

CHAPTER 7

SUMMARIZING THE FINDINGS AND RECOMMENDATIONS

7.1 **Disaster Management in India** India has been traditionally vulnerable to natural disasters on account of its unique geo-climatic conditions. Floods, droughts, cyclones, earthquakes and landslides have been recurrent phenomena. Over the past couple of years, the Government of India has brought about a paradigm shift in the approach to disaster management. The new approach proceeds from the conviction that development cannot be sustainable unless disaster mitigation is built into the development process. The approach has been translated into a National Disaster Framework [a roadmap] covering institutional mechanisms, disaster prevention strategy, early warning system, disaster mitigation, preparedness and response and human resource development. The expected inputs, areas of intervention and agencies to be involved at the National, State and district levels have been identified and listed in the roadmap.

7.2 **The Core Theme of Research** Early warning in the context of cyclones is a short-term effective mitigation measure. It employs detection of the system, its continuous monitoring, prediction, formulation of warnings, identification of threat areas and population and communication of warning with lead time and clarity so that action is taken by the concerned people to avoid negative consequences. The emphasis is on disaster risk reduction. It is said that one dollar invested in disaster preparedness can prevent seven dollars' worth of disaster-related economic losses which is a considerable return on investment. An attempt has been made in this research to analyse the EWS in India and ascertain the improvements made there off.

7.3 **Case Study of Cyclones in Odisha** India's eastern coast has a long history of devastating cyclones. The worst of these (since 1990) was the "Great Orissa Cyclone of 1999." This cyclone killed 9,000-10,000 people when it made its landfall on October 19, 1999 with 155 mph winds and a storm surge of 26 feet (8 metre). The storm was classified as a 'Super Cyclonic Storm' in the nomenclature of tropical storms that affect the North Indian Ocean, Bay of Bengal, and the Arabian Sea. **Very Severe Cyclonic Storm Phailin** (Thai meaning "sapphire") was the second-strongest tropical cyclone ever to make landfall in India, behind only the 1999 Odisha cyclone. After the super cyclone the OSDMA was formed as the nodal agency to take up the mitigation activities but also the relief, restoration, reconstruction and other measures. The effort of OSDMA and other agencies showed in the reduced toll in Cylone Phailin.

7.4 **Importance of Early Warning System** A TC warning system is not just a set of definitions of different warning status or warning criteria. It must contain the means to communicate essential and relevant information to the intended audience to enable them to take appropriate responsive actions, to avert danger or to minimise risk. The design of a TC warning system should take into consideration --the prevailing state of meteorological science, the available technological means of communication, the built-up environment such as dwellings and transport infrastructure, the appropriateness of protective actions as well as the expectations of society. The key requirements of a good and effective TC warning system are simple, easy to understand, triggering effective actions by emergency response units and orderly responses of the public in accordance with the needs and expectations of society. The ultimate goal is to prevent loss of lives and minimise damage to property. The effectiveness of the EWS has been amply proved in the drastic reduction of deaths Lam (2005).³⁸

³⁸ <http://data.weather.gov.hk/publica/reprint/r582.pdf>

7.5 **Mitigation Measures for Cyclones** The National Cyclone Risk Mitigation Process was launched in India. The main objectives of the project are to minimize risk and vulnerabilities to cyclones, to adopt structural and non-structural cyclone mitigation efforts and to build capabilities and capacities of people for cyclone risk mitigation in harmony with the conservation of coastal ecosystems in coastal cyclone hazard prone States and Union Territories. Mitigation means "measures taken in advance that are aimed to decrease or eliminate the impact of disasters on the community and environment". Today, the Policy makers and Disaster Management specialists have changed the approach to disaster management by investing in risk reduction & mitigation measures rather than concentrating on post disaster response (relief & reconstruction).

7.6 **Revisiting the Research Questions**

The core issues which prompted this research were the importance of a good EWS in mitigation of the impact of a disaster like cyclone. India being a country susceptible to a number of natural and manmade disasters with particular emphasis on cyclones, importance of having a good and effective EWS need not be stressed. Towards this we chose the following research questions:-

- (a) What is the existing EWS in India?
- (b) What changes has taken place in the EWS in the last 15 years?
- (c) What changes has taken place in the communication system for disseminating Early Warning in the last 15 years?
- (d) How an improved EWS can reduce the loss of life and property?

