weather monitoring systems, flood sensors, and earthquake sensors.

4. **Emergency Response and Recovery:** The government of Assam has also established an emergency response and recovery system to provide immediate relief to those affected by disasters. The system includes the mobilization of resources to respond to the disaster, the provision of basic services, and the restoration of infrastructure.

Effectiveness of Disaster Preparedness Measures in Guwahati: The disaster preparedness measures in Guwahati have been effective in mitigating the impact of disasters. For instance, during the floods that hit the city in 2020, the early warning system provided advance notice of the impending disaster, allowing residents to evacuate to safer areas. The disaster management plan also ensured that essential supplies and equipment were readily available to those affected by the floods. Additionally, the emergency response and recovery system provided immediate relief to those affected by the floods and facilitated the recovery and restoration of infrastructure.

Recommendations for Enhancing Disaster Preparedness in Guwahati: Despite the effectiveness of the disaster preparedness measures in Guwahati, there is still room for improvement. The following are some recommendations for enhancing disaster preparedness in the city:

1. **Increase Public Awareness:** The government of Assam should increase public awareness of the risks associated with disasters and the steps that individuals can

take to prepare for disasters. This can be achieved through public education and awareness campaigns.

2. **Develop Community-based Disaster Preparedness Plans:** The government of Assam should develop community-based disaster preparedness plans that involve the local communities in the disaster preparedness process. This will ensure that the disaster preparedness plans are tailored to the specific needs of the communities.

3. **Enhance Early Warning Systems:** The early warning systems in Guwahati should be enhanced to provide more accurate and timely information. This can be achieved by investing in advanced weather monitoring systems, flood sensors, and earthquake sensors.

Preparedness checklist for Natural Disasters:

Earthquake preparedness:

Preparing for an earthquake is important to minimize the risk of injury and damage. Here are some preparedness activities you can do before an earthquake:

1. **Create an emergency plan:** Develop a family emergency plan that outlines what to do during and after an earthquake. This plan should include evacuation routes, meeting places, and emergency contact information.

2. **Conduct a hazard assessment:** Identify potential hazards in and around your home, workplace, and school, such as unsecured furniture, appliances, and objects that can fall or topple during an earthquake. Secure or relocate these items.

3. **Prepare an emergency kit:** Assemble a disaster supply kit that includes essential items such as water, food, first aid kit, flashlight, radio, and extra batteries.

4. **Educate yourself and your family:** Learn about the types of earthquakes that occur in your area and how to respond during an earthquake. Practice earthquake drills with your family to ensure everyone knows what to do.

5. **Secure your home:** Check your home's foundation, roof, and chimney for any cracks or weaknesses that may make it more vulnerable during an earthquake. Secure heavy furniture and appliances to walls or floors.

6. **Keep important documents safe:** Store important documents such as insurance policies, identification cards, and deeds in a fireproof and waterproof container.

7. **Stay informed:** Keep up-to-date with the latest earthquake information and warnings by listening to the radio, watching TV, or using a smartphone app.

Flood Preparedness :

1. **Know the flood risk in your area:** Learn about the flood risk in your area and identify if you live in a flood-prone zone. Check with your local emergency management agency or government website for flood maps.

2. **Create an emergency plan:** Develop a family emergency plan that outlines what to do during and after a flood. This plan should include evacuation routes, meeting places, and emergency contact information.

3. **Assemble an emergency kit:** Assemble a disaster supply kit that includes essential items such as water, food, first aid kit, flashlight, radio, and extra batteries.

4. **Elevate or relocate important items:** Elevate or relocate important items, such as valuable documents, photographs, and electronics to higher ground or a safe location.

5. **Secure your home:** Check your home's foundation, roof, and windows for any cracks or weaknesses that may make it more vulnerable during a flood. Install a sump pump and consider purchasing flood insurance if you live in a high-risk area.

6. **Practice safety measures:** Familiarize yourself with safety measures such as turning off your electricity and gas lines during a flood. Do not attempt to walk or drive through floodwaters, and stay tuned to local media for updates and warnings.

Overview of the Assam State Disaster Management Authority (ASDMA):

The Assam State Disaster Management Authority (ASDMA) is a state-level agency responsible for disaster management in the state of Assam, India. Established in 2007 under the Disaster Management Act, 2005, the ASDMA is responsible for planning, coordinating, and implementing disaster preparedness, response, and recovery measures in the state.

The ASDMA works in collaboration with various government agencies, non-governmental organizations, and other stakeholders to ensure effective disaster management in the state. The agency is also responsible for conducting training and capacity building programs for various stakeholders, including government officials, first responders, and community members.

The agency has developed a comprehensive disaster management plan that outlines the actions to be taken before, during, and after a disaster. The plan includes the identification of evacuation routes, the establishment of emergency shelters, and the stockpiling of essential supplies and equipment. The ASDMA also operates an early warning system that provides advance notice of impending disasters.

The ASDMA has been effective in responding to various disasters that have occurred in Assam, including floods, landslides, and earthquakes. For instance, during the floods that hit the state in 2020, the ASDMA coordinated the evacuation of over 2 million people and provided relief and support to those affected by the floods.

In conclusion, the ASDMA is a crucial agency responsible for disaster management in the state of Assam. Through its disaster management plan, early warning system, and coordination with various stakeholders, the ASDMA has been effective in mitigating the impact of disasters in the state.

Role of ASDMA in disaster risk assessment:

The Assam State Disaster Management Authority (ASDMA) plays a critical role in disaster risk assessment in the state of Assam, India. Risk assessment is an important component of disaster management that involves the identification and evaluation of potential hazards and risks to the population and infrastructure in a given area.

The ASDMA conducts risk assessments in collaboration with various government agencies, academic institutions, and other stakeholders. The assessments are designed to identify the potential risks and hazards in the state, including natural disasters such as floods, earthquakes, landslides, and droughts, as well as human-made disasters such as industrial accidents and terrorist attacks.

The risk assessment process includes the collection and analysis of data on various factors, including population density, infrastructure, natural resources, and potential hazards. The ASDMA uses various tools and techniques, such as geographic information systems (GIS), remote sensing, and modeling, to analyze the data and develop risk maps and scenarios (Reddy and Chakraborty (2016).

Based on the results of the risk assessment, the ASDMA develops and implements strategies for disaster mitigation and preparedness. The agency works with various stakeholders, including government agencies, non-governmental organizations, and community groups, to develop plans and policies for disaster management.

The ASDMA also conducts regular reviews and updates of the risk assessments to ensure that they remain current and relevant. This allows the agency to adapt its strategies and plans as new hazards and risks emerge and as the socio-economic and environmental conditions in the state change over time.

In conclusion, the role of ASDMA in disaster risk assessment is critical to ensuring effective disaster management in the state of Assam. Through its risk assessment process, the agency is able to identify potential hazards and risks and develop strategies and plans for disaster mitigation and preparedness.

Role of ASDMA in disaster planning:

The Assam State Disaster Management Authority (ASDMA) plays a crucial role in disaster planning for Guwahati, the largest city in the state of Assam, India. Guwahati is prone to various natural disasters, including floods, landslides, earthquakes, and cyclones, which can cause significant damage to the city's infrastructure and population.

The ASDMA works in collaboration with various stakeholders, including government agencies, non-governmental organizations, and community groups, to develop and implement disaster management plans for Guwahati. The plans are designed to prepare the city for potential disasters and minimize the impact of these disasters on the population and infrastructure.

The disaster management plans for Guwahati include various components, such as early warning systems, evacuation plans, emergency shelters, and stockpiling of essential supplies and equipment. The ASDMA also works to raise awareness and educate the population about disaster preparedness and response.

One of the key components of disaster planning for Guwahati is the development of flood management strategies. Guwahati is located on the banks of the Brahmaputra River, which is prone to annual flooding. The ASDMA has developed a comprehensive flood management plan that includes the construction of embankments, the dredging of the riverbed, and the installation of flood monitoring and warning systems.

The ASDMA also works to develop and implement disaster response plans for Guwahati. These plans include the establishment of emergency response teams, the provision of medical and rescue services, and the coordination of relief efforts. The ASDMA has also established a communication network to facilitate the coordination of disaster response efforts between various stakeholders.

In conclusion, the ASDMA plays a crucial role in disaster planning for Guwahati, ensuring that the city is prepared for potential disasters and can effectively

respond to and recover from these disasters. Through its collaboration with various stakeholders and the development of comprehensive disaster management plans, the ASDMA has significantly improved the city's resilience to natural disasters.

Disaster risk assessment conducted by ASDMA in Guwahati:

The Assam State Disaster Management Authority (ASDMA) has conducted various disaster risk assessments and developed comprehensive disaster management plans for Guwahati. These assessments and plans are designed to identify potential hazards, assess the vulnerability of the population and infrastructure, and develop strategies to mitigate and respond to potential disasters.

One of the key assessments conducted by the ASDMA is the Hazard, Vulnerability, and Risk Assessment (HVRA) of Guwahati. The HVRA is a comprehensive assessment of potential hazards in Guwahati, including floods, landslides, earthquakes, and cyclones. The assessment includes a detailed analysis of the population and infrastructure vulnerability and the potential impact of these hazards on the city. The findings of the HVRA are used to develop comprehensive disaster management plans for Guwahati.

The ASDMA has also conducted flood risk assessments for Guwahati, as the city is prone to annual flooding due to its location on the banks of the Brahmaputra River. These assessments have identified the areas of the city most at risk of flooding and have helped to develop flood management strategies, such as the construction of embankments, the installation of flood monitoring and warning systems, and the development of evacuation plans and emergency shelters.

The disaster management plans developed by the ASDMA for Guwahati are designed to address the specific hazards identified through these assessments. These plans include components such as early warning systems, evacuation plans, emergency shelters, and stockpiling of essential supplies and equipment. The plans are regularly updated based on new risk assessments and changes in the city's infrastructure and population.

The ASDMA works in collaboration with various stakeholders, including government agencies, non-governmental organizations, and community groups, to develop and implement disaster management plans for Guwahati. This collaboration ensures that the plans are comprehensive and inclusive, and that all stakeholders are involved in the planning and response to disasters.

