CHAPTER 1

INTRODUCTION

1.1 Background

1.1.1 India is one of the most disaster prone countries in the world. With its vast territory, large population and unique geo-climatic conditions, in the last few decades the sub-continent has experienced many extreme hazardous events that have turned into disasters. Floods, droughts, cyclones, earthquakes and landslides are recurrent phenomena in the country. The Annual average loss table due to disasters in India is annexed to this report (**Annexure 1**). Out of the total geographical area of 328,263 sq. km, 54% of the landmass is prone to earthquakes, over 40 million hectares are prone to floods and about 8% of the total area is prone to cyclones. Such extreme conditions and frequent disasters have greatly eroded developmental gains and caused loss of people's lives. The coastal eco-system sustains a large portion of the population all over the world and India is no exception with a coastline of about 8041 km (Arabian Sea on the East and Bay of Bengal on the West). In India more than 10 million people live in the coastal states, two union territory and two groups of islands. Besides, the population pressure on coastal areas is growing due to migration from inland to the coastal zone, which is more developed with more employment opportunities when compared to the hilly areas. Unfortunately, the activities in these areas have exceeded the absorption capacity of the natural coastal eco-system and the people who live in the coastal area are more vulnerable to the increasingly frequent and intense natural and man-made hazards. This is true especially in the case of cyclones.

1.1.2 India has a long coastline. People living in most of the coastal states of India are vulnerable to Cyclone related disasters. Many natural disasters including Cyclones refer **Annexure 2,** results in large scale deaths, loss of

means to livelihood, damage to public property and severe infrastructural damage. Disasters of greater magnitude thus affect the process of development.

1.1.3 Developing a system capable of issuing accurate forecasts and warnings in a form readily and easily understood will help save life and property. Improved early warning systems, better methods of risk assessment and increased public awareness will reduce human and property loss. National Disaster Management Guidelines for cyclones, NDMG (2008), specifies that a good Early Warning system (EWS) should be able to detect the system (Cyclone), ensure continuous monitoring, prediction of intensity, likely damage, landfall location/path, formulation of warnings etc. This will help in identification of threat areas and population. Warnings need to be communicated with sufficient lead time and clarity so that concerned agencies can take action to mitigate or limit damage to life and property. The emphasis should be on disaster risk reduction.

1.1.4 It is generally seen that strategies to build up an effective warning system is seriously taken up when memories of a major disaster is fresh in the mind. After some time the same zeal is not visible and effort for drafting an effective EWS takes a back seat. This is more so as the earlier perception used to be to deliver relief after a disaster has occurred. To change this mindset, policies, plans and guidelines for disaster management, implementation of timely and effective response to disasters needs to be prepared.

1.1.5 A very important part of EWS is to have a very effective communication system. This will help relay the warning to the areas likely to be affected along with the time and date of landfall. Once the initial warning has been transmitted it is essential to monitor the progress and intimate any changes in the likely area that will be affected. This is relevant when major Cyclones like 'Nargis' which hit Myanmar coast in May 2008, changed course midway.

1.1.6 For any EWS to be effective, it requires a very good communication system. Information regarding an impending disaster is of no use if the same does not reach the people who will be affected or those who needs to carry out relief activities. Study of the communication system is very important as this will help identify the gaps and shortcomings and adopt necessary steps to overcome this. The communication network, especially the towers must withstand the high speed winds. Communication system can have conventional media like radio, telephones, television, mobile network etc. However in case of disaster of a larger scale, the power supply system, TV/radio as well as telephone network towers will be destroyed. This will disrupt communication. We can use sat phones which utilize satellite communication. VSAT networks with mini Base transmitting system (BTS) can be set up to replace the mobile communication network which can be set up anytime, independent of the terrain, is the need of the hour. Such backup systems need to be procured and kept ready at all times. Another means of communication is the amateur HAM radio network.

1.1.7 Government's response to natural disasters has improved over the years. Emphasis on pre-disaster activities including an efficient EWS will reduce the damage in the case of a major disaster. Due to its long coastal line and susceptibility to Cyclone disasters, attention needs to be given to develop an effective pre-disaster standard operating procedure (SOP). Attention also needs to be given to the unregulated development, especially in the coastal areas, which may destroy the ecological balance. This was evident from the causative factors which aggravated the Uttarakhand disaster.

