Reading Manual on Introduction to Disaster Management (PGS 507)

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Content

Important Terminologies related to Disaster Management

Disaster

Disaster means a catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or manmade causes, or by accident or negligence which results in substantial loss of life or human suffering or damage to, and destruction of, property, or damage to, or degradation of, environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area (definition according to Disaster Management Act 2005, Government of India).

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. Hazards arise from a variety of geological, meteorological, hydrological, oceanic, biological, and technological sources, sometimes acting in combination. In technical settings, hazards are described quantitatively by the likely frequency of occurrence of different intensities for different areas, as determined from historical data or scientific analysis.

Natural hazard

Natural process or phenomenon 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. Natural hazards are a sub-set of all hazards. The term is used to describe actual hazard events as well as the latent hazard conditions that may give rise to future events. Natural hazard events can be characterized by their magnitude or intensity, speed of onset, duration, and area of extent. For example, earthquakes have short durations and usually affect a relatively small region, whereas droughts are slow to develop and fade away and often affect large regions. In some cases hazards may be coupled, as in the flood caused by a hurricane or the tsunami that is created by an earthquake.

Technological hazards

A hazard originating from technological or industrial conditions, including accidents, dangerous procedures, infrastructure failures or specific human activities, that may cause loss of life, injury, illness or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Examples of technological hazards include industrial pollution, nuclear radiation, toxic wastes, dam failures, transport accidents, factory explosions, fires, and chemical spills. Technological hazards also may arise directly as a result of the impacts of a natural hazard event.

Vulnerability

The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard. There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors. Examples may include poor design and construction of buildings, inadequate protection of assets, lack of public information and awareness, limited official recognition of risks and preparedness measures, and disregard for wise environmental management. Vulnerability varies significantly within a community and over time. This definition identifies vulnerability as a characteristic

of the element of interest (community, system or asset) which is independent of its exposure. However, in common use the word is often used more broadly to include the element's exposure.

Coping capacity

The ability of people, organizations and systems, using available skills and resources, to face and manage adverse conditions, emergencies or disasters. The capacity to cope requires continuing awareness, resources and good management, both in normal times as well as during crises or adverse conditions. Thus, the combination of all the strengths, attributes and resources available within a community, society or organization that can be used to achieve agreed goals is termed as its capacity. It may include infrastructure and physical means, institutions, societal coping abilities, as well as human knowledge, skills and collective attributes such as social relationships, leadership and management.

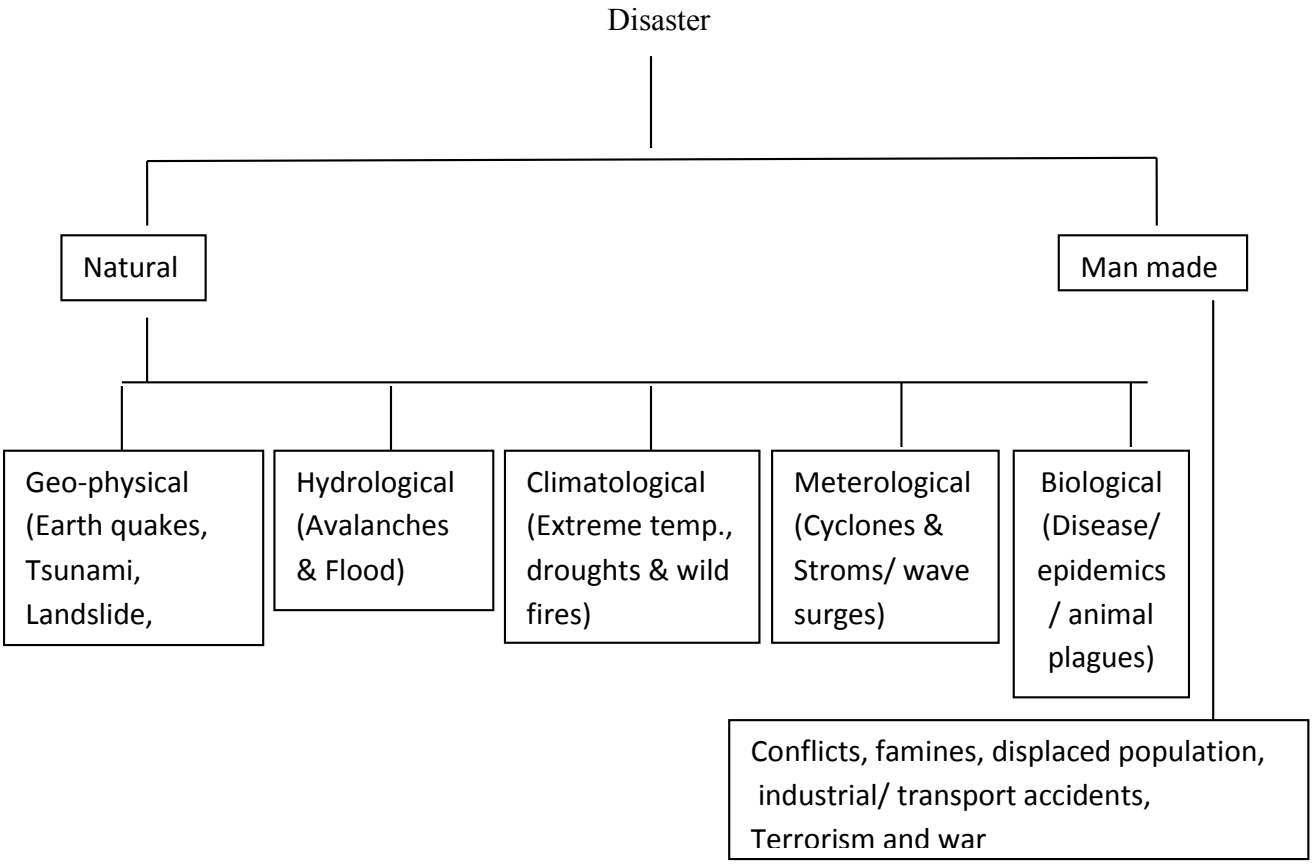
Risk

The combination of the probability of an event and its negative consequences. The word "risk" has two distinctive connotations: in popular usage the emphasis is usually placed on the concept of chance or possibility, such as in "the risk of an accident"; whereas in technical settings the emphasis is usually placed on the consequences, in terms of "potential losses" for some particular cause, place and period. It can be noted that people do not necessarily share the same perceptions of the significance and underlying causes of different risks.

Risk management

The systematic approach and practice of managing uncertainty to minimize potential harm and loss. Risk management comprises risk assessment and analysis, and the implementation of strategies and specific actions to control, reduce and transfer risks. It is widely practiced by organizations to minimise risk in investment decisions and to address operational risks such as those of business disruption, production failure, environmental damage, social impacts and damage from fire and natural hazards. Risk management is a core issue for sectors such as water supply, energy and agriculture whose production is directly affected by extremes of weather and climate.

Types of Disaster



Earthquake:

1. An earthquake is a phenomenon that occurs without warning and involves violent shaking of the ground and everything over it.
2. It results from the release of accumulated stress of the moving lithospheric or crustal plates.
3. The earth's crust is divided into seven major plates, that are about 50 miles thick, which move slowly and continuously over the earth's interior and several minor plates.
4. Earthquakes are tectonic in origin; that is the moving plates are responsible for the occurrence of violent shakes.

What to do during an earth quake?

Stay as safe as possible during an earthquake

If indoors

1. DROP to the ground; take COVER by getting under a sturdy table or other piece of furniture; and HOLD ON until the shaking stops. If there is no a table or desk near you, cover your face and head with your arms and crouch in an inside corner of the building
2. Protect yourself by staying under the lintel of an inner door, in the corner of a room, under a table or even under a bed

3. Stay away from glass, windows, outside doors and walls, and anything that could fall, (such as lighting fixtures or furniture).
4. Stay in bed if you are there when the earthquake strikes. Hold on and protect your head with a pillow, unless you are under a heavy light fixture that could fall. In that case, move to the nearest safe place.
5. Use a doorway for shelter only if it is in close proximity to you and if you know it is a strongly supported, load bearing doorway.
6. Stay inside until the shaking stops and it is safe to go outside. Research has shown that most injuries occur when people inside buildings attempt to move to a different location inside the building or try to leave.

If outdoors

1. Do not move from where you are. However, move away from buildings, trees, streetlights, and utility wires.
2. If you are in open space, stay there until the shaking stops. The greatest danger exists directly outside buildings; at exits; and alongside exterior walls. Most earthquake-related casualties result from collapsing walls, flying glass, and falling objects.

If in a moving vehicle

1. Stop as quickly as safety permits and stay in the vehicle. Avoid stopping near or under buildings, trees, overpasses, and utility wires.
2. Proceed cautiously once the earthquake has stopped. Avoid roads, bridges, or ramps that might have been damaged by the earthquake.

If trapped under debris

1. Do not light a match
2. Do not move about or kick up dust
3. Cover your mouth with a handkerchief or clothing
4. Tap on a pipe or wall so rescuers can locate you.
5. Use a whistle if one is available.
6. Shout only as a last resort. Shouting can cause you to inhale dangerous amounts of dust.

FLOOD:

India is highly vulnerable to floods. Out of the total geographical area of 329 million hectares (mha), more than 40 mha is flood prone. An average every year, 75 lakh hectares of land is affected, 1600 lives are lost and the damage caused to crops, houses and public utilities is Rs.1805 crores due to floods. The maximum number of lives (11,316) was lost in the year 1977. The frequency of major floods is more than once in five years.

Source: National Disaster Management Authority of India

What to do before a flood:

1. Avoid building in flood prone areas unless you elevate and reinforce your home. 2. Elevate the furnace, water heater, and electric panel if susceptible to flooding. 3. Install "Check Valves" in sewer traps to prevent floodwater from backing up into the drains of your home. 4. Contact community officials to find out if they are planning to construct barriers (levees, beams and floodwalls) to stop floodwater from entering the homes in your area. 5. Seal the walls in your basement with waterproofing compounds to avoid seepage.

If a flood is likely to hit your area, you should:

1. Listen to the radio or television for information. Be aware that flash flooding can occur. **2.** If there is any possibility of a flash flood, move immediately to higher ground. **3.** Do not wait for instructions to move. **4.** Be aware of streams, drainage channels, canyons, and other areas known to flood suddenly Flash floods can occur in these areas with or without such typical warnings as rain clouds or heavy rain.

If you must prepare to evacuate, you should:

1. Secure your home. If you have time, bring in outdoor furniture. Move essential items to an upper floor. **2.** Turn off utilities at the main switches or valves if instructed to do so. Disconnect electrical appliances. Do not touch electrical equipment if you are wet or standing in water.

If you have to leave your home, remember these evacuation tips:

1. Do not walk through moving water. Six inches of moving water can make you fall. If you have to walk

in water, walk where the water is not moving. Use a stick to check the firmness of the ground in front of you. **2.** Do not drive into flooded areas. If floodwaters rise around your car, abandon the car and move to higher ground if you can do so safely. You and the vehicle can be quickly swept away.

Urban Flood:

Urban flooding is significantly different from rural flooding as urbanization leads to developed catchments, which increases the flood peaks from 1.8 to 8 times and flood volumes by up to 6 times. Consequently, flooding occurs very quickly due to faster flow times (in a matter of minutes). Urban areas are also centers of economic activities with vital infrastructure which needs to be protected 24x7.

'Do's in Urban flood

1. Raise furniture, electrical appliances on beds and tables.
2. Put sandbags in the toilet bowl and cover all drain holes to prevent sewage back flow.
3. Use bleaching powder and lime to disinfect the surroundings.
4. Use chlorine tablets to purify water before drinking as advised by Health Department.
5. After the flood recedes, watch out for broken electric poles, damaged bridges, broken glass, sharp objects and debris.

Dont's in Urban flood

1. Don't walk through moving water. If you have to walk in water, walk where the water is not moving.
2. Use a stick to check the firmness of the ground in front of you.
3. Don't get near the electric poles and fallen power-lines to avoid electrocution.
4. Don't get near the sewage line, gutters, drains, culverts etc.
5. Don't drive into flooded areas. If floodwaters rise around your car, abandon the car and move to higher ground if you can do so safely. You and the vehicle can be quickly swept away.

Landslides:

Landslides and avalanches are among the major hydro-geological hazards that affect large parts of India besides the Himalayas, the Northeastern hill ranges, the Western Ghats, the Nilgiris, the Eastern Ghats and the Vindhyans, in that order, covering about 15 % of the landmass**.**

India has the highest mountain chain on earth, the Himalayas, which are formed due to collision of Indian and Eurasian plate, the northward movement of the Indian plate towards China causes continuous stress on the rocks rendering them friable, weak and prone to landslides and earthquakes.

The slow motion of the Indian crust, about 5 cm/year accumulates stress to which natural disasters are attributed. Landslides in the Darjeeling district of West Bengal as also those in Sikkim, Mizoram, Tripura, Meghalaya, Assam, Nagaland and Arunachal Pradesh pose chronic problems, causing recurring economic losses worth billions of rupees.

Do's in landslide prone locality:

1. Prepare tour to hilly region according to information given by weather department or news channel.

2. Move away from landslide path or downstream valleys quickly without wasting time.
3. Keep drains clean.
4. Inspect drains for - litter, leaves, plastic bags, rubble etc.
5. Keep the weep holes open
6. Grow more trees that can hold the soil through roots, Identify areas of rock fall and subsidence of buildings, cracks that indicate landslides and move to safer areas. Even muddy river waters indicate landslides upstream.
7. Mark path of tracking so that you can't be lost in middle of the forest.

Don'ts in landslide prone locality:

1. Try to avoid construction and staying in vulnerable areas.
2. Do not touch or walk over loose material and electrical wiring or pole.
3. Do not built houses near steep slopes and near drainage path.

Cyclones:

Cyclones are caused by atmospheric disturbances around a low-pressure area distinguished by swift and often destructive air circulation. Classified as: (i) extra tropical cyclones (also called temperate cyclones); and (ii) tropical cyclones. The word Cyclone is derived from the Greek word 'Cyclos' meaning the coils of a snake. The term coined by Henry Peddington because the tropical storms in the Bay of Bengal and the Arabian Sea appear like coiled serpents of the sea.

Extra tropical cyclones occur in temperate zones and high latitude regions, though they are known to originate in the Polar Regions. Tropical cyclones that develop in the regions between the Tropics of Capricorn and Cancer are called tropical cyclones. Tropical cyclones are large-scale weather systems developing over tropical or subtropical waters, where they get organized into surface wind circulation.

