

# INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & MANAGEMENT DISASTER MANAGEMENT MITIGATION IN INDIA

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## ABSTRACT

India has been traditionally vulnerable to natural disaster on account of its unique geo-climate conditions. Floods, droughts, cyclones, earthquakes, and landslides have been recurrent phenomena. About 60% of the landmass is prone to earthquake of various intensities; over 40 million hectares is prone to floods; about 8 % of total area is prone to cyclones and 68% of the areas is susceptible to drought. In the decade 1990-2000, an average of about 4344 people lost their lives about about 30 million people were affected by disaster every year. The loss in terms of private, community and public assets has been astronomical. At the global level, there has been considerable concern over natural disaster. Even as substantial scientific and material progress is made, the loss of life and property due to disaster has not decreased. In fact human toll and economic losses have mounted. It was in this background that the UN general assembly in 1989 declared 1990-2000 as the International decade of natural disaster reduction with the objective to reduce loss of lives and property and restrict socioeconomic damage through concerted international action. The Government of India have adopted mitigation and prevention as essential components of their development strategies. The Tenth Five Year Plan documents has a detailed chapter on Disaster Management.

The plan emphasizes the fact that development can not be sustainable without mitigation being built into development process. Each State is supposed to prepare a plan scheme for disaster mitigation in accordance with the approach outlined in the plan. In brief, mitigation is being institutionalized into development planning. The Finance Commission makes recommendation with regard to devolution of funds between Central Government and State Government as also outlays for relief and rehabilitation. The Government of India have issued guidelines that where there is a self of projects, projects addressing mitigation with be given priority. It has also been mandated that each projects in a hazard prone area will have disaster prevention/mitigation as a term of reference and the project documents has to reflect as to how project addresses that term of reference. In the sections are discussed the measures shortcoming, measures taken for the mitigation of the disaster.

**Keywords:** *Disaster, Management, Mitigation, Rehabilitation, Prevention, Relief.*

## I. INTRODUCTION

It is really an unfortunate and undesirable situation that in our country where more than 6 crore people are affected by disasters every year. Statistics is shown in figure.

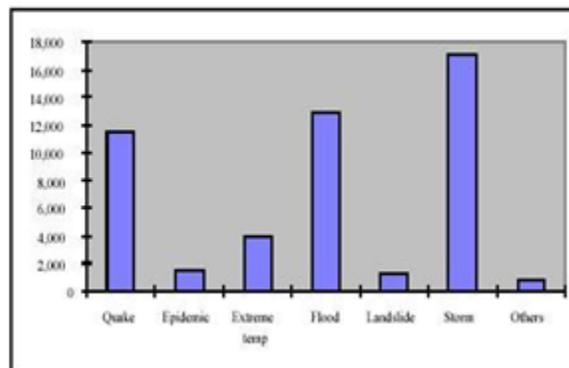


Fig A- Mortality due to natural hazards (1990-2000)

we have no policy on systematic disaster Management. It is only after a disaster strikes that the wheels of the government, both at the centre and at the states, move and that too slowly. Despite the need to build up capabilities to meet the challenges of disasters, the thrust has unfortunately been on alleviation and relief. Even the relief has not been quick and adequate, as few disasters such as Orissa super cyclone, Tsunami of 2004, Gujarat earthquake etc experiences has shown. India's response to and tackling of this two major disasters has thrown up the following weakness in our disaster management efforts.

**(a). Inadequate Early Warning System**

Though, the forecasting, monitoring and warning mechanisms are beautifully articulated on paper in practice, the warnings are not early enough and they do not reach all those likely to be affected. In case of Tsunami, 2004; Bhuj earthquake etc for example, communication facilities which could have resulted in better co-ordination of warning and reduction of damage to life and property were inadequate.



Tsunami of 2004



Bihar Flood 2009

**(b) Lack of Pre-disaster Preparedness**

With disasters striking India with increased regularity, there should be a plan in place to tackle the disaster and reduce its impact. On the contrary, people are caught unaware time and again. There is not planned information system as to what needs to be done when faced with a calamity. For example, during Tsunami, 2004, dead body laid floating in the water for many days due to the unavailability or lack of required equipment to meet the need of the time/emergency.