1.1.8 NDMG (2008), stresses that effective Cyclone management involves either taking structural or non structural measures. Structural measures would include strengthening of buildings, Cyclone resistant shelters at safe and elevated locations, good roads leading to the shelters which don't get inundated during Cyclones and accessible after the Cyclone, good storm drainage, culverts and strong bridges, embankments to keep out saline water incursion, Cyclone

resistant communication towers and power supply network, culverts and strong bridges, embankments to keep out saline water incursion, Cyclone resistant communication towers and power supply network. The towers and network needs to be designed keeping in mind the wind speeds in the last 100 years. National Cyclone Risk Management Program, NCRMP (2003), addresses the risks and vulnerabilities to Cyclone. It outlines the work needed to be carried out in Andhra Pradesh or Odisha as a part of improvement of structural measures required to reduce risk of damage in a Cyclone. It also aims to conserve the coastal eco systems.

1.1.9 Coastal area is generally epicenter of settlements and economic activity. The coastal vulnerability index (CVI) (2012), brings out the vulnerability index of the coast and how pictures obtained by aircraft based LIDAR images will give an idea about the coastal topography. It also gives information on how to demarcate a set backline beyond which economic development cannot be permitted. This demarcation can be as per marshy, wetland, river mouth area etc. The non structural measures include planting and development of mangroves; conserve sand bars, dunes, rocky cliffs and coastal wetlands. Coastal Zone Management Program (CZMP), (2012), specifies the activities to be undertaken to balance the protection of vulnerable ecosystem including mangroves

1.1.10 Mohanty (2005), states that Odisha was affected by a flood in August and a Cyclone on 17-18 Oct 1999 causing loss to life and property as well as untold miseries. The worst was yet to come as the state was hit by a super Cyclone on 29 Oct 1999. Torrential rains lashed the affected areas with a maximum of 955[1] mm of rains. The storm surge had waves of 5 to 7 m height. 150,000 people were evacuated. The communication facility in the state was disrupted on the morning of 29 Oct 99. This led to a situation where monitoring of the progress and communication between relief centers and outside world was affected.

[1] NCAR -Super Cyclone-99 final.PDF

1.1.11 Nayak (2009), states in his review, post the Cyclone that natural disasters cannot be prevented or avoided. But, the impact and subsequent loss can be reduced. This is possible if we have a very good Early Warning System and preparedness will help mitigate the losses. The Cyclone affected 1.89 crores in 128 blocks, 46 urban local bodies and 17993[2] villages in 14 districts, 8243 human lives were lost and 4.45 lakh livestock perished in this disaster. Infrastructure loss was close to 6250 crores.

1.1.12 Cyclone Phailin DREF report (2014), submitted that, when fourteen years later Cyclone Phailin on 11 oct 2013, hit Odisha and Andhra coast, Seventeen districts, 18374 villages were affected by the Cyclone. The Cyclone caused flooding at several places due to heavy rainfall. Some areas were affected and damages caused due to high speed winds. However, only 47[3] people were reported to have been killed. ***This reduction in losses was due to the improved EWS in place and also the action taken before the storm to mitigate losses.*** These actions included evacuation of people and livestock. Thus, effective disaster plan, preparation and dissemination of EWS led to minimal death toll. Evacuation involved shifting of one million people and 30000 livestock to special Cyclone resistant shelters. UNEP (2013), reports, that Early Warning alerts were disseminated days in advance before the Cyclone struck. This ensured the losses to lives and livestock was as minimal as possible, compared to that in the 1999 Odisha Super Cyclone. To compare the tolls, 47 human losses were reported in Cyclone Phailin against 10000 lives in the Odisha Super Cyclone. The positives and lesson learnt from the 1999 Cyclone ensured that the cooperation between the Government agencies and other stake holders responsible for relief, awareness at community level, improvements in communication for dissemination were better. This has helped in timely

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[2] Orissa review, October 2009, post super cyclone Orissa: An overview, Avaya K Nayak.

[3] DREF final report India : Cyclone Phailin.

evacuation. Better preparation and implementation of pre and post disaster activities has drastically reduced the damage. Odisha was the first state to establish a state agency to ensure better Disaster Risk reduction. This agency is called Odisha State Disaster Management Authority (OSDMA). Better awareness and early information received motivated the people to move away to safety.

