DISASTER MANAGEMENT APPLICATION AND CASE STUDIES

Case studies related to Landslide Hazard Zonation, Earthquake (Vulnerability Assessment of Buildings and Infrastructure), Drought assessment, Coastal flooding, Storm

8.1. Hazard Zonation maps in Landslide Risk Assessment:

According to A.I. Kelarestaghi, geological, topographic and climatic condition of the area and human factors such as land use changing and road construction are the important factors that have caused landslides.

Landslide zonation map is a map demarcating the stretches or areas of varying degrees of anticipated slope stability or instability. The map has an in-built element of forecasting and is hence of a probabilistic nature. Depending upon the methodology adopted and the comprehensiveness of the input data used, a landslide hazard zonation map provides help concerning some or all the following aspects:

- Location of proposed project
- Extent of the slope area likely to be affected, and
- Rate of mass movement of the slope mass.
- The use of aerial photographs and adoption of remote sensing techniques helps in the collection of data. For storage, retrieval and analysis, adoption of computerized techniques speeds up information processing.

Hazard zonation maps have multifarious uses, some of which are listed below:

- In the preparation of development plans for townships, dams, roads, and other development

- General purpose Master Plans and Land use Plans.
- Discouraging new development in hazard prone areas.
- Choice of optimum activity pattern based on risk zones.
- Quick decision making in rescue and relief operations.

A brief list of recent major Indian cearthquakes

Date	Details
October-2005	Jammu and Kashmir, Intensity 7.4, about 40,000 people dies.
26th January, 2001	Gujarat, Intensity 7.9, about 20,000 people died.
29th March, 1999	Chumoli, Uttaranchal, Intensity 6.8, about 1000 people died.
22nd May, 1997	Jabalpur and Mandla, M.P., about 50 people died.
30th September, 1993	Latur and Osmanabad, Maharashtra, about 10,000 people died.
20th October, 1991	Uttarkashi, Uttaranchal, Intensity 6.6, about 1000 people died.

8.1.1. Case study: Landslides in Shiwalik Hills:

- Some of the transmission towers of transmission lines connecting thermal plant at Ropar to Gobindgarh are located on top or near the top of small hillocks in the Shiwalik range.
- These are the low foot hills of the Shiwaliks and the small hillock shave steep sides. The lower ranges of Shiwalik hills in Northwest India are composed predominantly of sandstones with varying degrees of cementation.
- Clays are also found at certain locations in this region. These areas receive scanty rainfall and hence the slopes remain in a state of in saturation over most of the years, normally, such conditions are not conducive for slope failures or landslides.
- However, many slope instability problems have been experienced in these ranges. It has been observed that some hill-slopes failed generally a few hours after a storm. On some of these failed slopes, towel as of high voltage transmission lines are located.
- The possibility of such failure eventually endangers the stability of the transmission tower foundations, which has resulted in attention being focused on the problem. Slope stability problems

were faced at about 15 locations in the area, where high voltage transmission towers of the Punjab State Electricity Board (PSEB) were located. It was observed that some of the slopes were experiencing failures shortly after rainfalls.

The stability of slopes is usually calculated assuming that the slope is in a saturated state, which generally represents the worst condition. However, in regions like the present one, the slopes generally remain in a state of instauration. Therefore, the stability of hill slopes was assessed, taking into consideration the time required for the penetration of wetting front in conjunction with the conventional slope stability analysis. This novel approach enabled a realistic evaluation of the safety factor, identification of failure mechanisms and prediction of future stability of the slopes. Remedial measures appropriate to the mechanism of failure were adopted for stabilization of these hill slopes on which transmission towers are located.

8.2. Earthquake (Vulnerability Assessment of Buildings and Infrastructure):

Earth Quakes- Faults are planes that act as source of earth quake. Movement of plates with respect to each other releasing energy causes it. Magnitude and Intensity of earth quakes are determined by Ritcher scale and modified Mercalli scale. Earth quakes are unpredictable and unpreventable. 95% of the people die due to falling of buildings. So it is most dangerous when occur at night. Earth quakes may cause floods, fires, landslides and huge ocean waves called Tsunamis. Poor people living in the prone areas whose houses are mostly unable to resist the quake are more affected.

Based on the risk, we have divided India into various zones.

Zone 1 - Not affected;
Zone 2 - Low risk;
Zone 3 - Moderate risk;
Zone 4 - High risk;
Zone 5 - Very high risk.

