UNIT-I

INTRODUCTION

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INTRODUCTION:

Disasters are as old as human history but the dramatic increase and the damage caused by them in the recent past have become a cause of national and international concern. Over the past decade, the number of natural and manmade disasters has climbed inexorably. From 1994 to 1998, reported disasters average was 428 per year but from 1999 to 2003, this figure went up to an average of 707 disaster events per year showing an increase of about 60 per cent over the previous years. The biggest rise was in countries of low human development, which suffered an increase of 142 per cent. The figure shows the deadliest disasters of the decade (1992– 2001). Drought and famine have proved to be the deadliest disasters globally, followed by flood, technological disaster, earthquake, windstorm, extreme temperature and others. Global economic loss related to disaster events average around US $880 billion per year. While studying about the impact we need to be aware of potential hazards, how, when and where they are likely to occur, and the problems which may result of an event. In India, 59 per cent of the land mass is susceptible to seismic hazard; 5 per cent of the total geographical area is prone to floods; 8 per cent of the total landmass is prone to cyclones; 70 per cent of the total cultivable area is vulnerable to drought. Apart from this the hilly regions are vulnerable to avalanches /landslides /hailstorms/ cloudbursts. Apart from the natural hazards, we need to know about the other manmade hazards which are frequent and cause huge damage to life and property. It is therefore important that we are aware of how to cope with their effects o Disaster Management.

DISASTER DEFINITION:

A serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources

DISASTER MANAGEMENT- DEFINITION.

Can be defined as dealing with and avoiding both natural and manmade disasters.

Disaster management, on the other hand involves:

- Pre-disaster planning, preparedness, monitoring including relief management capability.
- Prediction and early warning damage assessment and relief management.

EFFECTS OF DISASTER

- Loss of life and properties
- Deaths
- Disability
- Loss of Properties
- Displacement o Environmental loss
- Increase in communicable disease
- Obstruction of development

CHARACTERISTIC OF DISASTER

- Sudden
- High potential
- High intensity
- Happen in short time

DISASTER MANAGEMENT- TERMINOLOGY:

Hazard:

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.

Vulnerability:

The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.

Mitigation:

The lessening or limitation of the adverse impacts of hazards and related disasters.

Risk :

Risk is the expected losses (lives lost, persons injured, damages to property and disruption of economic activity) due to a particular hazard. Risk is the product of hazard and vulnerability. Risk is the probability that a person will experience an event in a specified period of time. Risk as a function of hazard and vulnerability, a relationship that is frequently illustrated with the following formula, although the association is not strictly arthematic:

Risk = hazard x vulnerability

Risk is the probability of being affected by the unwanted consequences of a hazard. It combines the level of hazard and degree of vulnerability.

Capacity:

Capacity refers to all the strengths, attributes and resources available within a community, organization or society to manage and reduce disaster risks and strengthen resilience.

Disaster risk reduction:

The concept and practice of reducing disaster risks through systematic efforts, to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events. Early warning system: The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organizations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss. Emergency management: The organization and management of resources and responsibilities for addressing all aspects of emergencies, in particular preparedness, response and initial recovery steps.

Sustainable development: Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Vulnerability: The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.

TYPES OF DISASTERS:

Though, all kinds of disaster require more or less similar skill-sets and rescue-efforts at least a few days after the event, it is important to understand various kinds of disasters. Depending upon the actual nature of disaster, the immediate reaction needs to be different.

Also, the first few moments of disasters are distinctly different for each kind of disasters. Thus, understanding of each kind of disaster might also help in identifying the onset of a disastrous event, so that a trained person can undertake some key actions, during the initial few moments. This could have a major impact on the final outcome in terms of amount of final loss.

Natural disasters:

These are primarily natural events. It is possible that certain human activities could maybe aid in some of these events, but, by and large, these are mostly natural events.

- Earthquakes
- Volcano
- Floods
- Tornadoes, Typhoons, Cyclones

Man Made disasters:

These are mostly caused due to certain human activities. The disasters themselves could be unintentional, but, are caused due to some intentional activity. Most of these (barring coordinated terrorist activities) are due to certain accidents – which could have been prevented – if sufficient precautionary measures were put in place.

- Nuclear Leaks
- Chemical Leaks/Spill over
- Terrorist Activities
- Structural Collapse

RELEATION BETWEEN DISASTER AND HUMAN DEVELOPMENT:

Disaster impact is intimately connected with human development. A hazard turns into a disaster when the people, potentially in the danger zone, are vulnerable and do not have the capacity to cope with the impact of the hazard. For the sake of understanding the connection between hazard (H), disaster (D), vulnerability (V), and capacity (C), it can be concluded that:

D=(H*V)/C	D is H multiplied by V and divided by C

HYOGO FRAMEWORK OF ACTION (HFA: 2005-2015):

The World Conference on Disaster Reduction (WCDR) was held from 18-22 January 2005 in Kobe, Japan, and adopted the current Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters. HFA is an action framework for the disaster risk reduction in the next decade. Drawing on the conclusions of the review of the Yokohama Strategy, and on the basis of deliberations at the World Conference on Disaster Reduction and especially the agreed expected outcome and strategic goals, the Conference has adopted the following five priorities for action:

- Ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation.
- Identify, assess and monitor disaster risks and enhance early warning.
- Use knowledge, innovation and education to build a culture of safety and resilience at all levels.
- Reduce the underlying risk factors.
- Strengthen disaster preparedness for effective response at all levels.

The implementation and follow-up of the strategic goals and priorities for action set out in this Framework for Action should be addressed by different stakeholders in a multisectoral approach, including the development sector. States and regional and international organizations, including the United Nations and international financial institutions, are called upon to integrate disaster risk reduction considerations into their sustainable development policy, planning and programming at all levels. Civil society, including volunteers and community based organizations; the scientific community and the private sector are vital stakeholders in supporting the implementation of disaster risk reduction at all levels.

DISASTER MANAGEMENT CYCLE:

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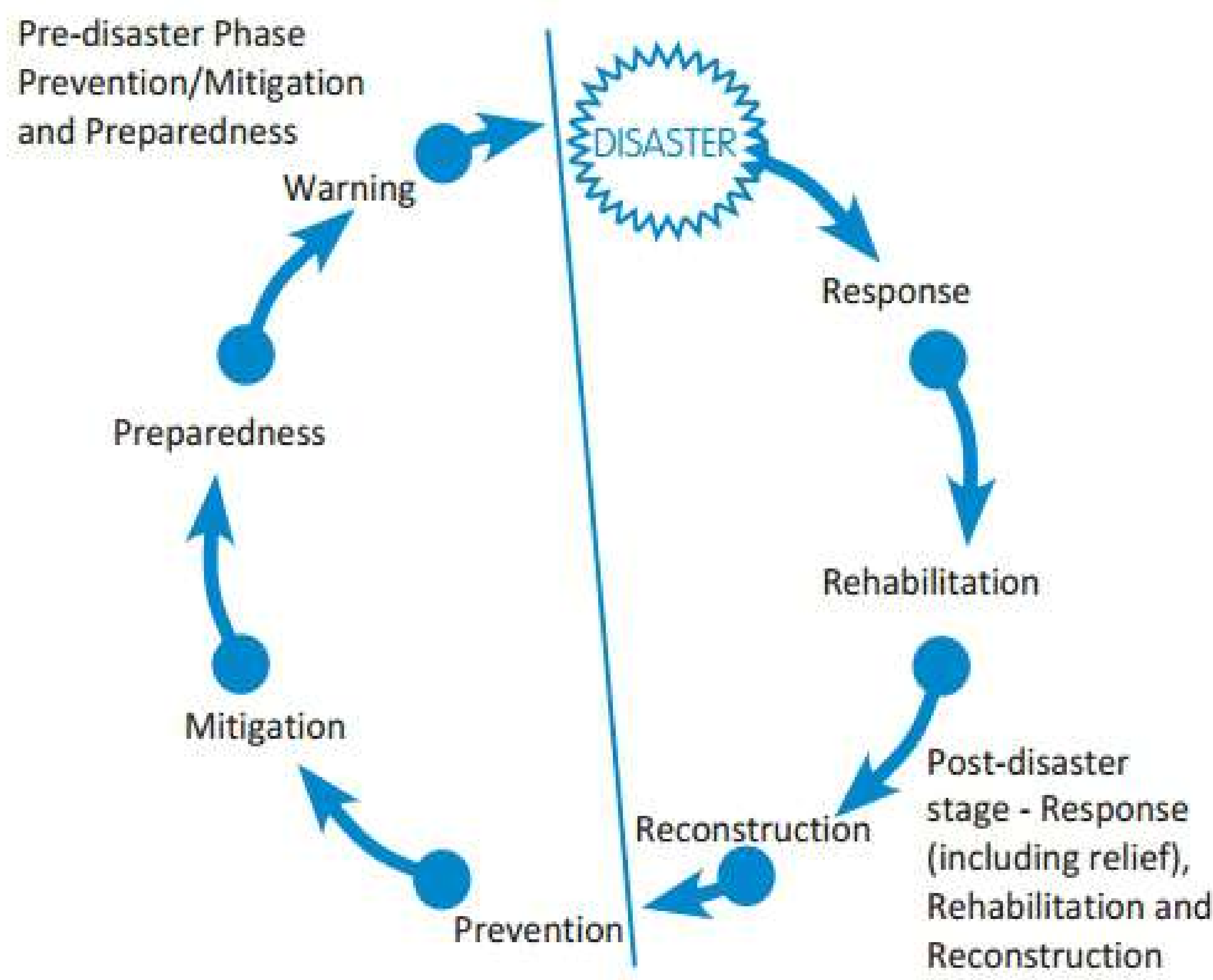


The Disaster Management Cycle consists of mainly two phases.

- Prevention

- Mitigation and Preparedness **Pre-disaster phase**
- Response and Relief
- Rehabilitation and Reconstruction **Post-disaster phase.**

Prevention:

Intention to completely avoid potential adverse impacts through action taken in advance

Example:

Seismic Engineering designs that ensure the survival and function of a critical building in likely earthquake

Mitigation:

Mitigation efforts are attempts to prevent hazards from developing into disasters altogether or to reduce the effects of disasters. The mitigation phase differs from the other phases in that it focuses on long-term measures for reducing or eliminating risk. Mitigation measures can be structural or non-structural. Structural measures use technological solutions like flood levees. Non-structural measures include legislation, land-use planning (e.g. the designation of nonessential land like parks to be used as flood zones), and insurance. Mitigation is the most cost-efficient method for reducing the affect of hazards although not always the most suitable. Mitigation includes providing regulations regarding evacuation, sanctions against those who refuse to obey the regulations (such as mandatory evacuations), and communication of risks to the public.

Preparedness:

Preparedness is a continuous cycle of planning, organizing, training, equipping, exercising, evaluation and improvement activities to ensure effective coordination and the enhancement of capabilities to prevent, protect against, respond to, recover from, and mitigate the effects of natural disasters, acts of terrorism, and other man-made disasters.

In the preparedness phase, emergency managers develop plans of action to manage and counter their risks and take action to build the necessary capabilities needed to implement such plans. Common preparedness measures include:

- Communication plans with easily understandable terminology and methods.

- Proper maintenance and training of emergency services, including mass human resources such as community emergency response teams.
- Development and exercise of emergency population warning methods combined with emergency shelters and evacuation plans.
- stockpiling, inventory, and maintain disaster supplies and equipment[9]
- Develop organizations of trained volunteers among civilian populations. Professional emergency workers are rapidly overwhelmed in mass emergencies so trained, organized, responsible volunteers are extremely valuable. Organizations like Community Emergency Response Teams and the Red Cross are ready sources of trained volunteers. The latter's emergency management system has gotten high ratings from both California, and the Federal Emergency Management Agency (FEMA).

Response:

The response phase includes the mobilization of the necessary emergency services and first responders in the disaster area. This is likely to include a first wave of core emergency services, such as firefighters, police and ambulance crews. They may be supported by a number of secondary emergency services, such as specialist rescue teams. A well rehearsed emergency plan developed as part of the preparedness phase enables efficient coordination of rescue.

There is a need for both discipline (structure, doctrine, process) and agility (creativity, improvisation, adaptability) in responding to a disaster. Combining that with the need to onboard and build a high functioning leadership team quickly to coordinate and manage efforts as they grow beyond first responders indicates the need for a leader and his or her team to craft and implement a disciplined, iterative set of response plans. This allows the team to move forward with coordinated, disciplined responses that are vaguely right and adapt to new information and changing circumstances along the way.

Recovery (It includes Rehabilitation and Reconstruction):

The aim of the recovery phase is to restore the affected area to its previous state. It differs from the response phase in its focus; recovery efforts are concerned with issues and decisions that must be made after immediate needs are addressed. Recovery efforts are primarily concerned with actions that involve rebuilding destroyed property, re-employment, and the repair of other essential infrastructure. Efforts should be made to "build back better," aiming to reduce the pre-disaster risks inherent in the community and infrastructure. An important aspect of effective recovery efforts is taking advantage of a ‘window of opportunity’ for the implementation of mitigative measures that might otherwise be unpopular. Citizens of the affected area are more likely to accept more mitigative changes when a recent disaster is in fresh memory.

UNIT – 2

DISASTERS CLASSIFICATION

CYCLONE

Cyclone is a type of rotating storm that occurs over the oceans and seas near the tropic. The rotation is clockwise in the Southern Hemisphere and anti clockwise in the Northern Hemisphere. A tropical cyclone is a storm system characterized by a large low pressure center and numerous thunderstorms that produce strong winds and heavy rains. India, with a 7,517 km coastline has the second highest number of people in the world exposed to tropical cyclone. The coastline along the Bay of Bengal is the most cyclone prone region of the world. Therefore, the east coast of India with very high density of population is more prone to tropical cyclones than the west coast. However, on June 9, 1998, a devastating cyclone hit the west coast in the Kutch district of Gujarat killing a large number of migrant salt pan workers. Cyclones strike in India in May—June and October—November coinciding with the onset and the retreat of monsoon. Coastal Andhra Pradesh, Tamil Nadu and Orissa and Sunderban in West Bengal are the major cyclone prone areas of India. The Orissa super cyclone in October 1999 has been the worst cyclone in the recent past. The wind velocity during this cyclone was as high as 350 km per hr. Cyclones are generally accompanied by sea surges, when the sea level rises up to 7 m. Cyclones are also associated with heavy rains. The factors which may lead to the formation of cyclones are:

- Right place and right temperature is needed for the formation of cyclones.
- The place must be within plus — minus 5^0 to plus — minus 15^0 latitude from the equator over the oceans and seas.
- The surface temperature of the ocean/sea needs to be 26.5 ^{0} or above.
- A low air pressure system (depression) with convection current starts to gather clouds.

Cyclones are easy to predict. The Indian Meteorological Department (IMD) is continuously monitoring with its radars for any low pressure developing in the atmosphere above the ocean. With the advancement of technology, it is possible to predict the intensity of the cyclonic storm and the coastal area to be hit by any potential cyclone. Yet, between the years 1980 and 2000, 350 million people in India have been exposed to cyclones. The reasons for this could be many: the cyclone forecasts do not reach the most vulnerable people living closest to the sea shore on time; people, even if warned, do not take this seriously; there may not be a safe place in the vicinity for people to take temporary shelter; many people do not have the legal entitlement of the land they have in their possession, and they are afraid that if they leave the place for safer areas others may grab their land if the forecast proves wrong.

The large belt along the east coast of India is prone to cyclone and the west coast in the south and north is also prone to cyclone. Two mega cities, Kolkata and Mumbai are situated in the cyclone prone map of India. Many industrial towns located along the east and the west coasts, state capitals and towns are also located in the cyclone hazard zone. It is worth a mention that in Andhra Pradesh, the cyclone hazard zone extends farthest into the mainland away from the sea.

TORNADO

By definition, tornado is a violent and dangerous rotating column of air in contact with both the surface of the earth and a cloud. It is also known as a twister because of its rotational character. It can be of any shape and size, but the typical tornado has the shape of a condensation funnel, the narrow end of which touches the earth. Tornados are found to occur in all the continents except Antarctica. However, a vast majority of tornados occur in North America. It has been observed that most tornados have wind speeds of less than 175 km per hr and are less than approximately 250 ft wide. Generally, these dissipate quickly after travelling a few km. However, the most extreme tornados can attain a speed of 450 km per hr, stretch over more than 3 km across and can stay on the ground for more than 100 km. The stronger tornados have the power of throwing moving cars, even trains into air; rip the buildings of their foundations. The tornados can be detected before or as they occur by the pulse—doppler radar, and hence, can be forecasted like cyclones with the likely velocity and the destructive zone.

HAILSTORM

A thunderstorm that reaches the ground is known as hailstorm. Hailstones can grow up to 6 inches and can weigh more than 0.5 kg. Stones larger than 0.75 inches can cause damage to houses with tin or thatch roofs, automobiles, standing crops, and livestock. Hails are formed in strong thunderstorm cloud, particularly those with intense upward drafts, high water content, large water droplets and where a good portion of the cloud is below the freezing point. The growth of hail is maximum when the air is near a temperature of minus 13 0 C. In Canada, hailstorm is one of the most expensive hazards.

CLOUDBURST

An extreme amount of precipitation normally lasting no longer than a few minutes but capable of creating destructive floods is known as cloudburst. These descend from very high clouds with the rate of rainfall equal to or greater than 100 mm per hr. In case of severe cloudburst, more than 2 cm of rainfall may occur in a matter of few minutes causing extensive damage to human lives, housing, infrastructure, livestock and crops. On August S, 2010, around midnight, the cold deserts of Ladakh and Leh were rocked by severe mudflows due to the worst cloudburst in recent times that killed more than 200 people and injured 300. A large number of people were also reported missing (officially 800).

