1.1. The term Measurement and Methods of Measurement Definition and concept of Disasters “Disaster Management can be defined as the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergences, in particular preparedness, response and recovery in order to lessen the impact of disasters”. The United Nations defines a disaster as a serious disruption of the functioning of a community or a society. Disasters involve widespread human, material, economic or environmental impacts, which exceed the ability of the affected community or society to cope using its own resources. The World Health Organization defines Disaster as “any occurrence that causes damage, ecological disruption, loss of human life, deterioration of health and health services, on a scale sufficient to warrant an extraordinary response from outside the affected community or area”.

1.2. Hazard Concept A hazard is a situation that poses a level of threat to life, health, property, or environment. A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage hazards are conditions that have the potential to harm to a community or environment. Table 1 Examples of Hazards and their Effects Table: Examples of Hazards and their Effects Workplace hazard Example of hazard Example of harm caused Source of energy Electricity Shock, electrocution Condition Wet floor Slips, falls Thing Knife Cut Substance Benzene Leukemia Practice Hard rock mining Silicosis Process Welding Metal fume fever

 As shown from previous table, Workplace hazards also include practices or conditions that release uncontrolled energy like:

 An object that could fall from a height (potential or gravitational energy),

 A run-away chemical reaction (chemical energy), The release of compressed gas or steam (pressure, high temperature),

 Entanglement of hair or clothing in rotating equipment (kinetic energy), Contact with electrodes of a battery or capacitor (electrical energy).

 So, hazards can include conditions, objects and practices which can threaten or tend to threatened life or property.

Types of Hazard

 A common way to classify hazards is by category. 1) Biological Hazard Bacteria, viruses, insects, plants, birds, animals, and humans, etc.

2) Chemical Hazard Depends on the physical, chemical and toxic properties of the chemical.

3) Ergonomic Hazard Repetitive movements, improper set up of workstation, etc.

4) Physical Hazard Radiation, magnetic fields, high pressures, noise, etc.

5) Psychosocial Hazard Stress, violence, etc.

6) Biological Hazard Slipping/tripping, equipment malfunctions or breakdowns, etc.

1.3. Vulnerability Concept In relation to hazards and disasters, vulnerability is a concept that links the relationship that people have with their environment to social forces and institutions and the cultural values that sustain and contest them. Exposed to the possibility of being attacked or harmed, either physically or emotionally. Vulnerability refers to the inability to withstand the effects of a hostile environment.

1.4. Risk Concept Risk is the potential of losing something of value. The values such as physical health, social status, emotional well-being or financial wealth. A probability or threat of damage, injury, liability, loss, or any other negative occurrence that is caused by external or internal vulnerabilities. Risk is an uncertain event or condition that, if it occurs, has an effect on at least one objective. Risk means ‘effect of uncertainty on objectives’. So, Risk is the chance or probability that a person will be harmed or experience an adverse health effect if exposed to a hazard. It may also apply to situations with property or equipment loss. Factors that influence the degree of Risk include: How much a person is exposed to a hazardous thing or condition? How the person is exposed, e.g. breathing in a vapour, skin contact etc. How severe are the effects under the conditions of exposure.

 What is Risk Assessment?

Risk Assessment is the process where you: Identify hazards, Analyse or evaluate the risk associated with that hazard, Determine appropriate ways to eliminate or control the hazard, and Review the ways of elimination or control.

1.6. Disaster Management Concept Disaster Management is the planned steps taken to minimize the effects of a disaster, and to be able to proceed to business continuity stage.

 Disaster Management includes sum total of all activities, programme and measures which can be taken up before, during and after a disaster with the purpose of avoiding, reducing the impact or recovering from its losses.

 Disaster Management means managing resources and various responsibilities to deal with all humanitarian aspects or emergencies. This may include preparedness before disaster, response and recovery i.e. rebuilding and supporting society. The purpose of this is to lessen the impact of disasters.

Aims of Disaster Management The aims of Disaster Management are: To reduce the potential losses from hazards (avoid, if possible). To assure prompt and appropriate assistance to victims when necessary. To achieve rapid and durable recovery.