Sub-Terranian areas of Himalayas are geologically active and are more prone to earth quakes.

Based on the effects seen, it is also classified in to 12 classes.

Class 1-3 : Felt by few people;
Class 4-6 : Pendulum clock stops, felt by everyone, objects fall;

Class 7-10 : Destruction;
Class 11-12 : Devastation.

Preparing to face the hazard is the major step in disaster management. Train ourselves in basic rescue and first aid functions and also help the survivors quickly, Retrofit the existing buildings, Use appropriate technology in building material and also adhere to norms in new constructions and train ourselves to respond to the situation are some of the steps to prepare for the earth quake.

8.2.1. Structural and Non-Structural Mitigation

Mitigation measures are classified *Structural* and *Non-Structural*.

Structural mitigation measures:

- It include building and planning regulations for proper land-use management, guidelines for new constructions based on earthquake mitigation measures and various technical measures of strengthening buildings.
- Some other examples of structural mitigation measures include construction of dykes to provide protection against river or sea floods (Charlotte Benson).
- It is important to differentiate between engineered structures and nonengineered structures for better analysis of structural mitigation.
- In case of earthquakes, classification is attempted between engineered structures and non-engineered structures.

8.2.2. Engineered Structures:

Engineered structures are those that are planned, designed and constructed by engineers and experts in related fields. While professionals are already trained to plan, design and supervise the construction of buildings and infrastructures, they might need additional training to achieve necessary structural safety standards, incorporate mitigation practices into their design of structures to make them resistant to seismic shock, storms wind or floods.

The application of sound technical principles is achieved through:

- Site planning Assessment of forces created by natural phenomena
- Planning and analysis of structural measures to resist such forces
- Design and proper detailing of structural component
- Construction with suitable material
- Good workmanship under adequate supervisions

8.2.3. Non-Engineered Structures:

- Such structures mainly comprise simple dwellings, mostly in rural areas, which are informally constructed, and which do not follow modern engineering norms.
- They are built with local materials on the basis of the local indigenous knowledge. It is held that these structures collapse quite easily during disasters, causing large-scale casualties.
- There is the other viewpoint, however, that recognizes merit in local knowledge and advocates incorporating the same in modern engineering know-how.
- Charlotte Benson refers to bamboo houses found in coastal areas among tribal indigenous communities, which are braced against cyclones.
- There are examples of storm masonry from Gujarat India, which provide reportedly earthquake resistant structures (Jigyasu, 2002).

Nothing could be said conclusively however, since researches give widely divergent views, some even suggesting that local structures are more adaptive to hazards and also more resistant. Without being precociously judgmental however, about the safety of such structures, as a policy measure, it should be ensured that informal structures are not built on hazardous sites such as steep slopes subject to landslides, floodplains subject to flash floods etc.

Though there are various definitions for an earthquake resistant construction, the following are some of the common aspects of buildings designed for earthquake mitigation as published by the International Association for Earthquake Engineering, October, 1986, revised edition of Basic Concepts of Seismic Codes: Vol 1 Part 2, 1980, and cited in Jigyasu (2002). These are as follows:

- An ordinary building should not suffer total or partial collapse
- It should not suffer such irreparable damage which would require demolishing and rebuilding
- It may sustain such damage which would be repaired quickly and the building put back to its usual functioning
- However some of the most desirable qualities are symmetry and regularity of building form, solid foundation base and reinforcement to improve ductility. Also there are basically, two types of structural framing, which can withstand gravity and

seismic load viz. bearing wall construction and framed construction. The framed construction may again consist of:

- Light framing members which must have diagonal bracing such as wood frames
- Substantial rigid jointed beams and columns capable of resisting the lateral loads themselves.

8.3. Drought and its assessment:

Drought causes lack of food, fodder, water and employment. Women are more affected and there will be distressed migrations. Lack of nutrition, education and proper health, increased school dropouts and child labour may also be seen. Based on the information given by IMD, we can make planned efforts to conserve resources and to prevent misuse of land and water. Farmers and tribal groups are mostly affected. Less availability of water for drinking, cooking, agriculture etc. cause decrease in production and thereby creates unemployment.

Steps To Mitigate Effects of Drought

- Rain harvesting
- Increase vegetative cover
- Promote watershed programs
- Adopt drought resilient varieties
- Use alternative crops
- Capacity building of communities
- Encourage crop and seed insurance scheme
- Awareness generation

Setting up of efficient irrigation systems also helps saving water. Conserve natural aquifers.