1.1.13 An important lesson that emerged from Cyclone Phailin and the subsequent damage assessment has been that even though the loss of lives has drastically come down the destruction of lives and property has been considerably high. The time taken for return to normalcy and reconstruction has been quite high. Thus focus is shifting to relief and recovery efforts based on past experiences. NDMG (2008), has specified the structural and non structural measures that need to be adopted as a part of Risk mitigation. Structural measures adopted include building of Cyclone shelters, Cyclone resistant buildings, road links, culverts and bridges, canals, drains, saline embankments, surface water tanks, cattle mounds and communication/power transmission networks. Non structural measures include coastal zone management, conservation of coastal wetlands, regulation of construction in coastal zone, coastal vegetation, sand dunes and coastal cliffs etc.

1.2 **Statement**

1.2.1 The Indian subcontinent has a long coastline, including that of the islands Lakshadweep in the Arabian Sea and Andaman Nicobar in the Bay of Bengal. This makes the country prone to be hit by Cyclones every year. Mohanty (2005), explains, the number of Cyclones originating on the western coast is much less compared to the eastern coast. The impact of the Cyclones on the eastern coast especially on the states of Tamil Nadu, Pudussery, Andhra Pradesh, Telenghana, Odisha, West Bengal and Andaman and Nicobar is of a greater magnitude. Odisha is the most affected state, with Balasore coast facing the maximum fury and risk of storm surge. This is followed by erstwhile Andhra Pradesh state, Tamil Nadu and West Bengal. The severe winds, tall waves

(Storm Surge) and very heavy rainfall causes destruction in its wake which is beyond imagination. In addition if the landfall site of the cyclonic winds changes its path midcourse, the time available for adopting precautions or evacuating the people is very less.

1.2.2 The National Disaster Management act DM Act, 2005 is a giant step taken to mitigate the disastrous after effects of any natural disaster. This act has helped focus on proactive and pre-emptive steps, rather than post disaster relief which was the norm hitherto. NDMG (2008), prepared guidelines for the management of Cyclones. The NDMA is headed by the honorable Prime Minister at the centre, the Chief Minister heading the State Disaster Management Authority in the states and District Magistrate (District Collector) in the District Disaster Management Authority. The present NDMA has the Honorable Prime Minister as chairman, five cabinet ministers of concerned ministries as members (Ex Officio), three full time members and member-secretary.

1.2.3 Designing a EWS which gives early information, monitors the progress of the Cyclone, likely landfall site, is very complicated and difficult task. The EWS will help compute the height of the waves in the storm surge, on shore wind tide and wind effect. This will help give an idea of the following:-

(a) Depth of inundation.

(b) Extent of inundation.

(c) Duration of inundation.

1.2.4 An effective EWS in Odisha will help in reducing damage caused to lives and property due to Cyclones. Being the first state to conceive and establish an agency Odiaha State Disaster Management Authority (OSDMA), for disaster management activity. The result has been outstanding as seen in the drastic reduction in loss to lives. Thus it is of paramount necessity to study the EWS for Cyclones in Odisha. An effective EWS will help reduce the damage to life and

property. A scientific study will be undertaken to identify steps to be taken to improve the EWS in Odisha and thus further minimize the losses and damages caused by Cyclones in Odisha.

1.2.5 This information is required to plan an appropriate Response mechanism. Considering the importance of EWS, case studies of Odisha Super Cyclone, Oct 1999 and Cyclone Phailin, Oct 2013 which caused devastation in Odisha have been taken up. The additional measures take up to make the EWS more effective is also examined.

1.3 Objectives of the Study

The objectives of this study are:-

- To carry out study of disaster preparedness, particularly the EWS for Cyclones in the state of Odisha.
- To carry out Case Study of two major Cyclones in Odisha in the recent past.
    - Odisha Super Cyclone on 29 Oct 1999.
    - Phailin Cyclone on 02 May 2013.
- To study and compare the shift in disaster preparedness in 13 years between the two major Cyclones, under study, that lashed Odisha coast.
- To study the communication system and suggest methods to ensure uninterrupted communication even after the Cyclone.

1.4 Justification for the study

1.4.1 Ramesh (1994), states that Cyclone is one natural disaster that coastal India is prone to and has to cope with on a regular basis year on year. Cyclones affect the eastern coast more than the western coast. National Disaster Management Guidelines, 2008 states that even though the eastern coast experiences only 07 % of the Cyclones the world over the impact and devastation caused is very high. The eastern coast experienced about 308 Cyclones between 1891 and 2005, of which 103[4] were very severe whereas the western coast experience only 48 Cyclones with 24 of them being of severe nature. Mohanty (2005) also states that the eastern coast is prone to be affected by Cyclones more frequently than the western coast and Balasore is more susceptible to storm surges. It has been seen that an effective EWS can help reduce the loss. Hence, through a case study of Odisha Super Cyclone and Phailin Cyclone an effort will be made to study the EWS in Odisha, identify the shortcomings to overcome the gaps and ensure uninterrupted communication.