**(c) Inadequate and Slow Relief**

Relief is an important aspect of the disaster management to provide help to the affected people. The relief operations are often handled in ad hoc and haphazard manner. How efficiently to provide food, medicine, to reduce the suffering of the affected people etc are addressed and met improperly. Even days after the Bhuj earthquake, and Tsunami, 2004,, many people could not be provided with safe drinking water, temporary shelter, and medicines. Such a scenario gives rise to law and order problem- looting of the relief materials and outbreak of the epidemic due to rotting dead bodies on the other hand.

**(d) Lack of Co-ordination**

Disaster management requires concerted efforts from Central Government, State Government, NGOs, International agencies and private sectors etc. Because of the lack of the co-ordination, relief material is not properly distributed among the people. Even worst happens when they are mis-utilized and are not distributed uniformly.

**(e) Slow Rehabilitation and Reconstruction**

While immediately after a disaster strikes, there is hectic relief and rescue mission, mainly aimed at feeding the people and stalling the outbreak of an epidemic, relief and rescue can not go on endlessly and rehabilitation and reconstruction should be given proper attention. However, this is an area which is often ignored and progressed is slow once the initial attention fades away. Restoration of infrastructure, hospitals, schools, houses, and sources of living of the people needs to be given proper attention.

**(f) Proper Administration**

A quick assessment of the extent of the damage is necessary so that relief and rehabilitation work can be properly planned. However, it was seen that even many months after the Bhuj earthquake and Tsunami of 2004, the government was yet to finish the preliminary survey of assessing the total impact of the damage. Apart from this, poor administration frustrated the best intentions and efforts of private initiatives. After the quake, Gujarat government was too slow and indecisive on some of the best rehabilitation plans proposed by the NGOs and Corporate.

**(g) Poor Management of Finances for Post-disaster Relief**

Mostly relief and rehabilitation work suffers from the lack of co-ordination, proper management, and supervision at all levels and indicated the absence of adequate planning and preparedness to meet any emergency. Consequently, the funds are mis-utilized and relief measures were tardy and inadequate, providing scope for pilferage of relief and rehabilitation remained unutilized and there is huge shortfall in distribution of emergency relief, shelter material cloths, house building assistance etc. There have also been reports of relief and rehabilitation funds being utilized for paying salary arrears of the state government employees.

**(h) Symbolism Rather than Relief**

It has been a recurrent experience that rather than making a serious effort at planning and management for tackling frequent disasters, our government adopts symbolic gestures like helicopter survey of disaster affected areas. The politics of relief works in a manner that tall claims are made by the Government other than the affected state to help the affected districts and by sending huge financial help but these claims prove hollow once the calamity recedes.

**(i) No Instruction for Pre-seismic Period**

There is no instruction for the pre-seismic period. Unfortunately, in the present administrative set up, no official will visit the pople during pre-seismic period to tell them about an eminent earthquake. But, during the post-seismic period, a large number of officials will visit the affected people with food, tents, medicine, cloths

and compensation funding to the relatives of the dead. This scenario has been repeated after Latur (1993), Jablpur (1997), Bhuj (2001), Andman (2004), and Kashmir(205) earthquakes. This pathetic situations has to be changed at the earliest. The issue need to be seriously pondered at the national level. The sole reason for this is the lack of knowledge about earthquake precursors and earthquake prediction. Most of the earthquake disaster management experts, agencies, and offices have a strong conviction that an earthquake can not be predicted. They are correct to some extent. Till now, there was onle one case of successful prediction in China. Earthquake prediction has almost become a taboo in most of the disaster management offices. The relevant rules also are empowered to take penal action against anyone who talks about earthquake prediction. As a result, an impression is inadvertently created in the society that moist of the disaster management agencies come in the picture during post-seismic period to clear the debris and the corpses. The present situation is skewed. On one hand, it is accepted that a large-magnitude earthquake is due and it may occur anytime; On the other hand, most of the disaster management agencies feet that an earthquake can not be predicted. If we want to protect people form an earthquake, it is essential that a suitable precursory warning is issued even in case of moderate scale of earthquake as it makes the people of the region aware the region is prone to disaster, and they should be careful.