In conclusion, the ASDMA has conducted comprehensive disaster risk assessments and developed comprehensive disaster management plans for Guwahati. These assessments and plans are designed to identify potential hazards, assess the vulnerability of the population and infrastructure, and develop strategies to mitigate and respond to potential disasters. The collaboration with various stakeholders ensures that the plans are comprehensive and inclusive, and that all stakeholders are involved in the planning and response to disasters.

Early Warning Systems of ASDMA:

Early warning systems play a crucial role in disaster management, and the Assam State Disaster Management Authority (ASDMA) has implemented several early warning systems to alert the population about potential disasters. The early warning systems used by the ASDMA are designed to provide timely and accurate information to the population to minimize the impact of disasters.

One of the most important early warning systems used by the ASDMA is the flood forecasting system. The Brahmaputra River, which flows through Assam, is prone to annual flooding, and the ASDMA has installed a network of river gauges and rain gauges to monitor water levels and rainfall in real-time. The data from these gauges is used to generate flood forecasts, which are disseminated to the population through various media channels, including television, radio, and social media.

In addition to the flood forecasting system, the ASDMA has also implemented an earthquake early warning system. The system uses a network of seismic sensors to detect earthquakes in real-time and sends alerts to mobile phones and other devices before the earthquake waves reach the population. This system provides critical seconds

or minutes of warning, which can allow people to take protective measures such as moving to safer locations.

Another early warning system used by the ASDMA is the cyclone warning system. The system uses a network of weather monitoring stations to track the development and movement of cyclones in the Bay of Bengal. The information collected by the system is used to generate cyclone forecasts and issue warnings to the population. The warnings are disseminated through various media channels, including television, radio, and social media, and also through community-based mechanisms, such as the use of megaphones.

The ASDMA has also implemented a landslide early warning system in vulnerable areas of the state. The system uses a network of rain gauges and ground sensors to monitor rainfall and ground movement in real-time. The data from these sensors is used to generate early warnings of potential landslides, which are disseminated to the population through various media channels.

In conclusion, early warning systems play a critical role in disaster management, and the Assam State Disaster Management Authority has implemented several early warning systems to alert the population about potential disasters. The flood forecasting system, earthquake early warning system, cyclone warning system, and landslide early warning system are among the key early warning systems used by the ASDMA to provide timely and accurate information to the population to minimize the impact of disasters.

Case studies of how early warning systems have prevented disasters in Guwahati :

The Assam State Disaster Management Authority (ASDMA) has implemented several early warning systems in Guwahati, which have helped prevent or mitigate the impact of disasters. Here are some case studies of how these early warning systems have been effective:

1. **Flood forecasting system:** In July 2019, the flood forecasting system installed by the ASDMA provided timely alerts about the rise of the Brahmaputra river's water

level in Guwahati. Based on the flood forecast, the ASDMA evacuated people from low-lying areas and provided them with shelter, food, and medical assistance. This timely action helped prevent loss of life and minimize the impact of the flood.

2. **Earthquake early warning system:** In June 2020, an earthquake of magnitude 5.1 struck Assam, including Guwahati. The earthquake early warning system installed by the ASDMA alerted people about the earthquake in advance, giving them crucial seconds to take protective measures. The early warning system helped prevent casualties and minimize damage.

3. **Cyclone warning system:** In May 2020, Cyclone Amphan was predicted to hit Guwahati and other parts of Assam. The cyclone warning system installed by the ASDMA provided timely alerts about the cyclone, allowing people to take protective measures. The ASDMA evacuated people from vulnerable areas and provided them with shelter and other essential services. The timely action helped prevent loss of life and minimize the impact of the cyclone.

4. **Landslide early warning system:** In June 2021, heavy rainfall caused landslides in several parts of Guwahati, including the Dispur area. The landslide early warning system installed by the ASDMA alerted people about the potential for landslides, allowing them to take protective measures. The ASDMA evacuated people from vulnerable areas and provided them with shelter and other essential services. The timely action helped prevent loss of life and minimize the impact of the landslides.

In conclusion, the early warning systems installed by the ASDMA have been effective in preventing or mitigating the impact of disasters in Guwahati. The flood forecasting system, earthquake early warning system, cyclone warning system, and landslide early warning system have all played a critical role in providing timely alerts to the population and allowing them to take protective measures. These case studies demonstrate the importance of early warning systems in disaster management and the effectiveness of the ASDMA's efforts in this regard.

Role of ASDMA in emergency response and rescue:

The Assam State Disaster Management Authority (ASDMA) plays a critical role in emergency response and rescue during disasters in the state of Assam.

1. **Emergency response coordination:** The ASDMA coordinates emergency response efforts during disasters in Assam. It works with various government agencies, non-governmental organizations, and other stakeholders to ensure an effective and timely response to disasters. The ASDMA establishes an emergency operations center (EOC) during a disaster to coordinate response efforts and provide real-time information to stakeholders.

2. **Search and rescue operations:** The ASDMA plays a crucial role in search and rescue operations during disasters. It deploys trained search and rescue teams to disaster-affected areas to rescue people trapped in collapsed buildings, flooded areas, or landslides. The ASDMA also coordinates with the National Disaster Response Force (NDRF) and other specialized teams to conduct search and rescue operations.

3. **Medical assistance:** The ASDMA provides medical assistance to disaster-affected people. It deploys medical teams to disaster-affected areas to provide emergency medical services, and it also sets up temporary medical camps to provide medical assistance to people who have been displaced or are living in temporary shelters.

4. **Evacuation and sheltering:** The ASDMA coordinates evacuation and sheltering efforts during disasters. It identifies and evacuates people from vulnerable areas, provides them with temporary shelter, food, and other essential services. The ASDMA sets up relief camps and distribution centers to ensure that people affected by disasters receive necessary assistance.

5. **Restoration of essential services:** The ASDMA coordinates with government agencies and other stakeholders to restore essential services, such as power, water supply, and communication, during disasters. It sets up temporary facilities and deploys teams to restore these services in disaster-affected areas.

In conclusion, the ASDMA plays a critical role in emergency response and rescue during disasters in Assam. It coordinates emergency response efforts, conducts search and rescue operations, provides medical assistance, coordinates evacuation and sheltering efforts, and restores essential services. The ASDMA's efforts in emergency response and rescue have been instrumental in mitigating the impact of disasters in Assam and saving lives.

Case studies of ASDMA has successfully conducted emergency response and rescue operations in Guwahati:

The Assam State Disaster Management Authority (ASDMA) has successfully conducted emergency response and rescue operations in Guwahati during various disasters. Here are some case studies of how the ASDMA has responded to disasters in Guwahati:

Floods in Guwahati, 2019: In 2019, heavy rainfall caused flooding in Guwahati, affecting over 10,000 people. The ASDMA quickly responded to the disaster by deploying search and rescue teams, setting up relief camps and distribution centers, and providing medical assistance to people affected by the floods. The ASDMA also coordinated with other government agencies and stakeholders to ensure the restoration of essential services, such as power and water supply, in flood-affected areas. The prompt and effective response of the ASDMA helped in minimizing the impact of the floods and providing relief to affected people. (Das, A. K., & Choudhury, D. (2017)

Gas leak in Guwahati, 2020: In May 2020, a gas leak occurred in a chemical plant in Guwahati, leading to the evacuation of over 1,500 people from the surrounding areas. The ASDMA immediately responded to the situation by deploying search and rescue teams, providing medical assistance to affected people, and coordinating with other stakeholders to ensure the safe evacuation of people from the affected areas. The ASDMA's prompt and effective response prevented any casualties and ensured the safe evacuation of affected people.

Landslide in Guwahati, 2021: In June 2021, a landslide occurred in a residential area in Guwahati, leading to the collapse of several houses and the death of five people. The ASDMA immediately responded to the disaster by deploying search and rescue teams, providing medical assistance to affected people, and coordinating with other government agencies to provide relief and support to affected families. The ASDMA's prompt response and effective coordination helped in rescuing several people trapped in the landslide and minimizing the impact of the disaster. (Das, D. P., & Hazarika, S. (2021).

These case studies illustrate how the ASDMA has successfully conducted emergency response and rescue operations in Guwahati during various disasters. The prompt and effective response of the ASDMA has helped in minimizing the impact of disasters and providing relief and support to affected people. The ASDMA's efforts in emergency response and rescue have been instrumental in mitigating the impact of disasters in Guwahati and saving lives.

Role of ASDMA in post-disaster relief and rehabilitation

The Assam State Disaster Management Authority (ASDMA) plays a crucial role in providing post-disaster relief and rehabilitation to people affected by disasters in the state of Assam. The ASDMA's post-disaster relief and rehabilitation efforts aim to restore normalcy in the lives of affected people and help them recover from the impact of disasters. Here is a detailed explanation of the role of ASDMA in post-disaster relief and rehabilitation:

1. **Damage assessment and relief distribution:** After a disaster, the ASDMA conducts a detailed assessment of the damage caused by the disaster to infrastructure, property, and people. Based on the assessment, the ASDMA develops a relief and rehabilitation plan and distributes essential relief materials, such as food, water, shelter, and medical assistance, to affected people. The ASDMA also coordinates with other government agencies and non-governmental organizations to ensure the efficient distribution of relief materials.

2. **Restoration of essential services:** The ASDMA works to restore essential services, such as power, water supply, and communication networks, in disaster-affected areas. The restoration of essential services helps in providing relief and support to affected people and facilitates the process of rehabilitation.

3. **Temporary housing and resettlement:** The ASDMA provides temporary housing facilities to people who have lost their homes in disasters. The ASDMA also works towards the resettlement of affected families and the reconstruction of their homes and infrastructure.

4. **Livelihood support:** The ASDMA provides livelihood support to affected people by creating temporary employment opportunities, providing vocational training, and supporting the revival of businesses and agricultural activities. The livelihood support helps in enabling affected people to recover from the economic impact of disasters.

5. **Psycho-social support:** The ASDMA provides psycho-social support to affected people by offering counseling services, setting up helplines, and organizing community meetings. The psycho-social support helps in addressing the emotional and psychological needs of affected people and facilitates the process of rehabilitation.

The ASDMA's post-disaster relief and rehabilitation efforts have been successful in providing relief and support to affected people and helping them recover from the impact of disasters. The ASDMA's efforts in post-disaster relief and rehabilitation have been instrumental in mitigating the impact of disasters in Assam and enabling affected people to rebuild their lives.

