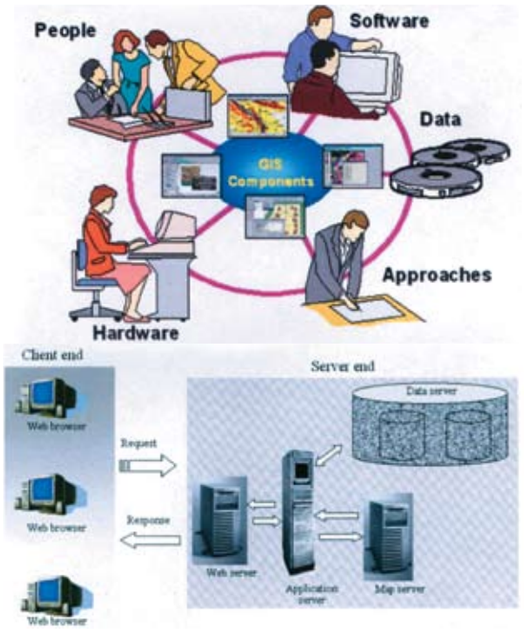
National Disaster Management Authority – Working towards a Safer and Disaster Resilient India

Science & Technology Initiatives for Holistic Management of Disasters



Every year, natural disasters result in enormous loss of life, and set back economic and social development by years, if not decades. Natural disaster cannot be prevented; however, they can be managed better with focus on overlapping phases of mitigation, preparedness, response, and recovery. Science & Technology driven knowledge-based information infrastructure is required to provide balanced support to each phase of these activities in the Disaster Management cycle. Broadly this approach by the NDMA calls for, inter-alia, development of essential scientific and technological infrastructure, some of which are outlined hereunder.

Vulnerability Analysis and Risk Assessment (VA&RA)

The policy of the NDMA has been to move away from the response-centric approach to proactive and holistic Disaster Management in the country, the single most important scientific tool that needs to be deployed is the "Vulnerability Analysis and Risk Assessment" (VA&RA) of the people, the habitats and the infrastructure in different parts of the country with respect to various natural hazards.

The level of mitigation and preparedness programmes are to be decided by the DM authorities on the basis of the level of protection aimed for (e.g. lifeline/vital infrastructure, will have to survive the worst possible hazard impact and hence enhanced level of protection is called for) and the mitigation resources that can be mobilized.

Centered around two parameters viz the demand for inherent hazard resisting capacity of the buildings/infrastructure from the hazard profiles (i.e. the damaging forces) and their actual capacity to withstand the same, vulnerability analysis and risk assessment involves estimation of the probability for five different damage patterns (nil, slight, moderate, extensive and complete). The damages so arrived at are then converted to economic losses and human causalities (in terms of different types of injuries) by using mathematical models.

The powerful VA&RA tool, would enable DM Stakeholders for holistic management of disasters by way of identifying and prioritizing (i) all mitigation tasks/projects; (ii) adaptation of appropriate rehabilitation and reconstruction work, including retrofitting of important structures; (iii) enforcement of building construction codes; (iv) planning for future land-use to minimize/eliminate unnecessary construction costs for new buildings/infrastructure; (v) design of underground lifeline infrastructure. (vi) decision on location of all essential inputs for rescue and relief operation, training centres, DM resource centres, shelters, relief centres, medical facilities etc as per vulnerability profiles (instead of an adhoc decision). However, the development of this scientific tool will be enabled through the availability of some technical inputs.

Digital Maps of India at Required Scales and Contour Intervals

Digital Base Maps at appropriate scale and contour intervals (required for managing flood and landslide hazards) of the Indian landmass are essential for development of Geographical Information System (GIS)-platform (prepared by over-laying on such maps, the other information like demographic, landuse, habitats, infrastructure, hazard profile etc) which is crucial for management of all hazards. NDMA has taken up the preparation of Digital maps for all the assessed 312 Multi Hazard Prone (MHP) districts on priority.

Preparation of Upgraded Hazard Maps initially for Multi-Hazard Prone districts.

For proper management of disasters, there is an urgent need for identifying scientifically the list of hazard-prone districts (with reference to earthquake, landslide, flood and cyclone) in terms of intensity, frequency of occurrence, and duration of the hazards in addition to the area affected. The upgraded list of earthquake and landslide hazard-prone districts has already been finalized by an expert committee constituted by the NDMA. A similar list for cyclone hazard has also been approved by the committee and the confirmation of the same with the archive data of the India Meteorological Department (IMD), New Delhi is expected soon.

Probabilistic Seismic Hazard Analysis (PSHA) for Seismic Microzonation

Earthquakes are low probability events but with high level of risk to the society. Hence, either underestimation or overestimation of seismic hazard would prove costly in the long run.