Drought Assessment:

The National Agricultural Drought Assessment and Management System (NADAMS) has been developed by the Department of Space for the Department of Agriculture and Cooperation and is primarily based on monitoring of vegetation status through National Oceanic and Atmospheric Administration's (NOAA) Advanced Very High Resolution (AVHR) data. The drought assessment is based on a comparative evaluation of satellite observed green vegetation cover (both area and greenness) of a district in any specific time period, with that of any similar period in previous years.

Drought Risk Assessment:

As explained by Fatima Rabab, the Normalised Difference Vegetation Index (NDVI) index helps forewarn of droughts. NDVI is a satellite data processed index, which can be used to indicate deficiencies in rainfall and portray meteorological and /or agricultural drought patterns and measure of the amount of radiation being absorbed by plants.

- Amount of radiation absorbed is directly related to 'evapo-transpiration,' since the plant must cool primarily by evaporating water. The evapo-transpiration is constrained by the amount of water in the soil, which in turn is constrained by low rainfall. (Rowland et al, 1996),
- Onset of drought conditions over a large area can be predicted by comparative analysis of the trend of derived NDVI of that year, relative to the trend in the normal year.
- Other factors along with vegetation cover that need monitoring; include climate, soil type, hydrology, and socio economic condition of people. Hence multidisciplinary spatial analysis with the help of GIS can lead to a decision support system for concerned government departments, NGOs and others to help drought vulnerable people and others living in potential drought prone areas.
- Application of NDVI will aid decision-making allowing better integration and timelier planning of methods to promote food security.
- Droughts affect the poor more than the resourceful (access to labour capital and wealth). Unlike rapid onset events like earthquakes, drought has slow onset, which can be observed and curbed with timely preventive action.
- Accordingly, Drought Indices have been developed to monitor and forecast drought. Such indices incorporate data collected over time regarding multifarious factors like rainfall, snow pack stream flow, and other water supply indicators, which together give the comprehensive 'big' picture.
- Drought indices for areas with undulating topography need to take account of additional factors like surface water supply index etc.

8.4.1. Coastal flooding: Mitigation and response:

Coastal flooding is largely a natural event; however human influence on the coastal environment can exacerbate coastal flooding. Extraction of water from groundwater reservoirs in the coastal zone can enhance subsidence of the land increasing the risk of flooding. Engineered protection structures along the coast such as sea walls alter the natural processes of the beach, often leading to erosion on adjacent stretches of the coast which also increases the risk of flooding.

i. Mitigation:

- It has been said that one way to prevent significant flooding of coastal areas now and into the future is by reducing global sea level rise. This could be minimized by further reducing greenhouse gas emissions. However, even if significant emission decreament is achieved, there is already a substantial commitment to sea level rise into the future.
- International climate change policies like the Kyoto Protocol are seeking to mitigate the future effects of climate change, including sea level rise.
- In addition, more immediate measures of engineered and natural defenses are put in place to prevent coastal flooding.

Engineered defences:

- There are a variety of ways in which humans are trying to prevent the flooding of coastal environments, gypically through so called hard engineering structures such as seawalls and levees.
- That armoring of the coast is typically to protect towns and cities which have developed right up to the beachfront.
- Enhancing depositional processes along the coast can also help prevent coastal flooding. Structures such as groynes, breakwaters and artificial headlands promote the deposition of sediment on the beach thus helping to buffer against storm waves and surges as the wave energy is spent on moving the sediments in the beach than on moving water inland.

Natural defences:

- The coast does provide natural protective structures to guard against coastal flooding. These include physical features like gravel bars and sand dune systems, but also ecosystems such as salt marshes and mangrove forests have a buffering function.

- Mangroves and wetlands are often considered to provide significant protection against storm waves, tsunamis and shoreline erosion through their ability to attenuate wave energy. To protect the coastal zone from flooding, the natural defenses should therefore be protected and maintained.

ii. Response:

- As coastal flooding is typically a natural process, it is inherently difficult to prevent flood occurrence.
- If human systems are affected by flooding, an adaption to how that system operates on the coast through behavioral and institutional changes is required; these changes are the so-called non-structural mechanisms of coastal flooding response.
- Building regulations, coastal hazard zoning, urban development planning, spreading the risk through insurance and enhancing public awareness are some ways of achieving this.
- Adapting to the risk of flood occurrence, can be the best option if the cost of building defence structures outweighs any benefits or if the natural processes in that stretch of coastline add to its natural character and attractiveness.
- A more extreme and often difficult to accept response to coastal flooding is abandoning the area (also known as managed retreat) prone to flooding.
- This however raises issues for where the people and infrastructure affected would go and what sort of compensation should/could be paid.