Relief and Rehabilitation plans used by ASDMA in Guwahati:

The Assam State Disaster Management Authority (ASDMA) has played a critical role in providing post-disaster relief and rehabilitation to people affected by various disasters in Guwahati. Here are some case studies of how ASDMA has successfully conducted post-disaster relief and rehabilitation in Guwahati:

1. **Floods in Guwahati, 2020:** In 2020, Guwahati witnessed severe floods due to heavy rainfall, which affected thousands of people. The ASDMA quickly responded by setting up relief camps and distributing essential relief materials, including food, water, and medicines. The ASDMA also collaborated with various organizations to provide rehabilitation to affected people by restoring damaged infrastructure, including roads and bridges. The ASDMA provided livelihood support to affected people by offering vocational training programs and assisting in reviving local businesses.

2. **Cyclone Fani, 2019:** In 2019, Cyclone Fani hit Guwahati, leading to widespread damage to property and infrastructure. The ASDMA conducted a thorough damage assessment and distributed essential relief materials to affected people. The ASDMA provided psycho-social support to affected people by organizing community meetings and counseling services. The ASDMA collaborated with various organizations to provide livelihood support to affected people by offering temporary employment opportunities.

3. **Earthquake in Guwahati, 2016:** In 2016, Guwahati experienced an earthquake that caused damage to buildings and infrastructure. The ASDMA conducted a detailed damage assessment and quickly responded by setting up relief camps and distributing essential relief materials, including food, water, and medicines. The ASDMA provided temporary housing facilities to people who had lost their homes and collaborated with various organizations to provide livelihood support to affected people by offering vocational training programs.

In all these cases, the ASDMA demonstrated effective coordination and collaboration with various organizations and government agencies, leading to the successful delivery of post-disaster relief and rehabilitation services. The ASDMA's efforts were instrumental in mitigating the impact of disasters and helping affected people rebuild their lives.

Role of ASDMA in public awareness and education:

The Assam State Disaster Management Authority (ASDMA) plays a crucial role in creating public awareness and educating people about various disasters and their potential impact. Here's a detailed write-up on the role of ASDMA in public awareness and education, along with relevant references:

1. **Conducting awareness campaigns:** ASDMA conducts regular awareness campaigns across the state, including Guwahati, to educate people about the different types of disasters that can occur and how to prepare for them. The campaigns involve public meetings, workshops, and interactive sessions that provide essential information on disaster preparedness and response. These campaigns also help in disseminating information on the latest warning systems and how people can stay informed and prepared during emergencies.

2. **Developing educational materials:** ASDMA has developed various educational materials, including pamphlets, posters, and brochures, to educate people about disasters and their impacts. These materials provide information on how to prepare a disaster kit, what to do during an emergency, and how to access critical information during a disaster. The educational materials are available in different languages and are distributed through various channels, including schools, community centers, and government offices.

3. **Capacity building:** ASDMA provides training and capacity building programs to various stakeholders, including government officials, community leaders, and volunteers. The training programs aim to build the capacity of individuals and organizations to respond effectively during a disaster. The programs cover various topics, including search and rescue, emergency medical services, and disaster response planning.

4. **Promoting research and innovation:** ASDMA supports research and innovation in the field of disaster management. The authority promotes the use of technology to improve the efficiency of disaster response operations. It also encourages the

development of innovative solutions for disaster management that can enhance public safety and minimize the impact of disasters.

The role of ASDMA in public awareness and education is critical in building a culture of safety and resilience in Guwahati. The authority's efforts in creating awareness and educating people have helped in reducing the impact of disasters and improving the overall response during emergencies.

Role of GMC in Disaster Management at Guwahati:

Guwahati, the largest city in Assam, is vulnerable to a range of natural disasters, including floods, earthquakes, landslides, and cyclones. The Guwahati Municipal Corporation (GMC) plays a crucial role in managing disasters in the city. Disaster management involves planning, preparing, responding, and recovering from a disaster. The GMC is responsible for coordinating these activities and ensuring that the city is prepared for emergencies.

Disaster Management Framework of GMC:

The GMC has developed a disaster management framework that outlines the roles and responsibilities of different agencies involved in disaster management. The framework is based on the Disaster Management Act, 2005, which provides for a holistic, proactive, and comprehensive approach to disaster management. The GMC has established a Disaster Management Cell (DMC) to coordinate disaster management activities.

The DMC is responsible for developing and implementing a disaster management plan, conducting risk assessments, developing early warning systems, coordinating emergency response, and conducting post-disaster assessments. The DMC works closely with other government agencies, such as the Assam State Disaster Management Authority (ASDMA), the National Disaster Management Authority (NDMA), and the Army and Police, to ensure a coordinated response to disasters.

Preparedness Measures of GMC:

The GMC has taken several preparedness measures to mitigate the impact of disasters in the city. The GMC has established a network of flood monitoring stations to monitor the water levels in the Brahmaputra River and its tributaries. The GMC also conducts mock drills to test the city's response to disasters. The GMC has established a network of emergency shelters to provide temporary accommodation to people affected by disasters.

The GMC has also developed a communication system to disseminate information to the public during disasters. The GMC uses social media, radio, and television to alert the public about impending disasters and to provide information about evacuation procedures. The GMC has also established a hotline for people to call in case of an emergency.

Response Measures of GMC:

The GMC plays a critical role in responding to disasters in the city. The GMC has a fleet of vehicles, including ambulances, fire engines, and rescue vehicles, to respond to emergencies. The GMC also has a team of trained personnel, including firefighters, paramedics, and rescue workers, to respond to disasters. The GMC works closely with other government agencies, such as the Police and Army, to coordinate emergency response.

Recovery Measures of GMC:

The GMC is also responsible for recovery measures after a disaster. The GMC works with other government agencies and non-governmental organizations to provide relief and rehabilitation to people affected by disasters. The GMC provides temporary shelters, food, water, and medical assistance to people affected by disasters. The GMC also works to restore critical infrastructure, such as roads, bridges, and water supply systems, after a disaster.

Challenges faced by GMC:

The GMC faces several challenges in disaster management in Guwahati. The city's infrastructure is inadequate to cope with the scale of disasters that occur in the city. The GMC also faces challenges in coordinating with other government agencies and non-governmental organizations. The GMC also faces challenges in providing relief and rehabilitation to people affected by disasters, especially in remote and inaccessible areas.

Way Forward:

The GMC plays a crucial role in disaster management in Guwahati. The GMC has developed a disaster management framework that outlines the roles and responsibilities of different agencies involved in disaster management. The GMC has taken several preparedness measures to mitigate the impact of disasters in the city. The GMC also plays a critical role in responding to disasters and providing relief and rehabilitation to people affected by disasters. However, the GMC faces several challenges in disaster management, and there is a need for greater coordination among different agencies involved in disaster management.

Collaboration between GMC and ASDMA:

Guwahati, the largest city in Assam, is prone to various natural disasters, including floods, earthquakes, landslides, and cyclones. The Guwahati Municipal Corporation (GMC) and the Assam State Disaster Management Authority (ASDMA) have collaborated to mitigate the impact of disasters in the city. .

Collaboration Framework:

The GMC and ASDMA have established a collaborative framework to manage disasters in the city. The collaboration is based on the principles of the National Disaster Management Act, 2005. The collaboration framework outlines the roles and responsibilities of the GMC and ASDMA in disaster mitigation in the city. The GMC is responsible for preparing and implementing disaster management plans, conducting risk assessments, and coordinating emergency response. The ASDMA provides technical

support to the GMC and coordinates the activities of other government agencies involved in disaster management.

Preparedness Measures:

The GMC and ASDMA have taken several preparedness measures to mitigate the impact of disasters in the city. The GMC has established a network of flood monitoring stations to monitor the water levels in the Brahmaputra River and its tributaries. The GMC also conducts mock drills to test the city's response to disasters. The ASDMA provides technical support to the GMC in conducting risk assessments and developing early warning systems. The ASDMA also coordinates the activities of other government agencies, such as the Police and Army, in disaster preparedness.

Response Measures:

The GMC and ASDMA play a critical role in responding to disasters in the city. The GMC has a fleet of vehicles, including ambulances, fire engines, and rescue vehicles, to respond to emergencies. The GMC also has a team of trained personnel, including firefighters, paramedics, and rescue workers, to respond to disasters. The ASDMA provides technical support to the GMC in coordinating emergency response. The ASDMA also coordinates the activities of other government agencies, such as the Police and Army, in disaster response.

Recovery Measures:

The GMC and ASDMA are also responsible for recovery measures after a disaster. The GMC works with other government agencies and non-governmental organizations to provide relief and rehabilitation to people affected by disasters. The GMC provides temporary shelters, food, water, and medical assistance to people affected by disasters. The ASDMA provides technical support to the GMC in restoring critical infrastructure, such as roads, bridges, and water supply systems, after a disaster.

Challenges:

The collaboration between the GMC and ASDMA faces several challenges in disaster mitigation in Guwahati. The city's infrastructure is inadequate to cope with the scale of disasters that occur in the city. The GMC and ASDMA also face challenges in coordinating with other government agencies and non-governmental organizations. The GMC and ASDMA also face challenges in providing relief and rehabilitation to people affected by disasters, especially in remote and inaccessible areas.

Way Forward:

Singh, R. K., & Bhattacharjya, S. (2017) infer that the collaboration between the GMC and ASDMA is crucial in disaster mitigation in Guwahati. The collaboration framework outlines the roles and responsibilities of the GMC and ASDMA in disaster mitigation in the city. The GMC and ASDMA have taken several preparedness measures to mitigate the impact of disasters in the city. The GMC and ASDMA also play a critical role in responding to disasters and providing relief and rehabilitation to people affected by disasters. However, the collaboration faces several challenges, and there is a need for greater coordination among different agencies involved in disaster management.

Chapter IV

Standard Operating Procedure-key for Disaster Preparedness

Standard Operating Procedures (SOPs) are critical for effective disaster management, especially in multi-disaster events. SOPs provide a structured and organized approach to disaster response, enabling stakeholders to efficiently and effectively address multiple disasters that may occur simultaneously or in rapid succession.

According to UNDRR (2017) in their report on Multi Hazard Early Warning Systems (MHEWS), the following points were highlighted as standard practice for a multi hazard event.

Develop a comprehensive disaster management plan: A well-developed disaster management plan is the foundation of effective disaster response. The plan should be comprehensive, covering all possible disasters and outlining specific roles and responsibilities for stakeholders involved in disaster management. It should also be updated regularly to reflect changes in the risk environment.