Importance of Disaster Management Over past 20 years disasters have affected 4.4 billion people, caused $2 trillion of damage and killed 1.3 million people. These losses have outstripped the total value of official development assistance in the same period. Natural disasters disproportionately affect people living in developing countries and the most vulnerable communities within those countries. At the global level, there has been considerable concern over natural disasters. Even as scientific and material progress is made, the loss of lives and property due to disasters has not decision. India has been traditionally vulnerable to natural disasters on account of its unique geo climate conditions. Floods, droughts, cyclones, earthquakes and landslides have been recurrent phenomena.

Phases of Disaster Management Disaster Management activities can be grouped into five phases that are related by time and function to all types of emergencies and disasters. These phases are also related to each other, and each involves different types of skills. These phases are: Planning and Mitigation Preparedness Response Recovery

Planning Phase Activities necessary to analyse and document, the possibility of an emergency or disaster and the potential consequences or impacts on life, property, and the environment. This includes assessing the hazards, risks, mitigation, preparedness, response, and recovery needs.

Mitigation Phase Activities that actually eliminate or reduce the probability of a disaster (e.g. arms build up to deter enemy attack). It also includes long-term activities designed to reduce the effects of unavoidable disaster (e.g. land use management, establishing comprehensive emergency management programs such as vegetation, building restrictions in potential flood zones).

Preparedness Phase Activities necessary to the extent that mitigation measures have not, or cannot, prevent disasters. In the preparedness phase, governments, organizations, and individuals develop plans to save lives and minimize disaster damage (e.g. compiling state resource inventories, installing early warning systems, and preparing predetermined emergency response forces). Preparedness measures also seek to enhance disaster response operations (e.g. by stockpiling vital food and medical supplies, through training exercises and by mobilizing emergency response personnel on standby).

Response Phase Activities following an emergency or disaster. These activities are designed to provide emergency assistance for victims (e.g. search and rescue, emergency shelter, medical care, and mass feeding). They also seek to stabilize the situation and reduce the probability of secondary damage (e.g. shutting off contaminated water supply sources, and securing and patrolling areas prone to looting) and to speed recovery operations (e.g. damage assessment).

Recovery Phase Activities necessary to return all systems to normal or better. They include two sets of activities: Short-term recovery activities return vital life-support systems to minimum operating standards (e.g. clean-up,

temporary housing, and access to food and water). Long-term recovery activities may continue for a number of years after a disaster. Their purpose is to return life to normal or improved levels (e.g. redevelopment loans, legal assistance, and community planning).

UNIT 2.1. Classification of Disasters A common way to classify hazards is by category.

1) Geological Disasters Earthquakes, Landslides, Tsunami and mining, etc.

2) Hydro-Meteorological Disasters Floods, Cyclones, Lightening, Thunder-storms, Hail storms, Avalanches, Droughts, Cold and heat waves.

3) Biological Disasters Epidemics, Pest attacks, Forest fire etc.

4) Technological Disasters Chemical, Industrial, Radiological, Nuclear, etc.

5) Manmade Disasters Building collapse, Rural and urban fire, road and rail accidents, etc.

3.2. Paradigm Shift in Disaster Management

 The meaning of paradigm shift is “a fundamental change in approach or underlying assumptions”.

 For paradigm shift, the disaster management authority should know Weather or not an emergency exists The demographics of the affected population and the number of people affected The details of the emergency (cause, location, magnitude of disaster etc.) The condition of the affected population (mortality and morbidity rates) The local response capacities and available resources, including organizational and logistical capabilities The extent and type of life-saving needs and priorities The likelihood of additional future problems or needs

 The starting point for any assessment is identification of the eventual users of the information and their particular information needs.

 Data, which include perceptions, numbers and facts, only become useful information when they are meaningful, and relevant at particular times and places, for specific purposes.