LIGHTNING

It is an atmospheric electrostatic discharge accompanied by clouds that is generally accompanied by a thunderstorm. Because of this discharge, lightning can travel at a speed of 220,000 km per hr and can attain a temperature upto 30,000 ^{0}C. If lightning strikes humans or trees, both will die instantly. Scientists have studied the root cause of lightning and have come to the conclusion that the ice inside the cloud at high altitude is the cause of development of lightning. It causes forcible separation of positive and negative charges in clouds thereby facilitating the process of the development of lightning.

EXTREME HEAT AND COLD

Heat and cold waves have become a part of extreme weather events causing enormous loss of lives, human discomfort and ailments. The World Meteorological Organization (WMO) assessed for the Year 2007 that the surface temperature of the Northern Hemisphere was the second warmest on record at 0.63^{0}C above a 30 year mean (1961 to 1990) of 14.6^{0}C. The Southern Hemisphere temperature was 0.20^{0}C higher than the 30 year average of 13.4^{0}C. A heat wave is a hot period lasting from a few days to some weeks. Severe heat waves can kill people from hyperthermia; can cause severe damage to crops. According to the Indian Meteorological Department (IMD) the extreme heat waves of the Year 2007 in India were the fourth warmest on record since 1901. The maximum anomalies were observed in the western parts of Uttar Pradesh, Haryana, Punjab and Jammu & Kashmir. Heat waves were also observed in the coastal areas of Andhra Pradesh. The heat waves raised the temperature of the central region of the country by 5^{0}C—7^{0}C killing 72 people. In the same year, the whole of north India was under severe cold wave in the month of January that claimed more than 72 lives, particularly in Uttar Pradesh. The cold wave resulted in the dropping of temperature to less than 3^{0}C—5^{0}C of the average temperature and in the major town of Uttar Pradesh, the temperature was close to 5^{0}C. The cold wave also prevailed over Jammu Kashmir during the second week of March killing more than 60 people.

AVALANCHE

By definition, Avalanche is the rapid movement of snow down a slope triggered either naturally or by human activity. This occurs typically in the mountain terrain. An avalanche can mix air, water with the descending snow. The destructive potential of an avalanche is rated in the logarithmic scale as that of an earthquake, but in this case, it consists typically of five categories. India, because of the Himalayas, is one of the most avalanche prone countries of the world. The available statistics show that between 1980 and 2009, India had:

Number of events: 73

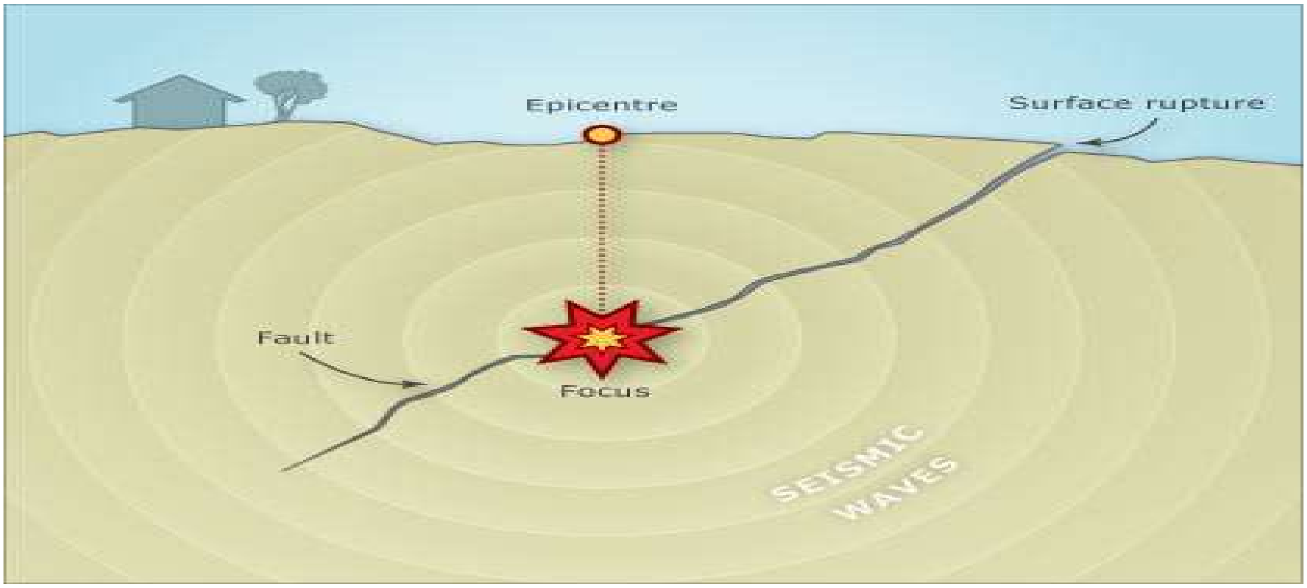
Number of people killed: 3,532

Number of people affected: 69,637

Economic damage in US Dollar: 807489000

EARTHQUAKE

An earthquake (also known as a tremor) is caused due to the release of energy in the earth's crust that causes seismic waves. The occurrence and intensity of earthquakes are measured with a seismometer. The intensity of the earthquake is measured on the Richter scale. The Richter scale assigns a single number from 1 to 10 in the ascending order to quantify the amount of seismic energy released by an earthquake. This scale from 1 to 10 is in geometric progression with a common ratio of 10. This means that the seismic energy released in an earthquake measured at 6 on the Richter scale is 10 times higher than that of 5 and is 100 times higher than that of 4 on the Richter scale. The energy release of an earthquake is closely related to its destruction power. The difference of energy released due to an earthquake between 4 and 5 on the Richter scale is 31.6 and between 4 and 6 is 1000.



The following table describes the typical effects of earthquakes of various magnitudes near the epicenter. Epicenter is the point on the surface of the earth or the sea bed directly under which an earthquake takes place. This table should be studied with extreme caution, since the intensity and thus the ground effects depend not only on the magnitude, but also on the distance to the epicenter, the depth of the earthquake's focus beneath the epicenter, and the geological conditions (certain terrains can amplify seismic signals) (Source: US Geological Survey).

Table: Intensities of Earthquakes, their Effects and Probable Frequency of Occurrence

Source: US Geological Survey

Richter magnitudes	**Description**	**Earthquake effects**	**Frequency of occurrence (Globally)**
Less than 2.0	Micro	Micro earthquakes, not felt	About 8,000 p day
2.0-2.9	Minor	Generally not felt, but recorded	About 1,000 p day
3.0-3.9	Often felt, but rarely causes damage	49,000 per year	
4.0-4.9	Light	Noticeable shaking of indoor items, rattling noises. Significant damage unlikely	6,200 per yea
5.0-5.9	Moderate	Can cause major damage to poorly constructed buildings over small regions. At most, slight damage to well-designed buildings	800 per year

6.0-6.9	Strong	Can be destructive in areas up to about 160 km (100 miles) across in populated areas	120 per year
7.0-7.9	Major	Can cause serious damage over larger areas	18 per year
8.0-8.9	Great	Can cause serious damage in areas several hundred miles across	1 per year

LANDSLIDE

Landslides are caused by the movement of masses of rock or debris over land or under the sea/ocean. Huge under—sea landslides can cause a tsunami. Landslides are rapid movements of landmass or debris along a natural or manmade slope. Landslides occur when the gravitational force on a landmass along a slope exceeds the resisting force like friction. The main causes of landslides are:

- Gravity.
- Sharp changes in groundwater table.
- Earthquakes, volcanic eruptions or other vibrations.
- Unscientific and unsystematic constructions on the hill tops.

Although landslides, a high impact and sudden natural or man-made phenomenon, receives far less attention compared to other high impact disasters, like earthquakes, cyclones, tsunamis and floods, the mortality due to this in 2005 was 30,000 globally.

Landslides are predictable. With the help of satellite imageries, GIS maps scientists are now able to pinpoint the possibility of landslides anywhere in the world.

MAN MADE DISASTERS

INDUSTRIAL DISASTER

The Bhopal gas leakage, also known as the Bhopal Gas Tragedy, is considered as the world's worst industrial disaster. The city of Bhopal with a population of about I million (1991 Census) experienced the worst industrial disaster of the last century. On the midnight of December 3, 1993, 40 tonnes of the deadly methyl isocyanate (MIC) accidentally leaked out of the Union Carbide Corporation's pesticide manufacturing plant in Bhopal. The disaster immediately killed about 8000 people and caused multisystemic injuries to more than 500,000 that would take a very long time and many generations to heal.

The worst affected due to this disaster were the low-income people living in slums and on the pavements, who were engaged in the informal sector for their livelihood. Since MIC is heavier than air, the lethal toxins released from the factory soon settled close to the surface of the earth. Because of this, the children and people sleeping on the floor inhaled the gas more than others.

People, who ran to get out of the effects of the toxins, inhaled it more than those who escaped in cars.

The people of India, immediately after the disaster, responded angrily against the multinational and demanded strong punishment against the perpetrator, the Union carbide. The civil society individuals and organizations converged at Bhopal and tried to do as best as they could in such a massive disaster. The capacity of the state-run hospitals were far too inadequate compared to the number of people exposed to the gas and thereby the number of people needing medical attention. This resulted in the proliferation of the private clinics. In either of the case, doctors prescribed antibiotics and life savings steroids based on the individual's understanding of the cause, because Union Carbide Corporation refused to divulge the exact composition of the lethal gas. Institutions, like the WHO could have been of great help in this situation, but they were conspicuously absent.

Though there are some studies, though grossly inadequate, on the medical impacts of the exposure to MIC, conducted by the Indian Council of Medical Research (ICMR) and Medico Friends Circle, a civil society initiative, the social impact of the disaster has not been systematically documented. There are no records of the number of women who had natural abortion because of fetal poisoning or the number of women denied marriage due to the exposure.

NUCLCAR DISASTER

A disaster caused due to radiations is defined by the International Atomic Energy Agency (IAEA) as an event that leads to significant consequences to the people, the environment and the facility. The prime example of this is the Chernobyl disaster in 1986, which occurred in Ukraine. It caused the death of 56 people directly and approximately 4,000 people additionally dying of cancer-related disease. Nearly 350,000 people of Ukraine, Belarus and Russia were forcibly resettled away from the disaster. The disaster damaged around 7 billion USD worth of property. It has been reported worldwide that from 1952 to 2009, there have been 98 disasters caused due to radiations and almost two-third of them were in the United States.

ACCIDENT RELATED DISASTERS

FOREST FIRE

Forest fire, caused by nature or humans, is the most common hazard in the forests. It not only destroys the forest wealth, but also the biodiversity, the ecology and the environment. During long summer months without rain, the forests littered with dry leaves and twigs can burst into flames with the slightest spark. The Garhwal Himalayas have been burning regularly during the last few summers causing enormous loss of vegetation cover in the region. The eastern Himalayas are less prone to forest fires compared to the west.

MINE FLOODING AND FIRE

Two out of the 10 worst worldwide mining disasters in terms of mortality in the last century took place in Dhanbad, Jharkhand. On May 28, 1965, 375 miners died due to a coal mine fire in Dhanbad. On December 27, 1975, in a coal mine in Chasnala near Dhanbad, 372 miners were trapped inside the mine whose roof caved in. As a result, 7 million gallons of water per minute entered into the mine killing all the 372 trapped miners. The coal belt of Jharia in the Jharkhand state is a huge storehouse of coke coal in the country with 23 large underground mines and 9 large open cast mines. Though the mining activity in the area started in 1894, it peaked in 1925 under the control of private owners. In 1916, the first fire in the mine of this region was detected. Coal is formed from organic matter and is high in carbon content. This, when exposed to certain conditions such as temperature, moisture, oxygen, etc., tends to ignite and burn spontaneously. This combustion could be a natural process or may be triggered by other causes including human activities. Once a coal seam catches fire and is not controlled in the initial phase as happened in the Jharia coal belt in Jharkhand, it could burn for tens to hundreds of years. Air, water and land are affected by this pollution; land can ultimately become unsuitable for agriculture. The smoke from these fires contain oxides and dioxides of carbon, nitrogen and sulphur causing several lung and skin diseases. Respiratory diseases, like chronic bronchitis and asthma, are common in this region. A huge population of the state of Jharkhand was bearing the brunt of unscientific exploitation of coal by the private owners till coal mining was nationalized.

STRUCTURAL COLLAPSE

Two of the worst 20 structural collapses in the world occurred in India. On August 28, 2003, at least 25 people, including 23 school children were killed due to the collapse of a bridge in Daman. A school bus, a number of vehicles and pedestrians were thrown into the swirling river due to this. On December 2, 2006, at least 30 people were killed when a 150 year-old bridge, which was being dismantled, collapsed on a moving train near Bhagalpur in Bihar.

On October 29, 2005, a small rail bridge near the town of Valigonda in the south of Hyderabad was swept away by a flash flood. The 'Delta Express' train traveling over the bridge at night derailed at the broken section of the railway line killing at least 114 people and injuring more than 200 people.

On September 27, 2010, a roof collapsed in the weight lifting arena of the Jawaharlal Nehru Stadium, New Delhi, only 6 days before the Commonwealth Games were scheduled to begin. Many participating nations delayed arrival of their teams causing anxiety to the organizers of the Games.

ASTEROIDS AND COMETS

Ever since the earth was formed 4.5 billion years ago, it has been hit by these extra celestial bodies. There is paleontological evidence that cosmic collision has played a significant role in the mass extinction of earth's fossil records. These objects therefore, without any doubt pose a threat to the earth. Such collisions, depending on the size of the objects colliding with the earth, has the potential to cause massive damage at local and global scales. Comet Shoemaker—Levy 9 broke into 21 pieces, some as large as 2 kms in diameter, and crashed into the atmosphere of Jupiter. Had these fragments hit the earth instead, there would have been a global catastrophe.

ROAD, RAIL AND AIR ACCIDENTS

According to the World Health Organization, in its first ever Global Status Report on road safety, India has the dubious distinction of having the worst road accident rate worldwide: 130,000 deaths annually. This number is more than the annual casualties of all the natural disasters taken together. In 2009, the death toll due to road accidents in the country was 14 per hr. According to the National Crime Research Record Bureau, the death toll due to road accidents have passed the mark of 135,000 annually.

Rail accident is almost a regular phenomenon in the country and takes place all over. According to the information from the Indian Railways, from the year 1981 to 2009, around 4,575 people were killed due to rail accidents.

The worst air accident of an Indian Airliner was caused due to a bomb explosion over 33,000 feet on the Montreal—London—Delhi Air India flight named after emperor Kanishka on June 1985. The plane exploded over the Irish airspace killing all 329 people on board. On May 22, 2010, the Air India express flight from Dubai crashed outside the Mangalore airport killing 158 people on board.

URBAN FIRE

Urban fire is perceived by the urban poor, especially those living in the slums, as the most dreaded disaster. Metropolitan cities, like Mumbai, where 54% of the total population lives in slums with the density of population as high as 100,000 per km^2 , and Kolkata, where one-third of the population lives in the 5,500 slums with very high density of population, fire can cause serious damage to the hutment, lives and livelihood of the poor. In spite of the fact that there has been rapid urbanization in India, the fire fighting capacities in the country have not developed proportionately. This has been evident time and again. There have also been a number of incidents of fire in hotels, night clubs and theatre halls in the urban areas, both in India and outside the country with devastating consequences.

INDIA’S VULNERABILITY AND HAZARD PROFILE

Indian sub-continent has unique geo-climatic and socio-political conditions that make it vulnerable to both the natural as well as manmade disasters. *Around 6% of the population of India is impacted annually* by the exposures to disasters. They Key natural disasters in India include floods, droughts, cyclones, earthquakes, landslides and avalanches that have resulted in loss of lives and livelihoods.

According to a Planning Commission report, the key vulnerabilities of India include the following:

- Coastal States, particularly in the East Coast and Gujarat on west coast, are vulnerable to cyclones.
- 4 crore hectare land mass is vulnerable to floods and river erosion.
- 68 per cent of net sown area is vulnerable to drought.
- 55 per cent of total area is in Seismic Zones III-V and vulnerable to earthquakes of moderate to high density.
- Sub-Himalayan/ Western Ghat are vulnerable to landslides.

Vulnerability to disasters or emergencies of Chemical, Biological Radiological and Nuclear (CBRN) origin has increased on account of socioeconomic development. The occurrence of heat waves, cold waves, floods, droughts, intense cyclones and flash floods is getting increased due to climate change and global warming.

INDIA'S HAZARD PROFILE

India is prone to disasters due to a number of factors; both natural and human-induced, including adverse geo-climatic conditions, topographic features, environmental degradation, population growth, urbanisation, industrialisation, non-scientific development practices etc. Various hazards to which India is prone to can be broadly divided into three categories viz. Hydrological or climate related; Geological and Technological hazards. They have been discussed below:

Hydrological and Climate related Hazards

Floods

Floods can be caused by heavy rainfall, inadequate capacity of rivers to carry the high flood discharge, inadequate drainage to carry away the rainwater quickly to streams/ rivers. ice jams or landslides blocking streams, typhoons and cyclones etc. Further, flash floods occur because of high rate of water flow particularly in areas with less permeability of soil.