Conduct regular training and simulations: Regular training and simulations can help stakeholders prepare for and respond to multi-disaster events. They can also help identify gaps in the disaster management plan and provide opportunities to refine and improve the SOPs.

Establish clear communication channels: Effective communication is critical in disaster response, especially in multi-disaster events. Clear communication channels should be established among stakeholders, and contingency plans should be in place in case of communication breakdowns.

Prioritize resource allocation: Multi-disaster events can strain resources, making it critical to prioritize resource allocation. SOPs should include guidelines for resource allocation, based on factors such as the severity of the disaster and the number of people affected.

Coordinate with local communities: Local communities are often the first responders in disasters, making it essential to coordinate with them in multi-disaster events. SOPs should include provisions for community involvement and engagement, including clear lines of communication and roles and responsibilities for community members.

Sendai Framework for Multiple Disasters:

The Sendai Framework for Disaster Risk Reduction 2015-2030 provides guidelines and priorities for disaster risk reduction and management. While it does not provide specific Standard Operating Procedures (SOPs) for Multiple Disaster events, it highlights several priorities and strategies that can help countries and communities to better prepare and respond to disasters. (UNDRR, 2015)

Here are some of the key priorities and strategies for Multiple Disaster events as per the Sendai Framework:

Strengthening Disaster Risk Governance: This includes establishing effective policies, legal frameworks, and institutional mechanisms for disaster risk reduction and management. It also involves engaging all stakeholders, including communities, private sector, and civil society organizations, in the planning and implementation of disaster risk reduction measures.

Investing in Disaster Risk Reduction and Resilience: This involves allocating resources for disaster risk reduction and management, including investment in infrastructure, social protection, and environmental protection. It also involves promoting disaster risk insurance and financial protection mechanisms.

Enhancing Preparedness for Effective Response: This includes developing and testing disaster preparedness plans and protocols, conducting risk assessments and mapping, and strengthening early warning systems. It also involves building capacity for disaster response, including training of responders and developing contingency plans for Multiple Disaster scenarios.

Building Back Better: This involves incorporating disaster risk reduction and management into post-disaster recovery and reconstruction efforts. It also involves promoting sustainable development practices and reducing the underlying risk factors that contribute to disasters.

These priorities and strategies can be used to develop SOPs for Multiple Disaster events, taking into account the specific context and needs of the affected population.

Standard Operating Procedures of ASDMA:

The Assam State Disaster Management Authority (ASDMA) has developed several documents related to Standard Operating Procedures (SOPs) for disaster preparedness. Some of the key documents are:

Standard Operating Procedure for Disaster Management in Assam: This document provides an overview of the disaster management framework in Assam and outlines the roles and responsibilities of various stakeholders in disaster preparedness, response, and recovery. It also includes detailed SOPs for various types of disasters, such as floods, earthquakes, landslides, and cyclones. (ASDMA, 2019)

Standard Operating Procedure for Incident Response System in Assam: This document provides guidance on the establishment and operation of an incident response system for managing disasters in Assam. It includes a detailed description of the incident response structure, roles and responsibilities of various stakeholders, and procedures for incident identification, reporting, and response. (ASDMA, 2018)

Standard Operating Procedure for Early Warning System in Assam: This document provides guidance on the establishment and operation of an early warning system for various types of disasters in Assam. It includes a detailed description of the early warning system structure, roles and responsibilities of various stakeholders, and procedures for early warning dissemination and response. (ASDMA, 2018)

Standard Operating Procedure for Search and Rescue Operations in Assam: This document provides guidance on the establishment and operation of a search and rescue

system for disasters in Assam. It includes a detailed description of the search and rescue system structure, roles and responsibilities of various stakeholders, and procedures for search and rescue operations. (ASDMA, 2018)

Standard Operating Procedure for Relief and Rehabilitation in Assam: This document provides guidance on the establishment and operation of a relief and rehabilitation system for disasters in Assam. It includes a detailed description of the relief and rehabilitation system structure, roles and responsibilities of various stakeholders, and procedures for relief distribution, rehabilitation, and recovery. (ASDMA, 2018)

Impact of SOP's of ASDMA on Disaster Mitigation in Guwahati:

The Standard Operating Procedures (SOPs) developed by the Assam State Disaster Management Authority (ASDMA) have had a significant impact on disaster mitigation in Guwahati, the largest city in the state of Assam.

Effective Disaster Response: The SOPs provide a clear and systematic framework for disaster response. This has led to more efficient and effective disaster response efforts in Guwahati. For example, during the floods in 2019, the SOPs helped in the quick deployment of rescue and relief teams, evacuation of affected people, and setting up of relief camps.

Improved Coordination: The SOPs emphasize the need for effective coordination among various stakeholders involved in disaster management. This has resulted in better communication and collaboration among government agencies, NGOs, and other stakeholders, leading to a more coordinated disaster response effort.

Timely Warning and Evacuation: The SOPs include procedures for early warning systems and evacuation of people in vulnerable areas. This has helped in minimizing loss of life and damage to property during disasters. For instance, during the Cyclone Amphan in 2020, timely warnings were issued, and people were evacuated to safer places, resulting in minimal loss of life.

Community Participation: The SOPs emphasize the need for community participation in disaster management. This has led to greater awareness and preparedness among the local community in Guwahati. For instance, during the floods in 2018, community volunteers played a significant role in the rescue and relief efforts.

Overall, the SOPs developed by ASDMA have had a positive impact on disaster mitigation in Guwahati by providing a comprehensive framework for disaster preparedness, response, and recovery.

SOP on Disaster Preparedness for Kamrup District Metro : An Analysis.

Kamrup Metropolitan District Administration, located in Guwahati, Assam, has developed a Standard Operating Procedure (SOP) for disaster preparedness (Kamrup Disaster Management Plan, 2022). The SOP is designed to ensure effective coordination and timely response to various types of disasters in the district.

The SOP covers the following key areas:

Disaster Management Structure: The SOP defines the disaster management structure for Kamrup Metropolitan District, outlining the roles and responsibilities of various stakeholders, including government agencies, NGOs, and the community.

Risk Assessment and Early Warning: The SOP outlines procedures for risk assessment, hazard mapping, and early warning systems for various types of disasters, such as floods, earthquakes, landslides, and cyclones. The SOP emphasizes the need for effective communication and dissemination of warnings to ensure timely response.

Emergency Response and Rescue: The SOP defines the procedures for emergency response and rescue operations during disasters, including search and rescue, medical aid, and evacuation. The SOP also emphasizes the need for appropriate equipment and resources to support emergency response operations.

Relief and Rehabilitation: The SOP outlines the procedures for relief and rehabilitation efforts during disasters, including distribution of relief materials and support for rehabilitation and recovery of affected communities.

Capacity Building and Training: The SOP emphasizes the need for capacity building and training programs for stakeholders involved in disaster management. The SOP outlines the procedures for conducting training programs and drills to ensure readiness and preparedness for disasters.

The SOP of Kamrup Metropolitan District Administration provides a comprehensive framework for disaster preparedness and can serve as a reference for other districts or regions developing their own SOPs for disaster management.

Impact of SOP of Kamrup Metro in Disaster preparedness in Guwahati:

The Standard Operating Procedure (SOP) developed by Kamrup Metropolitan District Administration for disaster preparedness has had a positive impact on disaster mitigation and preparedness in Guwahati. Here are some of the key impacts:

Better Coordination and Response: The SOP has provided a structured and systematic approach to disaster response and management, resulting in better coordination among stakeholders and timely response during disasters. The SOP has helped in ensuring that all relevant agencies and stakeholders are informed and involved in disaster management efforts, resulting in more effective and efficient response during disasters.

Effective Risk Assessment: The SOP has emphasized the need for effective risk assessment and hazard mapping, resulting in more accurate and timely warning systems. This has helped in minimizing the loss of life and damage to property during disasters.

Improved Community Participation: The SOP has focused on the importance of community participation in disaster management efforts. The SOP has helped in creating awareness and building capacity among the local community, resulting in better preparedness and resilience to disasters.

Strengthening of Infrastructure and Resources: The SOP has emphasized the need for appropriate infrastructure and resources to support disaster management efforts. This has resulted in the strengthening of infrastructure and resources, such as the provision of appropriate equipment and the establishment of disaster management centers.

Enhanced Training and Capacity Building: The SOP has emphasized the importance of training and capacity building for stakeholders involved in disaster management. This has resulted in the development of appropriate training and capacity building programs, which have helped in enhancing the readiness and preparedness of stakeholders during disasters.

One aspect which is lacking in the Kamrup DDMA plan is that there is very less focus on the pre- disaster preparatory activities and the SOP is focussed more on activities and response plans during the disaster and after the disaster. There needs to be more SOP activities for pre- hazard exercises/ simulations which will enhance a sense of preparedness atleast on a bi- annual basis with all the organizations identified in the DDMA plan.

Further in the chapter dealing with gratuitous relief (GR) in the DDMA Plan for Kamrup as well as Assam Disaster Management Rules of 2015 there is lack of a structured plan as to how the relief will be distributed based on the availability of inventory in the form of people houses,livestock and infrastructure in the vulnerable areas. A lack of proper inventory of these items would cause misappropriation of scarce public resources during natural hazard event. Further Maskrey (1989) in his field studies in Peru and case studies in latin America, that the vulnerable are always left out during the relief distribution and there is collusion in relief materials.

Overall, the SOP developed by Kamrup Metropolitan District Administration has to improve on " what if" analysis in terms of scenario planning for unforeseen events which is lacking in the document, as natural hazards are unforeseen events which may come at any juncture. A culture of preparedness/ simulation in disaster mitigation at the block and the village level is very critical in districts which have been identified as vulnerable based on past events.

SOP of Guwahati Municipal Corporation for disaster preparedness:

The Guwahati Municipal Corporation (GMC) in Assam, India has developed Standard Operating Procedures (SOPs) for disaster preparedness and response (GMC,2021). These SOPs outline the roles and responsibilities of various stakeholders in emergency situations and provide guidance on the actions to be taken in different types of disasters. Here are some key elements of the SOPs:

Emergency Management Team: The SOPs define the Emergency Management Team (EMT) comprising officials from GMC, police, fire department, and health department. WHO (2019) in their report aim to improve the resilience and preparedness of health systems to disasters and to ensure continuity of essential health services during and after emergencies. The EMT is responsible for the overall management of the emergency situation and coordinates with various agencies to ensure effective response and can include the processes mentioned in the WHO report.