Pre-Disaster Preparedness All phases of emergency management depend on data from a variety of sources. The appropriate data has to be gathered, organized, and displayed logically to determine the size and scope of emergency management programs. During an actual emergency it is critical to have the right data, at the right time, to respond and take appropriate action. Emergencies can impact all or a number of government departments. Emergency personnel often need detailed information concerning pipelines, building layout, electrical distribution, sewer systems, and so forth.

3.3. Disaster Risk Assessment

 Some general risks frequently present in the emergency phase are: Continuing presence of hazard agents – secondary flooding, fire, landslides, extreme cold, chemical pollution etc. Loss of lifeline services – clean water, waste disposal, medical treatment Inadequate supply of emergency clinical services Inadequate supply of essential foods Effects of severe climate conditions exacerbated by lack of shelter, warm clothing or heating fuel

 Tools for conducting disaster risk assessment A national risk assessment is a strategic risk assessment that supports the design of National Disaster management strategies, policy and regulations, NDM programming, and budget allocation. A local risk assessment is an operational risk assessment for NDM action planning, contingency planning, pre-disaster recovery planning, and proper urban planning to conduct risk assessment in pilot regions. Build national disaster observatories (NDO). A NDO is a sustainable local institution helps the countries to learn from their disaster history and incorporate that knowledge into the national NDM strategy and the implementation of disaster risk management activities.

3.4. Disaster Risk Mapping Risk mapping is the process of establishing the spatial and temporal extent of risk (probability and consequences). The results of risk mapping are usually presented in the form of maps that show the magnitude and nature of the risk. Risk mapping requires combining maps of hazards, exposure, and vulnerability. The average frequency of occurrence and location of most extreme events can be determined with some degree of accuracy. While global maps of hazards, such as potential desertification, severe storms, and earthquake and volcanic activity, do exist, a more detailed approach is of more use to environmental health and disaster planners. Maps of the zones surrounding hazardous factories and the routes used to transport hazardous materials, plus data on seasonal wind velocity and direction, can be used to predict the scale of possible hazards and determine the method of evacuation or other emergency response if leaks or explosions occur.

3.5. Relief and Rehabilitation Approach Relief is no longer perceived only as gratuitous assistance or provision of emergency relief supplies on time. It is on the contrary, viewed as an overarching system of facilitation of assistance to the victim of disaster for their rehabilitation in states and ensuring social safety and security of the affected persons. The relief needs to be prompt, adequate and of approved standards. Guidelines defining minimum standards of relief will be prepared by the NDMA. Setting up of temporary relief camps. DDMAs, especially in recurring disaster prone areas, may identify locations for setting up temporary camps. The temporary relief camps will have adequate provision of drinking water and bathing, sanitation and essential health-care facilities. Ensuring minimum standards of relief and speedy management of supplies are important.

3.6. Reconstruction and Redevelopment Approach 1. Owner Driven Reconstruction Reconstruction plans and designing of houses need to be a participatory process involving the government, affected community, NGOs and corporate sector. Reconstruction program will be within the confines and the qualitative specifications laid down by the government.

2. Speedy Reconstruction Essential services, social infrastructure and intermediate shelters/camps will be established in the shortest possible time.

3. Contingency plans for reconstruction In highly disaster prone areas need to be drawn out during the period of normalcy, which may include architectural and structural designs in consultation with the various stakeholders.

4. Linking recovery with safe development Efforts will be made to support and enhance the viability of the livelihood systems, education, health-care facilities, care of the elderly, women and children etc.

5.Livelihood Restoration State government will have to lay emphasis on the restoration of permanent livelihood of those affected by disasters and special attention to the needs of women-headed households, artisans, farmers and people belonging to marginalized and vulnerable sections.

3.7. Capacity Development Approach A strategic approach to capacity development can be addressed effectively only with the active and enthusiastic participation of the stakeholders. This process comprises awareness generation, education, training, R&D etc. It further address putting in place appropriate institutional framework, management systems and allocation of resources for efficient prevention and handling of disasters. Identification of knowledge-based institutions with proven performance. Promotion of international and regional cooperation. Capacity analysis of different disaster response groups at state/district/local levels. Adoption of traditional and global best practices and technologies. Laying emphasis on table-top exercises, simulations, mock drills and development of skills to test the plans.