Worldwide terminology:

Cyclones are given many names in different regions of the world. They are known as Typhoons in the China Sea and Pacific Ocean; Hurricanes in the West Indian islands in the Caribbean Sea and Atlantic Ocean; Tornados in the Guinea lands of West Africa and Southern USA.; Willy-willies in North-Western Australia and Tropical cyclones in the Indian Ocean.

Do's in Cyclone (Before the Cyclone season):

1. Check the house; secure loose tiles and carry out repairs of doors and windows.
2. Keep some wooden boards ready so that glass windows can be boarded if needed.
3. Keep a hurricane lantern filled with kerosene, battery operated torches and enough dry cells.
4. Keep some extra batteries for transistors.
5. Keep some dry non-perishable food always ready for use in emergency.

Do's in Cyclone (When the Cyclone starts):

1. Listen to the radio and follow the instructions (All India Radio stations give weather warnings).

2. Ignore rumours and do not spread them; this will help to avoid panic situations.
3. Believe in the official information.

Post-cyclone measures:

1. You should remain in the shelter until informed that you can return to your home.
2. You must get inoculated against diseases immediately.
3. Strictly avoid any loose and dangling wires from lamp posts.
4. If you have to drive, do drive carefully.
5. Clear debris from your premises immediately.
6. Report the correct losses to appropriate authorities.

International Standardized System for cyclone warning:

Blue alert: Winds may reach Beaufort Force 6 in 24 hours or winds of Beaufort Force 6~7 are already blowing.

Yellow alert: Winds may reach Beaufort Force 8 in 24 hours or winds of Beaufort Force 8~9 (gale force) are already blowing.

Orange alert: Winds may reach Beaufort Force 10 in 12 hours or winds of Beaufort Force 10~11 (storm force) are already blowing.

Red alert: Winds may reach Beaufort Force 12 in 6 hours or winds of Beaufort Force 12 (hurricane force) are already blowing.

Cyclone Warning System in India

India is a large country with a coastline of about 8000 km, which makes the country vulnerable to severe tropical cyclones arising in the Bay of Bengal and the Arabian Sea. Tropical cyclones are mostly characterized by torrential rain, gales and storm surges, causing massive loss of life and property. They also result in extensive damage to standing crops and loss of livestock. In the last five decades, government is making attempts to highlight the use of information technology in providing early warning systems for effective disaster management, especially in Andhra Pradesh, Orissa and West Bengal coasts, which are susceptible to such storms**.**

Area Cyclone Warning Centres in India

Area Cyclone Warning Centres

- Calcutta
- Chennai
- Mumbai

Cyclone Warning Centres

- Bhubaneswar
- Visakhapatnam

- Ahmedabad.

Cyclone Warning Division, New Delhi

Mission of Cyclone Warning Division

As per one of the recommendations of the Cyclone Review Committee (CRC), a Cyclone Warning Directorate co-located with RSMC-Tropical Cyclones, New Delhi was established in 1990 in the Office of the Director General of Meteorology, New Delhi to co-ordinate and supervises the cyclone warning work in the country in totality. The mission of this division is to improve the cyclone warning activity in the country and to improve linkage between early warning system of cyclone and disaster management.

Volcanic Hazards:

Volcanoes occur because the Earth's crust is broken into 17 major tectonic plates that are rigid but float on a hotter, softer layer in the Earth's mantle. Within the Earth's mantle, temperatures are hot enough to melt rock and form a thick, flowing substance called magma. Magma is lighter than the solid rock that surrounds it—buoyant like a cork in water—and, being buoyant, it rises. As the plates shift, they spread apart, collide, and/or slide past one another. Volcanoes grow because of repeated eruptions. Most occur near the edge of plates or along the edges of continents where one plate overlaps a second plate; this is called a subduction zone. Active volcanoes seen on land occur where plates collide; however, most of Earth's volcanoes are hidden from view, occurring on the ocean floor. Volcanic eruptions occur only in certain places and do not occur randomly. Some tend to be explosive when they erupt, whereas others tend to be loosely flowing and non-explosive. Some volcanoes may exhibit only one characteristic type of eruption during an interval of activity; others may display an entire range of types. (see *http://pubs.usgs.gov/gip/volc/eruptions.html*).

Types of Volcanoes

Strombolian: Huge clots of molten lava burst from the summit crater to form arcs through the sky; lava clots combine to stream down the slopes of the volcano.

Vulcanian: A dense cloud of ash-laden gas explodes from the crater and rises high above the peak; steaming ash forms a whitish cloud near the upper level of the cone.

Vesuvian: This type is named after the eruption of Mount Vesuvius in Italy in AD 79. Great quantities of ash-laden gas are violently discharged to form a cauliflower-shaped cloud high above the volcano.

Peléan: Large quantities of gas, dust, ash, and incandescent lava fragments are blown out of a central crater, fall back, and form avalanches that move down the volcano at velocities as great as 100 mph.

Hawaiian: This term is used for a fissuretype eruption where molten, incandescent lava spurts on the volcano's rift zone and feeds lava streams that flow down the volcano, or or a central-vent eruption where a fountain of fiery lava spurts to a height of several hundred feet or more.

Phreatic: This type of eruption is driven by explosive expanding steam—a result of cold ground or surface water coming into contact with hot rock or magma. The distinguishing feature of phreatic eruptions is that they only blast out fragments of preexisting solid rock from the volcanic conduit; no new magma is erupted.

***Plinian**:* This is the most powerful type of eruption, involving the explosive ejection of relatively viscous lava that can send ash and volcanic gas tens of miles into the air. Also volcanoes generally fall into one of **three general categories** - active, dormant, and extinct.

An active volcano is one that is currently erupting or is continues to show signs of the possibility that it could erupt. Dormant volcanoes are those that haven't erupted in quite some time but the signs are there that it is possible they could again in the future. Extinct volcanoes are those that are believed to no longer have the ability to erupt now or any time in the future.

Some volcanoes are still quite dangerous as they fall into the classification of super volcanoes. They are believed to still have the ability to erupt and to create a great deal of havoc and destruction if that happens. Researchers and scientists keep a very close eye on such volcanoes to prevent a natural disaster from taking place.

Volcanic hazards

We can divide volcanic hazards into short term, and long term.

The short term hazards are generally associated with immediate effects of an eruption. The long term hazards can be more widespread and last for some time.

Primary Volcanic Hazards

Lava flows can often be avoided personally, although often structures that we build are lost to the steady march of lava.

Pyroclastic flows are very dangerous since they travel upwards of 150 km/hr they can seldom be outrun. They are a mixture of superheated ash, gas, and rock and level or bury pretty whatever is in their path.

Secondary Volcanic Hazards

Lahars are probably the most dangerous. They are volcanic mudflows. They also travel fast and are generally mixtures of water, ash, pyroclastic material. The water may come from lakes rivers or melted ice.

Ash falls is another hazard associated with volcanic eruptions. Ash can choke people and collapse houses. They can also cause problems for airplane engines.

Landslides are common on steep-sided volcanoes and thus represent another secondary hazard for those that live near a volcano.

Climate changes - throughout Earth's history, large volcanic eruptions have impacted the climate. We can see evidence for incredible volcanic eruptions such as that which formed Crater Lake. These voluminous events can alter the amount of sunlight reaching Earth by ejecting ash into the high atmosphere.

Explosive volcanic eruptions can be dangerous and deadly. The fiery clouds and hot lava that race down mountainsides destroy nearly everything in their path, including trees, plants, insects and other wildlife. Ash erupting into the sky falls back onto the Earth, creating a blanket that can suffocate plants, crops, animals, and humans. They can also spark forest fires near the volcano. Volcanic eruptions can also affect climate and weather patterns. Eruptions produce sulfuric acid aerosols that form a layer of

haze in the stratosphere. This haze, which can remain in the atmosphere for years, reflects the Sun's radiation and reduces surface temperatures. On the other hand, volcanoes also provide many benefits to the environment. The gaseous emissions from volcanic vents over hundreds of millions of years formed the Earth's earliest oceans and atmosphere, supplying the ingredients vital to evolve and sustain life.

Some of the greatest impacts (and associated risks) from volcanic eruptions occur due to the interaction of volcanic material with the hydrosphere and atmosphere. Volcanically induced mudflows, for instance, occur when volcanic ash and debris interact with surface waters (or ice). When the **Nevado del Ruiz volcano** in **Colombia** erupted in 1985 under a cap of snow and ice, the resulting mudflows killed more than 23,000 people in a very short time.

(see*http://vulcan.wr.usgs.gov/Volcanoes/Colombia/Ruiz/description_eruption_lahar_1985.html*).

However, much of the damage associated with the 1991 eruption of Mount Pinatubo in the Philippines occurred months and even years after the eruption, as monsoonal rains mobilized the volcanic ash left behind on the flanks of the volcano (Wolfe and Hoblitt 1996). Atmosphericcontributions from major volcanic eruptions can also have significant global impacts affecting climate and the geochemical cycling of various chemical elements. It is often the case that the indirect consequences of these events can have greater economic, meteorological, agricultural, and sociological impacts than the initial effects of the events.

Disaster Management Cycle

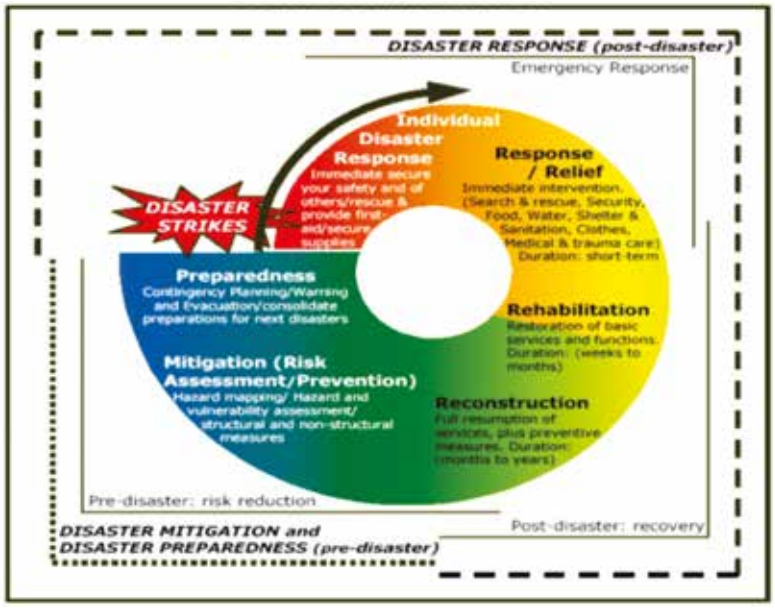
A holistic and integrated approach will be evolved towards disaster management with emphasis on building strategic partnerships at various levels.

The Themes Underpinning the Policy:

1. Community based disaster management, including last mile integration of the policy, plans and execution.
2. Capacity development in all spheres.
3. Consolidation of past initiatives and best practices.
4. Cooperation with agencies at national and international levels.
5. Multi-sectoral synergy.

Community Based Disaster & Risk Management (CBDRM)

Building the resilience quotient of local population/communities for disaster risk management and build back better through awareness, capacity building and participation of communities in disaster management interventions



Disaster Risk Management (DRM)

It is a series of actions to; reduce the risk of disaster minimize the effect of disaster facilitate a rapid recovery. Actions will be taken before, during and after the occurrence of a disaster.

1. Prevention/Mitigation Phase:

This phase include taking action to reduce damages to a community before a disaster happens. Activities like; educating the public on the risk of potential disasters and their effects building codes public safety regulations etc.

2.Preparedness Phase:

A set of actions that enhance the ability of communities and governments to respond to a disaster. Preparedness steps may include;

i. Developing plans of action in response to disasters
ii. Practice drills and exercises for emergency personnel
iii. Putting warning systems in place
iv. Developing evacuation plans and
v. Installing emergency communications systems

3. Response Phase:

Quick actions are taken during and after the disaster in order to provide emergency; First aid & Medical Care, Food, Water& Sanitation, Shelter, Transportation of disaster victims, Safety & Security.

4. Rehabilitation, Reconstruction, Recovery Phase:

Actions taken to restore the community to a normal state through; Re-construction of houses, damaged roads and basic infrastructure, Restore livelihood and build back better.

Disasters and Communities:

In case of disasters, the people at the community level have more to lose because they are the ones directly hit by disasters, whether major or minor. Some people residing in the same disaster-hit area suffer more than others (called vulnerable groups).

On the other hand, community has the most to gain if they can reduce the impact of disasters by effectively using their capacities. This concept gave rise to the idea of community-based disaster management where communities are put at the forefront.

Community Based Disaster Management (CBDM):

- A process of disaster risk management in which at risk communities are actively engaged to reduce their vulnerabilities and enhance their capacities through;
  1. Identification
  2. Analysis
  3. Treatment
  4. Monitoring and
  5. Evaluation of disaster risks
- Steps in CBDRM Process
  1. Mobilizing of the community.
  2. Rapport building and understanding the within the community.
  3. Participatory community risk assessment.
  4. Participatory action planning.
  5. Community-led implementation of the project.
  6. Participatory monitoring and evaluation of CBDRM project.

Essentials of a Disaster Risk Plan in Community Context:

What will a plan have

1. Detailed Profile of the local community (database)
2. Risks/capacities assessed of the local community (SWOT)
3. Disaster Management Teams
4. Roles and Responsibilities with respect to different phases of disaster (primary, secondary and tertiary)
5. Initiatives to augment the capacity of local communities (with timeframe and resources)
6. Initiatives to mainstream Disaster Risk in ongoing development programmes (integration with larger plans)

7. Response Matrix – ESF (0-72 hours – activities)

International Experience on CBDM Efforts:

1. Effects of a disaster are first felt at the level of the community.
2. DRR measures are most successful when they involve the direct participation of the people.
3. Disaster relief and recovery responses that do not directly involve the affected communities, frequently provide inappropriate and unsustainable forms of assistance.
4. Failure to understand the risk behavior and culture of local communities can lead to badly designed early warning systems and risk awareness-raising campaigns.
5. Investments in community-based preparedness and early warning systems have proved to save lives, protect property, and reduce economic losses.
6. The involvement of local people promotes self-reliance and ensures that emergency management plans meet local needs and circumstances.
7. Local communities are essential sources of indigenous knowledge, wisdom and innovation with respect to hazards and mitigation.
8. A community-level focus facilitates the identification of vulnerable groups.