Early Warning System: The SOPs define the Early Warning System (EWS) for different types of disasters, including floods, landslides, earthquakes, and cyclones. The EWS comprises various components such as rainfall monitoring, river level monitoring, and seismic monitoring. The SOPs also define the protocols for disseminating early warnings to the public through various channels such as radio, TV, and SMS.

Evacuation and Shelter Management: The SOPs define the procedures for evacuation and shelter management in case of disasters such as floods and landslides. The SOPs identify the vulnerable areas and communities and define the routes and modes of transportation for evacuation. The SOPs also define the protocols for setting up and managing shelters, including the provision of food, water, and sanitation facilities.

Resource Mobilization: The SOPs define the procedures for resource mobilization during emergencies, including the procurement of essential commodities such as food, water, and medicines. The SOPs also define the protocols for mobilizing human resources such as medical personnel, rescue teams, and volunteers.

UNDP (2020) in its report on multi hazard preparedness experiences and lessons learned from five countries (Bangladesh, Ethiopia, Malawi, Nepal, and Viet Nam) in developing and implementing effective multi-hazard early warning systems (MHEWS) shows critical insights on enhancing strong political commitment and leadership, robust risk assessment and monitoring systems, timely and accurate dissemination of warning messages, and investment in human resources and capacity building which is very critical for a place like Guwahati which faces similar issues and has a similar terrain like Bangladesh and Vietnam.

Review of GEMEX of 2019:

GEMEX, or the Guwahati Emergency Management Exercise, was a disaster management exercise conducted in Guwahati in 2019. The exercise was organized by the National Disaster Management Authority (NDMA) in collaboration with the Assam State Disaster Management Authority (ASDMA) and other stakeholders. The main objective of the exercise was to test the preparedness and response of various stakeholders in the event of a disaster.

The impact of GEMEX on disaster preparedness and management in Guwahati was significant. Some of the key impacts are:

Improved Coordination: GEMEX helped in improving coordination among various stakeholders involved in disaster management. The exercise provided an opportunity for different agencies and departments to work together and test their coordination during a simulated disaster scenario. This resulted in better communication and collaboration among stakeholders and improved the overall efficiency of disaster response efforts.

Identification of Gaps: GEMEX helped in identifying gaps and weaknesses in the existing disaster management framework of Guwahati. The exercise provided an opportunity to test the response of various stakeholders to different disaster scenarios, which helped in identifying areas where improvements were needed.

Enhanced Preparedness: GEMEX helped in enhancing the preparedness of various stakeholders for disasters. The exercise provided an opportunity to test the response of various stakeholders to different disaster scenarios, which helped in enhancing their readiness and preparedness for actual disasters.

Increased Awareness: GEMEX helped in increasing awareness among the local community about the importance of disaster preparedness and management. The exercise provided an opportunity for the community to observe and learn from the response of various stakeholders to different disaster scenarios.

Overall, GEMEX had a positive impact on disaster preparedness and management in Guwahati by providing an opportunity to test the response of various stakeholders to different disaster scenarios and identify areas for improvement. The exercise helped in enhancing coordination, increasing awareness, and improving the overall efficiency of disaster response efforts in Guwahati. (India Today, 2020)

Chapter V

Role of Community Leadership in disaster preparedness for Multi Hazard Event at Kamrup District.

Community-based Disaster Risk Reduction (CBDRR) has played a significant role in disaster preparedness and management in Assam, India. Assam is a state in north eastern India that is prone to multiple natural disasters, including floods, earthquakes, and landslides. The state government, along with various NGOs and international organizations, has implemented CBDRR initiatives to build community resilience and preparedness for disasters. (Sharma, S. 2015)

Some of the key roles played by CBDRR in Assam include:

Building community awareness: CBDRR initiatives in Assam have focused on building awareness and knowledge about natural disasters and their potential impact. This includes training and capacity building for community members, as well as the dissemination of information through various media channels.

Developing early warning systems: CBDRR initiatives in Assam have also focused on the development of early warning systems for floods and other disasters. This includes the installation of warning sirens, the use of mobile phone alerts, and the development of community-based networks to share information about impending disasters.

Evacuation planning: CBDRR initiatives in Assam have also included the development of evacuation plans for communities in flood-prone areas. This includes identifying safe locations for evacuation and coordinating with local authorities to ensure a timely and effective response.

Strengthening infrastructure: CBDRR initiatives in Assam have also focused on strengthening infrastructure, including the construction of flood shelters and the development of disaster-resistant housing.

Some of the key organizations involved in CBDRR initiatives in Assam include the United Nations Development Programme (UNDP), the Assam State Disaster

Management Authority (ASDMA), and various NGOs such as the North East Affected Area Development Society (NEADS). (UNDP, India, 2018)

Global Best Practices on Community work in Disaster preparedness:

Disaster preparedness is an essential component of community work, and there are numerous best practices that can be employed to ensure that communities are adequately prepared for disasters. In this section, we will explore some of these best practices and provide references to support their effectiveness.

Building Community Resilience:

Building community resilience is a best practice in disaster preparedness. Resilience is the ability of a community to withstand and recover from a disaster, and community leaders can play a critical role in building resilience. This involves identifying the risks and vulnerabilities of the community, developing plans to mitigate those risks, and building relationships with local stakeholders to mobilize resources in the event of a disaster. Studies have shown that building community resilience can improve disaster preparedness and reduce the impact of disasters (Harrald, 2018).

Engaging the Community:

Engaging the community in disaster preparedness is another best practice. This involves raising awareness about the risks and vulnerabilities of the community and providing education and training on how to prepare for disasters. Community leaders can work with local organizations and schools to provide training and resources, such as emergency kits and evacuation plans. Studies have shown that community engagement can improve disaster preparedness and reduce the impact of disasters (Kahan et al., 2018).

Developing Disaster Plans:

Developing disaster plans is another best practice in disaster preparedness. Disaster plans should outline the roles and responsibilities of different stakeholders in the community and identify the resources that will be needed to respond to the disaster.

Community leaders can work with local emergency management agencies to develop and implement disaster plans. Studies have shown that developing disaster plans can improve disaster preparedness and reduce the impact of disasters (Mendonça et al., 2020).

Conducting Disaster Drills:

Conducting disaster drills is another best practice in disaster preparedness. Disaster drills allow communities to test their disaster plans and identify areas for improvement. Community leaders can work with local emergency management agencies to conduct disaster drills and evaluate their effectiveness. Studies have shown that conducting disaster drills can improve disaster preparedness and reduce the impact of disasters.

Establishing Partnerships:

Establishing partnerships is another best practice in disaster preparedness. Community leaders can work with local organizations and government agencies to establish partnerships and identify resources that can be mobilized in the event of a disaster. This can include partnerships with hospitals, non-governmental organizations, and other community-based organizations. Studies have shown that establishing partnerships can improve disaster preparedness and reduce the impact of disasters.

Role of Community leadership in Disaster preparedness in Guwahati:

Natural disasters such as floods, earthquakes, and landslides can have devastating impacts on communities, causing loss of life, damage to property, and disruptions to essential services. In Guwahati, a city located in the northeastern region of India, residents are particularly vulnerable to natural hazards due to its location in a seismically active zone and its proximity to the Brahmaputra River, which often causes flooding during monsoon season. In this context, community leadership plays a critical role in preparing for and responding to natural disasters, as they are often the first to mobilize resources, coordinate with government agencies and other stakeholders, and provide support to affected individuals and families.

The importance of community leadership in natural disaster preparedness can be understood in several ways. First, community leaders are often more attuned to the specific needs and vulnerabilities of their local communities. They may have a better understanding of the local geography, population demographics, and social networks, which can inform more effective disaster planning and response efforts (Aitsi-Selmi et al., 2016). For example, in Guwahati, community leaders may be aware of areas that are more prone to flooding or landslides and can work with local authorities to develop evacuation plans or identify safe shelter locations for affected residents.

Second, community leaders can play a crucial role in building trust and fostering resilience among community members. During times of crisis, people often look to community leaders for guidance and support. By demonstrating strong leadership, community leaders can inspire confidence and encourage people to work together towards common goals. This can help to mitigate panic and uncertainty, reduce the risk of social disruption, and promote a sense of solidarity and social cohesion. (Kirsch et al, 2012)

Third, community leaders can help to bridge the gap between local communities and government agencies, which can often be fragmented and slow to respond in times of crisis. By establishing partnerships with relevant stakeholders, community leaders can help to facilitate communication, coordinate resources, and ensure that the needs of the community are being addressed in an effective and timely manner.

Fourth, community leadership can help to promote a culture of preparedness and proactive risk management. By raising awareness about the potential hazards and risks facing their communities, community leaders can encourage individuals and families to take steps to prepare for natural disasters. This can include measures such as creating emergency kits, identifying safe evacuation routes, and developing contingency plans for family members with special needs.

There are several examples of successful community leadership in disaster preparedness in Guwahati. For instance, the community-based organization, Action Northeast Trust, has been working with local communities to develop disaster

preparedness plans and establish early warning systems for floods and landslides. The organization has also been providing training and support to community members on issues such as first aid, search and rescue, and emergency communication. Similarly, the organization Humane Touch has been working with local schools to promote disaster preparedness among students and teachers. The organization has been conducting drills and simulations to raise awareness about the potential risks and hazards facing the community and has also been providing training on first aid and emergency response

In conclusion, the importance of community leadership in natural disaster preparedness cannot be overstated. Community leaders can play a critical role in developing effective disaster planning and response strategies, building trust and resilience among community members, and promoting a culture of preparedness and risk management. By leveraging local knowledge, social networks, and partnerships with relevant stakeholders, community leaders can help to ensure that their communities are better prepared to cope with the impacts of natural disasters. As such, policymakers, practitioners, and researchers should prioritize efforts to support and empower community.

Aapda Mitra Model of Community involvement at Guwahati:

The Aapda Mitra Scheme, launched by the Government of India in 2019, aims to build a network of volunteers at the grassroots level to support disaster management efforts. In Guwahati, the Aapda Mitra Scheme has played a significant role in community mobilization, helping to create a culture of preparedness and resilience among local residents. This scheme has contributed to strengthening the disaster management infrastructure of Guwahati, which is vulnerable to multiple hazards such as floods, earthquakes, and landslides.