3.8. Search and Rescue of Disaster Survivors Disaster Mitigation requires rapid and efficient search and rescue of survivors. The goal of search and rescue is to locate and access injured or trapped victims, stabilize the emergency situation, and transport the patients to safety. Relief workers need to speedily find the trapped survivors in collapsed buildings and crumbled structures in the aftermath of disasters. Newer and advanced technologies and equipment have recently made in search and rescue operations, making them easier and quicker, while improving a missing or injured person’s chance of survival.

Technology Options: The choice of search and rescue tools and methods depends on their availability and the needs of the situation. For example, storm and earthquakes wreckage may require tools for lifting debris whereas flood damage may require boats and ropes. Different scenarios require differing technology options for disaster search and rescue. These are summarized below:

 Improved real time data access The ability to communicate Lighter, more efficient power

sources Improved monitoring systems Improved personal protective equipment Improved debris removal systems etc.

Search and Rescue of Disaster

Survivors Tools and Equipment: The tools and equipment for disaster search and rescue operations include cutting equipment, diving equipment, forcible entry tools, jacks, life rafts, lighting torch, lamps, searchlights, location beacons, night vision equipment, pneumatic/hydraulic equipment and tools, rescue equipment, rescue tools, rope rescue systems, rescue belts, safety equipment, search equipment, spreading tools, thermal imaging equipment, water rescue equipment, winches, robotic systems, etc.

High-tech Tool for Disaster Rescue: Scientists have provided risk communication models and insight into how humans percieve and react to risk communication. Another tool being developed by RESCUE researchers is a complex disaster simulation platform called MetaSim. This computer system allows researchers to merge different types of simulations at once in order to provide planners with a more accurate picture of what conditions may like during and after a disaster.

3.9. Early Warning System

1. Early warning systems are combinations of tools and processes embedded within institutional structures, coordinated by international and sometimes national agencies.

2. Whether they focus on one particular hazard or many, these systems are composed of four elements: Knowledge of risk A technical monitoring and warning service Dissemination of meaningful warnings to at risk people and Public awareness and preparedness to act.

3.10. Technology for monitoring and warning

Forecasting and modelling technology Several countries have early warning systems based on seasonal to interannual climate forecasts. These systems are based on using monitoring data, including temperature and rainfall values, and state of the art climate models.

Remote sensing and geographic information systems (GIS) applications Remote sensing and GIS applications have significantly advanced famine early warning systems. The Regional Centre for Mapping of Resources for Development (RCMRD) has been using remote sensing based regional early warning systems for food security to supplement national initiatives in eastern African countries.

Satellite communication technology Improvements in satellite communication have helped decrease the lag time between data collection and warning. For example, the pacific tsunami warning system works by a recorder on the seabed relaying data on anomalies to a buoy on the surface. This data is then transmitted via satellite to ground stations every 15 seconds. In India, it is done by ISRO.

Mobile phone technology This technology is now increasingly used to communicate warnings and coordinate preparation activities, particularly SMS alerts for disseminating mass messages. For example, upon detection of p-waves that precede earthquakes shaking, Japanese agencies send out SMS alerts to all registered mobile phones in the country.

ICTs for crowd sourcing The use of crowd sourced data is gaining traction with increasing internet connectivity and use of information and communication technologies such as mobile phones. Crowd sourcing was used extensively in the response to the 2010 Haiti earthquakes, allowing local people, mapping experts and other stakeholders to communicate what they saw and heard on the ground, and to produce information that could be used by humanitarian workers. This was particularly useful in locating survivors who needed assistance.

Crisis mapping Through initiatives such as Ushahidi and Google Crisis Response, crisis mapping utilizes crowd sourcing as well as satellite imagery, participatory maps and statistical models to power more informed and effective early warning. It can provide real time information on an upcoming crisis in times of uncertainty and confusion.