8.5. Cyclones and its mitigation:

Indian sub-continent is one of the six major cyclone prone areas in the world. Cyclones occur due to warm ocean temperature, high relative humidity and atmospheric instability. During cyclones, strong winds uproot trees, destroy power and telecommunication, terrestrial rain causes flood, high tidal waves hit the coastal areas.

How to prepare?

1. Knowing the prone areas (usually 50-200 North and South of equator). In India, our east coast is the most prone area.
2. Giving awareness and knowledge.
3. Forest along coasts acts as wind barriers. But deforestation and encroachment of coastal shelter-belt is a threat. By destroying the mangrove forests, we are ourselves increasing the risk.

Indian Meteorological Department (IMD) does forecasting and warning. They track cyclones. It is done by INSAT satellite and cyclone detection radars. The Disaster Warning System (DWS) helps in dissemination of warning at isolated places in local languages. In cyclonic seasons, listen to TV/RADIO updates, Identify safe shelters Keep an emergency kit, Check the perimeter for safety, Store adequate food, Keep a list of emergency numbers, Conduct mock drills.

There is a no wind period in between the cyclone. It is the eye of the cyclone. The winds are on the walls of the eye.

8.6. Man Made Disasters and their mitigation:

Use of weapons of mass destruction is a serious threat to the social, economic and political stability. Bhopal gas tragedy in 1984 due to the outbreak of poisonous Methyl Iso cyanate killed many people and so many were living with the harmful side effects. The after effects of radiations were also harmful. In nuclear, chemical and biological warfare, the destructions take a much longer time to get restored and in some cases cannot be gone back to normal.

Radioactivity does not penetrate solid structures even though fire causes damage. So it is better to stay indoors. In chemical exposure, don't be panic; remain indoors. Close all doors and windows. Put wet cloth on face and breathe through it. Lying down may help as these gases are light and tends to rise upwards. Accidental disasters cause much loss.

8.7. Miscellaneous issues in Disaster Management:

8.7.1. Being Prepared-A Vital Part of Disaster Management:

The activities to mitigate effects of disasters and emergency situations, to provide a framework for helping people at risk, to avoid or recover from the impacts of the disaster is called disaster management. It includes steps to be taken prior to, during and after disaster and involves preparedness, mitigation, response and recovery. Disaster preparedness means the steps or activities and precautions taken collectively before a disaster to reduce the impact and to cope with it effectively. Community being the first responder (immediately affected and can give help before others, must be made aware and trained to cope with the disaster.

Manmade disasters are preventable. Natural disasters can only be mitigated. Without that, we may be taken backwards in development

and progress. Economic developments must be in accordance with protection of the environment. Environmental degradation is an important factor of disaster. Development must be planned in a judicious manner and in tune with sustaining and protecting the environment. To face disasters, we must be very well aware of its causes and effects to form a disaster resilient society.

October 29 - National Day for Disaster Reduction.

Government of India had brought a shift from its relief centric approach to the one with greater emphasis is on preparedness, prevention and mitigation. Without disaster management, sustainable development is not possible. And also disaster management became part of the policy framework as poor and under privileged are more affected.

Disaster management is a multi disciplinary area which includes forecasting, warning, search and rescue, relief, reconstruction and rehabilitation. It is also a multi sectoral task as it involves administrators, scientists, planners, volunteers and communities. CRITICAL NEED IS THE CO-ORDINATION OF ALL THE ACTIVITIES BETWEEN THEM. For developing countries, disaster management is a major concern as it directly influences the economy, agriculture, food and sanitation, water, environment and health. Disasters also have social, economic and psychological dimensions. So appropriate strategies are necessarily been developed.

Managing Disasters in India:

According to World Bank report- 'Natural Hazards, Unnatural Disasters', floods and storms are the most widespread while droughts are prevalent. These disaster areas are the home for most hungry in the world. The changing climatic pattern worsens the situation. So we have to recognize the hazards and vulnerabilities in a comprehensive manner and should take effective steps for prevention, mitigation and management.

The Hyogo Framework of Action (HFA) of 2015 by UNISDR to which India is a signatory advocates mainstreaming disaster risk reduction into socio-economic development planning and activities by adopting five priorities for action through a five-fold process.