## **II. MEASURES/FACTS TAKEN TO IMPROVE DISASTER MANAGEMENT IN INDIA**

### **Central Level**

At the central or national level, Ministry of Home affairs is entrusted with the nodal responsibility of managing disaster. At the apex level, there are tow cabinet committees viz. cabinet committee on national calamity and cabinet committee on security. All the major issues concerning natural disasters are placed before cabinet committee on natural calamity whereas calamities which can affect internal security or which may be caused due to use of nuclear, biological or chemical weapons etch are placed before cabinet committee on security. The NCMC (National Crisis Management Committee) is the next important functionary. The cabinet secretary heads it. It includes secretaries of concerned department/ministers. Its main function is to give direction to Crisis Management Group (CMG) and any minister/department for specific action needed for meeting the crisis situation. CMG lies below the NCMC. The Central Relief Commissioner is its chairman. His primary function is to coordinate all the relief operations for natural disaster. Apart from coordinating the relief operations, it reviews the contingency plans formulated by Central Ministers/Department and measures required for dealing with natural disaster. CMG meets every six months however in event of any disaster it frequently meets to review the relief operation and explore all possibilities to render all possible help to the affected region.

### **State and District Level**

At the state level, there are state relief commissioners who are incharge of the relief measures in wake of natural disaster in the perspective states. The chief secretary is the overall in charge of the relief operations in the state. The relief commissioner and additional relief commissioner work under his direction and control. In addition, there are number of secretaries, head of various departments who also work under the overall direction of chief secretary. At the district level, districts are headed by District Collector or district magistrate who is responsible for the overall supervision and monitoring of relief measures and preparation of disaster management plans. At the tehsil level DSO/SDM take care of the disaster management.

Despite there being a general tardiness about the manner in which we respond to disasters, there has been significance progress in this area and there have been many experiments and success stories worth emulating,

(I) Learning from the Latur earthquake calamity, Maharastra hss launched India's first disaster management infor-network. Soon after this quake, state government launched the Maharastra Emergency Earthquake Rehabilitation programme. The programme aimed at achieving preparedness through an information-network so that unpredictable and uncontrolled disaster impacts could be offset with planned and manageable disaster mitigation efforts. This info-network links the state government machinery with all its tehsils and districts along with other strategically and economically important agencies based in the state. The state has been mapped for potential disasters. Statistics for potential natural calamity zones are now being complied. Record for the tide movements, potential typhoons and earthquake prone zones are being linked up with geographical information system to mitigate the disaster. The Multi-hazards Disaster Mitigation Plan will create a disaster management information at emergency operation centre at state government headquarters. Apart from forewarning of calamities like flood, earthquake, etc; post disaster

relief and rehabilitation is another area of use of this network. It will help in co-ordinating among hospitals, voluntary organizations, ambulances, fire brigades and government relief measures.

(II) Some State Government have got their acts together, learning from past experiences. In 1991, A.P. Government was able to implement previously planned programme to evacuate 6 lakh people from the path of an approaching cyclone with 52 hours. Fatalities numbered less than on tenth of what could have otherwise been. This was achieved through a planned approach combining both traditional and advanced channels.

(III) The IMD has set up a National Seismic Telemetry Network to anticipate threats from seismic disturbances. After the Gujarat quake, 10 new seismological observation equipped with latest facilities were set up and 14 of the 45 existing observatories were upgraded with state of the art digital seismograph for better monitoring of effects of earthquake in the seismic zones.

(IV) The IMD has set up cyclone warning centres along many coastlines. Information on cyclone warning is furnished to the central control room in the Ministry of Agriculture. Besides, high powered cyclone detection radars are installed at various places on the coastal belt, that can track disturbances within a range of 400 KM. Satellite imagery is another tool used when cyclone are beyond the range of the coastal radars. The ISRO has placed 250 storm warning receivers all along the Indian coast. In a time of crisis, these receivers are switched on via satellite and broadcast siren and local language warnings.