Risk Profile of India:

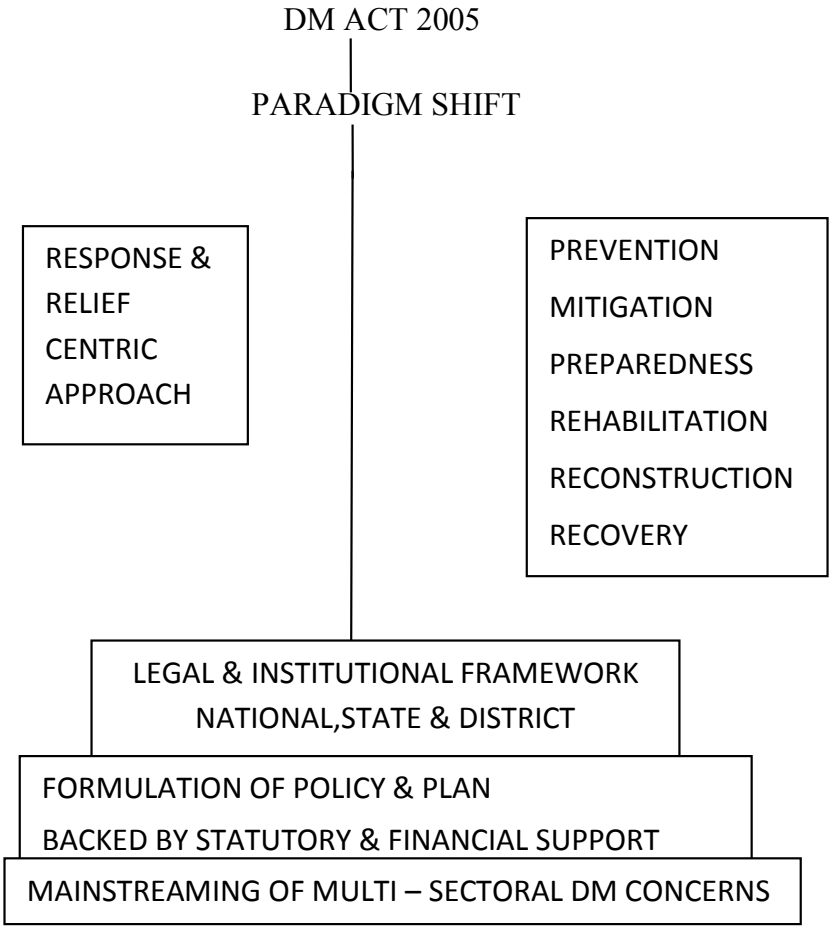
1. Among the “high risk” countries.
2. Increasing trend of weather and climate related disasters.
3. Reduced loss of human lives; escalating economic losses and displacement- Higher cost of recovery.
4. 58.6 % of the landmass is prone to earthquakes of moderate to very high intensity.
5. Over 40 million hectares (12 per cent of land) is prone to floods and river erosion.
6. Of 7516 km coastline, close to 5700 km is prone to Cyclones and Tsunamis.

Management of Disasters in India

- Until 2001 – Responsibility with the Ministry of Agriculture
- Committees Set Up by Govt. on Disaster Management :

  High Powered Committee under Chairmanship of Shri J C Pant – August 1999 (Prior to Odisha Super Cyclone).

  All Party National Committee under the Chairmanship of Prime Minister – Feb 2001 (After Gujarat Earthquake)
- NDMA constituted with Executive Order in May 2005.
- The Disaster Management (DM) Act passed in December 2005.



Disaster Management Institutional Framework at the National Level:

NDMA-

1. Apex Authority to provide strategic leadership and support Disaster Risk Reduction (DRR) Efforts.
2. To Lay down Policies, Plans and Guidelines.

3. Coordinate enforcement & implementation of the policy & plan with Departments of Govt. of India. State Governments and other DM Stakeholders.
4. Undertake measures for prevention , mitigation, preparedness and capacity building.

NEC-

1. Under HS with Secretaries of 14 Ministries and Chief of IDS.

Ministries/Departments of Government of India-

1. Take necessary measures for prevention of disasters, mitigation, preparedness and capacity building; (Section 36).
2. Integrate the measures for prevention or mitigation of disasters into their development plans and projects; (Section 36).
3. Prepare Disaster Management Plan and update annually; (Section 37).
4. Allocate funds for undertaking the activities under its DM Plan. (Section 49).

NDRF- Largest dedicated DR Force in the world; 12 Battalions; community capacity building in peace times.

NIDM- National Capacity Building; Training, Research and Documentation.

Institutional Mechanism: Nodal Ministries/ Departments:

Sl. No.	Disaster	Disaster being handled by	Nodal Ministry
1.	Earthquake	Ministry of Home Affairs	Ministry of Earth Sciences
2.	Flood	Ministry of Home Affairs	Ministry of Water Resources
3.	Cyclone	Ministry of Home Affairs	India Meteorological Department under Ministry of Earth Sciences
4.	Tsunami	Ministry of Home Affairs	Ministry of Earth Sciences
5.	Landslide	Ministry of Home Affairs	Ministry of Mines
6.	Avalanches	Ministry of Home Affairs	Ministry of Defense
7.	Drought, Hailstorm & Pest Attack	Ministry of Agriculture & Cooperation	Department of Agriculture & Cooperation, Ministry of Agriculture
8.	Forest Fire	Ministry of Environment, Forests & Climate Change	Ministry of Environment, Forests & Climate Change
9.	Nuclear Disaster	Ministry of Home Affairs/ Department of Atomic Energy	Department of Atomic Energy
10.	Industrial and Chemical Disasters	Ministry of Environment, Forests & Climate Change	Ministry of Environment, Forests & Climate Change
11.	Biological Disasters	Ministry of Health & Family Welfare	Ministry of Health & Family Welfare
12.	Rail Accidents	Ministry of Railways	Ministry of Railways
13.	Road Accidents	Ministry of Road Transport & Highways	Ministry of Road Transport & Highways
14.	Aviation Accidents	Ministry of Civil Aviation	Ministry of Civil Aviation

Institutional Mechanism: Early Warning & Dissemination:

Sl. No.	Disaster	Nodal Ministry/ Agency
1.	Flood	Ministry of Water Resources/ Central Water Commission
2.	Cyclone	India Meteorological Department under Ministry of Earth Sciences
3.	Tsunami	Ministry of Earth Sciences/ INCOIS
4.	Drought, Hail-storm & Pest Attack	Department of Agriculture & Cooperation, Ministry of Agriculture

XIIth Five Year Plan – Disaster Management Approach:

1. Strengthening Early Warning Systems, leveraging science & technology (In the Plan budget of Ministry/ Depts. of Earth Sciences, Science & Technology, Space and CWC)
2. Mainstreaming Disaster Risk Reduction into flagship schemes (In the Plan budgets of Ministries of Agriculture, Health, Water Resources, Urban & Rural Development, Education, Environment, Panchayati Raj)
3. Capacity Building:

i. Government, State Disaster Management Authorities (SDMAs) and District Disaster Management Authorities (DDMAs).

ii. Technical personnel.

iii. Communities.

Lessons learnt from CBDM interventions:

1. It is important to focus in people's knowledge more than physical infrastructure.

   - Build and sustain capacity of disaster management committees.

2. Strengthening of local institutions.

   - Lack of institutionalized and legal arrangements can affect the sustainability of DRM intervention at local Level.

3. CBDM through multi stakholdership.
4. Involvement of communities in processes leads to greater ownership.
5. Open ended, and community based projects yield monumental spin-offs.
6. Well implemented, and documented grassroots initiatives can, and do influence national policy environment.

On the Mitigation & Preparedness Front… National Cyclone Risk Mitigation Project (NCRMP):

Destruction of poultry farm

Damage of pond and fisheries

Damage of plantation

Loss of paddy crop ready for harvest

Damage of pond

Village planning for agricultural rehabilitation

Capacity building in trauma life support:

1. To develop cadre of dedicated and well trained doctors, nurses and paramedics in trauma life support care procedures.
2. Duration of the Project - June 2012 - June 2013 (Bihar, A.P and Assam).

3. 117 Doctors were trained in Advanced Trauma Life Support Course.
4. 50 Nurses were trained in Advance Trauma Care for Nurses Course.
5. 48 Doctors and Nurses trained in Pre Hospital Trauma Life Support Courses.
6. 131 Doctors, Nurses and Paramedics were trained in Rural Trauma Team Development Course.

So, disaster management is a collective responsibility which comprises of **'5c'**s,

i. COMMUNICATION
ii. COORDINATION
iii. CAPACITY BUILDING
iv. CONTINGENCY PLANNING
v. COMMUNITY

Man-made Disasters

Why Man-made Disasters?

Worldwide, People are migrating towards cities for their development purpose. As of 2017, there are 37 megacities playing important role in the global economy and it will be 41 megacities by 2030 (United Nations, 2014). Due to the effects of rapid urbanization causes lot of manmade disasters in the world, especially developing region of Asia. It affects environment and spoil natural human living atmosphere. After World War II in 1950, these cities acted as a centralized global economic hub for Industrial development, trade and services during that period. At the same time, the sustainable demand based Agrarian civilizations and Industrial development happened over the centuries in many cities. Then, after Second World War, all countries interested to promote rapid economic development in a decentralized manner in all over the world in particular to developing countries such as Asian and African countries.

It leads the Industrialization and service sectorial development in the urban areas of the particular countries. It attract the rapid migrated populations in and around the city and urban areas. It is due to the rapid migration to metro cities rather than a sustained inclusive development in the cities and urban areas. Further, the economic liberalization based urbanization attracted the rural mass to urban areas. At present, among the world's 31 megacities in 2016 and 24 are located in the less developed regions or the "global South" where the sustainable and planned residential, other infrastructural facilities and greeneries are not obtainable.

These urbanization process is not only due to rising population, this has been triggered by massive migration. Hence, the absolute number of slum dwellers is rising. The majority of these come from the fringes of urban margins, located in legal and illegal settlements with insufficient housing and sanitation facilities, air pollution, the industrialization nearby cities and urban areas rapidly growing vehicles in cities, poor drainage and waste disposal mechanism affect the people and natural environment. These are all the major reasons for manmade disasters (Tertius Chandler, 1987).

Manmade Disasters - Chemical disasters, Nuclear disasters and Biological disasters

Chemical disaster

The accidental release of a quantity of toxic chemicals into the environment, resulting in death or injury to workers or members of nearby communities. Examples include the release of **methyl isocyanate** from a chemical plant in **Bhopal, India,** at a cost of 2000 lives; and a nuclear accident at Chernobyl, Ukraine, requiring the removal of 160,000 people from their homes; the **Itai Itai** diseases caused by excessive cadmium which is an noted example of heavy metal pollution. We can quote many such examples.

Industrial hazards are threats to people and life-support systems that arise from the mass production of goods and services. When these threats exceed human coping capabilities or the absorptive capacities of environmental systems they give rise to industrial disasters. Industrial hazards can occur at any stage in the production process, including extraction, processing, manufacture, transportation, storage, use, and disposal. Losses generally involve the release of damaging substances (e.g. chemicals, radioactivity, genetic materials) or damaging levels of energy from industrial facilities or equipment into surrounding environments. The growth of chemical industries has led to an increase in the risk of occurrence of incidents associated with hazardous chemicals (HAZCHEM). A chemical industry that incorporates the best principles of safety can largely prevent such incidents. Common causes for chemical accidents are deficiencies in safety management systems and human errors, or they may occur as a consequence of natural calamities or sabotage activities. Chemical accidents result in fire, explosion and/or toxic release.

The nature of chemical agents and their concentration during exposure ultimately decides the toxicity and damaging effects on living organisms in the form of symptoms and signs like irreversible pain, suffering, and death. Meteorological conditions such as wind speed, wind direction, height of inversion layer, stability class, etc., also play an important role by affecting the dispersion pattern of toxic gas clouds. The Bhopal Gas tragedy of 1984—the worst chemical disaster in history is still fresh in our memories. Such accidents are significant in terms of injuries, pain, suffering, loss of lives, damage to property and environment. A small accident occurring at the local level may be a prior warning signal for an impending disaster. Chemical disasters, though low in frequency, have the potential to cause significant immediate or long-term damage.

Sources of Chemical Disasters:Chemical accidents may originate in:

I) Manufacture and formulation installations including during commissioning and process operations; maintenance and disposal.

II) Material handling and storage in manufacturing facilities, and isolated Storages; warehouses and godowns including tank farms in ports and docks and fuel depots.

III) Transportation (road, rail, air, water, and pipelines).

Actions and considerations after Bhopal accident:

One of the worst industrial chemical disasters occurred without warning early on the morning of December 3, 1984, at Union Carbide's pesticide plant in Bhopal, India. While most people slept, a leak,

caused by a series of mechanical and human failures, released a cloud of lethal methyl isocyanate over the sleeping city. Some two thousand people died immediately and another eight thousand died later. Health officials, not informed about chemicals at the factory, were completely unprepared for the tragedy. Congressional hearings that followed the Bhopal accident revealed that U.S. companies routinely discharged hazardous chemicals into the air, while emergency planners knew little about the potential for disaster at local industrial facilities.

In 1990, amendments to the Clean Air Act required industrial chemical companies to submit a risk management plan that included "worst case" chemical accident scenarios. Industry leaders did not want these potential disasters made public and argued that they could alert terrorists which facilities to target. In July 2002, the Senate's Environment and Public Works Committee approved a bill to identify plants vulnerable to terrorist attacks that produce hazardous chemicals.

To help emergency responders know what they are dealing with, the Department of Transportation (DOT) has established a hazardous materials placard system. Rail cars and trucks carrying toxic or dangerous materials must display a diamond-shaped sign having on it a material identification number, which can be looked up to determine what hazardous materials are on board, and a hazard class number and symbol that tells whether the contents are flammable, explosive, corrosive, etc. Color codes also convey instant information: blue (health), red (flammability), yellow (reactivity), white (special notice).

The placard system is as follows:

- Hazard class 1: Explosives (class 1.1-1.6, compatibility groups A–L)
- Hazard class 2: Gases (nonflammable, flammable, toxic gas, oxygen, inhalation hazard)
- Hazard class 3: Flammable liquids
- Hazard class 4: Flammable solids (flammable solid, spontaneously combustible, dangerous when wet)
- Hazard class 5: Oxidizer and organic peroxide
- Hazard class 6: Toxic/poisonous and infectious substances labels (PG III, inhalation hazard, poison, toxic)
- Hazard class 7: Radioactive (I, II, III, and fissile)
- Hazard class 8: Corrosive
- Hazard class 9: Miscellaneous dangerous goods

Major Chemical Accidents in India:

Following the Bhopal Gas Disaster in 1984, major incidences of chemical disasters in India include

- A fire in an oil well in Andhra Pradesh (2003);
- A vapour cloud explosion in the Hindustan Petroleum Corporation Limited Refinery (HPCL), Vishakhapatnam (1997); and an explosion in the Indian Petrochemicals Corporation Limited (IPCL) Gas Cracker Complex, Nagothane, Maharashtra (1990).
- Over 20 major chemical accidents have been reported in MAH units during 2002–06.