Over 40 million hectare of landmass in India is prone to floods. Nearly 75% of the total annual rainfall is concentrated over a short south-west monsoon season of three to four months from June to September. As a result there is a very heavy discharge from the rivers during this period causing widespread floods. Flood problem is chronic in at least 10 states. From October to December each year, a very large area of South India, including Tamil Nadu, the coastal regions of Andhra Pradesh and the union territory of Pondicherry, receives up to 30 percent of its annual rainfall from the northeast monsoon (or winter monsoon). These have caused devastating floods in Chennai in 2015. Most devastating floods in recent times have been the 2013 Assam floods, 2013 Uttarakhand Floods, 2012 Brahmaputra Floods etc.

Cyclones

India has a very long coastline which is exposed to tropical cyclones arising in the Bay of Bengal and Arabian Sea. *Indian Ocean is one of the six major cyclone-prone regions in the world*. In India cyclones occur usually in April-May, and also between October and December. The Eastern coastline is more prone to cyclones as about 80 percent of total cyclones generated in the region hit there. The worst hitting cyclones have been the Andhra Pradesh cyclone of November 1977 and the super cyclone of Odisha in the year 1999. The impact of the cyclones is mainly confined to the coastal districts, the maximum destruction being within 100 Km. from the centre of the cyclones and on either side of the storm track. The principal dangers from a cyclone include the gales and strong winds; torrential rain and high tidal waves (storm surges). Most casualties are caused by coastal inundation by tidal waves and storm surges.

Heat Waves, Cold waves and Fog

Heat waves refer to the extreme positive departure from the maximum temperature in summers. The fatalities caused by heat waves have increased in recent decades. The problem of heat wave is compounded by a decrease in diurnal temperature Range (DTR). In urban areas, the heat wave is increasing gaining notoriety for more and more fatalities. Cold waves occur mainly due to the extreme low temperature coupled with incursion of dry cold winds from north-west. Most affected areas of country due to the cold waves include the western and north-western regions and also Bihar, UP directly affected by the western disturbances.

Thunderstorm, Hailstorm, Dust Storm etc

India's central, north-eastern, north-western and northern parts are generally affected by these. The southern coastal areas are less prone to thunderstorms, hailstorms and dust storms. The hailstorms are more frequent in Assam, Uttarakhand and some parts of Maharashtra. Dust storms are common in Rajasthan, MP and Haryana. Tornadoes are rare in India.

Droughts

Drought refers to the situation of less moisture in the soil (which makes the land unproductive) and scarcity of water for drinking, irrigation, industrial uses and other purposes, usually caused by deficient/less than average rainfall over a long period of time. Some states of India feature the perennial drought such as Rajasthan, Odisha, Gujarat, Madhya Pradesh etc.

Sixteen percent of the country's total area is drought-prone and approximately 50 million people are affected annually by droughts. In India about 68 percent of net sown area in the country is drought-prone. Most of the drought-prone areas identified by the Government of India lie in arid, semi-arid and sub-humid areas of the country. In the arid and semi-arid zones, very severe droughts occur once in every eight to nine years.

Geological Disasters

Earthquakes

Earthquake is almost impossible to be predicted, so it is the most destructive of all natural disasters. It is almost impossible to make arrangements and preparations against damages and collapses of buildings and other man-made structures hit by an earthquake. More than half of India's total area is vulnerable to seismic activity of varying intensities.

The most vulnerable regions are located in the Himalayan, Sub-Himalayan belt and Andaman & Nicobar Islands. The Himalayan ranges are among world's youngest fold mountains so the subterranean Himalayans are geologically very active. The Himalayan frontal arc, flanked by the **Arakan Yoma** fold belt in the east and the **Chaman fault** in the west make one of the seismically active regions in the world.

Tsunami

Tsunami refers to the displacement of a large volume of a body of water such as Ocean. Most Tsunamis are seismically generated, result of abrupt deformation of sea floor resulting vertical displacement of the overlying water.

The Tsunami waves are small in amplitude and long wavelength (often hundreds of kilometres long). The east and west coasts of India and the island regions are likely to be affected by Tsunamis generated mainly by subduction zone related earthquakes from the two potential source regions, viz. the Andaman-Nicobar-Sumatra Island Arc and the Makran subduction zone north of Arabian Sea.

Landslides

Landslides are common in India in Himalayan region as well as Western Ghats. The Himalayan ranges are among the youngest fold mountains of world. They comprise a series of seven curvilinear parallel folds running along a grand arc of around 3400 kilometres. The landslides in this region are probably more frequent than any other areas in the world.

The Western Ghats, particularly Nilgiri hills also are notorious for frequent landslides.

Technologic Disasters

Industrial, Chemical & Nuclear Disasters

The industrial and chemical disasters can occur due to accident, negligence or incompetence. They may result in huge loss to lives and property. The Hazardous industries and the workers in these industries are particularly vulnerable to chemical and industrial disasters.

The most significant chemical accidents in recorded history was the 1984 **Bhopal Gas disaster**, in which more than 3,000 people were killed after a highly toxic vapour, (methyl isocyanate), was released at a Union Carbide pesticides factory.

UNIT 3

DISASTER IMPACTS

INTRODUCTION

Appropriate disaster response depends on the assessment of the impact that helps senior management of the private and public institutions to make informed choices. The possible immediate impacts of a disaster are:

LOSS OF LIFE

In the last two decades of the last century, more than half a million people were killed due to four natural disasters alone: floods, cyclones, earthquakes and droughts. Human loss is the most widely used indicator of the extent of a high impact disaster like flood, earthquake, tsunami, cyclone and civil war. This, however, reveals the tip of the iceberg of human suffering due to disaster: for every one person killed, 3,000 people are exposed to the hazards of natural disasters. In case of slow impact disasters like drought, HIV/AIDS, arsenic contamination in drinking water, loss of life alone cannot be the indicator of the extent of the impact: number of people affected and the geographical spread are the better indicators of impact.

LIVESTOCK LOSS

In case of a severe disaster, livestock losses can reduce the income and food security of people primarily dependent on livestock, for up to five years till stocks and herds are rebuilt. Disaster can threaten livestock in a given region in case of both slow and rapid onset of disaster. Persistent drought is possibly the most serious type of disaster: a serious drought in the Horn of Africa in 2000 caused death of more than 70% of livestock in some countries. In states, like Gujarat and western Rajasthan, in case of drought, the need of the poor cattle owner is not cash for work but fodder, which needs to be transported from a distance and hence this becomes beyond their capacity to access.

LOSS OF HABITATION

Loss of habitation is one of the major problems of the disaster-affected people after high onset disasters, like flood, cyclone, earthquake and tsunami. The Orissa Super Cyclone of October 26, 2000 left no mud and thatch house standing along the coast from Astarang in Puri to Paradip port in Kendrapara district. The Gujarat earthquake of January 26, 2001 fully damaged more than 100,000 houses in Kutch district alone. The Indian Ocean tsunami on December 26, 2004 destroyed completely countless number of houses across the affected countries in Asia, including India. The Bihar flood of August 2008 destroyed more than 300,000 houses. The hurricane Katrina in USA left behind more than 40,000 completely damaged houses.

AGRICULTURAL LOSS

In 2007, agriculture accounted globally for employment to one-third of the total workforce of the world. In the same year, in India, agriculture contributed to almost 16.6% of the GDP and provided employment to 52% of the total workforce in the country. However, agriculture is heavily dependent on weather, climate, availability of water, distribution of the annual rainfall, and hence, is adversely affected by hydro meteorological disasters, in particular. As an example, in the Bihar flood of August 2008, 840,000 acres of standing crop was completely damaged. Before 2005, disaster relief and response in the country was the responsibility of the Department of Agriculture, Government of India. This was possibly because the impact of disasters was assessed by the loss of agriculture, apart from human loss.

LIVELIHOOD LOSS

It has been mentioned earlier that 52% of the total workforce of India is dependent on agricultural activities. Any serious disruption of agricultural practices due to disaster is bound to adversely impact the livelihood of the majority of the workforce in the country. All natural disasters, therefore, shrink the livelihood opportunity, moreso of the poor in the unorganized sector. For this reason, the think tank of the British Government agency for International Development (DFID) in its development policy recognized the importance of looking for livelihood options for the poor, who are not dependent on the vagaries of weather. The author visited Gujarat four weeks after the 2002 riot. He observed how the riot had impacted the livelihood of the poor, both the Hindus and Muslims. Gujarat is famous for readymade garments. In this industry, which is decentralized and home based, there is a strong dependence on the poor from both the religions. As a result, immediately after the riot, there was a breakage of the conveyer process of making these garments, depriving the poor from both the communities of livelihood opportunities for months.

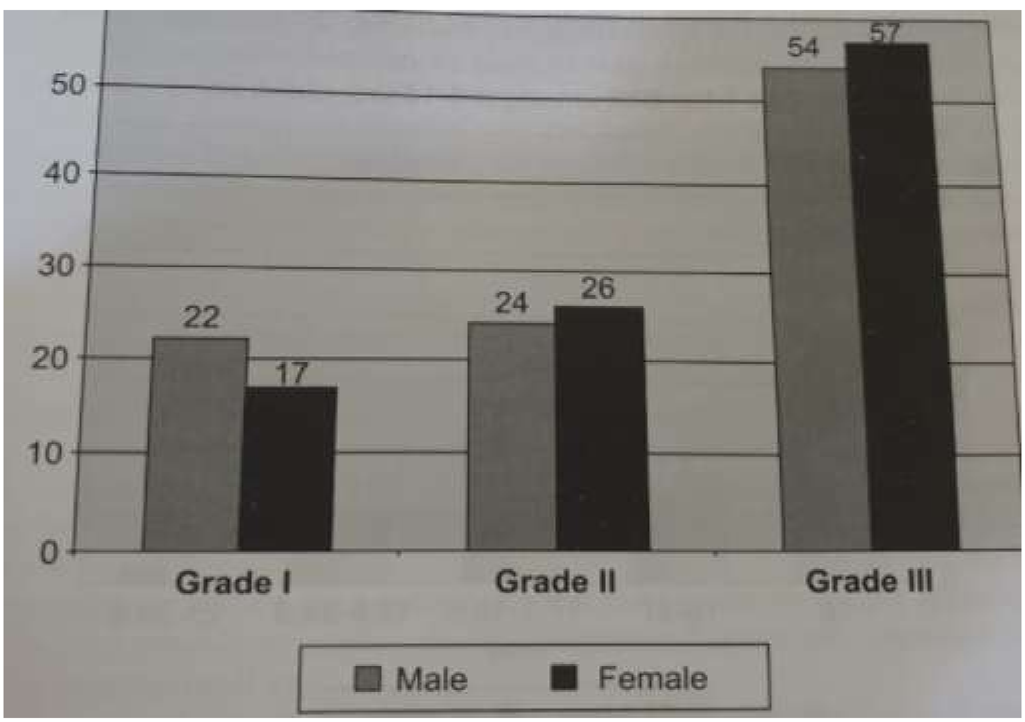
ADDITIONAL HEALTH HAZARDS AND MALNUTRITION PARTICULARLY AMONG UNDER FIVES

In the chaos that follows natural disasters, the risk of outbreak of communicable diseases is generally presumed to be very high. It has been observed globally, that the risk factor of epidemic is associated primarily with population displacement. The factors that influence the risk and consequently the deaths, are: availability of safe drinking water, sanitation facilities, the degree of crowding and the underlying health status of the displaced population like the nutritional status, level of immunity to vaccine— preventable diseases such as measles. The outbreak is less frequent in natural disasters than in the conflict affected population. Presence of a large number of dead bodies in the disaster affected areas may heighten the concern of outbreak of diseases. In spite of the absence of dead bodies due to natural disasters posing a risk for epidemic, the health officials and the media frequently exaggerate the threat. "When death is directly due to a natural disaster, human remains do not pose a risk of outbreak. Dead bodies only pose health risks in cases such as deaths from cholera and hemorrhagic fevers".

The under—five nutrition is the best quantitative indicator of the well being or non — well being of a household. Figure below is a real-life example of the under—five nutrition of children in a closed tea garden after one year of the closure. This is also an example of how under—five nutrition can be quickly assessed using a simple method.

In a disaster, quick nutritional assessment of children from six months onwards to 59 monfrths is done using the method of measurement of Mid Upper Arm Circumference (MUAC) by a specially designed colored tape. Measurement of MUAC is the measurement of the middle portion of the upper arm, that is, the portion of the arm between the elbow and shoulder. The tape has three colors: red, yellow and green. While measuring the MUAC, if the position of the tape is in red, the child is severely malnourished; if yellow, moderately malnourished; and if green, normal.

The graph depicts the measurements for MUAC done with children between 6 to 59 months. Amongst the 402 children, 204 were boys and 198 girls. 54% boys and 57% girls were suffering from Grade Ill malnutrition (MUAC > 12.5), 26% boys and 24% girls were suffering from Grade Il malnutrition (MUAC < 13.5 and > 12.5 cm), 22% boys and 17% girls were suffering from Grade I malnutrition. What is significant to note is that none of the 402 children registered normal nutritional status (MUAC < 16 cm).



Distribution of MUAC for under five children

CONTAMINATIONOF DRINKING WATERSOURCES

Lack of access to safe drinking water due to contamination caused by a disaster may lead to water—borne communicable diseases. This has been found most frequently in South Asian countries. The examples are: flooding in Bangladesh in 2004 led to an outbreak of cholera resulting in 17,000 cases; 16,000 cases of cholera epidemic in West Bengal in 1998 were attributed to preceding flood. In the waves of the floods in Orissa during July—August that affected the tribal areas of Koraput, Rayagada, Dasamantaput and Kalahandi districts, 184 deaths were reported by UNDP due to cholera epidemic. It has, however, been observed in recent years that people affected by a disaster know the importance of safe drinking water. After the Orissa Super Cyclone that ravaged the coastal areas of the Orissa State, there were no reported cases of the outbreak of any epidemic. It has been observed by the author that the agencies: both public and private, involved in the distribution of halogen tablets to disinfect drinking water, do not provide the necessary instructions about the use of these tablets. The tablets are given to the disaster affected people wrapped in paper. As a result, in no time, the chlorine coming in contact with air evaporates, thereby giving the disaster affected people a false sense of security.

A study was done by the Water and Sanitation Unit of Oxfam, Great Britain, after the 1998 flood in Bihar. It was observed by the team that the water of the tube-wells that were not completely submerged in the flood water had bacteria-free water, but the same water consumed by the people at home had 22 different types of bacteria. This was because of unhygienic storage and usage.

IMPACT ON CHILDREN: EDUCATION, SCHOOL DROP OUT

Children, especially the young, because of their physical, social and psychologcal characteristics, are less equipped to deal with the consequences of disasters. It estimated by agencies working with a focus on children like Save the Children, that in the late 1990s, there were 66.5 million disaster-affected children globally. It was also apprehended that by the end of the first decade of the new millennium, this figure could rise up to 175 million. These figures are estimates without disaggregation by age, sex and other social contexts. In most circumstances, children are still grouped with women; thereby a real picture of vulnerability of children is often missing. But the impact of disaster persists on children well beyond the immediate phase, with long term negative impact on their well being.

In case when people are forced to live for a protracted period in relief camps or in a safe place away from their villages, the education of children gets seriously affected. In several places, the coping mechanism of the poor post disaster is to get children, mainly boys out of school and engage them in employment in the exploitative unorganized sector. Girls in their early teens are dropped out of school and are married off much before they attain the marriageable age.

ENVIRONMENTAL LOSS

Degradation of environment is both the cause and effect of a disaster. The biggest threat that the world is facing today, i.e., global warming, has been caused by changes in the environment. According to the News Release of June 2000 of the United Nations Environment Program, land degradation alone affected more than 1900 million hectares of land globally. The loss of potential productivity due to this was estimated to be equivalent to 20 million tons of grain every year. The problem of land degradation is most acute in Africa, where more than 65% of the region's agricultural land was found to be affected by soil erosion. But the problem is global.

CLIMATE CHANGE

Introduction

The most accepted definition of climate change is: "a change in the statistical properties of the climate system when considered over long periods of time, regardless of its cause". Global warming is the continuing rise in the average temperature of the Earth's atmosphere and oceans. This is caused by increased concentrations of greenhouse gases in the atmosphere, resulting from human activities, like deforestation and burning of fossil fuels. This finding is recognized by the national science academies of all the major developed and developing countries and is not disputed by any scientific body of national or international standing.

The term 'Climate Change' is sometimes used specifically to refer to changes caused by human activity; for example, the United Nations' Framework Convention on Climate Change (UNFCCC) defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability". Climate change is synonymous with global warming. Parts of the climate system, like the oceans and ice caps respond very slowly to pressure creating climate change because of its large mass.

Phrases, like 'global warming', 'climate change', are being used by scientists, the United Nations and the key political figures of the world for quite some time now.

These essentially mean warming of the earth's atmosphere that in turn increases the temperature of the world. Earth's atmosphere is comprised of many gases, collectively known as 'Greenhouse' gases. The Greenhouse gases are responsible for maintaining the average temperature of the earth at a comfortable 17°C and without the Greenhouse effect, the earth's temperature would have been minus 15°C.

What are the apprehended and evidence-based impacts of global warming: an increase in global temperature will cause the rise of the sea level endangering people living in small islands, barely few meters above the sea level; it will change the amount and pattern of rainfall and probably expansion of deserts. It is expected that the warming will be the strongest in the Arctic-region, which would be associated with continuing retreat of glaciers. Other likely effects of the warming include more frequent occurrence of extreme weather including extreme heat and cold waves, droughts, heavy rain falls in certain parts. All these would result in negative changes in agricultural yields. The changes will be so significant that the limit of human adaptation may be exceeded in many places while the limits for adaptation for natural systems would largely be exceeded throughout the world. Hence, the ecosystem services, upon which human livelihoods depend, would not be preserved.