Based on the analysis of the data researched we can arrive at the following conclusions:-

7.7 **Early Warning System in India**

Due to very destructive nature of tropical cyclones (TCs) and their adverse impact on human activities, an Early Warning System (EWS) has been developed for TCs. The EWS is required to monitor and forecast cyclones. For this, data is required from the ocean where it forms as well as the entire globe if sufficient lead time is to be provided. The EWS is taking information from land based, ocean based and space based observational systems as below:-

(a) Land based EWS consists of :-

- (i) AWS and Rain Gauge Network
- (ii) High Wind Speed Recorder one for each district.
- (iii) Surge Recorder one for each district.

(b) Ocean Based EWS consisting of:-

- (i) Shallow Water Buoy
- (ii) Deep Water Buoy
- (iii) Ships of Opportunity.
- (iv) Coast Guard and Indian Naval ships.
- (v) Islands.
- (vi) Deep ocean Assessment and Reporting of Tsunami (DART).

(c) Space based EWS consisting of:-

- (i) Use of two Geo Stationary Satellite : INSAT3D and KALPANA.
- (ii) Water Vapour Channel.
- (iii) Vertical Sounder.
- (iv) High Resolution Data sets using IRS and the global Satellites.

All available data is assimilated on global regional and Meso (local) level to generate track intensity and landfall forecast associated with TCs affecting coastal states and Union Territory. Based on intensity and movement of TC, storm surge inundation models are run to generate extent and depth of coastal inundation associated with TC and landfall.

7.8 Changes in EWS in the 15 years between Super Cyclone and Cyclone Phailin

After research of available data, and based on the table of comparison, for the Odisha super cyclone, early warning was available to with high grade of accuracy only 24 hrs before landfall. However, in case of cyclone Phailin, this warning was available as much as 120 hrs in advance. This was possible due to the modernization taken up by IMD. From comparison of observation equipments in **table no. 8** below, it is clear that prior to 2007, when NDMA guidelines for management of cyclones was issued the IMD had basic facilities for cyclone warning. The following equipment has increased drastically:-

- (a) Rain Gauge : 2579 part time to 9851(including Non departmental).
- (b) Radar (DWR): 5 to 16
- (c) Radar (Storm Detection): 21 to 26
- (d) Wind Profilers: 01 to 45

NDMA has recommended the country should have Aircraft Probing of cyclone as most missions, as most of the developed countries this facility. This will result in forecasting of TC intensity due to availability of In situ observations from cyclone core environment itself. This will give an improvement in accuracy by 15-28% as per reports published in USA involving Atlantic and Pacific ocean cyclone.

SI No	Observation type	Pre 2007	Post
1	Automatic Weather Station(AWS)	125	675
2	Automatic Rain Gauge(ARG)	2579(part time)	1272 8579 non dept
3	Agrometeorological Observatories	-	219
4	Surface Observatories	-	559
5	Air Quality Monitoring system	-	10
6	Urban Climatological Units	-	2
7	Urban Climatological Observatories	-	13
8	GPS Sonde	-	16
9	Doppler Weather Radar (DWR)	5	16
10	Aviation Current Weather Observatories	-	71
11	High Wind Speed Recording Stations	-	13
12	Hydro meteorological Observatories	-	701
13	Drifting Buoys	-	10
14	Moored Buoys	-	19
15	Radars Storm Detection	21	26
16	Wind Profilers	1	45

Table 8: Details of observation Stations.

Source: National Disaster Management Guidelines, Management Of Cyclones and Dr KJ Ramesh, Advisor MoES, Gol.

7.9 Changes in the last 15 years in communication system for disseminating Early Warning

Advancement in Information Technology in the form of internet, GIS, Remote Sensing, Satellite Communication etc it has become possible for IMD to implement Disaster Reduction Plans which in turn help contain damage on a long term basis. INSAT based CWDS were replaced by Digital CWDS. Communication link between operation center (OC) at NDMA and MHA to respective SDMA, SEOC, DDMA and DEOC has been operational on ISDN as main link; POLNET, RAILNET, NICNET and SPACENET of ISRO as standby media. Satellite based real time voice data messaging for Cyclone warning system has been operationalised to forward authoritative Alert messages compatible with internet, News media, TV, Radio, Wired Telephone, Mobile telephone etc. DVB-RC (satellite based), EDUSAT, DTH (Prasar Bharati, Tata Sky, Airtel, DTH etc.) are also planned to be utilized for DM. Other medias that are available and integrated in the DM plan are the Battery less radio for fishermen, SATPHONE, Community radio etc. Refer **annexure 4** for communication systems augmented after Odisha Super Cyclone.