(V) Measures for flood mitigation were taken from 1950 onwards, As against the total of 40 million hectares prone to floods, area of about 15 million hectares have been protected by construction of embankment. The State Government have been assisted to take up mitigation programmed like construction of raised platforms etc. Flood continues to be a menace however mainly because of the huge quantum of silt being carried by the rivers emanating from the Himalayas. This silt has raised the bed level in many rives to above the level of countryside. Embankment have also given rise to problem of drainage with heavy rainfall leading to water logging in area outside the embankment. To evolve both short-term and long term strategies for flood management / erosion control, Government of India have recently constituted Central Task Force under the chairmanship of Central Water Commission. The task for will examine causes of the problem of recurring floods and erosion in States and region prone to the flood and erosion; and suggest short term and long term measures.

(VI) Due to erratic behavior of monsoons, both low and medium rainfall regions are vulnerable to periodical drought. Experience has been that almost every third year is a drought. However, in some of the States, there may be successive drought years enhancing the vulnerability of population in these areas. Local communities have devised indigenous safety mechanism and drought oriented farming methods in many parts of the country. From the experience of managing the past droughts particularly severe drought of 1987, a number of programme have been launched by the Government to mitigate the impact of drought in the long run. These programmes includes Drought Prone Area Programme (DPAP), Desert Development Programme (DDP), Integrated Water Development Projects (IWDP) etc.

(VII) In order to respond effectively to floods, Ministry of Home Affairs have initiated National Disaster Risk Management Programme in all the flood prone States. Assistance is being provided to the States to draw up disaster management plans at the State, District, Block/Taluka and village levels. Awareness generation campaigns to sensitize all the stakeholders on the need for flood preparedness and mitigation measures. Elected representative and officials are being trained in flood disaster management under the programme. Bihar, Orissa, West Bengal, Assam, and Uttar Pradesh are among the 17 multi hazard prone States where this programme is being implemented with UNDP, USID and European Commission.

(VIII) A Comprehensive programme has been taken up for earthquake risk mitigation. Although, the BIS has laid down the standard for construction in the seismic zones, these are not being followed. The building construction in urban and suburban areas is regulated by the Town and Country Planning Act and Building Regulations. In many cases, Building regulations do not incorporate the BIS codes. Even where they do, the lack of knowledge regarding seismically safe construction among the architects and engineers as well as lack of awareness regarding their vulnerability among the population led to most of the construction in urban and suburban areas being without reference to BIS standards. In the rural areas, the bulk of the housing is non-engineering construction. The mode of

construction in rural areas has also changed from mud and thatch to brick and concrete construction thereby increasing the vulnerability. The increasing population has led to settlement in vulnerable areas close to the river bed which are prone to liquefaction. The Government have moved to address these issues. A National Core Group for Earthquake Risk Mitigation has been constituted consisting of experts in earthquake engineering and administrators. The core group has been assigned with the responsibility of drawing up a strategy and plan of action for mitigating the impacts of earthquakes' providing advice and guidance to the States on various aspects of earthquake mitigation; developing/organizing the preparation of handbooks/pamphlet/types designs for earthquake resistance construction.; working out systems for assisting the States in the seismically vulnerable zone to adopt/integrate appropriate BIS code in their buildings; evolving systems in the training of municipal engineers as also practicing architects and engineers in the private sectors in the salient features of BIS codes; Evolving a system of certification of architects/engineers for testing their knowledge of quake resistance construction; evolving systems for training of masons and carry out intensive awareness generation campaigns.

(IX) Hospital preparedness is crucial to any disaster response system. Each hospital should have an emergency preparedness plan to deal with mass casualty incidents and the hospital administration/ doctor trained for the emergency. The curriculum for medical doctors does not include hospitals preparedness for emergencies. Therefore, capacity building through in service training of the current health managers and medical personnel in hospitals preparedness for emergencies or mass casualty's incidents management is essential. At the same time, the future health managers must acquire these skills systematically through the inclusion of health emergency management in undergraduate and post-graduate medical curricula. For the same, tow comities have been constituted for preparation of curriculum for introduction of emergency health management in MBBS curriculum, and preparation in service training of hospital managers and professions. Rajiv Gandhi University of health Sciences Karnataka has been identified as the lead national resources institution for the purpose.