The responses of countries to climate change include mitigation measures to reduce emissions, adaptation to the effects of climate change and geo-engineering efforts to remove the Greenhouse gases from the atmosphere. The main international mitigation effort is the Kyoto Protocol, which seeks to stabilize Greenhouse gas concentration to prevent a "dangerous anthropogenic interference". As of May 2010, 192 states had ratified the protocol. The only members of the UNFCCC that were asked to sign the treaty but have not yet ratified it are USA and Afghanistan.

Evidence of warming of the climate system includes observed increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising average sea level globally. The earth's average surface temperature rise by 0.74°C over the period 1906-2005. The rate of warming over the last half of that period was almost doubles that of the period as a whole. Compared to the pre-industrialization period, the carbon dioxide ($C0_2$) level of the atmosphere has increased from 280 parts per million of air (PPM) to 386 PPM: an increase of 37%[9]. Although the winter of 2008-09 in USA and Europe was the coldest after many years, during the last 100 years, the world has warmed up by an average of 0.740°C. This may not sound a significant change, but 1°C change can cause catastrophe in the world. With 0.740°C increases in the temperature of the world, we are now faced with the melting of ice caps and land based glaciers causing the sea level to rise endangering many islands, metropolis and cities in the coastal belt.

Temperature changes vary over the globe. Since 1979, land temperatures have increased about twice as fast as ocean temperatures (0.25°C per decade against 0.130°C per decade). Ocean temperatures increase more slowly than land temperatures because of the larger effective heat capacity of the oceans and because the oceans lose more heat by evaporation. The Northern Hemisphere warms faster than the Southern Hemisphere, because it has more land, and because, it has extensive areas of seasonal snow. More Greenhouse gases are emitted in the Northern Hemisphere as compared to the Southern Hemisphere; but this does not contribute to the difference in warming, because the major Greenhouse gases persist long enough to mix between hemispheres.

The global climate is changing. It has become no longer an environment issue alone; it is already affecting the lives and livelihoods of a significantly large number of people, moreso in the countries with low human development. Sea level is rising: due to melting of glaciers and expansion of warmer sea water, sea level rise by 15 cm (6 inches). Scientific models predict that by the end of the 21st century, the sea level may rise as much as 59 cm (23 inches). Densely populated coastal areas of the world and large cities, like Mumbai and Chennai, would be severely threatened. The evidence of climate change has already attained alarming proportion. The future, therefore, is bleak to say the least, unless concerted efforts are made by all countries to reduce the manmade cause that has contributed to this. Agriculture, the bedrock of economy of many countries of the world, particularly those with low human development, has become and would continue to be, in future, more and more unpredictable because of extensive flooding and drought and unpredictable rainfall distribution due to climate change.

PROBABLE IMPACTS OF CLIMATE CHANGE

- Arctic ice is melting: There is scientific evidence that the thickness of Arctic Sea ice is half of what it was in 1950.
- Glaciers are melting.
- Heavier rainfall is causing extensive flooding in some parts of the world.
- Extensive drought is increasing, erratic and unpredictable rainfall affects monsoon dependent agriculture, which, in turn, affects a very large population of the world from the perspective of livelihood and food security.
- The frequency and intensity of tropical cyclones have changed.
- More frequent extreme heat and cold waves.
- Warmer temperature is adversely affecting human health and some killer diseases, like malaria have become rampant, new pathogens have appeared and those which were dormant have resurfaced with vengeance.
- The rise of sea levels is threatening many coastal areas, like small island countries and large river deltas around the globe.
- New pests and new crop diseases are severely affecting agricultural production causing more hunger in the world.
- Acute shortage of drinking water in some parts of the world in the very near future would occur.
- Climate change has the potential to make living and livelihood impossible in some parts of the world in forthcoming years, causing larger numbers of refugees.
- Possibility of extinction of many animal species.
- Sea water is becoming more acidic.
- The hills of Uttarakhand, Kashmir, North east India, and Darjeeling will become malaria prone in the next two decades.

GREENHOUSE GASES

The 'Greenhouse Effect' is the process by which the absorption and emission of infrared radiation by gases in the atmosphere warm a planet's lower atmosphere and surface. The major Greenhouse gases are: water vapor, which causes about 36—70% of the Greenhouse effect; carbon dioxide which causes 9—26%; methane which causes 4-9%; and ozone which causes 3—7%. Human activity since the Industrial Revolution has increased the amount of Greenhouse gases in the atmosphere, leading to increased radiation from carbon dioxide, methane, troposphere ozone, chlorofluorocarbon (CFC) and nitrous oxide. The concentrations of carbon dioxide and methane have increased by 36% and 148% respectively since 1750. These levels are much higher than at any time during the last 800,000 years, the period for which reliable data has been extracted from ice cores. Less direct geological evidence indicates that carbon dioxide values higher than this were last seen about 20 million years ago.

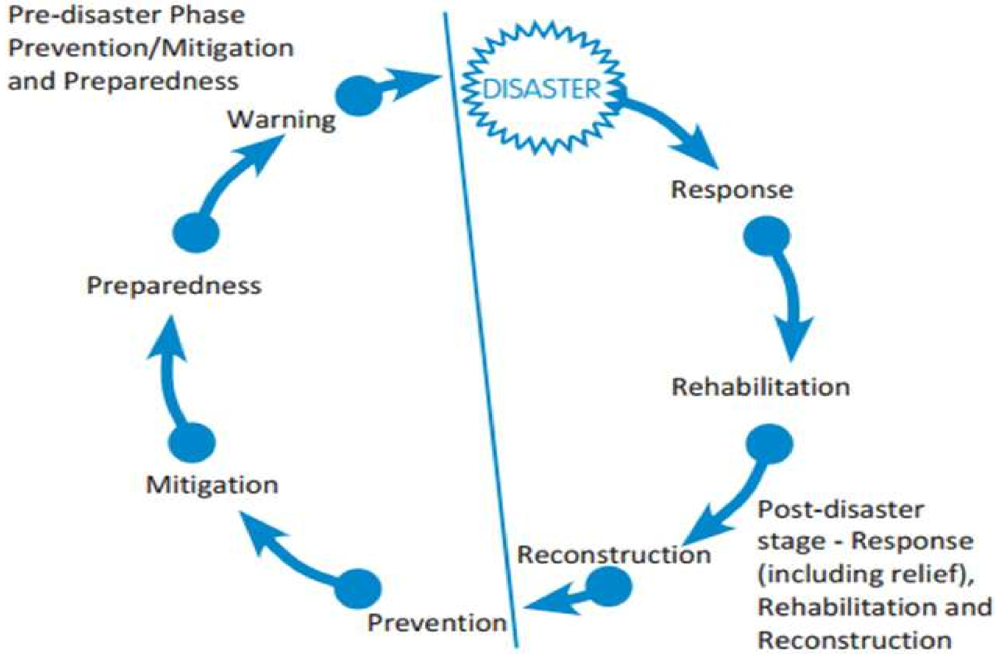
Vulnerability of human societies to climate change mainly lies in the effects of extreme weather events rather than gradual climate change. Impacts of climate change so far include adverse effects on small islands, adverse effects on indigenous populations in high-latitude areas, and small but discernible effects on human health. Over the 21st century, climate change is likely to adversely affect hundreds of millions of people through increased coastal flooding, reductions in water supplies, increased malnutrition and increased health impacts.

MITIGATION TO CLIMATE CHANGE

Reducing the extent of future climate change is called mitigation of climate change. The Intergovernmental Panel on Climate Change (IPCC) defines mitigation as "activities that reduce Greenhouse Gas (GHG) emissions, or enhance the capacity of carbon sinks to absorb GHGs from the atmosphere". Many countries, both developing and developed, are aiming to use cleaner, less polluting technologies. Use of these technologies aids mitigation and could result in substantial reductions in carbon dioxide emissions. Policies include targets for emission reduction, increased use of renewable energy and increase in energy efficiency. Studies indicate substantial potential for future reduction in emissions.

UNIT - 4

DISASTER MANAGEMENT CYCLE



RESPONSE

- The response phase includes the mobilization of the necessary emergency services and first responders in the disaster area.
- This is likely to include a first wave of core emergency services, such as fire-fighters, police and ambulance crews.
- They may be supported by a number of secondary emergency services, such as specialist rescue teams.
- In addition volunteers and other non-governmental organizations (NGOs) such as the local Red Cross branch may provide immediate practical assistance, from first aid provision to providing tea and coffee.
- A well rehearsed emergency plan developed as part of the preparedness phase enables efficient coordination of rescue efforts.
- Emergency plan rehearsal is essential to achieve optimal output with limited resources.

- In the response phase, medical assets will be used in accordance with the appropriate triage of the affected victims.

RELIEF

- During the relief phase, the focus is to provide basic necessities to victims of the disaster and to restore social equilibrium.
- Detailed assessment of human and other losses is also usually carried out during the relief phase, which helps in optimal allocation of resources.
- Relief phase may last between 1 to 3 months depending on the severity of the disaster and the resources of the government.

RECOVERY/REHABILITATION

- The aim of the recovery phase is to restore the affected area to its previous state.
- It differs from the response phase in its focus; recovery efforts are concerned with issues and decisions that must be made after immediate needs are addressed.
- Recovery efforts are primarily concerned with actions that involve rebuilding destroyed property, re-employment, and the repair of other essential infrastructure.
- The recovery phase starts when the immediate threat to human life has subsided.
- In the reconstruction it is recommended to reconsider the location or construction material of the property.
- In long term disasters the most extreme home confinement scenarios like war, famine and severe epidemics last up to a year. In this situation the recovery will take place inside the home.

RECONSTRUCTION

- The reconstruction phase typically starts at the end of relief phase and may last for several years.
- The short term plans of the recovery process are clearance of debris, building housing units, restoration of the lifelines and infrastructures, while the long-term objective is to build a safer and sustainable livelihood.

- Past experiences show that the efforts are sustainable only with community / government partnership, while NGOs and international organizations role is reduced after a certain period.

Disaster management

It is the set of activities related to different phases of the disaster cycle. There are two major classes of activities: pre-disaster and post-disaster. Pre-disaster phase is related to risk reduction, and post-disaster consists of relief (short-term) and recovery (long-term) management.

Disaster risk management

It incorporates all activities in the pre-disaster phase, which include among others preparedness and mitigation. It can be further divided into two parts: structural (building infrastructure) and non-structural measures (raising awareness, education).

Disaster relief management

This happens immediately after the disaster, and incorporates relief operations. Based on the nature and scale of the disaster, it may vary from a few weeks to several months.

Disaster recovery management

It denotes long-term recovery, and includes reconstruction and rehabilitation phases. Depending on the nature and scale of the disaster, it may continue up to several years.

Economic impact of disasters

There are different types of costs due to natural disasters.

Direct costs: Physical damage, including that to productive capital and stocks (industrial plants, standing crops, inventories), economic infrastructure (roads, electricity supplies) and social infrastructure (homes, schools, hospitals)

Indirect costs: Downstream disruption to the flow of goods and services—lower output from damaged or destroyed assets and infrastructure and the loss of earnings— as income-generating opportunities are affected. Disruption of the basic services, such as telecommunications or water supply, for instance, can have far-reaching implications. Indirect costs also include medical expenses and lost productivity arising from the increased incidence of disease and injury. However, gross indirect costs are also partly offset by the positive downstream effects of the rehabilitation and reconstruction efforts, such as increased activity in the construction industry.

Reported data on the cost of disasters relate predominantly to direct costs. Figures on the true cost of indirect and secondary impacts may not be available for several years after a disaster event, if at all. The passage of time is necessary to reveal the actual pace of recovery and precise nature of indirect and secondary effects. The average yearly loss during the 1990s was US$63 billion.

Annual infrastructure loss in 1990s in Asia was about $12 billion according to World Bank estimates, and it consisted of about 2/3rd of the total Bank lending to the region. Annual GDP losses, in dollar terms, can be between 296—15%. The impacts are severe in Low-income countries. Following are some of the statistics related to the economic losses of selected major disasters:

- 1995 cyclone in the Philippines caused damage of $350 million
- 1998 flooding in Bangladesh caused losses of $1.3 billion.
- 1999 Marmara earthquake in Turkey resulted in a loss of $16 billion.
- 2001 Gujarat earthquake had a direct loss of $3.3 billion.
- 2004 Indian Ocean tsunami has caused an estimated loss of $4.5 billion.

RISK MANAGEMENT FRAMEWORK

Risk management is a systematic process for undertaking risk reduction measures. It relates to a wide array of quantitative and qualitative factors requiring insight and input from many sources. The Risk Management Framework was developed by the Joint Technical Group of Standards Australia and Standards New Zealand. It defined risk management as, "the culture, processes and structures that are directed towards effective management of potential opportunities and adverse effects". The process outlined within AS/NZS 4360 : 1999 includes the following elements

- establish the context,
- identify risks,
- analyze risks,
- evaluate risks,
- treat risks,
- monitor and review,
- Communicate and consult.

The key issue is to repeat the process different levels. In the context of communities managing risks arising from natural hazards it is clear that it is not a single management process, but consists of many processes within which the risks must be considered These include public sector processes (such as those involved in land use management) as well as private sector processes (such as asset management and business continuity management of private sector utilities). It is important that all of these processes are strategically aligned. For instance, the range of treatment options for risks includes aspects of reduction and of response. In order to make the most effective and efficient decisions about managing risks, the same overall framework should dictate the processes for determining the types and levels of reduction and response activities a community might utilize with respect to a particular risk.

Risk management framework has been successfully adopted as the basic framework for risk reduction activities in several countries like New Zealand and Canada.10 There are different issues on institutionalizing the risk management framework, which need commitment from national and local governments. While, it is emphasized that risk management is a process of plan-Do-Check-Action (PDCA) cycle, the standard operation of risk management framework would require common understanding of terminology and institutional support from the countries and development agencies.

VULNERABILITY AND CAPACITY ASSESSMENT

While a lot of work has been done on the physical aspects of vulnerability (such as building collapse, breaching of embankment, and disruption of supply lines), the social aspects of vulnerability have been rather underexplored until recent years. It has been increasingly recognized that while it is important to reduce vulnerability, it is also required to enhance the capacity of the system to cope with the natural disasters. Capacity is often described as the potential in the communities, which should be explored in the appropriate way to maximize its use to reduce the potential losses due to disasters. The term, 'capacity' is not restricted to the communities, but has a wider context in terms of local government, leadership, social organizations, social capital and others.

CVA (Capacity Vulnerability Analysis) is a framework for planning and evaluation. The basis of CVA framework is a simple matrix for viewing people's vulnerabilities and capacities in three broad, interrelated areas: physical/material, social/organizational and motivational/attitudinal. Each of these three areas covers a wide range of features.

- Physical/Material: This is the most visible feature of vulnerability. It includes land, climate, environment, health, skills and labour, infrastructure, housing, finance and technology.
- Social/Organizational: It includes social strata, internal conflict and external linkages.
- Motivational/Attitudinal: This includes how people in a society view themselves and their ability to alter their environment. It includes ideology, belief systems, awareness and traditional wisdom.

VCA (Vulnerability and Capacity Assessment) is an important tool to support decisions related to disaster preparedness and development of mitigation programs. Information gathered from a VCA describes the risk people or institutions face in preparation for the next disaster. Another important dynamic of VCA is its ability to raise public awareness of hazards, vulnerabilities and capacities and the risk contributed by society. The VCA process can often trigger positive responses by communities to initiate mitigation programs. The VCA can be thus considered both as a diagnosis and planning tool.

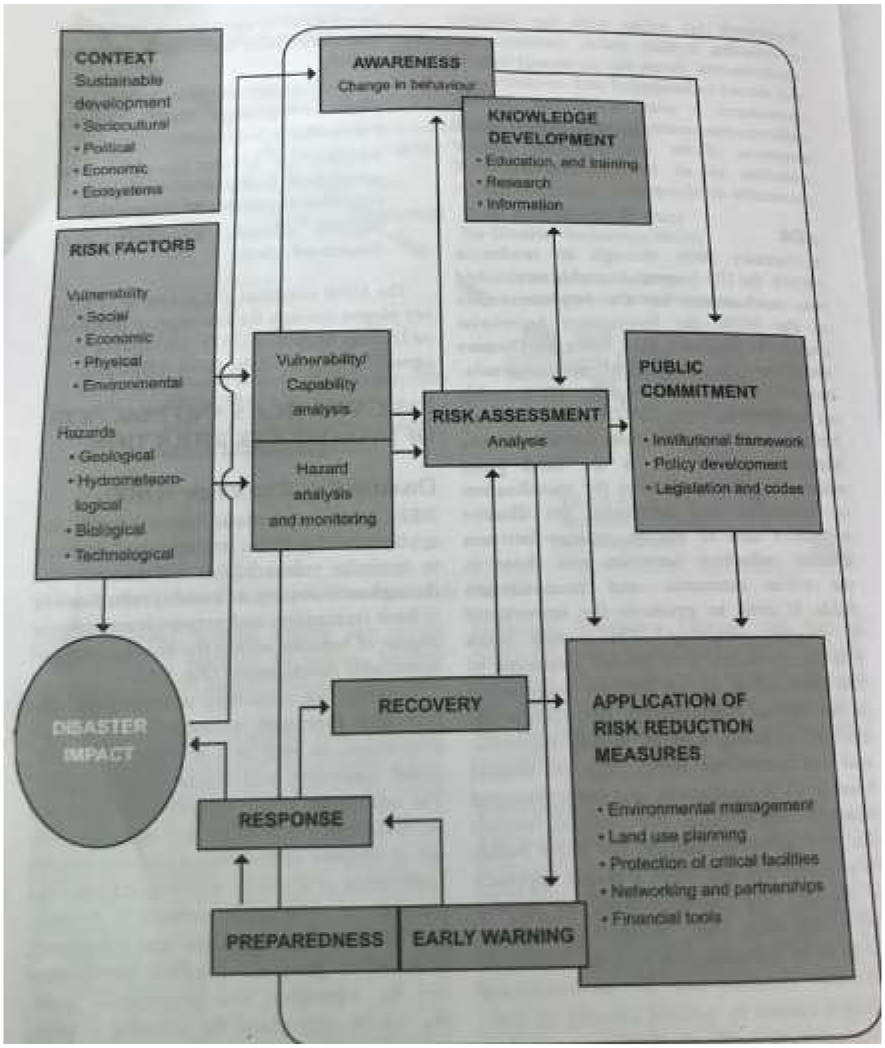
Most of the local-level vulnerability analysis will be based on participatory techniques and tools, largely derived from Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA), including: transect walk, mapping and modelling, wealth ranking, stories and histories, semi-structured interviews, focus group discussion, time chart of change of trends, problem trees, direct observation and Venn diagrams of Institutional linkages.