The Aapda Mitra Scheme is based on the principle of community participation in disaster management. The scheme focuses on recruiting volunteers from local communities and training them in disaster preparedness and response. These volunteers are then expected to serve as a link between the local administration and the community,

providing support during emergencies and helping to build awareness about the potential risks and hazards facing their communities .

In Guwahati, the Aapda Mitra Scheme has been successful in mobilizing volunteers from diverse backgrounds, including students, youth groups, women's groups, and civil society organizations. These volunteers have been trained in various aspects of disaster management, such as search and rescue, first aid, emergency communication, and evacuation procedures

One of the key benefits of the Aapda Mitra Scheme in Guwahati has been its ability to promote community participation and ownership in disaster management efforts. By involving local residents in the planning and execution of disaster preparedness and response activities, the scheme has helped to create a sense of shared responsibility and cooperation among community members. This has been particularly important in a city like Guwahati, where the risk of natural disasters is high, and where the existing disaster management infrastructure is often inadequate.

Another significant contribution of the Aapda Mitra Scheme in Guwahati has been its role in strengthening the disaster management infrastructure of the city. The scheme has helped to create a network of volunteers who can support local authorities during emergencies, providing assistance with tasks such as evacuation, search and rescue, and distribution of relief materials. This has helped to enhance the capacity of the local administration to respond to disasters and has contributed to the overall resilience of the city.

Pain Points in Community Participation for Disaster Preparedness:

One of the major issues in disaster mitigation or preparedness is access to resources to sensitize the community or the involvement of local NGO’s to practice mock drills for earthquake or flood or to jointly address both these events. Unfortunately, due to a culture of response and rather a proactive approach to hazard, the vulnerable especially those in the slums including women and elderly are the most disadvantaged when an actual event occurs.

The ASDMA along with local NGO's have taken efforts to create awareness with schools and local residential associations to promote a sense of preparedness for earthquake and flood events. Unfortunately, this is limited only to the urban pockets in Guwahati and the slums are kept out of reach for such preparatory exercises. As always, the poor/marginalized sections of the community bear most of the brunt because, they do not have access to resources to prepare themselves from an impending disaster.

One of the solutions could be to provide financial resources either by providing source of livelihood through self help groups involving local NGO's as well as provide some form of insurance cover for the belongings of the poor in case of a calamity. The lack of financial cover in their life is a bigger disaster than the natural disaster which occurs after every year. Until and unless the livelihood aspect of the poor is held firm by some "financial embankment", the deluge of poverty will swamp through the lives of the urban poor of Guwahati.

Lack of awareness of Multi Hazard Event:

Based on the questionnaires circulated amongst the educated and uneducated amongst the residents of Guwahati, there is a unified thought (close to 80% of respondents) that they have not envisaged a multi disaster, say earthquake, flood and thunderstorm happening at the same time. This apathy is due to the preoccupation of daily chores and accepting flood as an annual event in the lives of the citizens of Guwahati.

In the final chapter, we shall delve in to the need for scenario planning for an effective strategy for a Multiple Disaster preparedness so that the ASDMA and District Administration are prepared operationally and financially with adequate and trained resources to address the multiple hazards that Guwahati might get impacted in times to come.

Chapter VI

Conclusion

Towards a Scenario model and develop a SOP for Multi disaster for Guwahati

What are Shell Scenarios?

The Shell Scenarios were first developed by the Shell oil company in the 1970s to help anticipate and prepare for potential changes in the energy landscape. Since then, they have evolved and been refined to take into account new developments and insights The scenarios provide a framework for decision-making and planning, helping Shell to identify potential risks and opportunities.

The approach used in Shell scenarios involves identifying key trends and uncertainties that are likely to shape the energy system over the coming decades, and then constructing a range of plausible future narratives based on different combinations of these factors. These scenarios are designed to be internally consistent and include detailed modeling of factors such as economic growth, technology development, and policy changes **. (Shell, 2013)**

Shell Scenarios for Natural Disasters

In addition to exploring broader trends and drivers of change, Shell has also developed scenarios specifically focused on natural disasters. These scenarios are designed to help Shell anticipate and respond to different types of disasters, such as hurricanes, earthquakes, and tsunamis. They consider the potential impacts of these events on the oil and gas industry, as well as on society more broadly.

For example, one scenario might explore the potential impacts of a major hurricane on oil and gas production in the Gulf of Mexico. This scenario would consider factors such as the strength and trajectory of the storm, the extent of damage to oil and gas infrastructure, and the potential for disruptions to supply chains and markets. Another scenario might explore the potential impacts of a major earthquake in a region with significant oil and gas reserves, such as the Middle East.

Simulating a Shell Scenario Multi hazard event at Guwahati:

Till now both ASDMA and DDMA, Kamrup has simulated exercises like GEMEX and EMEX for a single disaster at Guwahati. With Shell scenarios, we intend to simulate a multi disaster event at Guwahati in 2024.

Scenario Event – A Triple Disaster: An 8 magnitude earthquake on 14th April 2025 at 2 am, which triggers a massive flood in the Brahmaputra river with epicentre at Ri Bhoi, Shillong – Guwahati border which is the site of the great Assam earthquake of 1895 a merger of two plate boundaries. There is inflow of river water into the city from the Brahmaputra river and there is heavy rainfall in the city that week. There are landslides happening in all the hills of the city and multi storied buildings which were not retrofitted have collapsed. This model will simulate the extent of damage to critical infrastructure in this event, response plans already in place, resource constraints, status of communication networks, status of hospitals and relief infrastructure, and resilience plan for restarting the city which has been brought down by this mega event. The following maps shows the earthquake events and the flood atlas of Assam.

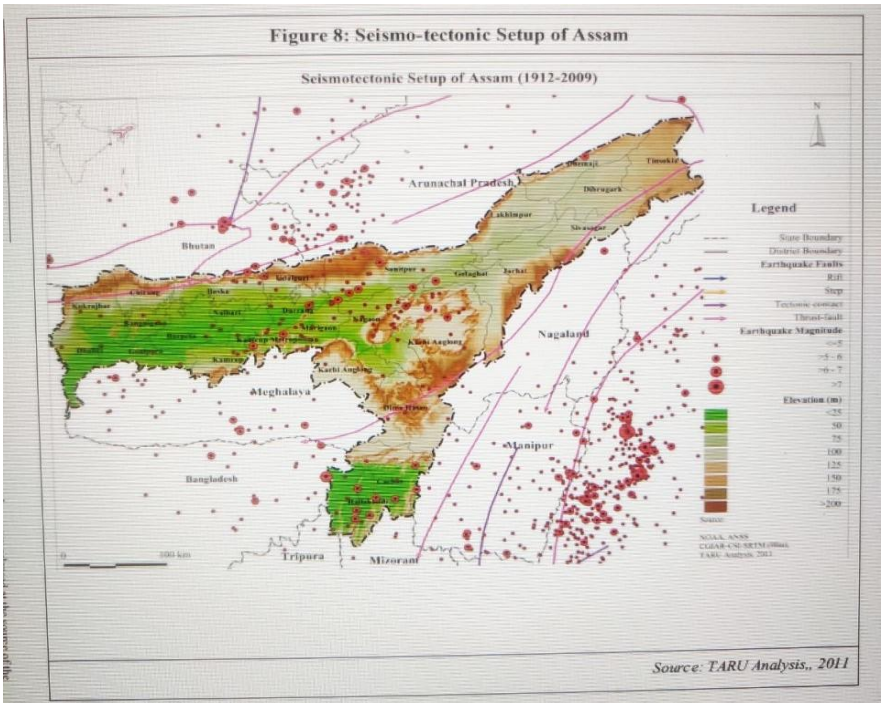

Figure 1: Seismo Tectonic Setup of Assam. Source : TARU Analysis, 2011

On discussions with ASDMA officials, they were interested to have a State level symposium for a multi hazard modelling for Guwahati involving SDMA, DDMA, GMC and all other stakeholders including political and bureaucratic leadership on the lines of Shell scenario. They were of the view that the drainage systems of Guwahati are old and overwhelmed and needed a serious overhaul.

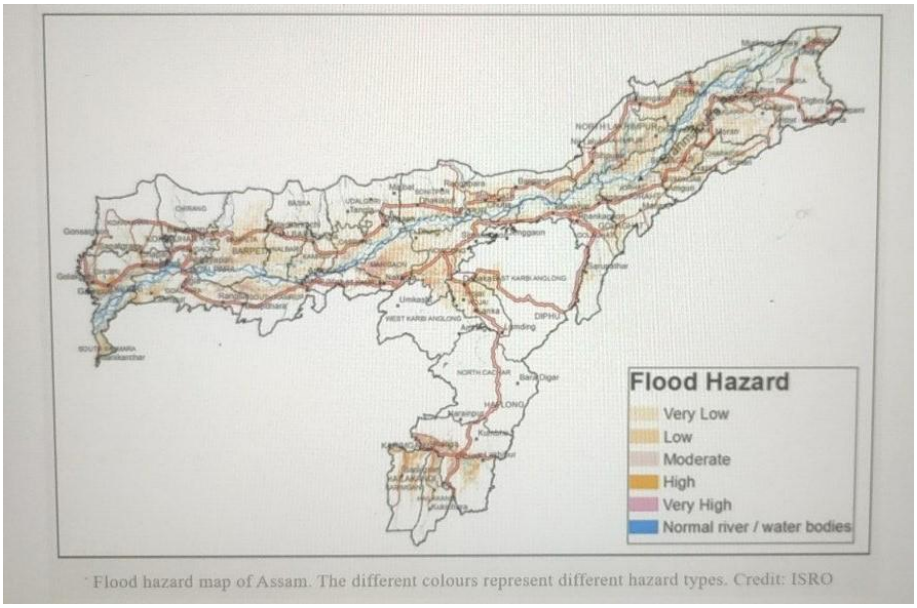

Figure 2: Flood Hazard Map of Assam, Credit: ISRO.

Guwahati or Kamrup Metro district where this study is focussed falls in the ISRO study of highly prone zone of floods and landslides. There is enough statistical data on flood and landslides in Guwahati to feed into this model which might help the district administration to have enough counter measures in place to avoid the negative impacts of flood and landslides.