(X) While above mitigation measures will take care of the new constructions, the problem of unsafe existing building stock would still remain. It will not be possible to address the whole existing building; therefore, the most important buildings such as hospitals, schoold, cinema halls, muti-storied apartment are being focused on. The States have been instructed and advices to have such buildings assessed and where necessary retrofitted. The ministry of Civil Aviation, Railways, Telecommunication, Power and Heath and Family Welfare have been instructed to take up necessary action for detailed evaluation and retrofitting of lifeline buildings located in seismically vulnerable zones so as to ensure that they comply with the BIS norms. Plan have been drawn by such ministries for detailed vulnerability analysis/evaluation and retrofitting/ strengthening of building and structures. The Finance Ministry have been requested to advice financial institutions to give loans for retrofitting on easy terms. Accordingly, the Finance Ministry had advised RBI to issue suitable instructions to tall the banks and financial institutions to see that BIS codes laws are scrupulously followed while financing/refinancing construction activities in seismically prone zones. An Earthquake Mitigation Project has been drawn up; the project has been given principle clearance by the Planning Commissions. The programme includes detailed evaluation and retrofitting of lifeline buildings such as hospitals, schools, water and power supply units, telecommunication buildings, airports, railway stations, bus stands and important administrative buildings in the seismic zone IV, V. The programme also includes training of masons in earthquake resistant constructions. Besides, assistance will be provided under this projects to the state Government to put in place appropriate techno legal regime.

Urban earthquake vulnerability reduction programme has been taken up in 38 cities in seismic zones III, IV, V with population a million and above. 447 orientation programmes have been organized for senior officers and representative of the local planning and development bodies to sensitize them on earthquake preparedness and mitigation measures. The training programme for engineers and architects are being organized to impart knowledge about seismically safe construction and implementation of BIS norms. For enhanced school safety, education programmes have been organized in schools, colleges and other educational institutions. This programme will be further extended to 166 earthquake prone districts in seismic zones IV, V. Awareness generation programmes, community and neighborhood organizations have been started in these cities. These cities are also assisted to review and amend their building laws to incorporate multi hazard safety provisions. City Disaster Management Plans are being developed under these projects.

Rural housing and community assets for vulnerable sections of the population created at a fairly large scale by the Ministry of Rural Development under the Indira Awas Yojna and Sampooran Grameen Rojgar Jojna. ABOUT 250

thousand small but compact housing are constructed every year, besides community assets such as community centre, recreation centers, anganwadi centres etc. Technology support is provided by about tow hundred rural housing centers spread over the entire country. The Ministry of Home Affairs is working with the Ministry of Rural Development for changing the guidelines so that the housed constructed under IAY or school buildings/ community buildings constructed under SGRY are earthquake/cyclone/flood resistant; as also that the schemes addressing mitigation are given priority under SGRY. Ministry of Rural Development are carrying out an exercise for this purpose. This initiative is expected to go along way in popularization of seismically safe construction at village/block levels.

(XI) A project for cyclone mitigation has been drawn up in consultation with the cyclone prone states. This projects envisages construction of cyclone shelters, costal shelters belt plantation in areas which are prone to storm surges, strengthening of warning system, training and education etc. This project has also been given in principle clearance by the Planning Commission and is being taken up with World Bank assistance.