BASIC STRATEGIES AND PRACTICES OF DISASTER RISK REDUCTION

DISASTER RISK REDUCTION (DRR)

DRR is the systematic development and application of policies, strategies and practices to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) adverse impact of hazards, within the broad context of sustainable development (Fig).

Disaster risk reduction strategies include, first and foremost, vulnerability and risk assessment, as well as a number of institutional capacities and operational abilities. The assessment of the vulnerability of critical facilities, social and economic infrastructure, use of effective early warning systems, and the application of scientific methods are essential features of a disaster reduction strategy. The sharing of information and experience, both for the purposes of public information and for education and professional training are as important for creating a safety culture, as are the crucial involvement of local community action and new forms of partnership motivated by cooperation and shared responsibilities. Information access and communication can facilitate wider exposure and networking that these new and shifting forms of association require. Above all, functions associated with disaster reduction need to be viewed not as an expense, but as an investment in a society's future. As common as all of these attributes are to any sustained strategy of disaster reduction, one must also take account of the various political, cultural and social distinctions that exist among countries. There are fundamental elements in every disaster reduction strategy, but the priorities, relative emphasis, available resources and specific ways of implementation must take account of practices that are most suited to local conditions and understanding.

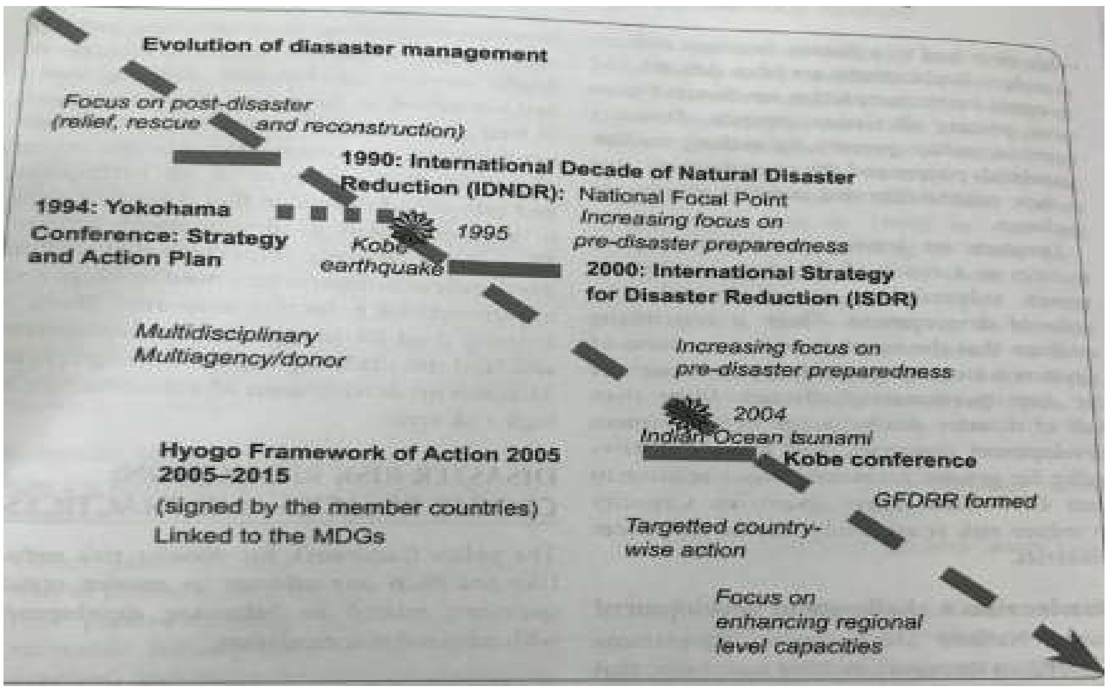


DISASTER RISK REDUCTION: GLOBAL POLICIES AND PRACTICES

Evolution of disaster risk reduction

Disaster reduction was considered as merely relief and reconstruction issues till the late 1980s. From 1990 to 1999, during the International Decade for Natural Disaster Reduction (IDNDR) declared by the United Nations, the focus was to advance a wider commitment to activities that could reduce the consequences of natural disasters, under the theme, Building a Culture of Prevention. The Yokohama Strategy and Plan of Action for a Safer World (World Conference on Natural Disaster Reduction, Yokohama, 1994) stressed that every country had the sovereign and primary responsibility to protect its people, infrastructure and national social or economic assets from the impact of natural disasters. Experience gained since then has demonstrated that by focussing on the socioeconomic factors involved, human actions can reduce vulnerability of societies to natural hazards and related technological and environmental disasters.

Initially, largely scientific and technical interest groups influenced the IDNDR. However, a broader global awareness of the social and economic consequences of natural disasters developed as the decade progressed, highlighting the increasing importance of engaging the community in hazard awareness and risk management practices. The importance given to socio-economic vulnerability as a rapidly increasing factor of risk in most of today's societies underlined the need to encourage wider participation of local communities in hazard and risk reduction activities. At the World Conference on Natural Disaster Reduction, Yokohama Strategy and Plan of Action for a Safer World in May 1994, the basic principles emphasized the incorporation of risk assessment, and pre-disaster preparedness and mitigation rather than post-disaster relief operation.



Evolution of disaster field and the main events

Yokohama Strategy and Action Plan

Although articulated in 1994, the principles contained in the plan are relevant to risk reduction even today. As the successor to IDNDR in 2000, the United Nations International Strategy for Disaster Reduction (ISDR) was designed to proceed from the previous emphasis of protection against hazards to the processes involved in the awareness, assessment and management of disaster risks. The ISDR provides a global framework for action with the objective of reducing human, social, economic and environmental losses due to natural hazards and related technological and environmental phenomena. It aims at building disaster resilient communities by promoting increased awareness of the importance of disaster reduction as an integral component of sustainable development.

ISDR

In January 2000, through its resolution 54/219, the UN General Assembly established two mechanisms for the implementation of the ISDR: the Interagency Secretariat and the Interagency Task Force on Disaster Reduction. This was reconfirmed in resolution 56/195 in December 2001. ISDR builds on the learning from IDNDR, the Yokohama Strategy and Plan of Action and the Geneva Mandate of 1999. It is the focal point within the United Nations for coordination of strategies and programs for disaster reduction and to ensure synergy between disaster reduction activities and those in the socio economic and humanitarian fields. It aims to promote the importance of disaster reduction. This would mean that communities with greater awareness of risk prevention as an integral component of sustainable development, can achieve the goal of reducing human, social, economic and environmental losses due to natural hazards or technological and environmental disasters. Recognizing that natural hazards can have global incidence, the ISDR builds on partnerships and takes a global approach to disaster reduction, seeking to involve every individual and community towards the goals of reducing loss of lives, the socioeconomic setbacks and the environmental damages caused by natural hazards. In order to achieve these goals, the ISDR promotes four objectives as tools towards reaching disaster reduction for all:

- Increase public awareness to understand risk, vulnerability and disaster reduction globally,
- Obtain commitment from public authorities to implement disaster reduction policies and actions,
- Stimulate interdisciplinary and intersectoral partnerships, including the expansion of risk reduction networks,
- Improve scientific knowledge about disaster reduction.

UNIT -5

EDUCATION AND COMMUNITY PREPAREDNESS

EDUCATION IN DISASTER RISK REDUCTION

The mission of education for disaster risk reduction, both for children and for adults in all walks of life, is to convey an understanding of the natural and environmental conditions and the human actions and inaction that lead to disaster, to stimulate changes in individual and group behaviour, and to motivate advocacy and raise expectations of social policy to reduce these threats. Since disaster risk reduction cannot be accomplished by any one sector or strata of society, it calls for the widest possible participation. The scope of disaster risk reduction education, therefore, includes every single stakeholder who may be affected by disaster in his or her lifetime, or their children or grandchildren's lifetime, and anyone whose opinions and decisions affect others.

OVERVIEW OF DISASTER RISK REDUCTION EDUCATION

We should be clear about what disaster risk reduction education is not.

- It is not simply teaching children, as is already being done in most places in the world, about so-called 'natural hazards'.
- It is not merely, 'campaigns for risk awareness' alerting people to their exposure to frequent or infrequent natural hazards and leaving them to figure out themselves what to do about it.
- It is only partially, as is being done in many countries, teaching children what to do in case of fire, earthquake and other disaster events. This phrase can refer only to what to do after the impact. While response preparedness is necessary, it should be understood as a measure of the inadequacy of our risk reduction measures.

CONTENT FOR BASIC DISASTER AWARENESSEDUCATION

The content for basic disaster awareness education can be obtained from an analysis of the most widely distributed English language educational materials over the past decade and a review of the literature on household hazard adjustments. In most of the current literature for the public, and in research on 'household hazard adjustments', action steps are typically presented as an uncategorized and prescriptive list of 'things to do'.

The conceptual organization of these tasks makes it possible for these to be seen in a broader context, and to recognize some of the biggest gaps in our efforts. The grouping of these myriad tasks into three broad areas may help. These categories are remarkably robust and consistent across various types of disasters, and can be expressed as follows:

- assessment and planning,
- physical and environmental protection,

- response capacity development.

Assessment and planning are joined together in order to emphasize their inseparable roles. Physical and environmental protection is the heart of disaster risk reduction; it is the most difficult and most neglected area, and must consider structural, infrastructural, nonstructural safety and environmental protection. Response capacity development encompasses both skills and provisions.

Family disaster plan sample checklist contents

ASSSESSMENT AND PLANNING

- We held a family disaster planning meeting, identified our risks and used this checklist for our planning (household, extended family, or family of one).
- We identified the safest places in the house and in each room in case of earthquake, fire, or hazardous materials release (away from windows, large and heavy objects that can fall, and objects like heaters that can cause fire).
- We identified exits and alternative exits from our house and building.
- We searched for and identified non-structural hazards in our environment.
- We know our out-of-area contact person(s) and phone number(s) (ideally mobile phone for text messaging). It is:________
- We know that we will only use the telephone in case of physical emergency after an earthquake. We will use radio and television for information.
- We know where we would reunite:

  Inside the house:

  Outside the house:

  Outside the neighborhood:

  and we have a secret message drop location outside our house.

- We made our copies of important documents, and key addresses and phone numbers. We have one set with our out-of-area contact and/or we keep one in our earthquake bag.
- We plan to review our plan again every six months
- We are spreading the word to everyone we know

PHYSICAL AND ENVIRONMENTAL PROTECTION

- We have fastened tall and heavy furniture, appliances, large electronics, lighting fixtures and other items that could kill us or our children, to wall stud or stable surface.
- We know never to light a match, lighter, or any other flame after an earthquake until we are sure there is no danger of escaping gas anywhere around.

- Our building has been designed and built according to seismic codes, or it has been inspected by a qualified engineer, and required repair or retrofit has been completed.
- We maintain our building, protecting it from humidity, and repairing damage when it occurs.
- We have put latches on kitchen cabinets, secured televisions, computers and other electronic items, and hung pictures securely on closed hooks to protect ourselves from things that could injure us, or would be expensive to replace

- We have secured family heirlooms and items of cultural value that could be lost to future generations.
- We have limited, isolated, and secured any hazardous materials to prevent spill or release.
- We keep shoes and flashlights with fresh batteries, by our beds.
- We reduce, reuse and recycle better all the time.

RESPONSE CAPACITY:SUPPLIES AND SKILLS

- We know how to use a fire extinguisher or other available fire suppression equipment (e.g., bucket with sand, fire blanket)
- We know how to turn off our electricity, water and gas.
- We have gathered survival supplies in our home and made up evacuation bags for our home and car. (including I gallon of water per person per day and food for three days, prescription medication, water, high-energy food, flashlight, battery, first aid kit, cash, change of clothing, toiletries and special provisions we need for ourselves, including elderly, disabled, small children, and animals.)
- We know principles of incident command systems or standard emergency management systems for organizing post-disaster self-help in our community.
- We have learnt first aid, light search and rescue, fire suppression, wireless communication or community disaster volunteer skills.

METHODS IN DISASTER RISK REDUCTION EDUCATION

There is a wide variety of methods that can be employed in education for disaster risk reduction, some of these are primarily school-based and others are primarily community-based, with many opportunities for overlap. When it comes to the development of formal and standardized curriculum approaches, feasibility, development time and capacity should be considered.

School-based stand-alone courses are perhaps the easiest programs to implement on a large scale and within a short timeframe. Stand-alone curricula can be delivered either through a cascading model of teacher training, and/or through partnership with voluntary organizations such as Red Cross/Red Crescent societies, scouting organizations and others. Distance learning self-study courses may be used to reach a large number of teachers. Stand alone semester- or year-long courses dedicated to disaster risk reduction may also be introduced as electives or even requirements in the curricula, with appropriate support for teachers. All of these require special curricular materials.

These courses are a short and swift way to disseminate important knowledge to schoolchildren. The articulated subject matter leaves no room for doubt about its importance. The typical disadvantages are that the usual school curricula are too full to support a full course, and so time and attention are limited.

School-based curriculum integration using stand-alone modules related to disaster risk reduction is designed to provide materials to be inserted into existing course curricula. These may be integrated at different grade levels and in different subjects throughout the curriculum. Subjects frequently found appropriate for integration of modules include: all sciences, social science, history, language and literature, health and safety and civics. This allows disaster risk reduction content specialists to design stand-alone materials. Typically, the full scope and sequence cannot be integrated into a single existing subject. Advantages are that entry points are easily identified and modules can be developed fairly rapidly, comprehensively covering the scope and sequence identified. Since disaster risk reduction is explicitly addressed as a unit of study, it receives recognition. Disadvantages are that it has to squeeze something else in the curriculum and may be competing for limited time. Modules are integrated during the next textbook printing in the curriculum adoption cycle for each subject. Since each cycle takes several years, and teacher training must be widely distributed, this can take many years to succeed.

ESSENTIALS OF SCHOOL DISASTER EDUCATION

The importance of school disaster education is increasing because:

(i) children are one of the most vulnerable sections of the society,
(ii) they are the future generation,
(iii) school is the centre of community, and
(iv) effects of education can be transferred to parents and community. Actually, schools need to play an important role in raising awareness among students, teachers, and parents.

Yokohama Strategy was adopted in 1994 during the IDNDR (International Decade for Natural Disaster Reduction). The strategy was mandated to support and consolidate activities in IDNDR. The strategy emphasized international cooperation. Disaster management was strict top-down style from international to local community. In Yokohama Strategy, importance of education and training was recognized but was not covered as the basis for the strategy.

The ISDR (International Strategy for Disaster Reduction) aims at building disaster-resilient communities by promoting increased awareness of the importance of disaster reduction as an integral component of sustainable development, with the goal of reducing human, social, economic and environmental losses due to natural hazards and related technological and environmental disasters.

In addition, the objectives are:

- Increase public awareness to understand risk, vulnerability and disaster reduction globally,
- Obtain commitment from public authorities to implement disaster reduction policies and actions,
- Stimulate interdisciplinary and intersectoral partnerships, including the expansion of risk reduction networks,
- Improve scientific knowledge about disaster reduction.

At the World Conference on Disaster Reduction (WCDR) in 2005, one of the sessions also focused on education named as 'Knowledge, innovation and education: Building a culture of safety and resilience'.

Following are the primary features in education for disaster risk reduction in schools:

- Formal education targetting children is considered the most important tool for knowledge development,
- Community participation and awareness raising should be a synergy of top-down and bottom-up approach.

Accordingly, it was recognized that education for children and combination of both top-down and bottom-up are important. Lessons learned from the experiences were discussed in the session:

- Education is a process for effective disaster reduction.
- Knowledge, perception, comprehension and actions are the four important steps.
- Schools and formal education play an important role in knowledge development.
- Family, community and self-education are important for comprehension of knowledge and implementing risk reduction actions.
- Holistic education includes actions at local level, as well as its policy integration.

In Hyogo Framework for Action (HFA) for education or developing knowledge is described as one of the most important issues for disaster reduction.