The following broad terms of reference can be used to navigate this above scenario so that disaster response is measured and structured.

1. **Identify the natural disasters that are likely to occur in Guwahati:** Guwahati is located in a region that is prone to floods, landslides, and earthquakes. Therefore, you need to identify the scenarios that are relevant to the region.

2. **Gather data on past disasters:** To create accurate models, you need to have a good understanding of the past disasters that have occurred in Guwahati. You can gather data on the frequency, intensity, and duration of past events to inform your models.

3. **Define the parameters of your scenario:** Once you have identified the disasters and gathered data on past events, you need to define the parameters of your scenario. This will include factors such as the magnitude of the disaster, the duration, and the area affected.

4. **Use a shell model to simulate the scenario:** You can use a shell model to simulate the scenario and predict the potential impact of the disaster. A shell model is a simplified representation of the real world that can be used to test different scenarios and outcomes.

5. **Analyze the results:** Once you have run the simulation, you can analyze the results to gain insights into the potential impact of the disaster. This can help you to develop effective strategies for preparing for and responding to natural disasters in Guwahati.

6. **Refine your model:** You can refine your model by adjusting the parameters and running additional simulations to test different scenarios. This can help you to improve the accuracy of your predictions and better prepare for future disasters.

Questionnaire data Interpretation and Analysis:

A questionnaire was circulated online amongst residents of Guwahati who are urban dwellers, students and slum dwellers. For the slum dwellers numbering 50, the questionnaire was translated in Assamese and data was collected through a local NGO at Guwahati. A total of 200 responses were received out of 300 emails sent. The questionnaire was about whether the citizens of Guwahati are aware of multiple disasters and what they know about disaster preparedness in general. 25.7% were female and 74.3 % were male.

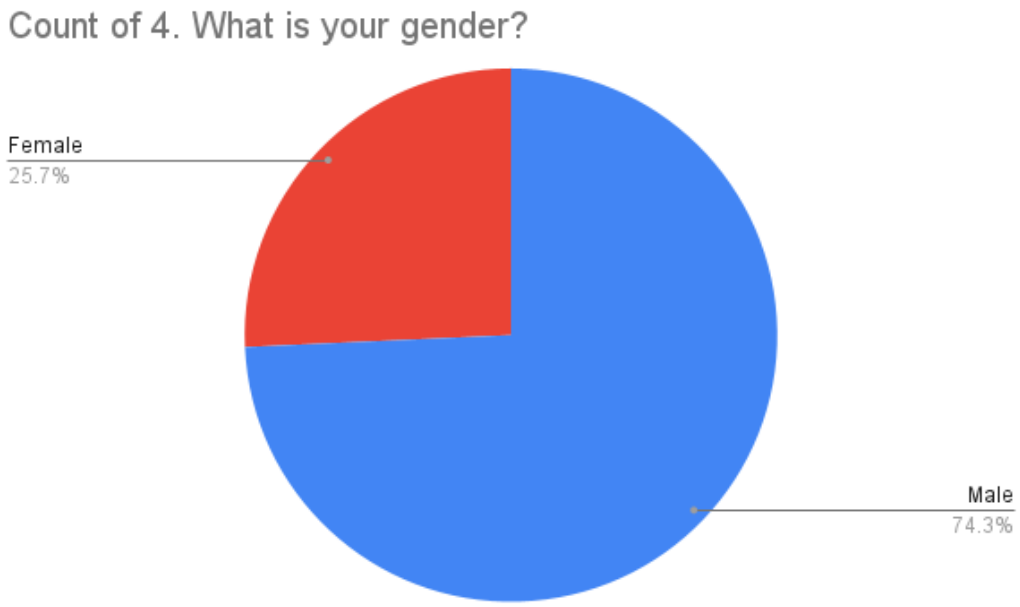

Figure 3 : Gender Distribution of Questionnaire Respondents.

<u>Experience of Natural Disaster from Guwahati Respondents</u> :

Out of the 200 respondents, 71.8% had experienced a natural disaster event in their lives till date.

Fig 4 : Details of Natural disaster experienced in life.

Awareness about emergency contact numbers of ASDMA or GMC :

The responses received from Guwahati residents show that more than 62 % are not aware of the emergency contact details of government agencies which are involved in disaster response. This is a startling revelation from the questionnaires that the residents are completely unaware about details of contact numbers. This lack of awareness in the city which has been having urban flood especially in 2017 and 2018 and in 2022, the sensitization campaigns of ASDMA and GMC should be intensified on traditional media such as newspapers, TV and radio as well as on social media channels.

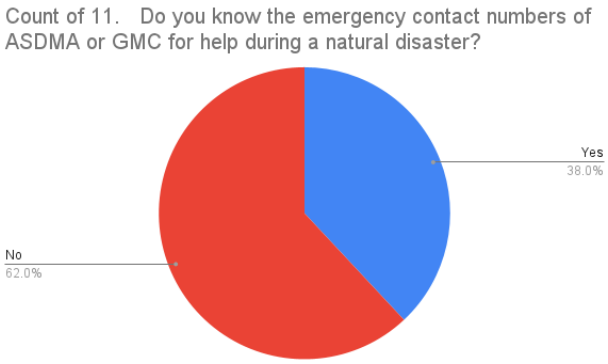

Fig 5 : Awareness about emergency contact numbers during natural disaster.

Details of Participation in Disaster Preparedness Activities :

Based on the data received from questionnaire, it is found that majority of the respondents (71%) have never participated in any disaster preparedness drills activity, and remaining 14% are unaware about disaster preparedness drills. Only 14% of the respondents have participated in such preparatory drills. This is also a major concern in Guwahati, when the citizens have never been part of a major simulation exercise. The last major such exercise was done in the year 2012 under NDMA supervision. There should be simulation and preparatory drills atleast once every year for areas which are low lying and flood prone in Guwahati like, Anil Nagar, , Bharalumukh ,Bhangagarh ,Ganeshguri ,Hatigaon ,Japorigog ,Panbazar ,Rehabari ,RG Baruah Road and Uzan Bazar

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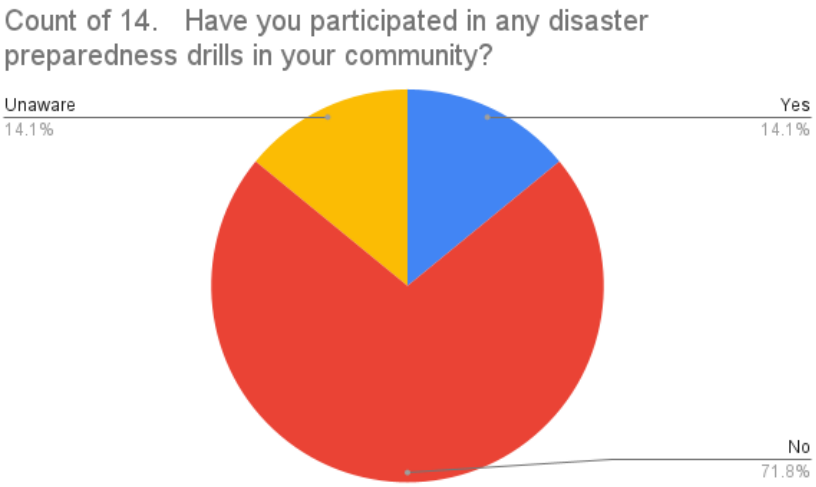

Fig 6 : Details of disaster preparedness experience in community.

<u>Awareness about Multiple Disaster Scenarios</u>:

58% of the respondents were aware of Multiple Disaster scenarios at Guwahati. They know that the city is susceptible to earthquakes, flood, landlslides apart from monsoonal heavy rainfall.

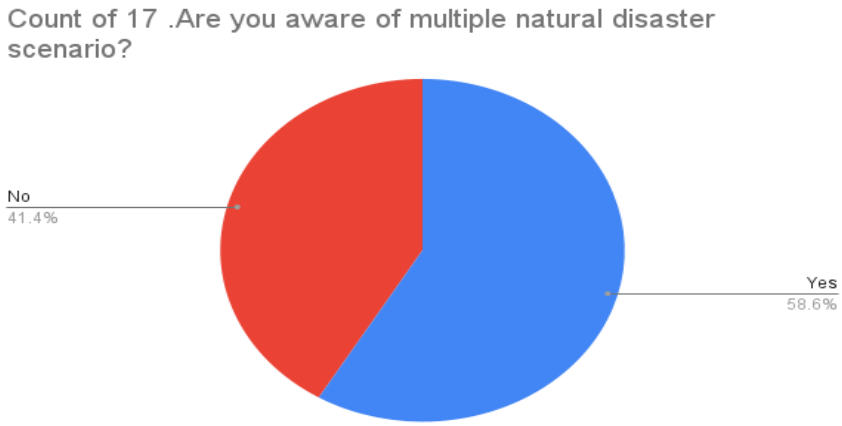

Fig 7: Awareness about Multiple Disaster scenarios in Guwahati.

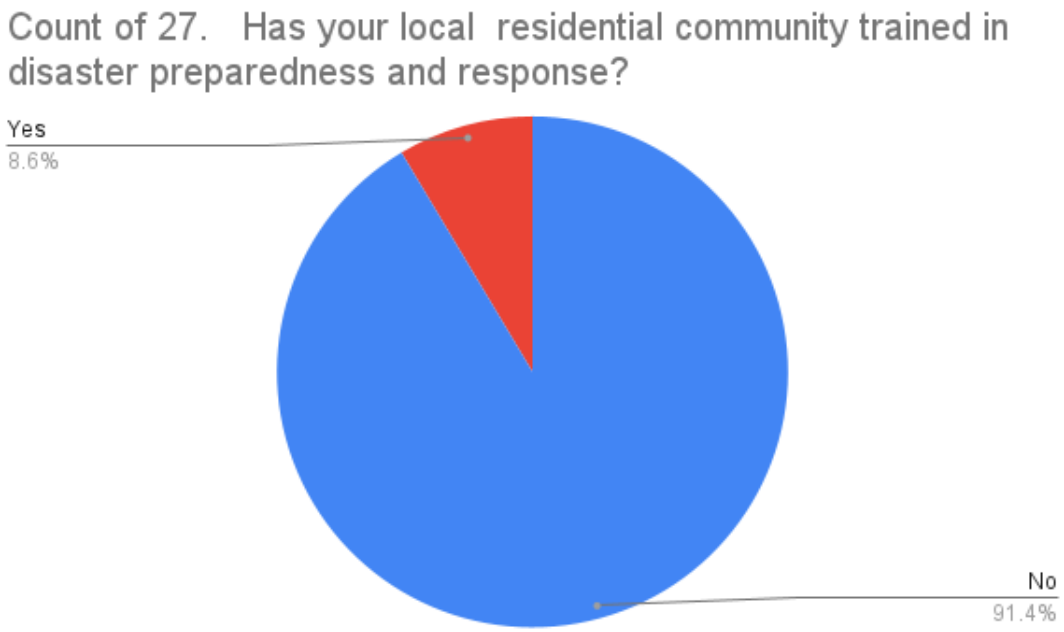

Fig 8: Status of Community Participation in Disaster preparedness amongst Guwahati residents.