(XII) A national core group has been constituted under the chairmanship of secretary, Border Management and comprising of Secretary, DST; Road Transport &Highways, and the heads of GSI and NRSA for drawing up a strategy and plan of action for mitigating the impact of landslide, provide advise and guidance to the State Government on various aspects of landslide mitigation, monitor the activities relating to landslide mitigation including landslide hazard zonation and to evolve early warning system and protocol for landslide/landslide risk reduction. The Government has designated GSI as the nodal agency responsible for coordinating/undertaking geological studies, landslide hazard zonation, monitoring landslide/avalanches, studying the factor responsible and suggesting precautionary and preventive measures. The States/UTs have been requested to share the list of habitation close to landslide prone areas for the purpose of landslide hazard zonation being carried out by them. A national strategy for mitigating landslide hazard in the country is being drawn up in consultation with all the agencies concerned.

(XIII) A disaster risk management programme has been taken up in 169 districts iin 17 multi -hazard prone states with the assistance of UNDP, USAID and EU. Under this project, the States are being assisted to draw up State, District, Block level disaster management plans; village disaster management plans are being developed in conjunction with the Panchayati Raj institutions and disaster management tem consisting of village volunteers are being trained in various preparedness and response functions such as search and rescue, first aid, relief coordination, shelter management etc. Equipment needs for district and state emergency operation centers have been identified by the state nodal agencies and equipment is being provided to equip them. Orientation training of masons, engineers and architects in disaster resistant technologies have been initiated in these districts and construction of model demonstration buildings have been started.

Under this programme disaster management plans have been prepared for 8643 village, 1046 Gram Panchayat, many blocks and districts. More than 29000 elected representative Panchayati Raj Institutions have already been trained, besides imparting training to member of voluntary organizations. About 18000 Government functionaries have been trained in disaster mitigation and preparedness at different level. 885 engineers and 425 architects have been trained under this programme in vulnerability assessment and retrofitting of lifeline buildings. 600 master trainers and 1200 teachers have already been trained in different districts in disaster preparedness and mitigation. Disaster management committees consisting of elected representatives, civil society members, Civil defense volunteers and Government functionary have been constituted all levels including village/urban local body/ward levels. With the creation of awareness generation on disaster mitigation, the community will be able to function as a well-knit unit in case of any emergency.

(XIV) The Government has initiated a national wide awareness generation campaign as part of its overall disaster risk management strategy. In order to devise an effective and holistic campaign, a steering committee for mass media campaign has been constituted at the national level with due representation of experts from diverse stream of communication. The committee has formulated a campaign strategy aimed at changing peoples' perception of natural hazards and had consulted the agencies and experts associated with advertising and media to instill a culture of safety against natural hazards. Apart from the use of print and electronic media, it is proposed to utilize places with high public visibility namely hospitals, schools, railway stations and bus terminals, airports, and post offices, commercial complexes and municipality offices etc to make people aware of their vulnerability and promote

creation of a safe living environment. A novel method being tried is the use of government stationary namely postal letters, bank stationary, railways tickets, airline boarding cards and tickets etc for disseminating the message of disaster risk reduction. Slogans and messages for this purpose have already been developed and have been communicated to concerned Ministries/agencies for printing and dissemination. The mass media campaign will help build knowledge, attitude and skills of the people in vulnerability reduction and sustainable disaster risk management measures.

(XV) Disaster management as a subject in Social Sciences has been introduced in the school curriculum for class VIII & IX. The CBSE which has introduced the curriculum runs a very large number of schools throughout the country. The teachers are being trained to teach disaster management for class X.

(XVI) In order to assist the State Government in capacity building and awareness generation activities and to learn from the past experiences including sharing of best practices, the Ministry of Home Affairs has compiled/prepared a set of resource material developed by various organization/institutions to be replicated and disseminated by State Government based on their vulnerability after translating it into the local languages. The voluminous material which runs in more than 10000 pages has been divided into four sections. These sections cover planning to cope with disaster; education and training; construction toolkit; and education and communication toolkit including multi-media resources on disaster mitigation and preparedness. The planning section contains material for analyzing community risk, development of preparedness. Mitigation and disaster management plans coordinating available resources and implementing measure of risk reduction.