3.11. IDNDR (International Decade for National Disaster Reduction) The United Nations General Assembly designated the 1990s as the International Decade for Natural Disaster Reduction (IDNDR). Its basic objective was to decrease the loss of life, property destruction and social and economic disruption caused by natural disasters, such as earthquakes, tsunamis, floods, landslides, volcanic eruption, droughts, and other disasters of natural origin. What is needed for the success of IDNDR? A large degree on the positive responses of outside agencies, engineers and scientists of all professions. Groups of people who are really devoted to take actions are needed. Team spirit among all nations, among engineers and scientists of different professions, and among all kinds of people working for disaster mitigation.

Technological Up gradation To share good practices and lessons learned to further disaster reduction within the context of attaining sustainable development, and to identify gaps and challenges. To increase awareness of the importance of disaster reduction policies. Public awareness and education, community participation. To increase the reliability and availability of appropriate disaster-related information to the public and disaster management agencies in all regions.

3.12. Yokohama Strategy

Strategy and plan of action – Introduction The World Conference on Natural Disaster Reduction, having met at Yokohama from 23 to 27 May 1994, recognizing the rapidly rising world-wide toll on human and economic losses due to natural disasters.

Basis for Strategy Natural disasters continue to strike and increase in magnitude, complexity, frequency and economic impact. In this context the least developed countries, small island developing states and land locked countries are the most vulnerable countries. In all countries the poor and socially disadvantaged groups suffer most from natural disasters and are least equipped to cope with them. Some patterns of consumption, production and development have the potential for increasing the vulnerability to natural disasters.

Strategy for the Year 2000 and beyond 1. The world conference, based on adoption of the principles and the assessment of the progress accomplished during the first half of the Decade, has formulated a strategy for disaster reduction centered on the objective of saving human lives and protecting property.

2. The strategy calls for an accelerated implementation of a Plan of Action to be developed from the following points: Development of a global culture of prevention as an essential component of an integrated approach to disaster reduction. Adoption of a policy of self-reliance in each vulnerable country and community. Education and training in disaster prevention, preparedness and mitigation. Improvement of awareness in vulnerable communities. Involvement and active participation of people in disaster reduction, prevention and preparedness, leading to improved risk management. Improved risk assessment, broader monitoring and communication of forecasts and warnings.

3.13. Hyogo Framework 1. In January 2005, 168 Governments adopted a 10-year plan to make the world safer from natural hazards at the World Conference on disaster reduction, held in Kobe, Hyogo, Japan. 2. The Hyogo Framework is a global blueprint for disaster risk reduction efforts during the next decade. Its goal is to substantially reduce disaster losses by 2015 in lives, and in the social, economic, and environmental assets of communities and countries. 3. The Hyogo Framework offers guiding principles, priorities for action, and practical means for achieving disaster resilience for vulnerable communities. 4. The five priority actions identified by the Hyogo Framework Action (HFA) are to: Ensure DRR is a national and a local priority. Identify, assess and monitor disaster risk and enhance early warning. Use knowledge, innovation and education to build a culture of safety and resilience at all levels. Reduce underlying risk factors. Strengthen disaster preparedness for effective response at all levels. The Hyogo Framework Action also identifies four priority cross-cutting areas for reducing disaster risk: gender, capacity development, communities and volunteers, and climate change adaption.

UNIT 4.1. Disaster Management in INDIA The Disaster, natural or man-made can destroy lives and properties on a very large scale, often pushing nations, in quest for progress, back by several decades. The Disaster, natural or man-made can destroy lives and properties on a very large scale, often pushing nations, in quest for progress, back by several decades.

Paradigm Shift in Disaster Management The Disaster, natural or man-made can destroy lives and properties on a very large scale, often

pushing nations, in quest for progress, back by several decades. The Disaster, natural or man-made can destroy lives and properties on a very large scale, often pushing nations, in quest for progress, back by several decades.