This response illustrates the fact that community disaster preparedness which is the "first responder" is almost nil as close to 91.4% respondents replied that their local community does not have a disaster preparedness culture through any exercise or simulation. This is an alarming scenario as residents live both in high storied buildings which are prone to earthquakes and low lying areas of Guwahati which are prone to urban floods. A lack of community preparedness for urban natural disaster like flood or an earthquake is a cause of concern.

Use of Technology for Disaster Preparedness :

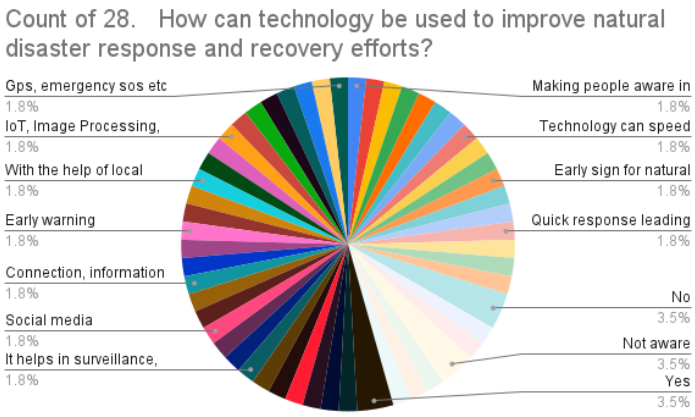

Fig 9 : Use of technology for disaster preparedness

The response from citizens for technology for disaster preparedness was multi facted. They are aware about various tools which could help in disaster preparedness, response and recovery.

Conclusion:

The research was initiated as the author who had experienced earthquake and flood during official posting at Guwahati from 2007 to 2010. The aims and objectives of this research was to understand how the district and block level disaster management authorities prepare and respond to a Multiple Disaster involving an earthquake, flood and monsoonal rains.

On analysis of responses from citizens of Guwahati and interaction with district and block level officials, the following points are placed as policy initiatives/ solutions.

a. **Passing laws by GMDA/GMC for hill slopes protection and illegal occupation**.

Hill cutting has caused major harm with the run off during rains clogging the urban drains in the city. This is mainly due to oversight of urban planning which has to be incorporated with changes in the Guwahati city Master Plan document and streamlining the urban migration by creating enough affordable housing which does not affect the water absorption capacity of water bodies and marshes in the city.

b) **Complete revamp of urban drains, and sewerage network by automating the entire system and mapping it using bots and AI.**

There are several best practices in the world, where urban drainage systems have been completed automated.

"Smart Rain" in South Korea:

The city of Daejeon in South Korea has implemented the "Smart Rain" system, which uses AI to predict and manage urban flooding caused by heavy rain. The system collects data from various sources, such as weather forecasts, water levels in rivers, and real-time rainfall data. Based on this data, the system generates flood risk maps and alerts city officials to take necessary actions to prevent flooding. (Alia Sabur, et al. (2021)

"Smart Sewer" in the Netherlands:

The Dutch water board Rijnland has implemented the "Smart Sewer" system, which uses sensors and AI to monitor and manage sewer systems. The system collects data on sewer levels, flow rates, and water quality, and uses this data to predict and prevent sewer overflows. The system also uses bots to automatically open and close sewer valves to manage the flow of water.(Philip Berggren, et al. (2019)

"Smart Monitoring" in the United States:

The city of Louisville, Kentucky has implemented a "Smart Monitoring" system that uses sensors and AI to monitor the city's stormwater system. The system collects data on rainfall, water levels, and flow rates, and uses this data to predict and prevent flooding. The system also uses bots to automatically adjust water levels in certain areas to prevent flooding.

The Guwahati city administration can utilize these models for using bots and AI for better drainage management. As of now, the city does not have a complete map of all the drains, be it flood or sewer. This is a major cause of concern. Using smart floating bots would help understand the points where the drains are clogged, silt and water levels and could help to design better drains for managing urban floods in the city.

c) Multiplicity of building permissions by GMC and GMDA:

As of now the building permissions are given by two local urban bodies which is overlapping. This leads to multiplicity of rules and they overlap jurisdictions causing red tape and proliferation of houses in water lands called as "beels" in Guwahati. The local administration has taken up the issue of removing encroachments in the "Silsako Beel" which is a huge water body in the city, which absorbs rains. Since, most of these water bodies are getting converted into urban settlements, the hard surface area is increasing causing heavier run off during monsoon rains.

d) A symposium on Multi Disaster Scenario Modelling for data based SOPs :

A symposium involving NDMA and ASDMA along with various departments of the state government needs to work on "Scenario Modelling Study for Multiple Disaster Event at Guwahati" in the coming months. This would allow agencies like NESAC, IMD , revenue, health and flood and water management department of Kamrup Metro which is one of the most vulnerable districts of Guwahati as the Brahmaputra becomes wider and less unbraided when it flows in Guwahati and its slope is higher than the drainage level of Guwahati.

Based in the results from this symposium a detailed SOP for multi disaster preparedness can be conceptualized for better utilization of human and financial resources for reducing vulnerability and better risk preparedness in the city of Guwahati in times to come to make is more resilient and prepared towards natural hazards triggered by extreme weather events.

Questionnaire used for data collection from residents of Guwahati for this research.

Questionnaire on Disaster Response Awareness about Multiple disaster scenario in Guwahati. Guwahati lies in zone V (Highest Risk) of the seismic zones of India. The river Brahmaputra runs through the city of Guwahati. This questionnaire intends to solicit responses from residents of Guwahati from varied backgrounds about a Multiple Disaster event at the same time, viz earthquake and flood at the same time, and the level of disaster preparedness and awareness amongst citizens/residents of the Guwahati about the same.

My name is T Kabilan, working as Director at NITI Aayog I am presently pursuing my public policy course from Indian Institute of Public Administration. This questionnaire is part of my thesis work for the course. I can be contacted at 9130533483 and kabjnu@gmail.com for any clarification on the same.

*Required

Email*

Cannot pre-fill email address

1. What is your name?

Your answer

2. What is your email id?

Your answer

3. What is your profession?

Government official
Private Sector
NGO/Civil Society
Student
Home Maker
Other:

4. What is your gender?

Male

Female
Third Gender
Other:

5. What is your residential location at Guwahati?

Your answer

6. What is your current knowledge about natural disasters?

I am aware
I dont know

7. How often do you hear about natural disasters happening in and around Guwahati?

Often
Rarely

8. Have you ever experienced a natural disaster in your life?

Yes
No

9. Do you know the different types of natural disasters that can occur in Guwahati?

Yes
No

10. What measures do you take to protect yourself and your family during a natural disaster?

Go to an open ground
Call for help
Shelter under table

11. Do you know the emergency contact numbers of ASDMA or GMC for help during a natural disaster?

Yes
No

12. What are the common warning signs for natural disasters in Guwahati?

Tremors
Heavy rainfall
Announcements on social media
Other:

13. Do you know the evacuation routes and safe zones during a natural disaster in your locality?

Yes
No

14. Have you participated in any disaster preparedness drills in your community?

Yes
No
Unaware

15.Do you know the importance of having an emergency kit at home during a natural disaster?

Yes
No
Unaware

16. Have you considered the needs of your pets during a natural disaster?

Yes
No

17 .Are you aware of multiple natural disaster scenario?

Yes
No

18. What measures do you take to secure your property before a natural disaster strikes?

Insurance
Securing valuables
Never thought about it
Other:

19. Do you know the role of government agencies in natural disaster response and recovery?

Yes
No

20. How do you access accurate and up-to-date information during a natural disaster?

Social Media
TV
Hearsay

21. What according to you are the common challenges faced by communities during and after a natural disaster?

Medical facility
Food
Shelter

22. Do you know the long-term effects of natural disasters on the environment and wildlife?

Yes
No

23. Have you ever donated or volunteered to help those affected by natural disasters?

Yes
No

24. Do you know the role of non-government organizations in natural disaster response and recovery?

Yes
No
if yes, pl elaborate

25. Are you aware of standard operating procedures to be done during an earthquake?

Your answer

26. Are you aware of contact details local government organizations when disaster strikes?

Your answer

27. Has your local residential community trained in disaster preparedness and response?

Yes
No

28. How can technology be used to improve natural disaster response and recovery efforts?

Your answer

29. Do you think the government and community are doing enough to prepare for and respond to natural disasters?

Yes
No

30. What suggestions do you have to improve natural disaster awareness and preparedness in Guwahati?

Your answer

31. Are you aware of the Aapda Mitra Scheme?

Yes
No

32. If the answer for the above question is yes, then how has the Aapda Mitra Scheme helped you or someone you know in times of natural disasters?

Your answer

33. What improvements, if any, would you suggest for the Aapda Mitra Scheme to make it more accessible and helpful for citizens affected by natural disasters?

Your answer

1. What is your name?

Your answer

2. What is your email id?

Your answer

3. What is your profession?

Government official
Private Sector
NGO/Civil Society
Student
Home Maker
Other:

4. What is your gender?

Male
Female
Third Gender
Other:

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Your answer

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Your answer

Get link

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Visits & Interactions:

Visit to Sikkim State Disaster Management Authority, dated 14th October, 2022: A detailed interaction was carried out with officials of SSDMA on 14th October, 2022 during forward area tour visit of APPA 48 course.

Interactions carried out with:

a) Officials of ASDMA (Assam State Disaster Management Authority) on 22nd March 2023 virtually to discuss the present state of Disaster preparedness in the State