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THE EFFECTIVNESS OF EARLY WARNING SYSTEMS DURING DISASTERS

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Abstract: *Disaster management is very wide subject and single paper cannot cover all dimensions involved in disaster management, so focus has been placed on modern detection and early warning systems. The threat has made the human being more vulnerable than ever before, mainly due to very fast growing population coupled with poor town planning in most parts of the countries. The developed countries are in effort of establishing strong and well equipped organizations to effectively deal with natural disasters. However the magnitude and area of influence of these natural disasters demands more cohesive and joint efforts. Natural disasters being faced by the Pakistan have also been covered. The early warning implications, as it is different for different types of calamities. Responsibilities of different groups have been discusses to provide early warning and also to ensure that the adequate time is available for the people to safely extricate from the dangerous zone. This paper deals with the latest systems available or being uses by developed countries and some recommendations for an effective early warning system in Pakistan.*
Keywords: *Disasters, vulnerability, safe handling, responsibilities*

INTRODUCTION

Pakistan has been experiencing different disaster intermittently in the past which cost loses to the lives and livelihood of its people. To make the people safer, there is a need to have an effective early warning system which must be people centered and be able to deliver timely information to the public well in time which is at risk. Pakistan, in the beginning remained without dedicated department looking after natural disaster. The Federal Flood Commission was created in 1977. Before that the Irrigation Departments at provincial (PIDs) were looking after the responsibilities of flood protection works. But after the experiencing frequent floods in seventies which left colossal losses to human lives, land and property, the need to have an organization at national level was felt to deal with flood protection and preventive measures across the country. Past experiences of earthquake in the country also supplemented the requirement. Over the last 20 years about 3 million lives have been lost and 1 billion people have been uprooted. The presence of an efficient forecasting and warning systems is necessary as part of effective alert strategies at national and regional level [1]. The aim of this paper is to analyze the early warning and detection organizations/equipment being used in the World with a view to recommend an appropriate system for Pakistan for a quick response at various levels to minimize the hazards.

NATURAL DISASTERS AND EXISTING ARRANGEMENTS

Pakistan has been suffering because of different natural hazards. The effects of these disasters in Pakistan can be measured by the fact that disasters during 2005 in south Asia caused 99,425 deaths, of which 84 per cent were due to one earthquake experienced in Pakistan. The migration of a large proportion of the population towards urban areas for education and employment has also magnified the quantum of threat. The unplanned habitation has made certain areas even more difficult to access. The details of major hazards in Pakistan includes floods, drought and earthquakes [2,3,4].

In Pakistan regular rainfall becomes the main source of water in the rivers which flow irrigates the plain areas. Mainly plain area of the country experiences flood which include the province of Punjab and Sindh. Due to more frequent rain in the mountain flash floods are experienced in the areas of KPK, Balochistan and FATA. Huge losses in terms of lives and property have been experienced during flood in the past. Drought has not been experienced in the past very frequently, in some part of the country where average rainfall is some time very low may suffer drought especially in Balochistan.

Due to the location of Pakistan near earthquake prone area small scale earthquake are very often in the country. This is more alarming as the increasing population and poor quality of buildings has made the area much vulnerable. Pakistan lies in the subduction zone. It is an area where two of the earth's rigid tectonic plates are converging towards one another. During 1935 an earthquake destroyed whole of Quetta. The history event of disaster was experienced in 2005 in which devastating earthquake hit Northern areas resulting death in thousands and huge losses to the property.

NATIONAL DISASTER MANAGEMENT POLICY

It reveals that the Pakistan's Disaster management revolves around flood disasters with more concentration on relief and rescue. Policy sometimes aims strategic preferences those are aimed at protecting important places. The lack of knowledge, threat, its analysis and management, will result into lack of readiness for the disasters. Disaster management policy deals more with post-disaster scenarios and it is not integrated with

development plan. There is institutional lack of coordination for proper management. Moreover, there is no authority to control disaster management at central level. The structural and nonstructural measures are not given equal importance for disaster management at state-level. And the departments and organizations responsible for disaster management remain unimportant in the government setup [5].

PAKISTAN METEOROLOGICAL DEPARTMENT

This functions under the Ministry of Defence which is dealing with the provision of services in the country [6]. The department is providing data on geophysical and meteorological matters, like generation of meteorological, phonological and geophysical data. It is responsible for the rapid dissemination of data through telecommunication system. It also provides data processing units for Climate for long term weather trends. And it also provides the data analysis system for forecasts and warnings for aviation, shipping, agriculture and irrigation.