#### **Development Of Response System**

Mitigation and preparedness measures go hand in hand for vulnerability reduction and rapid response to disaster. Several inadequacies of response were noted in the aftermath of Bhuj earthquake, 2001. The govt. decided to remove the inadequacies to maintain preparedness at all times. Major response initiatives include:

##### **(i) Preparation of Special Response Teams**

The central Govt. is now in the process of training and equipping specialist and rescue teams. Each team includes doctors, paramedics, structural engineers etc. These teams will be stationed in different parts of the country.

##### **(ii) Incident Command System**

In order to professionalize the response system, it is proposed to develop incident command system. It is a very effective system in which the most experienced and knowledgeable person at a disaster site is designated as incident commander who is charged with the responsibility of inter agency coordination and management of the incident.

##### **(iii) Standard Operating Procedure**

Standard operating procedure are being laid down to ensure that all step need to be taken for disaster management are put in place. Each department/sector will have their own SOP's for each level of functionaries.

##### **(iv) Trigger Mechanism**

The high powered committee on disaster management has incorporated trigger mechanism as an emergency quick response mechanism. It has been envisaged as a preparedness plan whereby the receipt of a signal of an impending disaster would simultaneously energize and activate the mechanism for response and mitigation without loss of crucial time.

##### **(v) Emergency Operation Centre**

It has also been recommended for setting up of emergency operation centers at the national capitals, state capitals and district headquarters. EOC will function as nerve centres for integrated command and control structure. They will be convergence points for all inter agency coordination and will be equipped with the state of the art communication network.

#### **Technological Developments**

Technological innovations are vital for effective disaster management, the DST, Govt. of India is taking several measure to upgrade technological inputs. The important developments include:

**(i) India Disaster Resource Network**

This is a web enabled centralized data base which will ensure quick access to resources to minimize response time in emergencies. This database will be available at National, State and district level simultaneously. Police network is another important communication network to be used for disaster management. In emergency, mobile satellite based units which can be transported to disaster sites are being procured.

**(ii) Development of GIS based National Data base for Disaster Management.**

The GIS is an effective tool for emergency responders to access information in terms of crucial parameters for the disaster affected areas. This includes location of public facilities, communication links, transport network etc. The GIS data is already available with government agencies, it is currently being upgraded. Comprehensive data district wise, multi layered maps based on this data are being generated.

**(iii) Installation of Early Warning and Hazard Detection Equipment**

Early warning systems have already been installed for cyclones and floods in the country by IMD and CWC. There is a well established organizational set up for detecting, tackling and forecasting cyclones. There are six cyclone warning centres at Kolkata, Bhubneshwar, Vishakapatnam, Chennai, Mumbai and Ahmedabad. Cyclone tracking is done with the help of INSAT satellite. Cyclone detection radars are located at ten centres in different coastal areas. CWC does flood forecasting. There are nearly 700 stations from where hydrological and hydro-meteorological data are collected. Now, govt. has also succeeded in acquiring and installing the Tsunami warning and detection system in the aftermath of Tsunami disaster of 2004.

**What India Needs**

In the view of the frequency of disaster striking India, there is a need for continued vigilance, preparedness and conscious efforts to reduce the occurrence and for mitigation of impact of natural disaster. What is required is a planned approach to disaster management; its management is a fundamental component of sustainable development because the reduction of disaster is equivalent to increased development. The following suggestions can be offered for an effective disaster management system in India:

(I) There should be a proper multi-tier organizational structure in a focussed and co-ordinated manner responsible for the overall management at national, state, districts and village levels.

(II) The basic design of disaster management should consist of planned co-ordinated efforts in following important areas:

- Identification and prediction -Early warning system -Evacuation
- Relief -Rescue -Rehabilitation -Compensation -Reconstruction - Preparedness

(III) There is a need to share the expertise and experiences so that states can learn from each other. There is also a need for training personnel likely to face natural disaster and those who deal with the relief operations.

**III. CONCLUSIONS**

India in the recent years has made significant development in the area of disaster management. A new culture of preparedness, quick response, strategic thinking and prevention is being ushered. The administrative framework is being streamlined to deal with the various disasters. Efforts are also being made to make disaster management a community movement wherein there is greater participation of the people. However, a lot more needs to be done to make disaster management a mass movement in the near future.

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