Nuclear disasters

The developing country like India with large population density, nuclear power will play an important role for sustainable supply of energy. There are now 439 nuclear reactors in operation around the world in over 30 countries, providing almost 16% of the world's electricity. Nuclear power is the fourth-largest source of electricity in India after thermal, hydro and renewable sources of electricity. As of 2010, India has 20 nuclear power plants in operation generating 4,780 MW while 5 other are under construction and are expected to generate an additional 3,900 MW. India's nuclear power industry is undergoing rapid expansion with plans to increase nuclear power output to 63,000 MW by 2032. Only Nuclear Energy offers Emission free energy on the massive and expanding scale the world so urgently requires. Moreover nuclear energy is considered to be an environmentally benign source of energy. **Nuclear fission** and **nuclear fusion** are the major techniques of nuclear power generation.

Nuclear reactors are fueled by naturally occurring uranium-235 whose nuclei split, when struck by neutrons. This process releases enormous amount of heat energy which is then used to power steam turbines and generate electricity. In conventional reactors, uranium releases about 20,000 times as much heat energy as an equivalent weight of coal. However, the more efficient breeder reactors may release as much as 1,500,000 times the heat energy of coal per unit weight of fuel. Nuclear reactors produce very little air and water pollution. As uranium is a concentrated form of energy, less strip mining is required and, therefore, less land is disturbed. The cost of transporting nuclear fuels is considerably less than an equivalent amount of coal. The use of nuclear fuels to generate electricity can save on coal, which can be used to generate synthetic liquid and gaseous fuels. This could result in stretching the supplies of petroleum and natural gas.

Nuclear Disasters

However, the risks associated with nuclear power are contamination of environment with radioactive wastes, thermal pollution and impact of radiation on health, limited supplies of uranium ore, high construction costs and dangers of accidents. Of all the environmental disaster events that humans are capable of causing, nuclear disasters have the greatest damage potential. The radiation release associated with a nuclear disaster poses significant **acute** and **chronic** risks in the immediate environs and chronic risk over a wide geographic area. Radioactive contamination, which typically becomes airborne, is long-lived, with **half-lives** guaranteeing contamination for hundreds of years. Concerns over potential nuclear disasters center on nuclear reactors, typically those used to generate electric power. Other concerns involve the transport of nuclear waste and the temporary storage of **spent radioactive fuel** at nuclear power plants. The fear that terrorists would target a radiation source or create a "dirty bomb" capable of dispersing radiation over a populated area was added to these concerns following the 2001 terrorist attacks on New York City and Washington, D.C.

Health hazards:

Radioactive wastes produced from the nuclear reactors cause health hazards in living things. The particulate and electromagnetic radiations emanating from radioactive materials inflict deleterious effects on the living cells. These effects are classified as "somatic" and "genetic effects". Somatic effects are caused on the exposed individuals and the cell damage caused may manifest in malignancies such as leukemia or cancer. Genetic effects are transmitted to the descendants of exposed individuals and thus can affect unexposed generation too.The radiation –induced changes in the genes may manifest themselves

in **a**. Gene mutations**, b.** Chromosome aberrations and **c.** Changes in the number of chromosomes. Such changes can result in abnormalities in the offsprings which may be mild or lethal.

The extent of damage is maximum in the reproductive organs, block forming tissues, the digestive tract and developing embryos which are called radiosensitive organs. Biochemical wastes originate from hospitals, clinics result in spreading of diseases. Radioactive emissions of particular concern include **strontium-90** and **cesium-137**, both having thirty-year-plus half-lives, and **iodine-131**, having a short half-life of eight days but known to cause thyroid cancer. In addition to being highly radioactive, **cesium-137** is mistaken for **potassium** by living organisms. This means that it is passed on up the food chain and **bioaccumulated** by that process. **Strontium-90** mimics the properties of **calcium** and is deposited in bones where it may either cause cancer or damage bone marrow cells.

Major Nuclear Accidents:

Chernobyl, Soviet Union (now Ukraine) April 26, 1986

INES Rating: 7

The Chernobyl nuclear accident is widely regarded as the worst accident in the history of nuclear power. It is the only nuclear accident that has been classified a "major accident" by the International Atomic Energy Agency. During a routine test, the plant's safety systems were turned off to prevent any interruptions of power to the reactor. The reactor was supposed to be powered down to 25 percent of capacity, but this is when the problems began. The reactor's power fell to less than one percent, and so the power had to be slowly increased to 25 percent. Just a few seconds after facility operators began the test, however, the power surged unexpectedly and the reactor's emergency shutdown failed. What followed was a full-blown nuclear meltdown. The reactor's fuel elements ruptured and there was a violent explosion. The fuel rods melted after reaching a temperature over 3,600 degrees Fahrenheit. The graphite covering the reactor then ignited and burned for over a week, spewing huge amounts of radiation into the environment. About 200,000 people had to be permanently relocated after the disaster. IAEA reported in 2005 that 56 deaths could be linked directly to the accident. Forty-seven of those were plant workers and nine were children who died of thyroid cancer. The report went on to estimate that up to 4,000 people may die from long-term diseases related to the accident. Those numbers are a subject of debate, however, as the Soviet Union did much to cover up the extent of the damage. The World Health Organization reported the actual number of deaths related to Chernobyl was about 9,000.

Windscale Fire, Great Britain Oct. 10, 1957

INES Rating: 5

Great Britain's first foray into nuclear energy had been successful for several years before the Windscale fire occurred in 1957. Operators noticed that the reactor's temperature was steadily rising when it should have been decreasing. They originally suspected the equipment was malfunctioning, so two plant workers went to inspect the reactor. When they reached the reactor, they discovered it was engulfed in flames. At first, they did not use water, because plant operators were worried the flames were so hot the water would break down instantly, and the hydrogen in the water would cause an explosion. But their other methods to put out the fire did not work, and so they turned on the hoses. The water was able to put the fire out without an explosion. It is estimated that 200 people in Britain developed cancer because of Windscale, half of them fatal. The exact number of fatalities is hard to come by because the British government attempted to cover up how serious the fire had been. Prime Minister Harold

Macmillan worried the incident would embarrass the British government and erode public support for nuclear projects. It's also difficult to put an exact number on the deaths because radiation from Windscale spread hundreds of miles across northern Europe.

Tokaimura, Japan Sept. 30, 1999

INES Rating: 4

Japan's most disastrous nuclear accident took place over a decade ago just outside Tokyo. A batch of highly-enriched uranium was prepared for a nuclear reactor that had not been used in more than three years. The operators had not been trained in how to handle uranium that was so highly enriched. They put far more uranium into the solution in a precipitation tank than is allowed. The tank was not designed for this type of uranium. Only when the tank was drained of the solution could the critical reaction be stopped, but by then, it was too late for two of the three operators working with the uranium, as they died of radiation. Less than a hundred workers and people who lived nearby were hospitalized for exposure to radiation, and 161 people who lived within 1,000 feet of the plant were evacuated, according to the World Nuclear Association.

Biological Disaster

A biological disaster may have a considerable impact in terms of human life, disability, quarantine, treatment costs and disposal of deceased persons in addition to long term environmental and economic consequences. It is important to recognise that biological disasters may be naturally occurring events (e.g. an influenza pandemic) or a deliberate event (biological terrorism). Looking back on history, we find that human beings have suffered from many biological disasters. Examples: infectious diseases such as cholera, plague, and small pox. Medical advances reduced the damages from some of infectious diseases, yet many remain to be conquered. Highly pathogenic avian influenza, a disease in birds occurring repeatedly since ancient times, is now found worldwide.

A World Health Organization (WHO) announced on February 15, 2007 that of 273 bird flu victims in 11 countries in Asia, the Middle East, and Africa, 166 have died. Since bird flu does not spread easily to human beings, the number of victims is limited. Once it mutates to a new strain of virus, however, it may be transmitted so easily that it could cause a large number of deaths.Many such cases have actually occurred in the past. The worst historically recorded ones involved Spanish flu, which started in 1918 during World War I among French and German soldiers and spread globally, resulting in 20 million to 60 million deaths. Spanish flu - said to have been named after its effects on the Spanish royal family - is known to have caused the highest number of deaths of any single infection. More than 30 types of emerging infectious diseases have recently been discovered including Lassa virus, Ebola virus, and ***Helicobacter pylori*** which causes stomach ulcers and stomach cancer. Among them, human immunodeficiency virus (HIV), which causes AIDS, has produced 30 million victims globally since its discovery in Los Angeles in 1981. We have experienced **biological terrorisms**, which are intentionally-causedbiological disasters by human. For example, the terrorist sent ***anthrax bacillus*** through the mail in the United States in 2001 - an act killed 5 people. WHO has warned that smallpox virus, plague bacillus, and **botulinum toxin** could also be used in bioterrorism.

Manmade Disaster - Building fire, coal fire, oil fire, forest fire and deforestation

Building Fires

A **Building fire** is a fire involving the structural components of various types of residential, commercial or industrial buildings, such as barn fires. Residential buildings range from single-family detached homes and townhouses to apartments and tower blocks, or various commercial buildings ranging from offices to shopping malls. This is in contrast to "room and contents" fires, chimney fires, vehicle fires, wildfires or other outdoor fires. Buildings-fires are the most common among the fire disasters. Increasing "population, increasing concentrations of population in closely built small houses or jhuggi jhoparpatties or in multi-storeyed buildings in cities, increase the fire hazard. Unnecessary accumulation of combustible or inflammable articles or hazardous material add to the danger.

Hotels and Cinema houses need special mention in this context. Lack of water or equipment for fire fighting allows the fires to burn fiercely. Hot and dry seasons add to the possibility of fires as also the careless use of electrical equipment, naked wires and loose joints. An electric short-circuit or a spark is often responsible for large-scale fire disasters the like of which are reported every summer from many cities. A large number of building fires owe their origin to the residents smoking in bed and falling asleep while smoking. Accidents in kitchens are also among the major causes of fire in buildings. In their start and further spread, the fires in buildings are as varied as the buildings themselves. For example, buildings can house residential units or apartments, hotels, schools, colleges, hostels, laboratories, business houses, industrial establishments and factories, stores and shops. Buildings may be closely situated in a colony or be independent bunglows or farmhouses with considerable vacant area around. Buildings could also be multi-storeyed. Heating systems and air-conditioning plants, especially in large and tall multi-storeyed buildings add to the fire hazard. The air conditioning ducts offer easy path for fumes, gases and smoke to be conveyed to other parts of the building quickly and false ceilings of inflammable material add to the hazard.

In fact, choking due, to smoke-or-soot is the cause for the majority of deaths in a fire incident. As indicated above, the electric installations and the wiring can cause fire in buildings when these get heated due to overload. People often do not realize that putting extra electrical load above the permissible limit causes overheating or break in the insulation in the electrical equipment which can either result in a spark or explosion or burn due to overheating.

Fires in Hospital

A fire broke out in a **Kolkata** AMRI hospital on 9 December, 2011. The fire spread fast from the basement of the hospital, engulfing one ward after the other and trapping hundreds of people. Around 25 fire engines was rushed to the spot. The fire fighters were seen using hydraulic ladders to rescue the patients and office staff by cutting open the glasses with gas cutters. 89 patients including three hospital staffers had lost their life in the incident. Out of the 150 admitted patients in the hospital, 90 were rescued. Emami shares fell down by 1.71% on the day incident took place.

Coal Fires

Coal is a common and cheap source of energy and is utilized through the process of burning. In other words, coal needs to be burnt so that it can be utilized as a source of energy. But this property of coal makes it a hazardous substance when large amounts of coal burn accidentally and without much control on the resultant coal fire. Coal fires are a serious health and safety hazard, affecting the environment by releasing toxic fumes, reigniting grass, brush, or forest fires, and causing subsidence of surface infrastructure such as roads, pipelines, electric lines, bridge supports, buildings, and homes. Whether started by humans or by natural causes, coal seam fires continue to burn for decades or even centuries until either the fuel source is exhausted, a permanent groundwater table is encountered, the depth of the burn becomes greater than the ground's capacity to subside and vent, or humans intervene. Because they burn underground, coal seam fires are extremely difficult and costly to extinguish, and are unlikely to be suppressed by rainfall. There are strong similarities between coal fires and peat fires. Across the world, thousands of underground coal fires are burning at any given moment. The problem is most acute in industrializing, coal-rich nations such as China. Global coal fire emissions are estimated to cause 40 tons of mercury to enter the atmosphere annually, and to represent three percent of the world's annual CO_2 emissions.

Thus, coal fire can occur either in large stocks of coal (coal pits or coal dumps) or in coal mines below the ground surface. Therefore, the coal mining areas such as those in Bihar, West Bengal, Orissa and Madhya Pradesh and Andhra Pradesh are prone to such disasters. Coal fires generally get started through negligence or ignition of combustible gases. Sometimes, soft coal (especially in deep mines or big dumps) gets so hot due to gases that it may itself start a coal fire (without an external source of fire or ignition) particularly when the atmosphere around is very hot and dry. Such occurrences are called "self- ignition".

In many areas of coal mines (e.g., Jharia in Bihar), there are underground fires burning in coal mines for decades and travelling along the coal-bearing areas below the ground. Such instances transmit considerable heat to the ground surface which often cracks and emits gases and smoke which heat and pollute the area and make it unfit for living. Thus, coal fires burning inside coal mines cause, double destruction - firstly by destroying the coal inside the mine and secondly by making the area on the ground surface hot, polluted and unfit for living.

Oil well Fires and oil fire

Oil well fires are more difficult to extinguish than regular fires due to the enormous fuel supply for the fire. Oil well fires can be the result of human actions, such as accidents or arson, or natural events, such as lightning. They can exist on a small scale, such as an oil field spill catching fire, or on a huge scale, as in geyser-like jets of flames from ignited high pressure wells. A frequent cause of a well fire is a high-pressure blowout during drilling operations.