Objectives Mitigation or reduction of risk of any disaster or its severity or consequences. Capacity building including research and knowledge management. Preparedness to deal with any disaster. Prompt response to any threatening disaster situation or disaster. Assessing the severity or magnitude of effects of any disaster. Evacuation, rescue and relief. Rehabilitation and reconstruction.

Approach The approach for Disaster Management policy are: Community based DM, including last mile integration of the policy, plans and execution. Capacity development in all spheres. Consolidation of past initiatives and best practices. Cooperation with agencies at national and international levels. Multi-sectoral synergy.

4.2. National Disaster Management Authority (NDMA) The NDMA, as the apex body for disaster management, is headed by the Prime Minister and has the responsibility for laying down policies, plans and guidelines for DM. The guidelines will assist the Central Ministries, Departments and States to formulate their respective DM plans. It will approve the National Disaster Management and DM plans of the Central Ministries/Departments. Central ministries/departments and State Governments will extend necessary cooperation and assistance to NDMA for carrying out its mandate. The general superintendence, direction and control of National Disaster Response Force (NDRF) are vested in and will be exercised by the NDMA. The National Institute of Disaster Management (NIDM) works within the framework of brad policies and guidelines laid down by NDMA.

4.3. National Executive Committee (NEC) The NEC, comprises the Union Home Secretary as the Chairperson, and the Secretaries to the GOI in the Ministries/Departments of Agriculture, Atomic Energy, Defense, Drinking Water supply, Environment and Forests, Finance, Health, Power, Rural Development, Science and Technology, Space, Telecommunications, Urban Development, Water Resources and the Chief of the Integrated Defense Staff as members. NDMA will be special invitees to the meetings of the NEC. The NEC is the executive committee of the NDMA, and is mandated to assist the NDMA in the discharge of its functions and also ensure compliances of the directions issued by the Central Government. NEC is to coordinate the response in the event of any threatening disaster situation or disaster. NEC will prepare the National Plan for Disaster Management based on the National Policy on Disaster Management.

At State Level At the state level, SDMA, headed by the Chief Minister, will lay down policies and plans for DM in the state. It will, inter alia approve the State Plan in accordance with the guidelines laid down by the NDMA. The State Government shall constitute a State Executive Committee (SEC) to assist the SDMA in the performance of its functions.

At District Level The DDMA will be headed by the District Collector, Deputy Commissioner or District Magistrate as the case may be, with the elected representative of the local authority as the Co-Chairperson. DDMA will act as the planning, coordinating and implementing body for DM at district level.

4.4. National Disaster Organizations

1. National Institute of Disaster Management (NIDM) The NIDM, in partnership with other research institutions has capacity development as one of its major responsibilities, along with training, research, documentation and development of a national level information base. It will network with other knowledge-based institutions, and function within the broad policies and guidelines laid down by the NDMA. It will organize training of trainers, DM officials and other stakeholders. The NIDM will strive to emerge as a 'Centre of Excellence' in the field of Disaster Management.

2. National Disaster Response Force (NDRF) For the purpose of specialized response to a threatening disaster situation or disasters/emergencies both natural and man-made such as those of Chemical, Biological, Radiological and Nuclear origin, the Act has mandated the constitution of a National Disaster Response Force (NDRF). The general superintendence, direction and control of this force shall be vested in and exercised by the NDMA and the command and supervision of the Force shall vest in an officer to be appointed by the Central Government as the Director General of Civil Defense and National Disaster Response Force. Presently, the NDRF comprises eight battalions.

3. National Crisis Management Committee The NCMC, comprising high level officials of the Government of India, headed by the Cabinet Secretary, will continue to deal with major crisis which have serious or national ramifications. It will be supported by the Crisis Management Groups (CMG) of the Central nodal Ministries and assisted by NEC as may be necessary. The Secretary, NDMA may be a member of this committee.

4.6 Major Disasters in INDIA

1. 1770 – Great Bengal Famine (Drought) The Great Bengal Famine was a large famine in Bengal during the British rule in the period of 1769 – 1773. Bengal famine was caused the deaths of 10 million people in Bengal, Bihar and some parts of Odisha.