1.4.2 Gupta and Sharma (2000), states that, as Northern Odisha coast consisting of Bhadrak and Balasore coast has a coastline which is curved in the shape of a concave. This shape makes it vulnerable to be lashed by Cyclones and also storm surge with tall waves. Odisha coast has been hit by eleven severe Cyclones and 55 Cyclonic storms in the last 120 years.[5] The height of the tidal wave or storm surge has been with maximum height of 5.5 m.

1.5 Research Question

1.5.1 What is the existing EWS in India?

1.5.2 What changes has taken place in the EWS in the last 15 years?

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[4] NDMG guidelines, Management of Cyclones,2008

[5] Disaster Management edited by Prof Vinod Sharma

1.5.3 What changes has taken place in the communication system for disseminating Early Warning in the last 15 years?

1.5.4 How an improved EWS can reduce the loss of life and property?

1.6 Scope of the Study

The scope of the study is limited to Cyclone disasters. The existing EWS for Cyclones in Odisha is studied for its efficacy and attempt is made to identify gaps. Case study of Odisha Super Cyclone, 1999 and Phailin Cyclone of 2013 is taken up in this research.

1.7 Limitations of the Study

1.7.1 Due to limitations of time, out of the many natural disasters that affect India, focus will be only on Cyclones.

1.7.2 Due to limitations of time as well as resources case study will be carried out for two Cyclones that affected the eastern coast, especially Odisha state.

1.7.3 The study is based on material available in public domain and limited interaction with experts in the domain from ministry of Earth Sciences, IIPA, OSDMA and NIDM. Existing literature from NDMG, websites of World Bank, IMD etc: Journals, Publications are also referred.

1.7.4 The dissertation aims to analyse the existing EWS, identify gaps and examine the remedial measures which may not be the alternate solution or model.

1.8 Methodology

1.8.1 The chief methodology of research is based on analysis of Primary and secondary data for the period from 1999 to 2013.

1.8.2 Carry out focused study of EWS in Odisha. The selected sources for secondary data are as given below:-

(a) National Disaster Management Guidelines (NDMG): Cyclone management guidelines.

(b) National Cyclone Risk Mitigation Program (NCRMP): Structural and non structural measures.

(c) National Cyclone Zone Management Program (NCZMP): Protection of vulnerable eco system.

(d) Coastal Vulnerability Index (CVI): Demarcate Coastal setback line.

(e) ISRO course material for SATCOM course at Space Application Centre, Ahmadabad.

1.8.3 **Research Design and Methods**. The research design adopted is **Exploratory and Descriptive. Face to face discussion with help of Questionaire** with domain experts will be adopted for primary data collection. Questionaire attached as **Annexure 3**. **Focused discussion** will be held with domain experts; Former Executive Director, National Institute of Disaster Management (NIDM) **Dr Satyendra Singh;** Advisor Ministry of Earth Sciences and IMD **Dr KJ Ramesh** Scientist G; **Prof Vinod K Sharma,** Professor Indian Institute of Public Administration (IIPA) and Vice Chairman Sikkim State Disaster Management Authority and OSDMA. The Appropriate **statistical tools**, like forecasting tools of IMD (Dynamic) will be utilized to forecast the land fall, quantity of rainfall, wave height etc: may be calculated. **Content analysis** will be carried out on the collected data and information. Case study will be carried out to see the improvement in EWS. This will also help assess whether the improvements has helped in better preparedness, thus mitigating losses.

1.9 Literature Review

1.9.1 Indian subcontinent is subject to different kinds of disasters like earthquakes, forest fires, flood, tsunami, Cyclones etc; Due to the country being surrounded by three oceans it has an extended coastline. This makes it vulnerable to more than one Cyclone each year. Prior to the last two decades, disaster relief has been only post disaster with emphasis on delivery of relief materials. Now focus has shifted to the activities that can be adopted before disaster. In case of Cyclones, sufficient lead time is available unlike in the case of earthquakes. Information about landfall site is available almost three days to four days in advance with fair degree of accuracy. Being a country with very high population it is seen that people are forced to settle in scarcely available space along the coast, which may be disaster prone.