Inflammable liquids such as kerosene oil, diesel, petrol, spirit, liquor, ghee, other oils, paints, tar and certain chemicals are prone to fires which can be grouped together in the category of "oil fires". Such liquids catch fire easily through naked flame or an electric spark. Then they burn on the surface and spread out, thus spreading the flame's as well. If the oil is in a container, there could be the vapours of the oil and these are also inflammable. This could lead to an explosion in the container. In fact, many such inflammable liquids are also prone to self-ignition because they undergo oxidation on coming in

contact with the oxygen in the air. This heats the liquid. If the temperature rises enough, the "flash point" is reached when the liquid starts burning by itself.

Therefore, such hazardous liquids of oils are stored carefully away from residential areas or crowded places. Further, good air circulation, cooling and ventilation is to be ensured to avoid the danger of oil fires. Petrol storage depots, airports, and oil tankers are/particularly vulnerable sites.

Gas Fires

The increasing use of cooking gas in houses and hotels both in cylinders and through pipes is indeed a fire hazard. This gas is also used in cars in some cases. Compressed Natural Gas (CNG) is being introduced in a big way in public buses. These gases are mostly supplied in compressed form and transported by trucks. Some industrial gases are also inflammable. All these constitute a widespread fire hazard.

FOREST FIRE

The most common hazard in forests is forests fire. Forests fires are as old as the forests themselves. They pose a threat not only to the forest wealth but also to the entire regime to fauna and flora seriously disturbing the bio-diversity and the ecology and environment of a region. During summer, when there is no rain for months, the forests become littered with dry senescent leaves and twinges, which could burst into flames ignited by the slightest spark. The Himalayan forests, particularly, Garhwal Himalayas have been burning regularly during the last few summers, with colossal loss of vegetation cover of that region. Forest fire causes imbalances in nature and endangers biodiversity by reducing faunal and floral wealth. Traditional methods of fire prevention are not proving effective and it is now essential to raise public awareness on the matter, particularly among those people who live close to or in forested areas.

Causes of forest fire

Forest fires are caused by Natural causes as well as Manmade causes

- Natural causes- Many forest fires start from natural causes such as lightning which set trees on fire. However, rain extinguishes such fires without causing much damage. High atmospheric temperatures and dryness (low humidity) offer favorable circumstance for a fire to start.
- Manmade causes- Fire is caused when a source of fire like naked flame, cigarette or bidi, electric spark or any source of ignition comes into contact with inflammable material.

Traditionally Indian forests have been affected by fires. The menace has been aggravated with rising human and cattle population and the consequent increase in demand for Forest products by individuals and communities. Causes of forest fires can be divided into two broad categories: *environmental* (which are beyond control) and *human related* (which are controllable).

Environmental causes are largely related to climatic conditions such as temperature, wind speed and direction, level of moisture in soil and atmosphere and duration of dry spells. Other natural causes are the friction of bamboos swaying due to high wind velocity and rolling stones that result in sparks setting off fires in highly inflammable leaf litter on the forest floor.

Human related causes result from human activity as well as methods of forest management. These can be intentional or unintentional, for example:

- Graziers and gatherers of various forest products starting small fires to obtain good grazing grass as well as to facilitate gathering of minor forest produce like flowers of *Madhuca indica* and leaves of *Diospyros melanoxylon*
- The centuries old practice of shifting cultivation (especially in the North-Eastern region of India and inparts of the States of Orissa and Andhra Pradesh).
- The use of fires by villagers to ward off wild animals
- Fires lit intentionally by people living around forests for recreation
- Fires started accidentally by careless visitors to forests who discard cigarette butts.

The causes of forest fire have been increasing rapidly. The problem has been accentuated by the growing human and cattle population. People enter forests ever more frequently to graze cattle, collect fuelwood, timber and other minor forest produce. It has been estimated that 90% of forest fires in India are man-made

EFFECT OF FOREST FIRE

Fires are a major cause of forest degradation and have wide ranging adverse ecological, economic and social impacts, including:

- Loss of valuable timber resources
- Degradation of catchment areas
- Loss of biodiversity and extinction of plants and animals
- Loss of wildlife habitat and depletion of wildlife
- Loss of natural regeneration and reduction in forest cover
- Global warming
- Loss of carbon sink resource and increase in percentage of CO2 in atmosphere
- Change in the microclimate of the area with unhealthy living conditions
- Soil erosion affecting productivity of soils and production
- Ozone layer depletion
- Health problems leading to diseases

- Loss of livelihood for tribal people and the rural poor, as approximately 300 million people are directly dependent upon collection of non-timber forest products from forest areas for their livelihood.

The needs of the fire management

The incidence of forest fires in the country is on the increase and more area is burned each year. The major cause of this failure is the piecemeal approach to the problem. Both the national focus and the technical resources required for sustaining a systematic forest fire management programme are lacking in the country. Important forest fire management elements like strategic fire centres, coordination among Ministries, funding, human resource development, fire research, fire management, and extension programmes are missing. Taking into consideration the serious nature of the problem, it is necessary to make some major improvements in the forest fire management strategy for the country. The Ministry of Environment and Forests, Government of India, has prepared a National Master Plan for Forest Fire Control. This plan proposes to introduce a well-coordinated and integrated fire-management programme that includes the following components:

- Prevention of human-caused fires through education and environmental modification. It will include silvicultural activities, engineering works, people participation, and education and enforcement. It is proposed that more emphasis be given to people participation through Joint Forest Fire Management for fire prevention.
- Prompt detection of fires through a well coordinated network of observation points, efficient ground patrolling, and communication networks. Remote sensing technology is to be given due importance in fire detection. For successful fire management and administration, a National Fire Danger Rating System (NFDRS) and Fire Forecasting System are to be developed in the country.
- Fast initial attack measures.
- Vigorous follow up action.
- Introducing a forest fuel modification system at strategic points.
- Firefighting resources.

Each of the above components plays an important role in the success of the entire system of fire management. Special emphasis is to be given to research, training, and development

Integrated forest protection

The main objective of this scheme to control forest fires and strengthen the forest protection in Tamilnadu. The works like fireline clearing, assistance to Joint Forest Management committees, creating water bodies, purchase of vehicles and communication equipments, purchase of firefighting tools, etc., are being undertaken.

Deforestation

Deforestation is the permanent destruction of indigenous forests and woodlands. The term does not include the removal of industrial forests such as plantations of gums or pines. Deforestation has resulted in the reduction of indigenous forests to four-fifths of their pre-agricultural area. Indigenous forests now cover 21% of the earth's land surface. Of great concern is the rate at which deforestation is occurring. The **World Resources Institute** regards deforestation as one of the world's most pressing land-use problems.

An area of forest equal to 20 football or rugby fields is lost every minute. Currently, 12 million hectares of forests are cleared annually. Almost all of this deforestation occurs in the moist forests and open woodlands of the tropics. At this rate all moist tropical forest could be lost by the year 2050, except for isolated areas in Amazonia, the Zaire basin, as well as a few protected areas within reserves and parks. Some countries such as Ivory Coast, Nigeria, Costa Rica, and Sri Lanka are likely to lose all their tropical forests in near future if no conservation steps are taken. South Africa's climate is such that less than 0.5% of its surface area is covered with indigenous forest - great care should be taken to conserve the little we have.

General causes of deforestation

Deforestation is brought about by the following:

- Conversion of forests and woodlands to agricultural land to feed growing numbers of people;
- Development of cash crops and cattle ranching, both of which earn money for tropical countries;
- Commercial logging (which supplies the world market with woods such as teak, mahogany and ebony) destroys trees as well as opening up forests for agriculture;
- Felling of trees for firewood and building material; the heavy lopping of foliage for fodder; and heavy browsing of saplings by domestic animals like goats.
- To compound the problem, the poor soils of the humid tropics do not support agriculture for long. Thus people are often forced to move on and clear more forests in order to maintain production.

Manmade Disaster - Air pollution, water pollution, Industrial wastewater pollution

Air pollution

Air pollution occurs when harmful or extreme quantities of substances comprising gases and particulates (both organic and inorganic), and biological molecules are introduced into Earth's atmosphere. It may cause diseases, allergies and even death to humans; it may also cause harm to other living organisms such as animals and food crops, and may damage the natural or built environment. Both human activity and natural processes can generate air pollution. Indoor air pollution and poor urban air quality are listed as two of the world's worst toxic pollution problems in the 2008 - Blacksmith Institute World›s Worst Polluted Places report. Outdoor air pollution alone causes 2.1 to 4.21 million premature deaths annually. According to the 2014 World Health Organization report, air pollution in 2012 caused the deaths of around 7 million people worldwide, an estimate roughly echoed by the International Energy Agency.

Particularly in the south Asian urban areas have significant problems with smog derived from vehicle discharges and industrial gases that react in the atmosphere with sunlight to form secondary pollutants that also combine with the primary emissions to form photochemical smog. Further, large amounts of coal burning casus smog by which produces a mixture of smoke and sulfur dioxide. Rapidly growing urbanizations in exact to the south Asian mega cities consequences large consumption of energy and other resources, which contributes to the severe air pollution. The megacity pollution discharge plumes contain high levels of criteria pollutants (e.g. Particulate matter, NOx, SO2,), greenhouse gases, ozone precursors and aerosols which affect the air in a local, regional and global level. Indoor air pollution and poor urban air quality are listed as two of the world's worst toxic pollution problems (WHO, 2014). The monetary value of air pollution is assessed at 0.5 to 2.5% of the world gross national product or some $150–750 billion every year (Klaus Topper, 2004). According to the 2014 WHO report, air pollution in 2012 affected the deaths of around 7 million persons worldwide (WHO 2014). Further, it damages the natural environment.

Definition of Air Pollution:

Air pollution may be defined as the presence in the outdoor atmosphere of one or more contaminants or combinations thereof in such quantities and of such duration as may be or may tend to be injurious to human, plant or animal life or property or which unreasonably interferes with the comfortable enjoyment of life or property or the conduct of business.

Distinct categories of air pollution:

In the broadest context, air pollution exists in **three** distinct categories:

Personal air pollution: exposure to dust, fumes and gases to which an individual exposes himself when he indulges in smoking like cigarette, cigar. Looks pose little problem, but potential hazard is serious. So give up smoking.

Occupational air pollution: exposure to potentially harmful concentrations of aerosols, vapors and gases in their working environment.

Community air pollution: most complex of the three varieties since it involves a varied assortment of pollution sources and contaminants, meteorological factors, also social, economic and health effects. Affects total environment say plants, animals etc.

Sources of Air Pollution - Classification

- **Based on chemical nature**, classified as

I. General primary pollutants:

(1.) Particulate matter, (2.) Sulfer compounds, (3.) Organic compounds, (4.) Nitronen compounds, (5.) Carbon compounds, (6.) halogen compounds and (7.) Radioactive compounds. Particulate matter is a term employed to describe dispersed airborne solid and liquid particles larger than single molecules (0.0002 μ in dia) but smaller than 500 μ (1μ = 10-4 cm). Particles in this size range have a lifetime in suspension varying from a few seconds to several months.

II. **Secondary pollutants** like proxy acyl nitrate (PAN), ozone and photochemical smog are derived from the primary pollutants due to chemical or photochemical reactions in the atmosphere.

- **Classification of particles based on the state of matter is given below:**

Particulate pollution, Gaseous pollutants, Aerosols, Dust, Smoke, Soot, Fumes, Mist, Fog and Haze.

Sources of Pollutants:

The major cause for air pollution is combustion which is the major process in most of the industries. Each year industrially developed countries generate billions of tons of pollutants. Many come from directly identifiable sources, SO2 for example comes from electric power plants burning coal or oil. Others are formed through the action of sunlight on previously emitted reactive materials (called precursors). For example, ozone, a dangerous pollutant in smog, is produced by the interaction of hydrocarbons and nitrogen oxides under the influence of sunlight. Ozone has also caused serious crop damage. On the other hand, the discovery in the 1980's that air pollutants such as fluorocarbons are causing a loss of ozone from the earth's protective ozone layer has caused the phasing out of these materials.

The combustion of coal, oil and petrol accounts for much of the airborne pollutants. More than 80 % of the SO2, 50 % of NO2 and 30 to 40 % of the particulates matter emitted to the atmosphere are produced by fossil –fuel- fired electric power plants, industrial boilers and residential furnaces. Eighty per cent of CO and 40 % of the Nitrogen oxides and hydrocarbons come from burning petrol and diesel in cars and lorries. Other major pollution sources include iron and steel mills; zinc and copper smelters; municipal incinerators; oil refineries; cement plants; and nitric and sulphuric acid plants.

Critical air pollutants in the cities and urban area

Criteria pollutants

There are six traditional **criteria pollutants**. They include fine particulates, carbon monoxide, sulfur dioxide, nitrogen dioxide, ozone, and lead. Except for lead, criteria pollutants are emitted in industrialized countries at very high rates, typically measured in millions of tons per year. All except ozone are discharged

directly into the atmosphere from a wide variety of sources. They are regulated primarily by establishing ambient air quality standards, which are maximum acceptable concentrations of each criteria pollutant in the atmosphere, regardless of their origin. Hazardous air pollutants are emitted in smaller amounts than are the criteria pollutants, usually from specific industrial activities. They are regulated primarily by emission standards, which are maximum allowable rates at which each air pollutant can be discharged from a particular source. Although the total emissions and the number of sources of these pollutants are small compared with those for criteria pollutants, hazardous air pollutants can pose an immediate health risk to exposed individuals and can cause other environmental problems.

Sulfur dioxide (SO2)

The Delhi mega city is among the top five SO_2 releasing megacities in the early nineties (Garg, A, 2001). It has been valued for megacity Mumbai that annual SO2 discharges from all sources are 55 Gg during the year 2010 (Bhanarkar, A.D, 2005). According to Nagpure et al., (2010) in 2010 transport sector is accountable for about 20 Gg of SO2 emissions of different categories of vehicle in Kolkata. Hence, a declining trend has been noticed since 2000 after CNG putting into practice has largely influenced the declining SO2 emission from the transport sector which can also be seen in trend analysis of SO2 ambient absorption in the south Asian mega cities (Kandlikar, M., 2007).

Oxides of nitrogen (NOx)

The Kolkata mega city is one of the largest NOx emitting urban focal point in India and major sources includes vehicles, emissions from local industries (including power generating plants) and the burning of fossil fuels (Mondal, R, 2000). Gurjar stated that the total NOx release from various sources ranges from 66 to 74% (transport sector), 13 to 29% (industrial sector), and 1 to 2% (domestic and other sources). However, the NOx levels are lower in Mumbai than Delhi as the public is more reliant on mass transport (local trains, buses etc.) than personal vehicles as in case of Delhi.