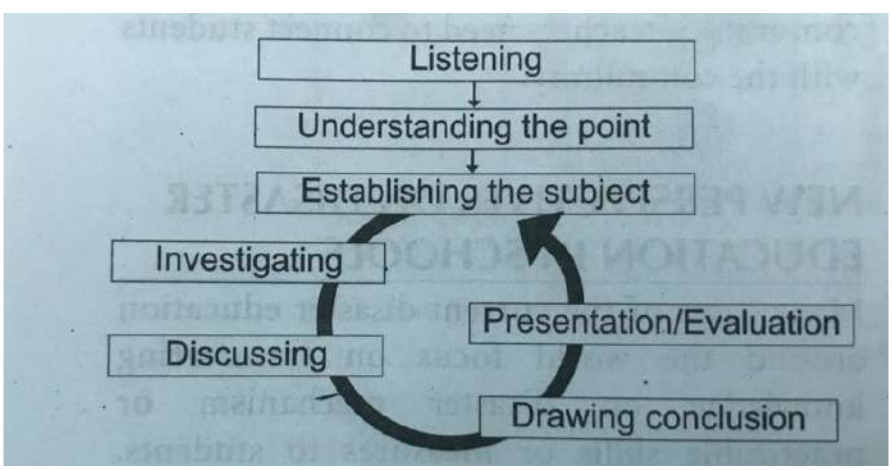
After WCDR, UN/ISDR has started some programs on disaster risk education including 2006—2007 World Disaster Reduction Campaign. This campaign is called 'Disaster risk reduction begins at school'.

School disaster education is one of the significant issues for disaster reduction. Many cases of disaster education are currently available in UN/ISDR website. Other websites or schools also provide their own disaster education. But most of these cases mainly transfer following knowledge:

- Characteristics of disasters,
- Disaster mitigation, preparedness, and response (how teachers and students should act in case of emergency),
- Impacts of disasters

NEW PERSPECTIVES ON DISASTER EDUCATION IN SCHOOLS

Many cases of the current disaster education around the world focus on transferring knowledge on disaster mechanism or practicable skills or measures to students. It is important for students to know the characteristics of natural hazards or what they should do for disaster reduction too. Actually, past disasters indicate that lack of knowledge or measures enlarges damages of disasters. If students acquire knowledge or skills in disaster reduction and they adopt these measures, they can appreciate the effectiveness of those measures. But the success of school disaster education lies in improving overall community survival. The most affected people in any disaster are the most vulnerable in the society, like elderly people, children, or the disabled. During disaster situation, daily problems or troubles emerge more obviously and seriously. Therefore, disaster education should contribute to building community which can help the most vulnerable people. Here, this disaster education focuses on not only disaster situation but also daily life. Disaster education aims that all people can live safely and comfortably. Such community can be resilient in disaster situation as well. Disasters make the daily problems of community more serious and help visualizing underlying risks or problems. It means that solving the current problems can contribute to future disaster reduction.



Disaster Education Model

The above Figure shows a disaster education model. As mentioned before, disasters highlight the pre-existing problems and the result of inaction in effectively addressing them. Disaster event can be regarded as a kind of magnifying glass to see the lifestyle of human beings. Learning from past experiences of disasters including the contributory factors before can give opportunities to students to consider alteration of lifestyle or at least modify the choices to prevent recurrences. In addition, prediction of future outcomes can contribute to identify current problems.

This model emphasizes choices in daily life. Several day-to-day issues are ignored as people do not think these are related to disaster management. Reconsidering daily life from past disasters and future disasters is useful for students to realize the current problems and to notice that emergency situations as a part of daily life. This does not aim at cultivating specialists in disaster management. Rather, it emphasizes that students should think about and pay attention to nature. Disaster education is provided not only for reducing impacts of disasters but also for community development. Disaster education is necessary for society.

Sometimes, school disaster education is regarded as education for school safety. In school safety, building safety and disaster education are regarded as two main factors. If school safety is defined as safety inside the school, school disaster education needs to provide knowledge and skills to save students or teachers. This includes measures in mitigation, preparedness and response. Learning how to save themselves can lead students to teach family and community members. Therefore, this kind of education is also a part of the proposed school disaster education. Improvement of livelihood of each person within community in daily life can be the topic of school disaster education. But this topic is not directly related to school safety defined above. School disaster education is a part of school safety although it is not widely included as school safety right now.

Implementing this type of disaster education enables coverage of a wide range of issues. Any school hour can be available for disaster education. A part of ongoing subjects and extra-curricular hours can also be utilized. Teachers are requested to consider how they can use their own subjects or school events for school disaster education.

Training of teachers is necessary to achieve success in school disaster education. Most teachers think disaster education is descriptive about disasters or how to cope with them. Such education is only a small part of the overall program and there are other core concepts. In addition, teachers think disaster education needs specialists although they can be facilitators to the community because school is one of the central facilities of any community. Moreover, teachers think providing disaster education is an additional task. These factors mean a change of attitude towards disaster education is necessary. Teachers play significant roles for future disaster reduction through character-building of schoolchildren.

COMMUNITY CAPACITY AND DISASTER RESILIENCE

The United Nations International Strategy for Disaster Reduction (ISDR) succeeded and carried forward the IDNDR risk reduction framework. In the World Conference in Disaster Risk Reduction, held in Kobe, Hyogo Prefecture Japan from 18—22 January 2005, 168 governments adopted the Hyogo Framework for Action 2005—2015: Building the resilience of nations and communities to disasters. The HFA has five priority areas with Priority 1 having as one of its key activities ensuring community participation, so that local needs are met.

"Priority 1: Ensure that disaster risk reduction is a national and local priority with strong institutional basis for implementation."

The community-based approaches or community participation in disaster management is also referred to as community-based disaster management (CBDM) or community based disaster risk management (CBDRM). Building on and strengthening community capacity is an essential feature of CBDRM to reduce vulnerability and disaster risk.

UNITING IN COMMUNITY-BASED DISASTER RISK MANAGEMENT

A disaster is a serious disruption of the functioning of a community causing widespread human, material, economic or environmental losses which exceed the ability of the affected community to cope using its own resources. A disaster happens when a hazard strikes a vulnerable community whose capacity is inadequate to withstand or cope with its damaging effects, resulting in damages, loss and disruption of community function. A hazard is a potentially damaging physical event, phenomena or human activity. Vulnerability refers to the conditions determined by physical, social, economic factors or processes, which increase the community's susceptibility to the impact of hazards. Capacity may also be seen as the positive factors which increase the ability of a community to cope with hazards. Capacity is the combination of all the strengths and resources available within a community that can be used to reduce the effects of disaster or reduce disaster risk.

The CBDRM process involves building on and strengthening of community capacity. The CBDRM process has the following key steps:

1. Linkage and rapport-building with the community (if CBDRM is facilitated by NGOs and/or local government units and other stakeholders),
2. Participatory disaster risk assessment (hazard, vulnerability, capacity assessments and understanding people's perception of disaster risk),
3. Participatory disaster risk reduction planning (or action planning),
4. Community-managed implementation,
5. Participatory monitoring and evaluation,
6. Progressive improvements in community safety, disaster resilience and development.

UNDERSTANDING COMMUNITY AND COMMUNITY CAPACITY

Categories and factors for Capacity Vulnerabilities Analysis (CVA)

The CVA considers three basic categories for capacities and vulnerabilities:

Physical/Material: What productive resources and skills exist?

Social/Organizational: What are the relations and organization among people?

Motivational/Attitudinal: How does the community view its ability to create change?

Physical/Material

- Location and type of housing/building materials: Land, water, animals, Capital, other means of production (access and control)
- Infrastructure and services: roads, health facilities, schools, electricity, communications, transport and housing.
- Human capital: population, mortality, eases, nutritional status, literacy, numeracy poverty levels
- Environment factors: forestation, soil quality, erosion

Social/Organizational

- Family structures (weak/strong)
- Leadership qualities and structures
- Legislation
- Administrative structures and Institutional arrangements
- Decision-making structures (who is left out, who is in effectiveness)
- Participation levels
- Divisions and conflicts: ethnic, class, caster, religion, ideology, political groups, language groups, and structures for mediating conflicts Degree of justice, equality, access to political process
- Community organizations: formal, informal, traditional/ governmental progressive Relationship to government, administrative structures
- Isolation or connectedness

Motivational/Attitudinal

- Attitude towards change
- Sense of ability to affect their world environment, get things done Initiative
- Faith, determination, fighting spirit
- Religious beliefs,, ideology
- Fatalism, hopelessness, despondency discouragement
- Dependent / independent (self-reliant)
- Consciousness, awareness

- Cohesiveness, unity, solidarity, cooperation
- Orientation towards past, present, future

COMMUNITY BASED DISASTER MANAGEMENT AND SOCIAL CAPITAL

Community-based Disaster Management (CBDM) has become a popular approach to implement disaster risk reduction at the community level. CBDM is a participatory approach that involves the local community in all processes of disaster management, from planning and implementation, to monitoring. One of the recent challenges in implementing CBDM has been the mitigation of adverse impacts from climate change. The causal relation between climate change and natural disasters has been recognized only recently. Also, a number of climate change impacts have been predicted for the medium to long-term future by the International Panel on Climate Change (IPCC) in 2007. One of the key factors that the IPCC has indicated is the ongoing and future changes in the patterns of hydrological events (such as heavy rains and typhoons), which leads to more disastrous events at the local level. The IPCC reports have strengthened calls for action to reduce vulnerability to disasters at all levels—individual, local, national and international. However, given the scenarios developed by the IPCC, community-level mitigation takes on added significance, and is urgently needed now. In this regard, the recent trends of highlighting and focussing on CBDM has been in the right direction.

DILEMMA OF DISASTER MANAGEMENT AND CBDM

The United Nations International Strategy for Disaster Reduction (UNISDR) defines 'disaster management' as follows:

The systematic process of using administrative decisions, organization, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters. This comprises all forms of activities, including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of hazards.

Preventing possible hazard is a real challenge as there are several issues associated with disaster management. The first dilemma is that the outcome of disaster management efforts, especially preparedness and mitigation, is 'invisible'. A second dilemma is that of the extent and coverage of activities that should be considered and included under 'disaster management'.

These two dilemma, ie., invisible outcomes and scope of disaster management, highlight the importance of incorporating CBDM in each of the disaster management cycle. Disaster management basically has four stages (response, recovery, reconstruction, preparedness), and each stage has different characteristics. Therefore, different tasks need to be taken up for each stage.

When a disaster strikes, emergency rescue and response become a major issue. In this phase (a) the utmost priority is to reduce human loss and damage. Also, during slow onset disasters, reducing physical and economic losses need to be taken into consideration. In the short-term recovery phase (b) where community kitchens, medical care and other essential services are provided, clearing of debris, reconstruction planning, and setting up of evacuation centres are carried out at the community/local levels.

In the next phase (c), efforts to undertake reconstruction to enable communities to recover and get back to normal are undertaken. Care is taken to ensure that efforts undertaken do not simply return the community to the same state of vulnerability as they faced before the disaster. For this reason, this phase is usually combined with activities related to preparedness and reduction of overall vulnerability.

Lastly, preparedness and mitigation come as the 'last' stage of disaster management. This phase might not receive adequate attention due to a lack of priority or awareness of disaster prevention and mitigation. The preparedness phase covers many different areas but as there are many stakeholders involved, coordination of such efforts is challenging. At the community level for example, it is important to integrate livelihood issues into disaster management at this stage.

SOCIAL CAPITAL AND CBDM

Social capital has two significant perspectives: 'bonding' social capital that literally bonds each member with strong ties in a particular group or society, and 'bridging' social capital, which is crosscutting ties beyond that group.

Disaster management, especially CBDM has been a target of social capital analysis in generating community awareness for better mitigation and reduction of disaster risks. Several research studies have been published on social capital's link to disaster response, recovery and rehabilitation.

In Japan, social capital is often mentioned in official government reports and their website indicating that it leads to better community resilience against disaster or better community development. But in many cases their use of the term is quite broad and general, and often lacks concrete explanations of what kind of social capital is critical, and its actual application in different disaster management cycles. As mentioned earlier, each stage of the disaster management cycle has different pre-conditions and expected activities. These should be analyzed in order to understand how social capital can be better used in actual CBDM activities.

The main argument is that each stage of disaster management cycle needs a different kind of social capital. As shown in fig, the response period requires bonding social capital. However, when disaster management cycle moves on to recovery and to reconstruction, the need for bridging social capital increases to fulfill necessary pre-conditions.

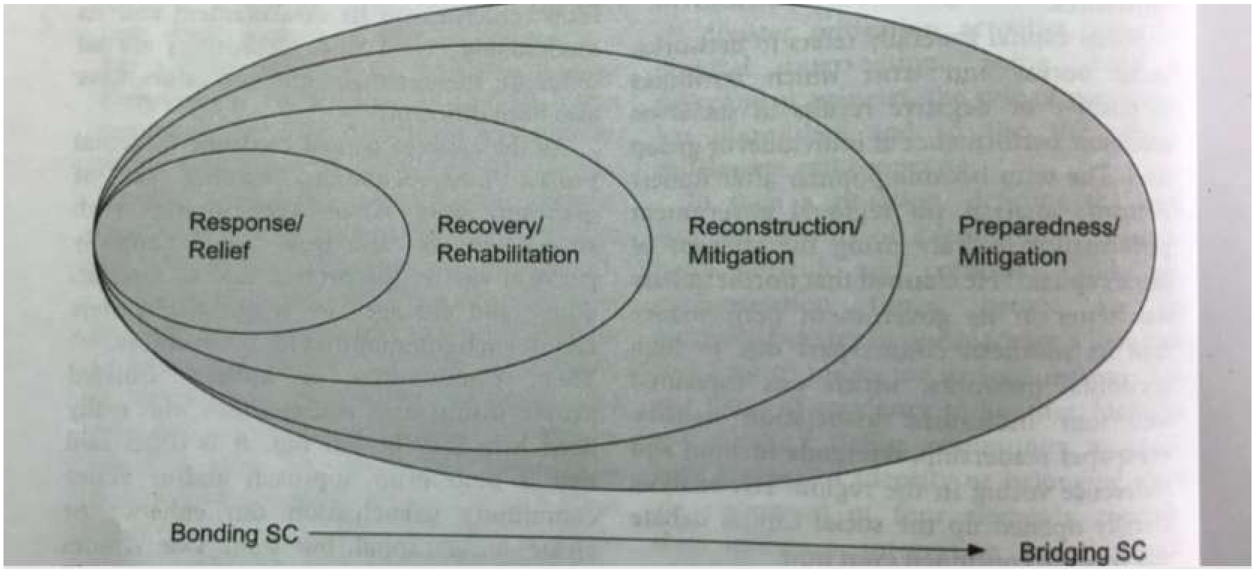


FIG: Level of Social Capital In Disaster Management

During the response period, the priority issue is to reduce human loss. For this, strong ties in the community (in other words, bonding social capital) is necessary to ensure timely and proper response. However, in the reconstruction and mitigation stages, bridging social capital would be much more necessary, as external agencies assist to rebuild the community. It also requires a high level of subsidiary in decision-making to ensure that the community receives full benefits from the assistance provided. Such capacity would be possible only with strong bridging social capital and a democratic environment. In below Table, different types of social capital required for each disaster management cycle are listed.

TABLE: TYPES OF SOCIALCAPITAL

	Response	Recovery/ Rehabilitation	Reconstruction/ Mitigation	Mitigation/ Preparedness
Type of social capital needed	Trust—strategic Norms—reciprocity Network—within community	Trust—strategic Norms—reciprocity and public or civic-minded Network—within and outside community	Trust—strategic and generalized Norms—public or civic-minded Network—within and outside community	Trust—strategic and generalized Norms—public or civic-minded Network—within and outside community

It is clear from the table, each component of social capital that is trust, norms and networks, has two dimensions. One is to make the group/community more cohesive (bonding) and the other is to connect to entities and resources outside of the group/ community (bridging).

DESIGNING RESILIENCE: BUILDING COMMUNITY CAPACITY FOR ACTION

While response to the 2004 and 2005 events listed above appears to validate the argument that organizing collective action for large groups is very difficult, even with the shared goal of reducing extreme danger, we explore a different set of cognitive processes that link information to action. Instead of searching for a 'logic of collective action', we explore the emergence of a 'common operating picture', a term used by emergency managers (EMS) to describe the collective recognition of danger that enables the simultaneous activation of different types of action at different levels of responsibility by distinct actors and organizations. This collective recognition of risk is even more difficult when an entire community is exposed to risk, as there is significant diversity among the individuals, households, groups and organizations, all of whom share the risk, but each has different degrees of knowledge, experience, resources, training, and capacity for action. Many of these diverse actors do not interact with others in the community on a regular basis. Yet, the degree to which an entire community can take informed, timely action in response to urgent threats depends upon its capacity for collective recognition of risk. Developing collective cognition would constitute a primary means of reducing risk and loss from disaster, and serve as a major component of building that community's resilience to recurring risk. We explore the relation between cognition and action for communities exposed to recurring risk, and the possibilities for designing collective cognition that lead to communitywide action to reduce risk.

COLLECTIVE COGNITION IN RISK ENVIRONMENTS

The process of perceiving risk, recognizing danger, and translating that knowledge into action has been studied by psychologists, but those findings have most often focused on individual actors or leaders. Klein and his colleagues have developed a model of 'recognition-primed decision-making' (RPD) that captures the process of perceiving risk, identifying plausible actions in a constrained environment, and formulating a workable strategy of action. This model has been recognized by emergency response personnel and military officers as an insightful representation of the decision making process they follow in 'urgent environments/ the focus of the RPD model, however, remains on the individual decision maker, not on collective cognition.