1.9.2 Vij (2008), emphasizes how the Indian subcontinent is facing the brunt of a number of Cyclones, which cause untold miseries both by way of loss of property and lives. Guidelines issued by NDMA have been drawn up after consulting ministries at centre, the states, district officials and union territories. Feedbacks from domain experts were also sought on the draft guidelines and incorporated. Inputs on local conditions were received from states, institutions and people who are closely involved with the process of risk reduction. The guidelines have spelt out the activities like planting mangroves that help in slowing the storm surge, good roads to these shelters that are accessible even after the Cyclone. World Bank had allocated Rs 1600 crore for the National Cyclone Risk Mitigation Project.

1.9.3 Yadav (2011), highlights some important guidelines issued by NDMA. This book discusses the various acts and guidelines for effective management of disasters. It highlighted the activity that needs to be undertaken by national, state and district bodies for risk reduction and post disaster relief activities.

1.9.4 Sharma (1994), states, that the Indian subcontinent is prone to be affected by number of natural disasters. The information about these disasters will be of great help to make an effective EWS and thus achieve disaster risk reduction.

1.9.5 Gupta and Sharma (2000), documented in their book, the issue of disaster management and explain the lessons that can be drawn by various stakeholders dealing with pre and post disaster activities. The various people involved are the administration, NGOs, uniformed personnel, industries and the community itself. This book addresses practices, coordination required among various stake holders mentioned above and proactive activities needed to avoid or reduce the damages of severe calamities.

1.9.6 Zschau and Kuppers (2003), describes, in a comprehensive manner the Early Warning Systems developed for hydro-meteorological disasters such as floods, storm etc. and for geological disasters such as earthquakes, volcanic activity or mountain hazards. One major theme of this book is the increasingly important role in EWS played by the rapidly evolving fields of space and Information technology. A comprehensive overview and in-depth insight into the state of the art EWS.

1.9.7 A number of websites of various agencies have been utilized to obtain a number of articles and reports. The websites referred to with extracts useful for this study are mentioned below.

(a) GoI website/World bank website on NCRMP[6], explains the structural measures undertaken by the Odisha and Andhra government. The site also gives insight about the national risk and Zone management program.

[6] www.ncrmp.gov.in/default.html

(b) NRSA, ISRO website, explains how aerial photography with LIDAR images can be used for demarcating set back line for development. No development is permitted beyond this line.

(c) Coastal Zone Management Program (CZMP), (2012), specifies the activities to be undertaken for protection of vulnerable ecosystem including mangroves

(d) In their project report on 'Study on Super Cyclone in Odisha 1999', Ashutosh has studied the status of EWS in Odisha and the socio economic impact of cyclone on some of the vulnerable district of Odisha.

(e) In their review article 'Post Super Cyclone Odisha: An Overview' Avaya Nayak explains how Odisha has shifted from reactive post Cyclone activities to proactive pre Cyclone activities like planning, prevention and preparedness.

(f) In the report 'Cyclone Phailin in India: Early Warning and timely action saved lives', Lindsey Harriman for UNEP focus on the lessons learned from Cyclone Phailin and how they can be applied to other disasters.

1.10 Chapterisation

1.10.1 The dissertation is divided into seven chapters:-

(a) Chapter 1 - Deals with Introduction, Statement of the problem, objectives of the study, Justification, Research questions, scope and limitations of the study, literature review, methodology and chapterisation. In the subsequent chapters a detailed literature study is carried out make on the topics to bring out the importance

of the main theme i.e. importance of EWS in mitigating the damages and loss of lives due to a disaster like Cyclone.

(b) Chapter 2 – Deals with basic Introduction to disasters and disaster management in India is attempted.

(c) Chapter 3 - Case study of two major Cyclones in Odisha, India i.e. Odisha Super Cyclone, 1999 and Cyclone Phailin, 2013 is carried out. The EWS is also studied and the additions to the EWS are examined to analyse, if this could help in mitigating the loss and sufferings.

(d) Chapter 4 - The Early warning system existing in India is studied and gaps if any will be highlighted. In addition various websites are reviewed to know about the activities to be adopted before and after the disaster to mitigate the loss to life and property. The communication system for warning dissemination is examined, and suggestions to improve it are listed.

(e) Chapter 5 - Deals with the Structural and non structural measures adopted to reduce damage due to Cyclone.

(f) Chapter 6 - This chapter analyses the lessons learnt from the two case studies and gives a few guidelines and strategies to make the EWS in India and in particular Odisha more effective.

(g) Chapter 7 – The chapter summarises and suggests a few recommendations emerging from the study, the core concepts and finally recapitulate the findings based on literature survey and data-analysis.