Particulate matter

The air pollutants in megacities were influenced by meteorological conditions which determined the formation mechanisms and seasonal variations of ozone (O3) and Particulate Matter (Jiang, F 2012). The main causes of SPM and PM10 are domestic coal burning, transportation, small scale industries, thermal power plants, , and biomass burning (cowdung, crop residue) (Gurjar, B.R, 2004); in Delhi, among all the industries, power plants were the largest contributors to SPM emissions and increased from 131 Gg in 1990 to 150 Gg in 2000. Transport added about 19% to SPM emission in the year 2000 and its emission doubled from 15 Gg in 1990 to 28 Gg in 2000 (Gurjar, B.R, 2004). Despites these anthropogenic sources natural source like dust from Thar Desert of adjoining Rajasthan state (Ravindra, K.,2003) also the major contributor of significant amount of particulate matter to Delhi's local air.

Further, in case of PM10, major contributions originate from vehicular exhaust plus re-suspension from roads (39%), non-combustion industrial sources such as stone crushing, construction, refuse-burning (26%), industrial oil-burning (18%) and domestic/commercial fuel burning e.g., wood, kerosene, liquefied petroleum gas (14%) (Larssen, S 1997). The World Bank (1997) suggests that motor vehicles accounts for nearly 35% of particulate emissions in Greater Mumbai. The Asian Development Bank (ADB, 2005) study found that the total annual PM10 emission in Kolkata was 76 Gg during 2003 with major contributions by road dust (61%) followed by vehicles (21%), industries and power plants (9%)

and other sources 9% (such as biomass burning, railway, domestic cooking light distillate oil burning, coal fuel kilns in brick industry).

Polycyclic Aromatic Hydrocarbons (PAH)

The Polycyclic Aromatic Hydrocarbons PAHs are a group of 100 different chemical compounds consisting of two to seven merged aromatic rings. It accounts for carcinogenic and pro-mutagenic effects on animal and human (Ravindra, K, 2001). Some of PAHs are semi-volatile in nature and can exist only in vapour phase while the rest exist mostly in particle phase (Ravindra, K 2001). Seasonal average absorptions of PAH were found to be maximum in winter and minimum during the monsoon in Delhi (Sharma, H 2007). In Delhi, the PAH concentration decreased around 50% after the implementation of CNG. Venkataraman (2001) quoted that automobile emissions are the likely primary contributors PAHs followed by some additional local sources i.e. cooking fuel combustion or industrial oil burning. Further, maximum PAH concentration was observed in winter season while minimum in monsoon.

Carbonmonoxide (CO)

The **Carbonmonoxide (CO)** is one of the significant sources of motor vehicle exhausts in the south Asian megacities (65). In Delhi, during 1990 to 2000, traffic contribution are one of themajor source (86%) of CO emission. (58). Nagpure et al., 2010 suggests that transport sector is responsible for about 111 Gg of CO emission in Kolkata, where two wheelers and cars sharing highest accountability (54). The comparison of annual average concentration before and after the implementation of CNG i.e. from 1998 to 2003, shows ~50% reduction in CO concentration in the Delhi mega cities (66).

Greenhouse gases

As per Intergovernmental Panel on Climate Change (IPCC), carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4), hydro fluorocarbons (HFCs), sulfur hexafluoride (SF6), per fluorocarbons (PFCs) and are the foremost greenhouse gases. Among the GHG's, carbon dioxide is the most dominant gas make happen global warming which accounts for nearly 77% of global total CO2 equivalent greenhouse gas (GHG) emissions (IPCC 2007). India figures among the top 10 contributors to greenhouse gas emissions (ADB, 2005). In the south Asian cities, transportation sector is one of the major anthropogenic contributors of greenhouse gases (Sharma, 2004). Agricultural sector contributes approximately 50% of N2O emissions (Gurjar et al., 2004). India is third biggest greenhouse gas emitter contributing about 5.3% of the total global emissions. The increasing interest in quantification of greenhouse gas emissions comes as a result of growing public awareness of global warming. Many global metropolitan cities and organizations are estimating their greenhouse gas emissions and developing strategies to reduce their emissions.

Effect of air pollution

General effects: Often the first noticeable effects of pollution are aesthetic and may not necessarily be dangerous. These includes visibility reduction due to tiny particles suspended in air, or bad odours such as the rotten egg smell produced by hydrogen sulphide emanating from pulp and paper mills. It causes respiratory problems and diseases in human beings. The other adverse effects of air pollution are potential injury to livestock and crops. The effects of long term exposure to low concentrations are not well defined; however, those most at risk are the very young, the elderly, smokers, workers whose jobs expose them to toxic materials and people with heart or lung disease.

How can air pollution hurt human health?

Air pollution can affect our health in many ways with both *short-term* and *long-term* effects. Different groups of individuals are affected by air pollution in different ways. Some individuals are much more sensitive to pollutants than are others. Young children and elderly people often suffer more from the effects of air pollution. People with health problems such as asthma, heart and lung disease may also suffer more when the air is polluted.

The extent to which an individual is harmed by air pollution usually depends on the **total exposure** to the damaging chemicals, i.e., the *duration of exposure* and the *concentration of the chemicals* must be taken into account. Examples of **short-term effects** include irritation to the eyes, nose and throat, and upper respiratory infections such as bronchitis and pneumonia. Other symptoms can include headaches, nausea, and allergic reactions. Short-term air pollution can aggravate the medical conditions of individuals with asthma and emphysema. Examples: Air pollution episode "Smog Disaster". **Long-term health effects** can include chronic respiratory disease, lung cancer, heart disease, and even damage to the brain, nerves, liver, or kidneys. Continual exposure to air pollution affects the lungs of growing children and may aggravate or complicate medical conditions in the elderly. It is estimated that half a million people die prematurely every year in the United States as a result of smoking cigarettes. Research into the health effects of air pollution is ongoing. Medical conditions arising from air pollution can be very expensive.

Large scale effects: The tall smokestacks used by industries and utilities do not remove pollutants but simply boost them higher into the atmosphere, thereby reducing their concentration at the site. These pollutants may then be transported over large scale distances and produce adverse effects in areas far from the site of the original emission. Sulphur dioxide and nitrogen oxide emissions from British are causing acid rain in Norway and Sweden. The pH or relative acidity of many fresh water lakes has been altered so dramatically by **acid rain** that entire fish populations have been destroyed. sulphur dioxide emissions and the subsequent formation of sulphuric acid can also be responsible for the attack on limestone and marble at large distances from the source. **Ozone depletion** is another major problem.

The worldwide increase in the burning of coal and oil since the late 1940s has led to ever-increasing concentrations of CO2. The resulting "**green house effect**" which allows solar energy to enter the atmosphere but reduces the reemission of IR radiation from the earth, could conceivably lead to a **warming** (**Global warming**) trend that might affect the **global** climate and lead to a partial melting of the polar ice caps. Possibly an increase in cloud cover or absorption of excess carbon dioxide by the oceans (in the so called carbon cycle) would check the greenhouse effect before it reached the stage of polar melting.

Injury to vegetation: Air pollution causes a number of distinctive effects on foliage. Four general foliar markings that indicates the possible presence of air pollutants are

1. Necrosis and bleaching of intercoastal areas of leaf margin
2. Glazing or silvering of leaf surface
3. Chlorosis or loss of chlorophyll
4. Flecking or strippling on upper leaf surface.

The difficulty with this list is that similar markings may also be caused by sources other than pollution, such as disease or mineral deficiencies. Among the most frequently encountered gases toxic to vegetation

are sulphur dioxide, ozone, PAN, nitrogen dioxide, hydrogen fluoride, ethylene, hydrogen chloride, chlorine, hydrogen sulfide and ammonia.

Effects of atmospheric particulate matter on human health:

Particulate matter alone or in combination with other pollutants constitutes a very serious health hazard. The pollutants enter the human body mainly via the respiratory system. Damage to the respiratory organs may follow directly, since it has been estimated that over 50 % of the particles between 0.01 to 0.1 that penetrates into the pulmonary compartment will be deposited there.

Particulate matter may exert effect in one or more of the following ways.

I. Health:

1. The particle may be intrinsically toxic of its inherent chemical and /or physical characteristics.
2. The particle may interfere with one or more of the mechanisms which normally clear the respiratory tract.
3. The particle may act as a carrier of an absorbed toxic substance.

II**. Visibility and related atmospheric characteristics**: One of the most common air pollution effects is the reduction in visibility resulting from the absorption and scattering of light by air borne liquid and solid materials.

III. **Effects on materials, vegetation and animals**: Air borne particles can be chemically inert or active or inert but absorb active substances. Ex: physical damage by soiling painted surfaces, clothing: Ex. chemically corrosive nature.

IV. Effects on vegetation:

- Little is known about effects on vegetation.
- However cement kiln dust in combination with mist or light rain has been observed to form a crust on the leaves of plants.
- Flurosis in animals when F in particulate matter falls on vegetation.
- Similar effect also seen with Arsenic poisoning. Smog is a major pollutant in many air pollution episodes. Nitrogen oxides and secondary pollutants are harmful to both man and plants. The pollutant, NO2, a pungent gas that produces a brownish haze cause nose and eye irritations and pulmonary discomfort. The lower concentrations of ozone irritates the nose and throat, while concentrations of it cause dryness of the throat, headache and difficulty in breathing. Ozone, PAN and nitrogen dioxide severely injure many forms of plant life, destroying the cells of leaves, damaging the chloroplasts and interfering with the plants metabolic process.

History of significant air pollution events (Air pollution episodes)

Many of the worst air pollution episodes occurred in the last two centuries in **London**

- key ingredients - calm winds, fog, smoke from coal burning
- 1873 - 700 deaths

- 1911- 1150 deaths
- 1952 - over 4000 deaths

this last event prompted the parliament to pass a Clean Air Act in 1956 other events around the world:

- 1930 - **Meuse Valley** pollution became trapped in a narrow valley - 600 people became ill, 63 were killed**.** In the U.S., air quality degraded quickly shortly after the industrial revolution. Again, the problem was coal burning in the central and mid western U.S.
- 1948 - Donora, PA in the Monongahela River Valley
- five-day episode - 1000's became ill, 20 were killed. 1960s - NYC experience several dangerous episodes. 1960s-70s - Los Angeles - increase in industry and automobile usage led to many pollution episodes

The above events led to passing the **Clean Air Act of 1970** (updated in 1977 and again in 1990)

- empowered the federal government to set emission standards that each state would have to meet

Other negative effects:

Acid Rain

Acid rain and the acidification of fresh water have received considerable attention over the past 20 years, but the problem is not new. Example: Out of 87 lakes in southern Norway, 24 % had a pH < 5.5 in the year 1920-50 and 47 % in 1970-80 and thereby losing of fish population. The term acid rain does not convey the true nature of the problem and therefore scientists use the term "acid depositions". This is because the acid which has formed due to pollution may return to the earth as a solid or a gas and not just as rain. Depending upon the climatic conditions it could also come down as rain, fog, or snow, and in the wet form it is known as "acid precipitation".

Sources of acidity:

The main pollutant responsible for acid rain are sulphur dioxide **(SO2)** and the oxides of nitrogen **(NOx).** Certain industries, as well as emissions from vehicles give rise to increase of sulphur dioxide and nitrogen oxides in the air. These emissions change into sulphates and nitrates under the influence of sunlight and moisture, and get converted into sulphuric acid and nitric acid, which come down as acid rain.

Coal generally contains between 2 - 3 % sulphur, and when it is burned, this sulphur is released into the atmosphere. Electric companies and other industries which burn coal cause a lot of emission of sulphur dioxide. Other industries which process raw ore containing sulphides in order to obtain copper, zinc, or nickel also cause an increase in sulphur dioxide levels in the atmosphere. The major source of emissions of nitrogen oxides into the air, is from vehicles and other places where fossil fuels are burned. Forest fires, often caused by man, either deliberately or accidentally, are another source of pollution.

Naturally occurring phenomena like volcanic activity, lightning, or organic decay, also gives rise to an increase in atmospheric pollutants but not much can be done about these causes. However over 90% of sulphur dioxide emissions and around 95% of nitrogen oxides released into the air are from man made sources. Around 60 % of the **SO2** is derived from power station and 30 % from industrial plants. For N, it is 45 % from power station and 30 % from vehicles. When **SO2** and **NOx** reach in the atmosphere,

they react with moisture and undergo oxidation, resulting in the formation of sulphuric and nitric acids which exists mainly in the clouds and fall to earth as rain or snow. Conversion rates are very rapid being approximately 100 % per hour in summer and 20 % per hour in winter.

In dry atmosphere, complex photochemical reaction involving highly reactive oxidising agents, such as ozone result in the production of sulphuric and nitric acid, conversion rates being approximately 16 % per day in summer and 3 % per day in winter, much slower than the reactions in a moist atmosphere. There is evidence that the whole atmosphere in the Northern hemisphere is more reactive than it was a few decades ago and this accelerates the process of acidification. Natural rainfall has a pH of around 6.0. This is because of the effect of Carbon dioxide in the air which combines with water to form carbonic acid. The effect of this is however negligible, as it is neutralised in the soil by alkaline material like limestone.

However the other emissions cause the pH of the rain water to drop below 5.5 and at this level it is considered to be acid rain. The soil cannot now neutralise the acidity of the rain water. In some places the acidification is so severe that the pH drops to around 4.0. Rare cases have been reported of acid rain having pH of around 2 - 2.5. As low as a pH of 2.32 was recorded in a rainfall sample in Pennsylvania (1978). Sulphuric acid contributes 70 % in the Northern Europe and 60 % in Eastern North America and the remainder being due to nitric acid. It is not a local problem but extended to several km away areas by wind blows. It is believed that around 50% of the acid rain that occurs in Canada is due to pollution caused in the United States of America, and the effect of polluting industries in England can be felt in Norway.

Acidification is most likely to occur when the bedrock is granite or gneiss and not of limestone. The acids naturally present in soil namely organic and carbonic acids are so called weak acids, but the dissociation is not the same extent as the strong acids (H+,SO42- and NO3-) which are derived from acid deposition. The transfer of acidity from soil to surface waters requires mobile negative ions (SO42- and NO3-) to bind to the acid H ions, then H displaces Na+, K+, Mg+ from exchange sites of soil particles. Due to this process, positively charged metals like Al causes its toxicity. Similarly heavy metals may also be mobilized. The SO4 ion thus efficiently transfers acidity from soil to surface waters. Diatom, typical of acid water dominate. When the bicarbonate buffer lost, then the acidification increases in the lakes.