DISTRIBUTION OF RESPONSIBILITIES FOR EARLY WARNING

The aims of community response and early warning system are to give sufficient reaction time to the members of effected society so that the losses in term of lives material and property are reduced to the minimum. This system includes risk assessment and monitoring of prevailing risk in order to provide effective early warning. This also includes the degree of exposure of the people thereby enabling the administration to take necessary measure to protect the people and property. Prediction of effects is necessary for developing mitigation and response plans in which schools, NGOs and community based organizations (CBOs) can play a major role [7].

Public awareness and participation are very important for disaster management. Each segment of society plays vital role for prevention, mitigation and recovery before, during and after disaster. They are responsible for people of the victim community must be aware of hazard so that they are able to take precautionary measures. Local Communities are responsible for people knowledge about hazard and precautionary measures to increase safety level. People should have enough acquaintance with hazards and comprehension of instructions received. Local communities should ensure passage of information to the public so that they can increase their safety level.

National government should issue timely hazard warning in an effective way. Ensure timely vacation of dangerous area at the time of need. Regional Institutions must render expert opinion and provide special knowledge to support and enhance the capacity to fight against hazards. Interconnectivity at International for sharing of data advisory information is very important for development of operational capacity at national level.

Early Warning System needs to well linked setup at national and local level within administration authority. These systems should form part of program of national level to reduce the hazards. In all the countries the responsibility for the issuance of early warnings relating all kind of disasters should stay with an organization detailed by the Government. Well known authority be earmarked to make decision on receipt of information of hazard. Well known Warnings System to local agencies. Assessment of the occurrence of hazards be done within Early warning systems. Inclusion of small hazards in early warning system.

Developed countries must render help to developing countries to fight hazards. An audit with effective identification of the needs for early warning capabilities by affected countries is very essential. Global level institutions responsible for dissemination of warnings be well linked with served countries and an effective technical integration is established as per the needs. Preparation of warnings be based on modern knowledge and technology and exchange of monitoring data amongst countries. Warning must be understood and accepted with international standards by all countries.

Predicting effects of geological hazards carries importance but understanding of the consequences of the hazard is foremost important. If an occurrence is reported and information is passed but the magnitude and intensity is not shared then people responsible for response plans will stay in illusion to pass the information for the level of preparation/action [8]. Long-Term Prediction relates to prediction about the happening of natural disasters in the future in an area, it links past happening and its causes. Maintaining the record of such event is helpful to determine the frequency and intensity of the event. This concept has been used to make a form of long-term prediction. Intermediate-Term Prediction relates to indications as a disaster may occur sooner rather than later takes us into the realm of intermediate-term prediction. It is normally correctly predicted other than earthquakes. Approach to this problem has been through the methodology of pattern recognition, which involves linking the numerous parameters that may have something to do with the occurrence of strong earthquakes.

Short-Term Prediction is the most important aspect of the early warning system as it will dictate the reaction time for the people to save their lives. Again as we have seen in the case of intermediate prediction it is difficult in the case of earthquakes. The only option is to detect the initial wave and activate some type of the community alarm. Also the short time available between detection and damage occurrence there has always been doubts as regard the efficacy of this system.

MODERN EARLY WARNING SYSTEMS IN THE WORLD

Prediction of a hazard and its location and magnitude is an uphill task however with the development of technology different means and ways are being used to overcome this need. Different countries have devise system to get early warning about the occurrence of a hazard detection of infrasound is of interest with respect to analysis of building structures, earthquake prediction, and other geometrically large sources [9,10]. Geological Application of Remote Sensing (GARS programme is being run with cooperation and joint efforts by UNESCO and IUGS with the objectives of mapping in tropical environments with new methods and use of multi sensor for improvement. Use of GIS technology based on the satellite data for Landslides mapping and analysis of natural hazards through remote sensing. The Remote Sensing Data Centre (DFD) is an earth monitoring system which can focus with satellite coverage of its highly mobile and flexible stations over an area endangered by environmental problem and the natural disasters.

Warning System in the Pacific (WSP) is allocated to the monitoring of hazards in the Pacific. International Tsunami Information Centre monitors the WSP's and is responsible for its functioning and facilitates transfer technology to other countries for their warning systems. SOS-LIFE Earthquake Early Warning and Detection System were designed for small scale usages for houses and small setup. This is bases on specially developed software. It senses the danger which has happened before, thereby leaving enough time to be on safer site.