2. 1839 – Coringa Cyclone (Cyclone) The Coringa Cyclone was one of the 10 big disasters that shook India, struck at a tiny village of Godavari district in Andhra Pradesh. The Great Coringa Cyclone killed around 20000 people in the ancient city of Coringa.

3. 1894 – Third Plague Pandemic (Epidemic) The major plague pandemic came to British India in 1896, killing more than 12 million people in India and China alone.

4. 1979 – Lahaul Valley Avalanche (Avalanche) Lahaul Spiti valley receives heavy snowfall during the winter season, causes Avalanches. This disaster in March of 1979 buried 200 people under 20 feet of snow, the only avalanche in the Himalayas and one of the 10 deadliest Avalanches in History of world.

5. 1998 – Mapla Landslide (Landslide) Mapla landslide was one of the worst landslides in India, at village Mapla in Pithoragarh of Uttarakhand. Around 380 people were killed when massive landslides washed the entire village along with Hindu pilgrims of Kailash Mansrovar yatra.

6. 2001 – Gujarat Earthquake (Earthquake) The massive earthquake occurred on India's 51st Republic Day on January 26, 2001 at Bhachau taluka of Kutch district of Gujarat. Gujarat earthquake had a magnitude of between 7.6 and 7.7 and killed around 20000 people.

4.7. Lessons Learnt from Previous Disasters

1.Drought India's population at the time of independence was about 350 million. With rapid increase in the population and heavy dependency on erratic rain, Indian farmers are vulnerable to drought situation. It was highly recommended by civil engineers and technocrats to develop irrigation system and network to avoid major catastrophic drought. For Gujarat Narmada's Sardar Sarovar Yojana is the example which is considered as lifeline of Gujarat. Also efforts have been made in Agricultural research, developing new seeds and techniques to get maximum crop. 2. Flood Indian rivers most of them over flood during monsoon causing massive damage to lives and property. Indian monsoon is very erratic and due to global factors it is affected easily. India has developed flood control management on major rivers. The early warning system also helps in evacuation and relief operations minimizing loss of life. National flood warning system provides warnings up to 10 days ahead to millions of villagers.

3. Cyclone Major vulnerable area are coastal areas like Andhra Pradesh, Oddisha, Gujarat, Tamilnadu, Kerala etc. The early warning system and monitoring of progress of cyclone by satellite has helped a lot to minimize the damage. The recent cyclone of Odisha is the example where thousands of lives could be saved against severe cyclone 'HUDHUD'.

4. Earthquake Most dangerous and unpredictable natural disaster of all. India is prone to earthquake hits at periodic time. The Himalayan plate causing major earthquakes in Northern parts of India has crossed magnitude 7 sometimes.

UNIT 5.1. Introduction • The application of science and technology can substantially reduce losses of lives and property in case of disaster. • The task of managing disaster risks and disaster events is necessarily dependent on scientific knowledge and evidence based technique. • Unprecedented development in information, communication, and space technologies (ICST), have wide-ranging applications in disaster preparedness, reduction, mitigation, and

management. • ICSTs provide vital support for disaster management in many ways: observation, monitoring, data collection, networking, communication, warning dissemination, service delivery mechanisms, GIS databases, expert analysis systems, information resources, etc. • ICSTs, especially remote sensing, have successfully been used to minimize the calamitous of disasters in all phases of disaster management.

5.2. Role of Information Technology • For correct decision making at any stage of natural disasters, from prediction to reconstruction, a considerable amount of data and information is necessary. • Experience has proved that information technology facilitates the receiving, classifying, analyzing, and dissemination of information for appropriate decision making. • The main data and information critical for an efficient and robust disaster management system are those made available from: ➢Observatory stations ➢ Satellites observed ➢Centre-to-centre ➢ Classified experiences ➢Research results ➢ Training contents ➢Reports and ➢news