Effects of acid rain on aquatic life:

The action of acid rain causes harmful elements like mercury and aluminium to be leached from the soil and rocks and it is then carried into the lakes where aquatic life may be affected. Warning signs have been posted at several lakes, telling about the dangers of eating fish which may have been poisoned by mercury (**Minamata epidemic**). Just as the soil has a natural ability to neutralise the acidity of rain water, within a certain limit, so also lakes and other water bodies can to a certain extent nullify the effects of acid rain.

However as the acidity increases, the natural mechanisms are no longer able to cope. As the water gets more acidic its pH goes down. As the pH reaches 5.5, plankton, certain insects and crustaceans begin to die. At a pH of around 5.0, the fish population begin to die. When the pH drops below 5.0, all the fish have died, and the bottom of the lake lies covered with undecayed material. Every year during the spring thaw, there is a sudden increase in the acidity of the lakes as frozen acid is suddenly deposited in them. This “Acid Shock” prevents the reproduction of aquatic species, or results in the deaths of the Hatchlings.

Effect of acidity on fish based on the pH Effect

The pH range between 4.5 to 4.9 - Harmful to the eggs of salmon and trout species (salmonids) and to adults when the levels of Ca, Na and Cl are low.

4.0 to 4.4 - harmful to many types of fishes

3.5 to 3.9 - lethal to salmonids

3.0 to 3.4 - Most fishes are killed within an hour.

High levels of Na and Cl ions are found in the blood plasma of **fish**. When Ca is present, it reduces the egress of Na and Cl and the ingress of H ions. The excessive loss of Na is the main cause of mortality in acid water. When the concentration of Na and Cl ions in the blood plasma falls by about a third, the body cells swell and extracellular fluids become more concentrated. Al is toxic to fish in the pH range of 5 to 5.5 and during episodes of acidity, Al ions are in high concentration. Al interferes with Ca thereby enhances Na loss. Al cause clogging of gills.

Reproductive failure is the cause in amphibians.

In Humans: Metals contaminated fish eating causes disorders. The drinking water of a number of cities is distributed through lead pipes and increased lead concentrations may result in blood and nervous disorders, reduced intellectual development and behavioural abnormalities in children. High concentration of Al leads to **osteomalacia**, a bone weakening disease. It also causes respiratory problems in animals too.

On plants: Both natural vegetation and crops are affected by acid rain. The roots are damaged by acidic rainfall, causing the growth of the plant to be stunted, or even in its death. Nutrients present in the soil, are destroyed by the acidity. Useful micro organisms which release nutrients from decaying organic matter, into the soil are killed off, resulting in less nutrients being available for the plants. The acid rain, falling on the plants damages the waxy layer on the leaves and makes the plant vulnerable to diseases. The cumulative effect means that even if the plant survives it will be very weak and unable to survive climatic conditions like strong winds, heavy rainfall, or a short dry period.

Effects on animals and birds:

All living organisms are interdependent on each other. If a lower life form is killed, other species that depended on it will also be affected. Every animal up the food chain will be affected. Animals and birds, like waterfowl or beavers, which depended on the water for food sources or as a habitat, also begin to die. Due to the effects of acid rain, animals which depended on plants for their food also begin to suffer. Tree dwelling birds and animals also begin to languish due to loss of habitat.

Associated effects such as reduction of visibility by acidic sulfate aerosols and the influence of sulfate aerosols on physical and optical properties of clouds.

All living things, whether plants or animals, whether living on land or in the water or trees, are affected either directly or indirectly by acid rain. Even buildings, bridges and other structures are affected. In cities, paint from buildings have peeled off and colours of cars have faded due to the effects of acid rain. From the Taj Mahal in India to the Washington Monument great buildings all over the world have been affected by the acid rainfall which causes corrosion, fracturing, and discoloration in the structures. In Europe,

structures like The Acropolis in Greece and Renaissance buildings in Italy, as well as several churches and cathedrals have suffered visible damage. In the Yucatan peninsula in Mexico, and in places in South America, ancient Mayan Pyramids are being destroyed by the acid rain. Temples, murals, and ancient inscriptions which had previously survived for centuries are now showing severe signs of corrosion. Even books, manuscripts, paintings, and sculpture are being affected in museums and libraries, where the ventilation system cannot eliminate the acid particles from the air which circulates in the building. In some parts of Poland, trains are required to run slowly, as the tracks are badly damaged due to corrosion caused by acid rainfall.

Mitigation Measures against the Airpollution :

It is necessity for Natural resources management and greening the cities to reduce the impact of air pollution, constructing accurate indicators and metrics for pollution control in the cities. Using cleaner fossil fuels, such as natural gas, burning these fuels more efficiently and increasing reliance over renewable sources of energy (hydro, solar, geothermal) are some of the best ways to control or reduce the air pollution without limiting economic growth to address the United Nations Sustainable Development Goals (SDGs). Further, creation of innovative ways to reduce the pollution through appropriate research studies and awareness programmes to improve the knowledge level to eradicate the air pollution issues. Finally, the Individual social responsibility is very important concern to reduce the air pollution in the cities and urban areas.

Transport regulations:

In Transport sector, introduction of cleaner fuels (e.g. unleaded gasoline, CNG, ultra-low sulfur diesel, LPG), upgraded engine technologies, alternate public transport (Delhi metro rail) to trim down the growing energy demand and emissions. Policies measures are suggested to reduce the air pollution in the South Asian mega cities. Further, introduction of electricity based vehicles to avoid the air pollution issues, shifting the fuel based vehicles to LPG based vehicles, Implementation of mandatory CNG for 3-wheelers and buses. Enhancement of the environment compensation charge on entrance of commercial vehicles in the megacity areas. Introduction of odd-even scheme in allowing private diesel and petrol driven cars to run on alternate days based on license plate number in the mega city areas.

Industrial pollution control strategies

Industrial emissions should be regulated under Environment Protection Acts. Which involves setting up of pollution controller equipment's to meet the emission guiding principle. Establishment of environmental clearance from Ministry of Environment has been to be mandatory for development projects through conducting Environmental Impact Assessment (EIA) study, public hearing and submitting eco-friendly statement near by the south Asian mega city regions. Moreover, other measured such as reduction in the sulfur contents of the coal, through relocation of industries (i.e. displacement of industries from inner parts of city to outer areas), use of clean fuel [e.g. use of less ash and sulfur content coal, liquid petroleum gas (LPG) and use of air pollution control devices have been taken. For reducing dust releases from stone crushers, use of bounded structures and water gushing system are some of the suggestive measures (B. R. Gurjar, 2015).

Control of Biomass burning:

Biomass burning is a major contributor to particulate matter concentrations. Nagpure et al., 2015 showed that open burning of municipal solid waste (MSW) could amount to 2-3% of total generated

MSW in Delhi. The reduction of harmful emission of pollutants and health impacts from burning of wood, agriculture waste and animal residue, by intervening and giving emphasis on improved cook stoves. Further, Introduction of improved chulhas for substantial reduction in emissions and fuel ingestion. Recently, India has issued various instructions to reduce air pollution from biomass burning and non-exhaust sources such as mechanical sweeping of roads to reduce suspended road dust, water sprinkling and covering of construction sites by municipal corporations, strict action against burning of agriculture/ municipal waste in open environment and elimination of use of kerosene for cooking (MoEF, 2015).

Greening the cities:

Globally, cities occupy only 2.5% of the earth's total land area but cities account for about 70% of CO2 emissions (ADB, 2012). Which encompass a significant share of global greenhouse gas emissions. Further, air in south Asian mega cities suffer from serious level of air pollution and may cause health problem. Hence, Tree planting has a significant effort in cleaning the atmospheric pollutants. Trees has the potential to improve the air quality by absorbing carbon dioxide and other pollutants (FAO-Urban forestry document). Trees in urban system provide a variety of ecosystem services including biodiversity conservation, removal of atmospheric pollutants, oxygen generation, noise reduction, mitigation of urban heat, microclimate regulation, stabilization of soil, groundwater recharge, prevention of soil erosion and carbon sequestration (Bolund, P, 1999). Without urban green spaces a sustainable city cannot be designed (Cheisura, A. 2004). Hence, greening the mega cities are one of the important strategies to reduce the air pollution in the cities and urban area.

Encouraging the use of low- carbon forms of transport

Encouragement of the Rail-based public transport, support for non-motorized travel modes, metro rail transport, road-based public transport and awareness-raising campaigns on air pollution issues by transportation in megacities, vehicle access or entry restrictions are some of the measures to reduce the air pollution in the south Asian mega cities (Dorina Pojani, 2015). Biofuels (mainly ethanol, biodiesel, and blends) could provide a significant reduction in urban greenhouse-gas emissions, particulate matter, and impulsive organic chemicals (Timilsina, G 2009). In developing countries, promotion of lower-cost activities and more feasible transport mechanisms such as car-free days, bicycle-to-work days, bicycle film festivals, free-vehicle-inspection days, car-pooling days, free-public-transport days, and media attention). Public awareness activities must boost shifts in existing paradigms. For example, bicycles must be presented as the healthy vehicles of the future (*i.e.*, a new status symbol rather) (Dorina Pojani, 2015). These are all some of the effective measures to control the air pollution in the South Asian megacities.

Control the migration by providing diversified enterprise opportunities in the villages

The mega cities normally attract people from both rural and urban areas mainly from within the country by providing employment opportunities in both formal and informal sectors. The decadal growth (1991 - 2001) in the population was 47 percent in Delhi. The contribution of in-migrants in the total population is 35 percent. The in-migration pattern in Delhi shows a great variation from different states. Only six states Uttar Pradesh, Haryana, Punjab, Rajasthan, Uttaranchal and Bihar contribute more than 80 percent, whereas the whole of the southern states add to less than 5 percent to the total volume of in-migration in Delhi. Employment (68 percent) is the major reason for of in- migration in Delhi (Chandrakanta,2008). Further, for business and education also plays important role in the migration process. Hence, promotion of alternate livelihood options or agro industries promotion in the villages

are important strategies and providing urban facilities in rural area are some of the important strategies to reduce the migration in South Asian mega cities.

Rurbun approach:

In South Asian Mega cities, due to the centralized human settlements, industrial developments, usage of vehicles leads the natural resources degradation of land and water in the urban area. At the same time, South Asia has not utilized the full potential opportunities of the decentralized agricultural based eco-friendly rural village settlement pattern for effective sustainable development process. One flat house cost in Mumbai is 15 million and around 50% population in Mumbai are settled in the slums. Weather it is a development? What extent it is sustainable? In these circumstances, 1 million is enough to construct a very good house with all the useful services in the village cluster area. The decentralized Cluster village patterns of settlements is a needy strategy to coup the population pressure, preventing the mega cities migration issues and conserve the natural resources for sustainable development (Smiti Chand 2015).

The village settlements requires various deficient development indicators of health, education, infrastructure, etc. So providing urban facilities to rural areas and develop the rural India is generally difficult in several dimensions. But, the village cluster pattern of development strategy is a form of cost effective planned residential development with the existing rural settlements supports the desirable standard of living with sustainable development and natural resource conservation. And so, it supports the foreign capital accumulation and controls the migration. Further, the social entrepreneurship based development is the solution to develop the rural cluster based village settlement. It also supported by the village natural capital of farm lands, water sources, flora and fauna, etc to help and sustain the agricultural economy. The Hub and spoke model of decentralized village cluster based settlement is a needy strategy to up coup the population pressure and conserve the natural resources for sustainable development. The Hub and spoke model of the decentralized village cluster based settlement is also a solution to improve the standard of living and controls the rural migration.The government schools, government Hospitals, mainstreaming the financial institutions and other services also supported the rural cluster based settlements (L. Muralikrishnan 2017). Under this context, government of India initially planned to develop rural clusters with economic activities, developing skills, local entrepreneurship and providing infrastructure ammonites through the scheme of Shyama Prasad Mukherjee, Rurban mission (SPMRM) which aims to develop 300 rural clusters in all states and union territories (Shyama Prasad Mukherji Rurban mission 2015).

Extension interventions:

Creation and promotion of innovative ways to reduce the pollution through appropriate extension research studies and awareness programmes to improve the knowledge level of the people to eradicate the air pollution issues. Finally, the Individual social responsibility is very important concern to reduce the air pollution in the South Asian megacities.

Water Pollution

The biological or chemical change in the quality of water due to the presence of contaminants in water is called water pollution. Most of this contamination as on date is due to various human activities. In fact, humans are responsible for the mass deaths of whales and other aquatic organisms often swept ashore at different beaches in the world.

Pollution eventually involves the hydrological cycle of the earth, because even pollutants emitted into the air and those present in the soil are washed out by precipitation. Water is considered polluted when it is altered in composition or condition so that it becomes less suitable for any or all of the functions and purposes for which it would be suitable in its natural state. This definition includes changes in the physical, chemical and biological properties of water, or such discharges of liquid, gaseous or solid substances into water as will or are likely to create nuisances or render such water harmful to public health, safety or welfare, or to domestic, commercial, industrial, agricultural, fish or other aquatic life. It also includes changes in temperatures, due to the discharge of hot water.

Types of pollutants:

- Oxygen demanding (organics, ammonia)
- Nutrients (N, P)
- Pathogenic organisms
- Suspended solids
- Salts
- Toxic metals (zinc from tires, Cadmium, lead used in manufacturing)
- Heat

Types of water pollution

Microbiological Disease - causing (pathogenic) microorganisms, Chemical: A whole variety of chemicals from industry, such as metals, Pesticides Oxygen-depleting Substances: Many wastes are *biodegradable*, that is, they can be broken down and used as food by microorganisms like bacteria. Nutrients, Suspended matter.

Microbiological Disease-causing (pathogenic) microorganisms, like bacteria, viruses and protozoa can cause swimmers to get sick. Fish and shellfish can become contaminated and people who eat them can become ill. Some serious diseases like polio and cholera are waterborne. Safe Drinking-Water: Water-associated infectious diseases claim 3.2 million lives, approximately 6% of all deaths globally. Over one billion people lack access to safe water supplies, while 2.6 billion lack adequate sanitation, and related problems of water scarcity are increasing, partly due to ecosystem depletion and contamination.

Chemical: A whole variety of chemicals from industry, such as metals and solvents, and even chemicals which are formed from the breakdown of natural wastes (ammonia, for instance) are poisonous to fish and other aquatic life. Pesticides used in agriculture and around the home-- insecticides for controlling insects and herbicides for controlling weeds-- are another type of toxic chemical.. The Niagara River, between the US and Canada, even caught fire at one time because of flammable chemical wastes discharged into the water.