To promote international cooperation in flood management, Japan has launched International Flood Network (IFNet) with the help of other international organizations. Which carries following objectives:

- ✓ *Provision of platform to the experts for exchange of information and experiences for efficient flood management.*
- ✓ *The effective early warning programs, establishment of partnership.*
- ✓ *Reduction in losses of life and material in the flood disaster, designing and coordination of efficient measures.*

Delft Hydraulics' Flood Early Warning System provides effective information about flood. The main features of the system are:

- ✓ *The system includes large number of data handling utilities.*
- ✓ *It gives an open connection to a more range of forecasting.*
- ✓ *This is used effectively both in highly complex and basic forecasting systems.*

Delft-FEWS used in multi environment for example alone, manually driven environment. Early Warning System and dissemination of information is very effective adopted by Czech Republic. Main Features of the System are:

- ✓ *Overall responsibility of flood warning rest with The Czech Hydro meteorological Institute (CHMI).*
- ✓ *Office of Civil Defense and the Main Center of Fire Protection Service disseminate flood warnings.*
- ✓ *Parts of the System Joint Flood Forecasting and Warning System are based on multi-sensor including weather information through Satellites. Level of water is taken with the help of Rainfall gauges. Stream flow is continuously observed through gauges.*

Establishment of drought early warning system is very complicated issue. Drought process very slowly and stay for very long time. Therefore its beginning and termination can be gauge correctly. Being slow in nature it gives time for reaction for protection and opportunity to mitigate its effects. At world level institutions are in try to prepare plan for drought and to handle it in better manner. Subsequently, an efficient monitoring and early warning system, Advanced Very High Resolution Radiometer (AVHRR), with operational weather satellites have been used for drought detection and monitoring. It also monitors the rain situation as drought is the result of scanty rain or no rain.

RECOMMENDATIONS

Although accurate and precise early warning of the disasters is difficult to achieve however well coordinated efforts at different levels and cooperation of community can reduce the damages. In the following paragraphs some of the recommendations are highlighted for the same purpose:

- ✓ *The current capabilities of the Pakistan Meteorological Department are insufficient to reduce the hazards of disasters. It is required that the meteorological, hydrological and seismological services of the department must be boosted to meet the future challenges. The department must be upgraded to include the following facilities for efficient and smooth operation for collection of meteorological and geophysical data, rapid dissemination of data and examination Meteorological data for issuance of forecasts and warnings including data processing units for climate for long term weather trends.*
- ✓ *There is a dire need to have disaster prediction study group to address the concerns at world level relating growing trend of development in dangerous areas with low quality of construction. A statistical approach is primarily used for long term earthquake prediction. For example when a prediction is made that "there is a 90% probability of that an earthquake to occur in the next 50 years, it does not mean that this earthquake cannot happen tomorrow or it may not be delayed by 50 years. In previous years, 29 major earthquakes were tested for prediction, 8 of them were followed by strong earthquake, 6 were predicted and 2 were missed. It is no wonder that there is great concern worldwide about the continuing growth of megacities in places of high seismic hazard, and often with low building standards.*
- ✓ *The national seismic center should have technical facility, well trained experts, technicians for functioning round the clock and whole week. The center should perform as central point at national level for interaction at regional and international level.*
- ✓ *Pakistan Meteorological Department must establish a national seismic network. This network should have central recording stations, local seismic networks, tide measurement system for monitoring of sea level and dedicated satellite data links for early warning.*
- ✓ *Central Recording Station at Karachi has already been established by Pakistan Met Department consisting of broad bands sensors. This facility has to be extended to at least two recording stations with one in the northern part of the country due to the fault line passing through our northern areas.*
- ✓ *The whole country should be divided into small regions with seismic networks connected with national network. Central recording stations should be connected to respective local seismic networks.*
- ✓ *Southern early warning system should be established in Balouchistan as Quetta has been a victim of earthquakes in the past. This network should be capable of detecting any earthquake activity in the Balouchistan area. This network should be linked to central recording station at Karachi through satellite.*
- ✓ *The chances of Tsunami in Arabian Sea do exist. There is dire need to have an efficient warning system for tsunami there by enabling the authority to take precautionary measures before arrival of sea waves. A separate network for tsunami detection must be established at Karachi with additional elements i.e. deep ocean buoys and tide gauge network for monitoring of sea level.*