5.3. Role of Communication Technology • The role of communication technology in disaster management is to keep the flow of real-time data and information during all these phases. • A dynamic communication system would serve to integrate many different communication categories such as: ➢Data transfer from observatory stations ➢Data exchange among suppliers and users ➢Exchange of information and experience ➢Training and video conferences ➢Tele-control

5.4. Role of Space Technology • Space technology is a crucial component of ICST enabled disaster management systems. • The scope of space technology in disaster management is as follows: ➢A voluminous number of data can be collected. ➢Data collection can be conducted across a wide area. ➢Data accuracy can conform to the purpose of application. ➢A suitable transfer period can be regulated, depending on the type of data. ➢Data transference is more reliable and safe even during disasters. ➢Communication is faster in various locations. ➢Communication is reliable across a wide area and remote distances.

5.5. Role of Remote Sensing and GIS • Remote sensing is an investigative technique that uses a recording instrument or device to measure or acquire information on a distant object or phenomenon with which it is not in physical or intimate contact. • The technique is used for accumulating vital information on the environment. • It comprises Aerial Remote Sensing, which is the process of recording information such as photographs and images from sensors on aircrafts and satellite remote sensing. • Potential applications of remote sensing in disaster management include the following: ➢To map the variations in terrain properties, such as vegetation, water, and geology, both in space and time. ➢Helping to locate the area of a natural disaster and monitor its growing proportions while the forces of disaster are in full swing. ➢Monitoring the disaster event which provides, in turn, a quantitative base for relief operations. Such assessment can be used to map the new scenario and update the database used for the reconstruction of the crisis area.

Advantages of Remote Sensing ➢Saves time ➢ Users of the technology do not have to be in direct contact with danger zones. ➢Shows image of very large areas of land or space. ➢ Detect features at wavelengths not visible to the human eye. ➢Data can be regularly and routinely acquired and archived. ➢The most cost-effective dataset for monitoring change over large areas. ➢Can assist with damage assessment monitoring.

Limitation of Remote Sensing ➢It can be costly to build and operate a remote sensing system. ➢ Data can be difficult to interpret and may require expert skills. ➢Resolution is often coarse. ➢ Small size activities cannot be delineated on remote sensing imagery or through aerial photography.

5.6. Geographical Information System (GIS) • The GIS can be loosely defined as a system of hardware and software used for measuring, storing, retrieving, mapping, monitoring, modeling, and analyzing a variety of data types related to geographic and natural phenomena. • In other words, GIS is a computer-based system capable of integrating, storing, editing, analyzing, sharing, and displaying. • The most common applications of GIS in disaster management are the following: ➢GIS provides a versatile platform for decision support. ➢Hazard mapping for risk assessment. ➢GIS is used as a tool for the planning of evacuation routes. ➢GIS is used to organize the damage information. ➢GIS facilitates the calculation of emergency response times for emergency planners in the event of a natural disaster. ➢GIS based database will ensure the mobilization of the necessary resources.

Advantages of GIS ➢GIS has the ability to represent spatial information over a wide geographic area. ➢GIS effectively analyzes, collects, manages and distributes up-to-date information. ➢GIS is versatile and easy to use. ➢ Information from GIS can be easily tabulated.

Limitation of GIS ➢Major impacts on life of people, economy and environment. ➢GIS being a technological tool can be complex and a bit difficult to grasp initially. ➢Large amounts of information is usually required to get useful output from the system. ➢The decision making process may be stalled during an emergency.

• Integration of Remote Sensing and GIS ➢The integration of satellite data into Geographic Information System (GIS) is one of the great idea that focus on the rapid acceptance of GIS technology in to the geo information oriented applications in operational environments. ➢In remote sensing the data gathered is very large. So, comprehensive digital processing system is used to manage, manipulate and analyze these data. ➢GIS is used for spatial data analysis linked with attribute data. GIS is widely used for handling geographic data and performing analysis on those data for a number of earth related disciplines.

• The process of integrating remote sensing data into a GIS includes following analytical procedures: ➢Data acquisition ➢Data processing ➢Data analysis ➢Data conversion ➢ Error assessment