7.10 Can an improved EWS reduce the loss of life and property?

In cyclone Phailin an improved EWS along with quick and efficient response from concerned authorities helped reduce the toll. The warning was first available 120 hours in advance. The landfall site was also predicted 24 hrs in advance which was not so in the case of the super cyclone. There was no confusion about the landfall site and people were willing to be evacuated earlier as they could move with some of their valuables/belongings. The death toll has come down from 9800 plus in the Odisha Super Cyclone to 44 in cyclone Phalin. More than half of those killed in Phailin were due to flooding as a result of heavy rainfall and collapsing of mud wall houses due to saturation in the flood waters. This single

factor shows that an effective improved EWS along with good response from authorities can mitigate the damages and losses. The number of shelters available in Odisha has gone up from 23 to 500 plus. Availability of shelters has helped evacuate more number of people from landfall site to these shelters. Preparedness also helped as cattle mounds were made next to these shelters and stocked with fodder. Thus people who were sentimental about their cattle could also move out of the house. As is evident, the number of lives lost came down drastically, however number of houses destroyed has increased many folds. This may be because of the fact that more than 85 % of the houses are made of mud (temporary House) and rebuilding of houses in the same manner with no strengthening measures adopted. This resulted in high percentage of houses getting destroyed. Efforts have to be made to ensure structural safety of buildings and other lifeline infrastructure like power, communication network, Hospitals, all weather roads, bridges, culverts etc. so that rain water can easily flow into natural drains and prevent flooding.

The comment by WMO regarding EWS in India before Cyclone PHAILIN explains the effectiveness of EWS in mitigating cyclone related losses is quoted here:-

The World Meteorological Organization (WMO) regards political recognition of the benefits of developing and implementing EWS at the local and national level as one of ten principles of EWS good practice (WMO, 2011). "The role of cooperation and effective communication between local and national officials was evident during Cyclone Phailin. It was reported that coordination between the local and national levels was "remarkably good," which helped lead to successful preparedness efforts (Jain, 2013). For governments looking to emulate the collaborative approach the Indian government took, policies could be put in place to encourage participation at local and national levels for early warning communication, recovery and relief efforts. Moreover, the involvement of the community and the private sector are also essential to the establishment and implementation of prevention policy" (UNISDR, 2007).

7.11 Conclusions

7.11.1 **Disasters Cost India \$ 10 bn Per Year** New UN global assessment report on disaster risk says India's annual loss due to disasters is estimated to be \$9.8 bn. The global assessment report (GAR 2015)³⁹, produced by UN office for disaster risk reduction (UNISDR) urged countries, especially in

³⁹ The Times of India, dated 11 March 2015 New Delhi

Asia to treat this a wake up call and invest in disaster risk reduction(DRR), or it will hinder development. UN countries are to meet in Sendai, Japan to sign a new DRR protocol which will replace Hygo Framework for Action (HFA). India's 14th Finance commission has committed \$ 9 bn in the next five years towards disaster management. An annual investment of \$ 6 bn will generate benefits worth \$ 360 bn in terms of DRR.

7.11.2 Thus referring to the research questions to examine if we could find answers for them, a definite relation has been established between an effective Early Warning System and Risk reduction. An effective EWS will drastically reduce the loss of life as seen in cyclone Phailin. Hence in view of the outcome of the research and opinions of various world bodies like United Nations and WMO etc. the following recommendations are made for policy makers:-

- (a) Demographic factors need to be considered when evacuating people. Older people, women and children will require more assistance during evacuation.
- (b) An effective and reliable Early Warning System is very important if the intention is to reduce loss and damage to life and property.
- (c) Structural and Nonstructural measures brought out in the studies need to be adopted.
- (d) Easily accessible Multipurpose Shelters need to be built all around vulnerable areas. They need to be utilized in normal times to ensure maintenance. Record of location of schools and places of worship are held by disaster management authorities.
- (e) The EWS should have an effective communication facility with built in redundancies.

- (f) Political will is very important for ensuring all DM activities are well coordinated.
- (g) Creating Awareness regarding Disasters and the processes involved in evacuation etc is a very important part of preparedness. This will help in easy evacuation.
- (h) Policy makers and emergency workers need to be trained for their roles.
- (i) Transparency needs to be ensured in fund and relief material utilization.