- ✓ *In October 2005, one of the strongest earthquakes occurred in Northern part of the country causing huge damage to both lives and property. This all happened in the absence of early warning system. Therefore, a separate early warning system must be established to cover whole of the northern part of the country. It should have at least 20-25 sensors in the network.*
- ✓ *After establishing a comprehensive network of national level there is a need to augment it with stand alone early warning systems capable of saving lives. There are systems which are light in size and weight and can easily be installed in buildings and even of portable size like SOS LIFE earthquake early warning system and Meir Gitlis Life Saving System.*
- ✓ *Tsunami/flood Early Warning System will be more secure with full backup of communication through satellite. The setup will have the ability to wide range extension ability between the Regional and Main Centre.*
- ✓ *In Pakistan rain fall in the North is more than south the level of rain goes to over 700 mm to 200mm respectively. There is need to have flood forecasting and Warning Centre for provision of information of an impending flood. The development of flood forecasting and warning system is need of the time to meet the requirements of region and national level and is a high priority in Pakistan. The project envisages Flood Forecasting & Warning Centre. This center should be able to monitor glacier, monsoon water, flow of water in the river and temperature effects on snow on the mountains. All data received should be examined to see the possibility of hazard and predict the possibility of flood.*
- ✓ *No accurate systems are available in the World which can accurately predict the occurrence of drought. In this regard a drought study group be maintained at national level to continuously study the prevailing conditions. This group should incorporate all information from the met department to make an accurate picture of the possibility of drought. It is an established fact that satellite provides the best possible warning as regard the occurrence of the drought. Satellite remote sensing offers some unique advantage over conventional method i.e a unique vantage point, synoptic view and data archive.*

Disaster prediction and early warning is one of the important task and challenge for the developing world. Lack of town planning and over population has increased the hazardous effects of natural disasters. There is a dire need for Pakistani government to allocate required efforts in terms of the finance and expertise to reduce the hazard effects.

REFERENCES

[1.] *Muhammad Atiq Ur Rehman Tariq, Nick van de Giesen. (2012). Floods and flood management in Pakistan. Physics and Chemistry of the Earth, Parts A/B/C, Volumes 47–48, Pages 11-20*

[2.] *Ali Asgary, Muhammad Imtiaz Anjum, Nooreddin Azimi. (2012). Disaster recovery and business continuity after the 2010 flood in Pakistan: Case of small businesses. International Journal of Disaster Risk Reduction, Volume 2, Pages 46-56*

[3.] *Mateeul Haq, Memon Akhtar, Sher Muhammad, Siddiqi Paras, Jillani Rahmatullah. (2012). Techniques of Remote Sensing and GIS for flood monitoring and damage assessment: A case study of Sindh province, Pakistan. The Egyptian Journal of Remote Sensing and Space Science, Volume 15, Issue 2, Pages 135-141*

[4.] *Zubair Ahmed (2013). Disaster risks and disaster management policies and practices in Pakistan: A critical analysis of Disaster Management Act 2010 of Pakistan. International Journal of Disaster Risk Reduction, Volume 4, Pages 15-20*

[5.] *Ali Asgary, Muhammad Imtiaz Anjum, Nooreddin Azimi (2012). Disaster recovery and business continuity after the 2010 flood in Pakistan: Case of small businesses. International Journal of Disaster Risk Reduction, Volume 2, Pages 46-56*

[6.] *Syed Ainuddin, Daniel P. Aldrich, Jayant K. Routray, Shabana Ainuddin, Abida Achkazai (2013). The need for local involvement: Decentralization of disaster management institutions in Baluchistan, Pakistan. International Journal of Disaster Risk Reduction, Volume 6, Pages 50-58*

[7.] *M.J. Khan, A. Razzaq, M.K. Khattak, L. Garcia. (2009). Effect of different pre-sowing water application depths on wheat yield under spate irrigation in Dera Ismael Khan District of Pakistan. Agricultural Water Management, Volume 96, Issue 10, Pages 1467-1474*

[8.] *Muhammad Ali, Sher Jamal Khan, Irfan Aslam, Zahiruddin Khan. (2011). Simulation of the impacts of land-use change on surface runoff of Lai Nullah Basin in Islamabad, Pakistan. Landscape and Urban Planning, Volume 102, Issue 4, Pages 271-279*

[9.] *Andrew C. Kerr, Mehrab Khan, John J. Mahoney, Kirsten Ngaire Nicholson, Chris M. Hall. (2010). Late Cretaceous alkaline sills of the south Tethyan suture zone, Pakistan: Initial melts of the Réunion hotspot? Lithos, Volume 117, Issues 1–4, Pages 161-171*

[10.] *Adnan Ahmad Tahir, Pierre Chevallier, Yves Arnaud, Luc Neppel, Bashir Ahmad. (2011). Modeling snowmelt-runoff under climate scenarios in the Hunza River basin, Karakoram Range, Northern Pakistan. Journal of Hydrology, Volume 409, Issues 1–2, Pages 104-117*

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