A. **Political process:** It includes countries to develop policies, legislative and institutional frameworks and also allocate resources for its prevention.

B. **Technical process:** It includes science and technology for assessing, monitoring, identifying disasters and develops early warning systems.

C. **Socio-educational process:** It includes awareness and skill development; also safety and resilience in all levels.

D. **Development process:** It includes integration of disaster risk in all sectors of development planning and programs.

E. **Humanitarian process:** It includes factoring disaster risk reduction in disaster response and recovery.

India started to work on these ideas in 1999 by constituting a High Powered Committee (HPC) on Disaster Management under Shri. J.C.Pant (Former Secretary of Agriculture to the Govt. of India), along with experts. After December 26, 2004 Tsunami incident, India decided to enact a law on Disaster Management (DM) to provide a requisite institutional mechanism for drawing up and monitoring the implementation of DM plans.

The Disaster Management Act, 2015 lays down institutional, legal, financial and co-ordination mechanisms at central, state, district and local levels. This setup ensures the paradigm shift from the relief centric approach to the one which greater emphasis is on preparedness, prevention and mitigation. By enacting the law, National Disaster Management Authority was established under the chairmanship of PM. State and District DM authorities are also established. So now the country has a legal backing of DM architecture with clear delineation of rules and responsibility. There is also provision for budget allocation for the disaster risk reduction. It is up to state and central govt. to use it wisely.

The poor are more affected. Unless the disaster risk reduction is not met properly, our efforts to achieve 'inclusive growth' may not become successful. The steps to achieve this are;

a. Mainstreaming Disaster Risk Reduction (DRR) into development.
b. Strengthening early warning systems.
c. Increasing awareness and preparedness.
d. Strengthening relief and rescue mechanisms.
e. Better rehabilitation and reconstruction.

Govt. of India administers a number of programs in key sectors like agriculture, rural development, urban development, food security, water, rural roads, health and education, to improve the quality of life of

Post Disaster Impact Assessment and Funding Mechanism:

Hazards are natural but disasters are unnatural. It depends on the resilience of the society towards it. Geo-climatic and socio-economic vulnerabilities and bad development practices makes India prone to disasters. These disasters have a huge impact on our economy. We amounted around $30 billion for the past 35 years. The trend is increasing year after year.

Soon after a disaster, we make a situational report so that relief and response could be made effective. After that, a detailed assessment report is made based on direct losses with replacement value on current price basis. Direct and Indirect assessments are to be made. Currently, loss of infrastructure is calculated but the effect of revenue loss on economy remains unassessed. It affects the economy. This does not give any alternative to the decision makers for prioritizing long term recovery investment.

A damage and loss assessment report must be advantageously used to determine the post disaster needs including economic recovery planning and reconstruction program design. The major losses are decline in output, lower revenues, and high operational cost of services. Even after so many disasters we don't have an assessment done which can give an understanding of the disaster and its impact on development. The new dimension of disaster loss in an economy is that the loss in economy affects other due to the globalization trend. Companies may suffer from supply chain shags. There will be need to analyze the financial requirement needed for recovery to move along the growth path. Major needs include restoration of infrastructure, income and other services.

Financing the post disaster for immediate and long term recovery is a main problem. Usually central govt. provides the necessary financial aid to states. But these expenses largely affect the budget expectations. So now we have a National Disaster Relief Fund (NDRF), for the immediate temporary recovery. But there is no provision for the long term recovery (no dedicated fund). Our aim must be in preventing the impact of a disaster and not on the ways to increase the funds. Vulnerability of the state must be the main criteria for allocation of funds.

Direct damages induce indirect losses. If long term recovery is unaddressed, the ultimate result will be the huge pressure on economy

and development process. So we need to introduce a long term recovery fund, both at national and state levels.

Disaster Mitigation Funding Requires:

1. Making qualified assessment reports.
2. Risk zonation
3. Quantified maximum risk is known
4. Work out management modules
5. Planning for mitigation investments

Community Contingency Plan:

It is a serious of assessments and evaluations followed by the development of a plan of action in anticipation of a disaster. It includes:

1. Identification of potential threat
2. Identification of impacts of the disaster
3. Identification of methods of mitigation. For example, shelter belt plantations on coast to break the intensity of a cyclone.
4. Anticipating and developing optimum response threats
5. Identifying existing resources; to provide shelter, food, water, medicine, transportation, communication etc.
6. Conducting periodic 'mock drills'; to assess and improve the effectiveness of disaster preparedness plan.