In addition to the importance of realistic seismic microzonation in urban planning, construction of new structures and retrofitting of existing building/infrastructure, it is equally important (i) to the professionals for their decision on the extent of detailed geotechnical investigation to be undertaken, depending upon the nature of the building/infrastructure proposed in the specified microzone, (ii) for enforcement of building construction codes and above all (iii) for optimized use of resources available.

Probabilistic Seismic Hazard Analysis (PSHA) at the bedrock level of the Indian land mass takes into account the probability of exceedance of the ground motion against which the structures should be designed. In this approach, each broad region is sub-divided into a number of microzones or grids of about 25km X 25km size and the values of PGA and Sa at the nodes of each microzones are evaluated (with corresponding return period exceedance).

For seismic microzonation, PSHA is subsequently coupled with geotechnical investigations (to take care of the ground amplification of the rock level ground preparation of the rock level acceleration due to site-effect). These PSHA studies will be completed within next one year after which pilot studies of two cities will be carried out.

Development of GIS platform

GIS platform can be loosely defined as a system of hardware and softwares used for collection, storage, retrieval, demographic, topographic, infrastructure details, socio-economic data etc. and the hazard profile data in conjunction with satellite imageries to generate knowledge-based information called Decision Support System (DSS), on digitized maps that can be utilized for DM (instead of relying only on voice, data or video).

Using information on GIS platform, it is easy to visually observe the critical information on location, progression and/or regression of the disaster with reference to time and prepare appropriate action plans for post – disaster scenario that can be transmitted to various stakeholders for quick and efficient implementation with excellent coordination. GIS can support better planning for response in terms of evacuation routes, location of vital lifelines (like locations of fire stations, medical/paramedical units etc), relief materials, shelters, airports, railways and ports etc.

Development of National Disaster Information System (NDIS) to Generate Decisions/Decisions Support System (DSS) for various Stakeholders

No single source of information meets the demand of disaster managers, but fusion of various data/ information can provide decisions/DSS by way of a dynamic Mapping system (superimposed on GIS Platform) that are most meaningful and effective tool to the disaster managers. For example, instead of cyclone forecast in terms of time and space or flood forecast in terms of rainfall data/rise in water level, it would be most desired and effective, if the initiation, progression and recession scenarios could be realized in terms of area under coverage of cyclone/flood and likely damages to the infrastructure) expected. This is the end goal for which the NDMA is striving.

Creation of NDIS involves development of various software applications on the basis of hazard profile and the GIS Platform for stakeholders' use (during pre, during and post- disaster scenarios). Such software applications are must for Incident Command and Controls (at different levels, through EOCs) and essential for the district authorities in their planning and response programmes. It calls for selective fusion of data sources (viz fusion of hazard related parametric data with appropriate baseline data on GIS platform) to generate sophisticated actionable information for all the stakeholders at various level.

The National Disaster Information System (NDIS) at NDMA would provide GIS-based value added right information to the right place at the right time through a dedicated and reliable advanced technology-based communication network, called National Disaster Communication Network (NDCN), that is being implemented by NDMA for assured multi-services (audio, video and data), through the backbone of distributed sub-systems called Emergency Operation Centers (EOCs), with particular emphasis on last mile connectivity to the affected community during all phases of disaster management.

Development of Advance Forecasting Platform

Although damage to property cannot be avoided without major mitigation programs, developed countries have been able to reduce loss of life due to natural disasters much more effectively compared to the developing ones, primarily due to their the implementation of effective disaster forecasting/warning systems, one disaster photograph procedures and mitigation measures.

There is a need to strengthen the hands of IMD with Advance Forecasting Platform with (i) reduced error band of landfall, (ii) longer lead-time, (iii) along with prediction of intensity and likely time duration of the cyclones- the forecasting attributes, which are the essential from

DM angle. There is also the added need to provide forecast of the extreme weather events being experienced in the recent past, presumably due to climate change, which is equally important for proactive management of disasters.

The need for such Advance Forecasting Platform, though development of a hierarchy – model configuration, by a national team of experts in the various domains has already been recognized by nodal agencies in India. However, the proposed model configuration can never outweigh need for the equally important role of adequate number of quality observation data required for validation of this hierarchy- model configuration, for which the nodal agencies have already worked out their plans.

To conclude, NDMA has been developing and refining the basic scientific and technological tools to assist the administration at the national and other levels to manage disasters, aided by appropriate technology. In about two years, we feel confident that we will catch up with the advanced countries, which started such effort over 20 to 30 years ago.

What is most significant here is that all these efforts are strongly supported, and planned by the best scientific and technological talent in the country. Government agencies have been chosen in implement these efforts, but the study parameters and the choice of the software are all being decided and guided at the national level by experts in the field.

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