The challenge of building capacity for collective cognition on a community-wide scale lies in balancing the diversity of individuals, organizations, groups and information systems that make up even small communities with a common focus for the welfare of the community and a bias for action. For example, the Simuelue islanders constituted a small, homogeneous community with shared experience of earthquakes and tsunamis that threaten the island in recurring patterns. All members of the community shared a common history that includes recognition of tsunami risk, and a common goal of survival. In moving to a more complex community, the degree of heterogeneity increases with the size, number, and range of differences in knowledge, tasks and resources held by the actors in the community. The task of creating a 'common operating picture' increases with the degree of complexity that characterizes the operational components of the community as a system, and the interactions among those components. Further, if the interactions among the component groups are supported by multiple information processes, any member of the community is likely to be exposed to different, and often conflicting, information sources than other members.

BUILDING COLLECTIVE COGNITION OF RISK

The critical problem in building collective cognition of risk in rapidly changing environments lies in updating shared knowledge of risk with current information regarding imminent threats. This may mean revising existing beliefs based on outdated information, as well as reformulating strategies of action based on valid, current information. This task is difficult on an individual basis, but in environments exposed to shared risk, such as the Gulf Coast states in the US, or the coastal nations of the Indian Ocean basin, the task becomes magnified by the size of the area, the number of entities likely to be affected, and the heterogeneity of the entities in terms of differences in language, law and culture.

Two primary approaches have been proposed as a means of building collective cognition. The first is to develop a 'culture of prevention' in the region exposed to risk. Such a culture may develop over generations, as was shown in the Simuelue case. It is based on the assumption that beliefs about risk adopted at an earlier time remain valid across generations. Actions, based on these beliefs, are confirmed by recurring experience. As experience is shared, beliefs are reinforced throughout the community.

The second approach has been proposed by computer scientists. It is based on networks of technical sensors to measure and transmit information on changing conditions that reveal risk to the community under time sensitive conditions. This approach is based on developing a capacity for collective reasoning on a regional scale.

UNIT 6

ROLE OF TECHNOLOGY IN DISASTER MANAGEMENT

DISASTER MANAGEMENT FOR INFRASTRUCTURE

Infrastructure refers to the systems needed for the functioning of a community, and most basically includes water supply, and disposal of wastewater, road, rail, air and marine transportation, electric, gas and liquid fuels and communications systems. Infrastructure comprises an enormous portion of the built environment as shown in Table.

Taxonomy of infrastructure

SECTOR	SYSTEM	MAJOR COMPONENTS
Water	Water supply	• Reservoirs, wells transmission aqueducts pumping stations • Treatment plants • Terminal reservoirs/Tanks • Trunk lines • Distribution lines
Sanitary sewer	Sanitary sewer	• Mains pumping stations treatment plants
Energy	Electric power	• Fossil-fuel power plants hydroelectric power plants • Transmission lines • Transmission substations • Distribution lines • Distribution substations
	Natural gas	• Production wells liquefaction plants • Marine terminals • Gasification plants • Transmission lines • Tanks

		• Compressor stations • Distribution mains
	Petroleum fuels	• Production wells marine terminals • Refineries • Transmission pipelines • Distribution storage tanks
Transportation	Highway	• Major bridges conventional bridges • Tunnels • Limited access highways • Local roads
	Railway	• Bridges tunnels • Tracks/roadbeds • Stations/terminals • Maintenance yards • Signalling and control centres
	Air transportation	• Runways and taxiways passenger terminals • Fuel and freight facilities • Air traffic control system
	Water transportation	• Ports/cargo handling equipment inland waterways • Canals and locks
Emergency services	Police	Stations communications facilities
	Fire	• Stations communications

		facilities • Specialized water supply facilities
	Health care	Hospitals

IMPACT OF DISASTERS ON LIFELINE STRUCTURES

Earthquakes, tropical cyclones, floods and volcanoes can all have disastrous impact on lifelines. This section reviews the performance of lifelines components, and ways in which unsatisfactory performance can be improved.

PIPELINES

Elevated, at grade and buried pipelines are employed for supply of water and wastewater disposal, gas and liquid fuels, chemicals and industrial facilities. They take many shapes and sizes, and may be fabricated from steel or other metals, concrete, vitrified clay or various plastic materials.

The performance of pipelines in earthquakes is strongly dependent on whether or not the supporting soil fails. Modern pipelines provided with proper full penetration welds, heavy walls, and strong couplings are very ductile and have considerable resistance to earthquake damage. Welded steel pipeline performance depends on the integrity of the welds—modern butt-welded pipelines perform well. Special precautions reduce earthquake effects at bay, river and fault crossings. Transmission lines at fault crossings should be buried in shallow loose fill or installed above the ground near the fault to allow lateral and longitudinal slippage. Anchors such as thrust blocks or bends should be excluded within a distance 100 m of a fault zone, and strengthened pipe should be used within the zone. Valve spacing near fault zones or in areas of expected soil failure should be reduced. Automatic shutoff valves should not rely on commercial electricity. Proper maintenance to limit corrosion, which weakens pipes, is important for mitigating damage.

Pipelines are generally not very vulnerable to wind forces. If not enclosed, and particularly if exposed to structures or otherwise, pipelines are vulnerable to wind forces and wind-borne missiles.

TANKS

At grade tanks are used for water and wastewater services and, industrial facilities. They may be anchored or unanchored, cylindrical or conical, fixed or floating roof, vary from modest to over 100 meters in diameter, and be built of reinforced or unreinforced masonry, concrete, steel or wood. Larger tank height is nearly always less than the diameter. Construction materials include welded, bolted, or riveted steel. Tank foundations may consist of sand or gravel, or a concrete ring wall supporting the shell.

At grade tanks have sustained major damage and collapse in numerous earthquakes, primarily due to sloshing. Earthquake ground motions cause the confined fluid to oscillate in high amplitude low damped manner (slosh), which causes very large overturning forces to be imposed on the tank, leading to rocking and buckling of the tank shell.

Sloshing has proven difficult to mitigate to date, although new methods are emerging. Tank design should provide adequate freeboard to avoid spillage due to sloshing, and analysis of the tank is essential to avoid overturning.

TREATMENT PLANTS AND PROCESS FACILITIES

Treatment plants and process facilities include water supply and wastewater disposal plants, oil refineries, chemical plants and industrial facilities. They include extensive piping (below, at and above grade), basins, tanks, process units, control buildings, stacks and chimneys.

Structures and equipment in treatment plants and process facilities when subjected to earthquakes are vulnerable to settling of foundations, especially when founded on fill. Differential settlement of adjacent structures and components supported on different foundations is a particular problem. Pipes are vulnerable at locations where they connect to or penetrate treatment structures. Equipment such as pumps can be damaged by loads imposed by piping when differential settlement occurs.

ELECTRICAL SUBSTATIONS

Electrical substations are the termini of electrical transmission lines, and provide switching and voltage transformer functions. They typically consist of a fenced open area with overhead buses supported by steel (or concrete) structures.

When subjected to earthquakes, control buildings are subject to generic building damage ranging from dropped suspended ceilings and cracks in walls and frames to partial and total collapse. Unanchored or improperly anchored control equipment may slide or topple, experiencing damage or causing attached piping and conduit to fail. In the yard, steel towers are typically damaged only by soil failures.

Wind and ice are the governing loads for extra-high voltage (EHV) transmission lines, and are professionally designed and constructed to resist these loads. The major loading is a design wind on an ice-encrusted conductor.

Substations are highly vulnerable to flooding. If transformers or other equipment are inundated, they typically will require complete rebuilding; if live, fire and explosion are possible, resulting in total destruction. Consideration of flood in engineered design is typical. Peer review is a normal precaution. Substations are high-value installations, and protection through flood walls, levees, using platforms or mounded earth, is warranted and typical.

CRANES

Cranes are employed in a wide variety of shapes and sizes, and can be fixed or movable, transportable or railed. Cranes are typically of steel.

Cranes can be derailed in earthquakes or overturn by shaking or soil failures, or be derailed if their rails become misaligned as shown in fig. Dynamic analysis of the crane structure including interaction with the supporting structure is the key to avoid damage.

Outdoor cranes are most vulnerable to wind. A major category of cranes are waterfront gantry cranes, which are rail-mounted on quays to load ships. They are professionally engineered and designed for wind loading, which tends to govern their design. With a high wind forecast, gantry cranes will suspend operation, and be tied down with special wind hold-downs, which typically clamp to the rails. Fixed in this manner, their design makes them capable of surviving tropical cyclones without damage. Proof loading of a new crane is normal practice.

Electrical and mechanical components of cranes are quite vulnerable to flood if inundated. Normal flooding should not cause structural damage, although tsunami or storm surge can. In addition to community-scale protection, installation-specific flood walls, or emergency sandbagging, can be effective.

ROADS AND BRIDGES

In general, roadbed in the highway system includes embankments, pavement, drainage structures, signage, signaling and lighting equipment and structures. Conventional bridges are most commonly employed for highway and railway systems, and include all bridges with spans less than 150 m. Construction may include simple spans (single or multiple) as well as continuous/ monolithic spans. Bridges may be straight or skewed, fixed, moveable (draw bridge, or rotating), or floating. Reinforced concrete is the most common construction material while steel, masonry, and wood construction are common at water crossings.

Highway embankments and pavements themselves inherently have low vulnerability to wind. The most significant problem is windblown debris, which may impede traffic, pose a problem to persons and vehicles and, rarely, accumulate to the degree that it results in road blockage.

Conventional bridges are vulnerable to flood, particularly those over waterways and subjected to a velocity component. Even if water does not reach the superstructure for example, deck) of a bridge, foundations are vulnerable to scour (erosion of the soils surrounding and under the foundation, particularly spread footing foundations), and substructures (piers supporting the superstructure) may be damaged by swiftly moving debris carried by the floodwater (for example, barges, houses, ice). If floodwaters reach the superstructure, design lateral loads are generally exceeded— lighter bridges may float or collapse.

Conventional bridges are typically professionally designed and constructed, so that flood is considered in their design, and only rare floods exceeding design criteria are a concern. Flood risk may change due to changing upstream or downstream conditions so that the potential for development or other changing conditions should be anticipated in design and monitored.

DISASTER MANAGEMENT PROGRAM FOR EARTHQUAKES

Developing a disaster mitigation program involves the following five phases

Phase 0: Pre-program activities, involving increasing awareness of the potential earthquake problem, and gaining authorization for an initial assessment of the problem,

Phase 1: Assessing the risk, consisting of an initial review of life, property and business or functional exposures, and the threat that disasters may pose to them, in order to determine the current risk. That is, are disasters indeed are a problem and, if so, what is the magnitude and nature of that problem?

Phase 2: Developing the program, which consists of determining the organization's acceptable risk, existing options for reducing the current risk to an acceptable level, the costs, and the method to accomplish this.

Phase 3: Implementing the program, taking the actions that reduce the risk, and

Phase 4: Maintaining the program, so that the risk does not become unacceptable.

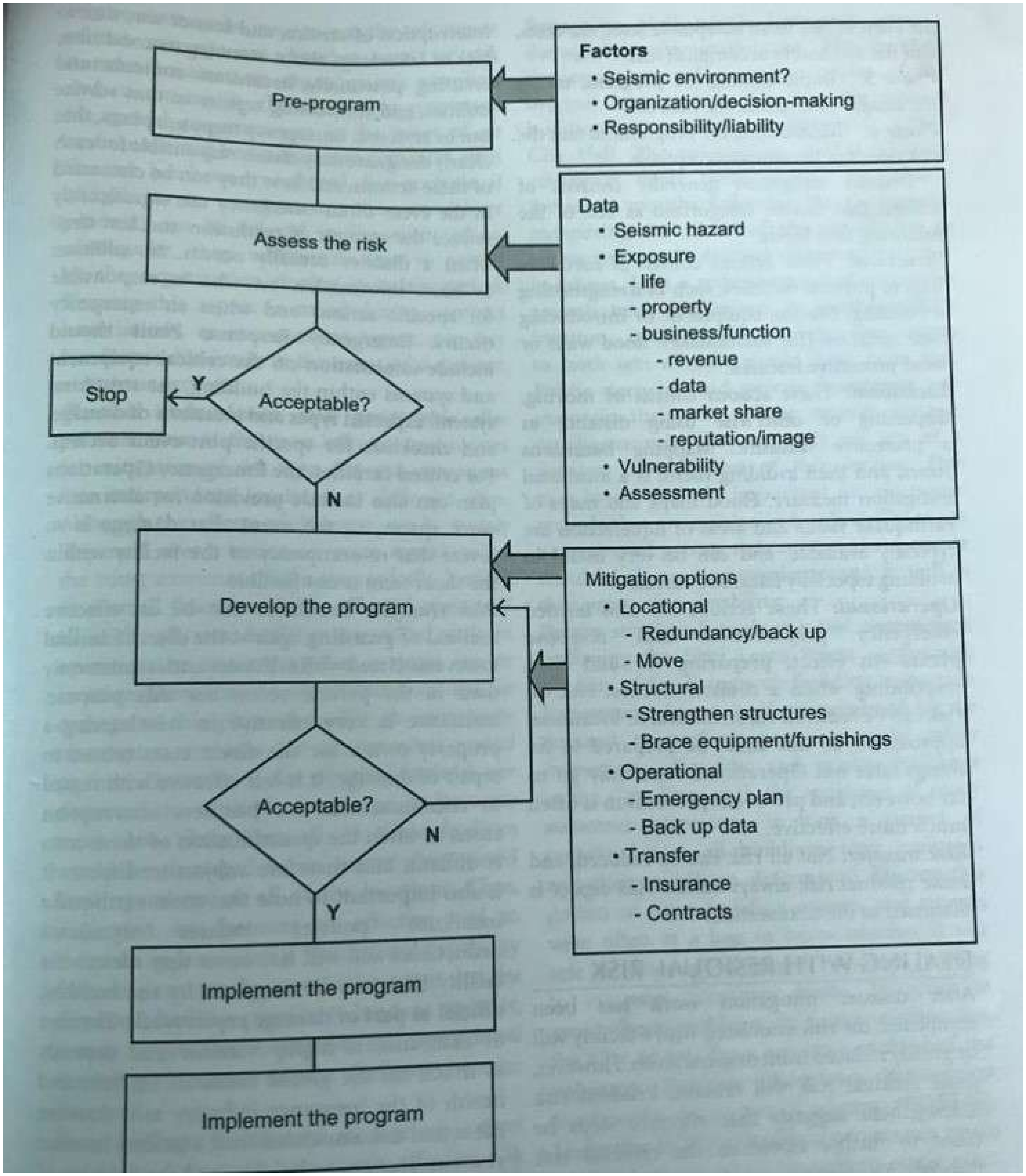
Disaster mitigation generally consists of actions that can be categorized as one of the following four kinds:

Structural: These actions consist of hardware fixes to physical facilities, such as strengthening a building, bracing equipment or introducing base isolation (for earthquake), flood walls or wind protective features.

Locational: These actions consist of moving, dispersing or otherwise using distance as a protective measure. Mapping hazardous zones, and then avoiding them, is a locational mitigation measure. Flood maps and maps of earthquake faults and areas of liquefaction are typically available, and can be very useful in avoiding especially hazardous areas.

Operational: These actions are also termed emergency preparedness and response plants—in effect, preparing for and then responding when a disaster occurs. Not all risk can be reduced via structural or locational approaches, so one must be prepared to fix things later on. Operational fixes only go so far however, and pre-event prevention is often much more effective.

Risk transfer: Not all risk can be reduced, and some residual risk always exists.



GEOSPATIAL INFORMATION IN AGRICULTURE DROUGHT ASSESSMENT

Monitoring agricultural drought has been a challenge due to its unique characteristics. In India, drought monitoring and early warning is carried out by the central and state agencies using the meteorological and agricultural data. India is also one of the few countries which use satellite data for monitoring and assessment of agricultural drought through a program called the National

Agricultural Drought Assessment and Monitoring System, (NADAMS).

FEATURES OF DROUGHT

Food production in the developing world declined from an average annual growth of 4.2% during 1991—1995 to 3.5% during 1996—2000. One of the reasons for this was the alarming increase in the number of countries affected by natural disasters, which rose from 28 in 1996 to 46 in 2000. One of the major disasters which severely impair food production is drought. It is a normal part of the climate, rather than a departure from normal climate. Drought is a complex phenomenon that can be defined from several perspectives? The definition of drought varies depending on place, time and person. Drought can broadly be defined as the water or moisture deficit at particular location, during a particular period of time and for a particular person. The location can be an arid region or a humid one. The period could be critical phase of the crop like germination or flowering and the person could be poor or rich. Hence, any accurate definition of drought will be applicable for a specific place and for a specific person during a particular time period.

Drought differs from other natural hazards in several ways. First, it is a slow onset natural hazard, often referred to as a 'creeping phenomenon'. A week of dry spell during the monsoon is always welcomed by most. As the dry spell extends for a fortnight or more it slowly gets transformed to what may prospectively become a drought. During this transition, no one will realize the onset of drought unless it starts hurting them by ways of shortage of drinking water or lack of soil moisture for the crops or loss in power generation due to lack of head in the reservoir. Second, its effect is over a larger geographic area unlike the other hazards which are local and location-specific. Ambiguity also exists in identifying the exact boundary of the drought affected area, as it is not discrete and there is a slow transition from the non-drought area to drought-affected area. Third, the duration of drought may range from few months to several years. The onset and ending of drought is again ambiguous. The impact of drought is nonstructural when compared to the damages that result from other natural hazards like flood, earthquakes and tropical storms.

TYPES OF DROUGHT

The basic reason for manifestation of drought in any region is the precipitation. In the hydrological cycle, rainwater gets transformed as soil water, run off water, deep drainage, plant water and water vapor. Any substantial shortfall of water at each transformation causes hydrological imbalance which will lead to a particular type of drought. Broadly, three types of drought are noted: meteorological, agricultural and hydrological. Meteorological drought is generally defined as deficiency of precipitation from the expected or 'normal' amount of rainfall during a particular period of time. Meteorological drought precedes all the other types. Agricultural drought may be characterized by a deficiency in soil water availability for crop growth. The precipitation deficiencies may lead to reduction in the soil water reserves which may affect the production potential of the crops. Hydrological drought may be a result of long-term meteorological droughts which result in the drying up of reservoirs, lakes, streams and rivers, and fall in groundwater level.

Based on the period at which the water stress happens during the cropping season, agricultural drought can be classified into three categories, namely, early season, midseason and late season or terminal drought. We also encounter two more types of drought, namely, apparent and permanent drought. These are discussed below.

Early season drought: Under rain-fed conditions, the cropping season commences with the significant first soaking rainfall. In India, sowing starts with the onset of monsoon during June. If there is delay in the onset of monsoon, sowing is also delayed. It is also possible that onset is timely and sowing is completed but followed by a long dry spell. Germination and the period just after are among the critical phases of the crop and dry spell leading to moisture stress then will lead to crop mortality and loss of het sown area. Unless and until these gaps are filled, there will be reduction in crop production. The loss of crop yield due to the early season moisture stress is called the early season drought.

Mid-season drought: When the crop in its vegetative phase experiences moisture stress due to break in monsoon or due to a long dry spell, it is called a midseason drought. Generally, when the crop is well-established and then undergoes such midseason drought, it becomes stunted but survives. Once the monsoon revives, the crop may partially or completely recover depending upon the persistence and intensity of dry spell. The loss in crop yield due to midseason drought is varying.

Late season or terminal drought: The flowering and milking stages of the crop are very critical phases. If there is moisture stress during this phase due to lack of rainfall, it will lead to loss of yield both in quantity and quality. The loss of crop yield due to moisture stress during the reproductive phases of the crop is called the late season drought,

Apparent drought: The rainfall during a particular period of time may be sufficient for one crop but it may not be adequate for another crop. The stress may also be induced by the type of soil on which the crop grows. The same amount of rainfall for similar crops at the same stage, on sandy and loamy soil will result in the former crop getting stressed early than the latter. This sort of differential stress to crops for the same amount of rainfall is called apparent drought.

Permanent drought: When the monsoon fails both in its amount and distribution temporally as well as spatially, complete failure of crops occur at a regional scale. Such scenarios often happen is the arid and semi-arid climatic regions where the rainfall has very high variance.

PREDICTION OF AGRICULTURAL DROUGHT

Though the main cause for agricultural drought is the deficiency of rainfall, it is the anomalies in atmospheric circulation which is responsible for deficit rainfall. Hence, in order to predict drought, it is important to monitor the atmospheric and ocean circulations. Enormous energy exchange takes place between the ocean and the atmosphere which has a lasting effect globally on a timescale of a few years. One such phenomenon is the Southern Oscillation (SO), an atmospheric component and associated El Nino, an oceanic component, jointly called the El Nino and Southern Oscillation (ENSO) which has a profound impact on the performance of global tropical monsoons. 'Strongest connection between ENSO and intense drought can be found in Australia, Indonesia, Philippines, parts of east and south Africa and Western Pacific Basin island, India, Central America and various parts of United States'. ENSO weakens the summer monsoon and is related to drought occurrence in India. ll During the period 1971 to 1988, 11 of the 21 droughts were attributed to ENSO phenomenon. About 58% of the drought events in India were associated with ENSO phenomenon.

AGRICULTURAL DROUGHT: MONITORING AND EARLY WARNING

Though prediction of drought is neither accurate nor precise, it is critical for planning through timely and reliable climate information, including seasonal forecasts, to aid decision makers. This information, if properly applied, can reduce the impact of drought and other extreme climate events. 18 An early warning system (EWS) for drought can be used to supply this information to the decision makers. Early warning and monitoring are crucial components of drought preparedness and mitigation plans. 19

In India, monitoring and early warning of drought is the responsibility of both the central and state governments. IMD carries out meteorological drought monitoring and forecasting function for the union Government through a network of 2800 rain gauge stations distributed in 36 meteorological subdivisions across the country.20 Department of Science and Technology of Government of India, in collaboration with Indian Council of Agriculture Research (ICAR) has set up 89 centres for short- and medium- range monitoring and forecasting of the weather. 21 The revenue department of each state collects the rainfall data at each tehsil and district. The state agriculture departments also collect the information on the area of crop sown, type of crop, condition of the crop, pest attack, if any, and other agriculture-related information. To integrate these data from various sources and to derive useful information about the problem areas, a mechanism called the Crop Weather Watch Group (CWWG) exists within the Union Agriculture Ministry of Agriculture. The deliberations of the group and exchange of information with a similar group at state level, serve as the triggering mechanism to activate drought response systems.

NATIONAL AGRICULTURAL DROUGHT ASSESSMENT AND MONITORING SYSTEM

(NADAMS)

NADAMS, which is operational at National Remote Sensing Agency, with the support of IMD and various state departments of agriculture, has been providing agricultural drought information in terms of prevalence, severity and persistence at state, district and sub district level. Presently it covers 13 agriculturally important and drought-vulnerable states of the country monitoring drought during kharif season (June—November), since most of the agriculture during this season is depends on rainfall. NADAMS monitors the agricultural drought conditions at state/district/sub district level using daily observed coarse resolution (1.1 km) NOAA AVHRR data for 9 states. Moderate resolution data from Advanced Wide Field Sensor (AWiFS) of Resourcesat- 1 at 56 m resolution and Wide Field Sensor (WiFS) of IRS IC and ID at 188 m resolution are being used for detailed assessment of agricultural drought at district and sub district level in four states namely, Andhra Pradesh, Karnataka, Maharashtra and Haryana. Moderate resolution satellite data from WiFS/AWiFS sensors from IRS platform is very useful in identifying the problem area at sub district level.

The methodology adopted in NADAMS reflects the harmonization of satellite derived crop condition with ground collected rainfall and crop area progression to evolve decision rules on the prevalence, intensity and persistence of agricultural drought situation. The agricultural drought warning and declaration procedures being followed are shown in Table. During June to August, drought warning information is issued in 'Watch, Alert and Normal' categories. In case of 'Watch', external intervention is required if similar drought-like conditions persist during the successive month while 'Alert' calls for immediate external intervention, in terms of crop contingency plans. During September and October, based on NDVI anomalies corroborated by ground situation, drought is declared as mild, moderate and severe drought.

Table Agricultural drought warning and declaration in NADAMS project

Month	Assessment	Implications
June, July, August	Normal	Agricultural situation is normal
	Watch	• Progress of Agricultural situation is slow • Ample scope for recovery • No external intervention needed
	Alert	• Very slow progress of agricultural situation • Need for intervention • Develop and implement contingency plans to minimize loss

September, October	Mild drought	Crops have suffered stress slightly
	Moderate drought	• Considerable loss in production. • Take measures to alleviate suffering
	Severe	• High risk; significant reduction in crop yield • Management measures to provide relief

MULTIMEDIA TECHNOLOGY IN DISASTER RISK MANAGEMENT AND TRAINING

CHALLENGES OF DISASTER EDUCATION

1nformation and Communication Technologies (ICT) are widely used in disaster risk management and can enhance the countries' capacity for preparedness and response to calamities. Examples include geographic information system (GIS), sensor networks and early warning systems, wireless public safety infrastructure, data collection and processing facilities, generation of improved and actionable information for decision makers, integration of geospatial and online data, coordination of rescue operations, management of collaboration among various players for better disaster management. Disaster education faces tremendous and exceptional challenges in terms of demand and supply. The use of technology helps to address some of them.

DEMAND PERSPECTIVE

The number of people exposed to potential disasters can be measured only by billions. These people should have the basic knowledge on risks they are exposed to and on the necessary actions that can be taken to reduce their risk and vulnerability to disasters. The number of people or masses to be reached already creates an exceptional set of issues not comparable to any other educational challenge. Not only the number, but also the diversity of the potential target audience exacerbates the challenges. The success of national disaster management systems depends on integration of key players in disaster management process. The key players include government agencies, local community leaders, NGOs and private participants market. Different methods to teach and different knowledge to acquire are necessary for distinct key players with varying educational background. This calls for diversified content and delivery modes.

The shifting paradigm of disaster management from emergency to risk management with a clear focus from post: to pre-disaster phases also contributes to the growing number of professionals to be educated at a minimum level to understand the linkages among •different disciplines as they relate to disaster risk reduction and be able to implement risk reduction in their specific field of engagement. In order to treat disaster risk reduction as a development agenda and incorporate it in development planning and thinking, the disaster education should broaden its reach from traditional counterparts in emergency agencies to a wide range of organizations at different levels of governments including ministries of finance, planning, infrastructure, and education.

SUPPLY PERSPECTIVE

Relying on traditional methods, countries are not prepared and do not have the capacity to reach out to as many potential participants as needed. This limited capacity to reach out becomes a critical constraint in lower-income countries. With vulnerable physical and human infrastructure, public and professional education becomes a more vital mitigation tool than in higher-income countries to withstand the impact of disasters. There are also very few, if any, organizations or agencies which are in a position to consolidate the knowledge of different disciplines as they relate to disaster risk management. Universities, with departments in different areas, might have the in-house expertise to combine the necessary knowledge encompassed for risk reduction, but their focus on academic achievements rather than on training in practical knowledge on the one hand and the institutional limitations to design multidisciplinary programs based on cross-departmental collaborations on the other hand explains why there are so few Of them offering disaster risk management programs.

ICT can change the way practitioners are trained in disaster risk management. It adds both depth to training via multimedia simulations, by bringing the best expertise, and facilitating knowledge exchanges and breadth via blending knowledge from various sectors. It allows professionals working in disaster risk management as well as other areas to receive training without interruption of their current work. It makes possible to significantly scale up training both in individual countries as well as at the regional and global level.

SCALING UP EDUCATIONAL

EFFORTS: E-LEARNING

Technology may help reach the same rate of scaling up without deterioration of quality at each node in the cascade scheme. This can be achieved by using the power of multimedia to capture knowledge of the best international and local experts, allowing simulations and other interactions with data and learning materials, including knowledge self-checks. However multimedia alone, often in the form of self-paced training modules, has limited power in creating a social environment conducive to successful learning experience. This flaw can be addressed by complementing use of multimedia with electronic channels creating opportunities for communication and collaboration among trainers and participants, allowing to move from traditional or self-paced learning to e-learning.

E-learning is especially effective when large numbers of people must be trained quickly, when they are spread across geographic areas (such as rural and remote areas, islands, mountains, natural disaster-torn areas), or when it is desirable that participants stay at their workplaces or other operating environments.

Using technology for training allows not only to scale up, but also to cut on travel costs, to reach experts not easily accessible otherwise and to study without interruption of work. It also creates several positive side effects: training practitioners with use of ICT accustoms them to apply technology later in their everyday work; the required interaction during training makes easier to collaborate in real-life environment; learning to access online repositories of data, best practices and to blend research data and experience widens the options to solve real-life problems; and finally it contributes to development of a culture of knowledge sharing.

The e-learning activity cycle follows the standard traditional training cycle. While the activity cycle seemingly has the same components—audience analysis, identification of knowledge gaps to be addressed via the learning program, planning, designing, developing and delivering the program, evaluating and improving it for future activities—the use of technology is shaping both the presentation of content and the design and implementation of activities.

Use of multimedia technology requires higher upfront investment and longer development as compared to traditional training. The more media, that is, (audio, video, flash, animations, simulations) is used, the longer and more expensive the development of learning modules will be. Successful multimedia development methodologies usually include design-time prototyping, evolutionary development, use of rapid development tools such as templates and template-based tools. When the budget is limited one often limits multimedia by hyperlinked electronic text and/or audio or video or PowerPoint with audio presentations of key experts. But replacing multimedia with 'cheaper' solutions might be not only due to upfront cost considerations. When the programs are needed in different languages, sophisticated multimedia solutions can create additional and often technical burden in making materials available in local languages.

THE WORLD BANK INSTITUTE DISASTER RISK MANAGEMENT LEARNING PROGRAM

World Bank Institute (WBI), the learning arm of the World Bank (WB), launched its disaster risk management program in 2004. The program development largely benefitted from the operational experience and related analytical work of the Bank, the biggest lender for disaster recovery. Since 1984, the Bank has financed 528 projects that addressed natural disasters, representing more than US$26 billion in lending.6 The Bank also provided access to the knowledge of leading experts who contributed fundamentally to the content development of the program.

The Institute's Comprehensive Disaster Risk Management Program addresses the increased demand for disaster assistance that calls for a structured, comprehensive disaster risk management capacity-building program. The program is designed on a global scale and offered to regions, particular countries, and to partner institutions. The content and design of the program serves the specific learning needs of different audience groups.

The components of the program are:

- Analytical work in specific areas of disaster risk management (DRM) such as gender mainstreaming, governance of DRM,
- Development of new learning products including design of e-learning courses in specific areas of DRM and certification program in urban risk management,
- Knowledge dissemination through on line courses, publications and website,
- Technical assistance to partner organizations to expand their capabilities by introducing innovative learning systems including customization of the courses to the specifics of the country in question,
- Platform for establishing and implementing south—south and Peer-to-Peer learning mechanisms.

WBI disaster risk management learning program clearly demonstrates the benefits of technology in disaster training and education, in opportunities to scale up the outreach and in providing access to cutting edge knowledge. Based on WBI experience the following factors play an important role in making e-learning activities a success:

- Needs-based, high-quality content,
- Adaptation, localization and ownership of the program via collaboration of content developers, adapters, prospective trainers and program managers,
- User-friendly and easy-to-navigate course materials, learning activities, and online environment ensured by the learning management system,
- Clear expectations and assessment criteria, High interactivity and well-structured learning activities via scheduled discussions and strict due dates for assignments,
- Commitment, capacity, and competencies of partners delivering e-learning activities,
- Administrative, pedagogical and technical support of both learners and instructors/facilitators,
- Building instructors competencies by taking the online courses as students,
- Demonstrating the benefits of e-learning to instructors and training them in the use of technology,
- Coaching and mentoring the instructors during their first few e-learning course deliveries,
- Blending traditional and technology-based approaches especially in the interactions with partner institutions and their staff.

TRANSFORMABLE INDIGENOUS KNOWLEDGE IN DISASTER REDUCTION

1n recent years, the number of disasters has increased steadily in different parts of the world. This is especially so in different parts of Asia. The Asian region has more than 40% of the world's population. Almost 38% of the hazardous events occur in Asia. Thus, it faces high vulnerability, which is exemplified by the fact that almost 60% of the world's victims and 50% of financial losses are of natural disaster, from Asia. Among the types of natural disasters, Asia has virtually all the types, including earthquake, flood, cyclone, volcano, drought and extreme temperature. Data for the last 25 years show that, while earthquake and cyclone result in more loss of lives, earthquake and flood cause more damage to infrastructure and flood, drought and windstorm produce the maximum number of displaced people.

INDIGENOUS AND TRADITIONAL KNOWLEDGE: CHARACTERISTICS AND CHALLENGES

Research in indigenous knowledge aims to facilitate the targeting of development resources more effectively on the poor. The compatibility of local ideas with scientific ones is a central issue. It is absolutely necessary to facilitate communication between scientists and local people, on the assumption, fundamental to development interventions, that science may have something to offer them in tackling their problems. Furthermore, it is possible that if scientific and indigenous knowledge are comparable, and if scientists are able to access local knowledge, this might enhance new development of research practices. Sillotoe et al have given a great example of mapping indigenous and scientific soil knowledge for effective floodplain management in Bangladesh. Combining scientific names as well as local names of the soil types, and its productivity, the study showed the unique way of resource utilization by using the maps. However, studies showed a number of interesting challenges of incorporating indigenous knowledge into the development processes.

While exploring indigenous and traditional knowledge, we come across different nomenclature: Indigenous knowledge (1K), Traditional knowledge (TK), local knowledge, community-based knowledge, Indigenous knowledge systems and practices (IKSP), Indigenous technical knowledge (ITK) and Traditional and local knowledge system. Each of these terms has its specific meaning and application.

Thus, indigenous knowledge is characterized by the following:

- Locally bound, indigenous to a specific area and communities,
- Culture- and context-specific,
- Non-formal knowledge,
- Orally transmitted, and generally not documented,
- Dynamic and based on innovation, adaptation, and experimentation,
- Closely related to survival and subsistence for many people worldwide

One of the major issues of 1K is that, in many cases, it survived as part of process of the people and communities. Thus, 1K is very much characterized by multidisciplinary nature, and is based on food security, human and animal health, education, natural resource management, and various other community based activities. The other issue of 1K is its dynamic evolution. 1K is the result of a continuous process of experimentation, innovation, and adaptation. It has the capacity to blend with knowledge based on science and technology, and should, therefore, be considered complementary to scientific and technological efforts to solve problems in social and economic development. The third aspect is the challenges of documentation. In most cases, 1K is orally transmitted, and thus, the challenges of its implementation are not properly documented. The fourth important challenge is classification of 1K. 1K can be which based on geographical context, thematic context, organizational context, and in many cases there are overlaps.