Oxygen-depleting Substances: Many wastes are biodegradable, that is, they can be broken down and used as food by microorganisms like bacteria. But, oxygen is not very soluble in water. Even when the water is saturated with dissolved oxygen, it contains only about 1/25 the concentration that is present in air. But while aerobic microorganisms-- those which use dissolved oxygen-- convert the nitrogen, sulfur, and carbon compounds that are present in the wastewater into odorless-- and relatively harmless--

oxygenated forms like nitrates, sulfates and carbonates, these anaerobic microorganisms produce toxic and smelly ammonia, amines, and sulfides, and flammable methane (swamp gas).

Nutrients: The elements, N and P

Added to lakes and streams, they cause nuisance growth of aquatic weeds, as well as "blooms" of algae, which are microscopic plants. This can cause several problems. Weeds can make a lake unsuitable for swimming and boating. Algae and weeds die and become biodegrable material, which can cause the problems mentioned above (and below). If the water is used as a drinking water source, algae can clog filters and impart unpleasant tastes and odors to the finished water.

Suspended matter: Other pollutants, referred to as *particulate* matter, consist of much larger-- but still very small-- particles which are just *suspended* in the water. They will eventually settle out. These *sediments* can decrease the depth of the body of water.

Toxic materials can also accumulate in the sediment and affect the organisms which live there and can build up in fish that feed on them (Biomagnification), grease-- float to the top, creating an aesthetic nuisance.

A **cyanobacterial bloom** will form on the surface and can accumulate downwind, forming a thick scum that sometimes resembles paint floating on the water. Because these mats are blown close to shore, humans and wild and domestic animals can come into contact with the unsightly material.

Toxic Blooms

Some algae produce toxic chemicals that pose a threat to fish, other aquatic organisms, wild and domestic animals, and humans. **Blooms of cyanobacteria** can flood the water biotoxin they produce. When toxic, blooms can cause human illnesses such as gastroenteritis (if the toxin is ingested) and lung irritations (if the toxin becomes aerosolized and hence airborne). Also cause skin irritation to people who swim through an algal bloom. Toxicity can sometimes cause severe illness and death to animals that consume the biotoxin-containing water affect photosynthesis when they are present in irrigation water, modify zooplankton communities, reduce growth of trout, and interfere with development of fish and amphibians. In some cases, toxins can be bio concentrated by fresh-water clams.

Microcystins comprise the most common group of about fifty cyanobacterial toxins. Harm the liver (hepatotoxins) or nervous system (neurotoxins). Can persist in water because they are stable in both hot and cold water. Even boiling the water, which makes the water safe from harmful bacteria, will not destroy microcystins. Hence a recommended water-quality guideline of 1.5 µg per liter of microsystin-LR (the most common hepatotoxin) can be achieved by removal from water only by activated charcoal

filters and chlorination.

Biomagnification: is the buildup of certain substances, such as DDT, in the bodies of organisms at higher trophic levels of food webs. DDT was once used extensively as an insecticide. DDT builds up in the fatty tissues of organisms. Organisms at lower trophic levels accumulate small amounts. Organisms at the next higher level eat many of these lower-level organisms and hence accumulate larger amounts. This happens for no biodegradable constituents. At the highest trophic levels the increased concentrations in tissues may become toxic.

Nitrate pollution Methemoglobinaemia

Contamination of water by nitrates. Nitrates are being washed from the soil into rivers, lakes, and aquifers. There they cause an excessive enrichment of the water (eutrophication), leading to a rapid growth of algae, which in turn darkens the water and reduces its oxygen content. The water is expensive to purify and many plants and animals die. High levels are now found in drinking water in arable areas. These may be harmful to newborn babies, and it is possible that they contribute to stomach cancer, although the evidence for this is unproven.

- The USEPA (United States Environmental Protection Agency)

- drinking water standard and health advisory level of 10 mg/L nitrate-nitrogen (equivalent to 10 ppm nitrate-nitrogen or 45 ppm nitrate) based on the human health risks due to nitrate consumption (Kross, 1993).

- Although there have been studies performed attempting to link nitrate consumption to various illnesses, only methemoglobinemia, (also infant cyanosis or blue-baby syndrome) has been proven to result from ingestion of water containing high nitrate concentrations, above 10 ppm (Kross, 1993).

Nitrate Pollution: *An Unseen threat to Amphibian Populations.*

- Amphibians are at the highest risk of exposure and are most sensitive to nitrates when they are in the egg and tadpole stage of the amphibian life cycle.
- For most amphibian species, the egg and tadpole life stages occur in the water during the months when fertilizers and other chemicals reach their peak application levels.
- Chronic effects on amphibians (reduced feeding, reduced swimming, and developmental deformities) occur at concentrations as low as 2-5 ppm in some species.

Fluoride Contamination

Fluorides are discharged into the atmosphere from the combustion of coal; the production of brick, tile, enamel frit, ceramics, and glass; the manufacture of aluminium and steel; and the production of hydrofluoric acid, phosphate chemicals and fertilizers.

Recommended Criteria

Total fluoride in irrigation water should not exceed 1.0 mg/L as a 30-day average or a maximum of 2.0 mg/L. The recommended fluoride level in the drinking water of all other livestock is a 30 day average of 2.0 mg/L and a maximum of 4.0 mg/L, unless fluoride is present in feed or mineral additives in which case a 30 day average of 1.0 mg/L and a maximum of 2.0 mg/L is recommended (Anon, 1984).

Thermal pollution

A reduction in water quality caused by increasing its temperature, often due to disposal of waste heat from industrial or power generation processes. Thermally polluted water often undergoes biological changes that render it less valuable for drinking, recreational, habitat and industrial uses. Thermal water pollution involves the release of energy in the form of radioactivity or heat into lakes, streams, rivers, and oceans to the extent that they interfere with the functioning of aquatic ecosystems. Thermal pollution is usually caused by the discharge of water that has been used as a coolant in fossil-fueled or nuclear-power

plants. This rise in water temperature can favor a diversity of aquatic life in waters that would otherwise be too cold. In a warmer body of water, however, the addition of heat changes its characteristics and may make it less suited to species that are considered desirable.

Acid mine drainage

Acid mine drainage or, more generally, acid rock drainage, results when rock containing metallic sulphides, such as pyrite, become exposed to water and air. Examples of this are mine tailings and excavation of acid rock through highway construction. The rate of acid generation is greatly enhanced by the presence of sulphur-oxidizing bacteria. The impact of this process is increased acidity and metal levels in receiving waters (surface water and groundwater) to the detriment of fish and other organisms, as well as to drinking water supplies.

Industrial wastewater pollution

During the past few decades, Indian industries have registered a quantum jump, which has contributed to high economic growth but simultaneously it has also given rise to severe environmental pollution. A number of industries produce large volume of effluents requiring proper disposal. Lack of suitable treatment technologies and disposal facilities is a major hindrance to industrial expansion. The recycling options of industrial effluents includes land application, use in irrigation, forestry, application to constructed wetlands or artificial marshlands. Sometimes, industries produce highly toxic effluents, which can neither be thrown into water bodies nor used for agricultural purpose as the toxic element may enter the food chain through plants, animals and fish. However, effluents of some industries have useful characteristics and have the potential to improve soil productivity (Kansal, 1994). This effective management of wastes brings economic benefits and protects fragile ecosystems from degradation.

Thus, the following are the objectives for utilization of industrial effluents for agricultural purposes.

- Increasing demand of water for agricultural purposes
- Irrigation to crops in areas where water is scarce
- Recycle it as irrigation water due to its possible nutrient value.
- Disposal problem of industrial effluents.
- Increasing pollution problem.

Classification of industries

With a view to simplify the procedures and to categorize the industries/ projects on the basis of the pollution potential in a simple manner so that common person can understand the severity of pollution from a particular industry, it is necessary to categorize the industries/ projects in three broad categories viz. Red, Orange and Green in decreasing order of severity of pollution.

‘Red’ represents highly polluting industries

‘Green’ represents marginally polluting units and

‘Orange’ categories are moderately polluting industries.

The proposed classification does not only simplify the common man's understanding regarding pollution but also helps in prioritization of plans and programmes of pollution control and surveillance according to pollution potential of a particular category of industry.

In our country, Paper and pulp mills, Sugar mills, distilleries, tanneries, pharmaceutical industries, fertilizers industries etc are the highly polluting red category. However, the effects of these industries on soil and water can be generalized as most of these wastes are rich in inorganic compounds like Na, K, Ca, Mg, SO4, nutrients besides organic impurities. Hence, the major effects of industrial effluents on soil are discussed below.

Characteristics of different industrial effluents

The effluent from paper and pulp, distilleries, sugar, tannery, textile, food processing, meat processing, coir, printing, chemical and fertilizer industries are the major potential source of effluent discharge. The characteristics of the industrial effluents are given in the following table.

Paper factory effluent has high load of COD, BOD and significant concentration of soluble organic matter. Tannery effluent contains large amounts of Cr, Na, N, Ca, S, P etc. The dying factory effluent is alkaline and contains high amounts of total suspended and dissolved solids. The spent wash from distilleries and breweries is highly acidic and contains solid that are mostly organic, high in K (7-15% of the total solids) and found to contain wood reaction products, spend cooking and bleaching chemicals, chlorine compounds, fibers, solid inorganic compounds and sodium compound.

Effluent utilization

Large and regularly produced industrial effluents is recycled or reused for different purposes after proper treatment. Its common uses are in agriculture for irrigation as well as crop fertilization, in aquaculture for fish production, application for forest land, in land reclamation and other related uses. These effluents supply major and minor nutrient required for plant growth as well as supply water requirements for crop growth.

Impact of industrial effluent on soil/land properties

Any effluent when applied to soils will affect the physical, chemical and biological properties of the soil. The important

1. **Physical changes**: Reduction in hydraulic conductivity Reduction in soil porosity, Decrease in the infiltration rate and increased bulk density.

2. **Chemical changes**: Increase in *electrical conductivity* (due to increased addition of salts to soil), *alternation in pH*. If the pH of effluent is acidic, then the soil over a period of time will turn acidic or if the effluent is alkaline, it will turn alkaline (Tannery effluent is near neutral in pH while the unbiomethanated distillery effluent is acidic in nature). The *nutrient level* in the soil may go up slightly due to increased addition of Ca, Mg, N, K, chlorides etc, but excess of these salts especially Na addition will turn the soil unsuitable for crop growth. The *exchangeable sodium percentage* in effluent affected soils is very high. Distillery effluent is rich in macro and micronutrients like zinc, manganese, iron and copper.

The *organic matter* level of the soil will increase, as most of the effluents are rich in organics. Besides these toxic compounds like pesticide residues, heavy metals, toxic chemicals etc present in the effluent will also get accumulated in the soil. For example, chromium is added to the soil in tannery polluted soils.

Movements of the salts through the soil will also result in contamination of ground water. One of the important chemicals that are responsible for ground water contamination is Na. In such waters, the SAR (Sodium Adsorption Ratio) and RSC (Residual Sodium Carbonate) values will be high.

3. Biological properties: Depending on the nature of chemicals, the influence on the biota varies. The yield and quality of crop produce also varies on the characteristics of wastes and better utilization of such wastes in crop production depends on the proper method of utilization.

Paper mill effluent

The paper industry is one of the major industries in India that contributes to water and soil pollution. At present, there are 525 pulp and paper mills with a total installed capacity of around 6.25 million TPA with a capacity utilization of about 67 per cent. The aggregate installed capacity by 2010 for paper and paperboard is expected to reach 8.3mt and 1.5mt for newsprint. Pollutants from the paper industry include suspended solids, lignin compounds, resin acids, fatty acids and phenolic derivatives. Most of these waters are applied to the land, since soil is believed to have a capacity for receiving and decomposing wastes and pollutants. Land treatment made lignin removal feasible and reduced treatment costs. The effect of high ESP is manifested by reduced soil permeability and specific toxicity to crops. This can be lowered by the addition of Ca and Mg salts or gypsum or hypochlorite in wastewater. Wastewaters having SAR of 5.3 to 6.6 seemed safe under the long run. Treated wastewaters with an EC of 2.3 – 2.4 dS m-1 can also be used safely on loamy sand, sandy loam, loam and sandy clay loam soils.

Higher amount of available N, P, K, Zn, Cu and organic carbon, CaCO3, pH, EC, CEC, exchangeable cations, Na, K contents were observed in soils irrigated with effluents for over three years (Udayasoorian *et al.,* 1999). The application of pulp and paper mill effluent to sugarcane tended to increase soil enzyme activities like amylase, invertase, cellulase, dehydrogenase and phosphatase. Continuous irrigation of paper mill effluent for over 15 years did not effect the quality of sugarcane juice but reduced the sugar and cane yield (Palaniswami and Sreeramulu, 1994). More microbial activity in the rhizosphere was observed in the plants irrigated with 50 – 75 per cent effluent concentration.

The retention of moisture necessary for growing sugarcane in sandy soils with effluent irrigation was attributed to humification and mineralization of organic matter.

Combined use of industrial effluents along with amendments will provide a soil with enough nutrients and with better physical and microbiological environment, thus increasing the soil fertility. The adverse effect of effluent from paper factory would be alleviated by resorting to the application of N, P, K along with organic and inorganic amendments such as press mud, farmyard manure and gypsum.

In rice, the grain yield was increased due to effluent irrigation by 25 per cent than that of well water irrigation. The impact of paper mill effluent irrigation along with soil amendments on the yield, nutrient content and their uptake in rice was recorded in acid and neutral soils. A marked reduction in the total N and K uptake as well as the grain and straw yield of rice under the effluent treatments was recorded in both the soils. Effluent tends to decrease the calcium uptake of rice in neutral soil and increased the Na uptake in acid soil. The soil amendments had a favorable effect on the P and K uptake of rice in acid soil. The use of 50 per cent diluted clarified effluents was found superior to raw effluent irrigation more particularly in neutral soil (Velu *et al.,* 1998). The adverse effect of raw effluent irrigation was more in

neutral soil compared to acid soil. Application of composted coir waste improved the grain yield of rice when raw effluent was used for irrigation in neutral soil.

Tannery effluent

Tanning is the process through which animal skins and hides are converted into non-biodegradable and tough material known as leather. Tanning industry is one of the major export industries in India. During the tanning process about 30-40 litres of water is used for every kg of leather processed. It is estimated that about 17000 tonnes of hides and skins are converted into leather, which results in generation of approximately 680 million litres of effluent per day.

The combined effluent from the different processes is alkaline nature. It carries a large amount of total solids with high EC values. The EC value shows that the effluent as such may not be suitable for irrigation. The BOD and COD are usually exceeding the prescribed limit of 100 and 250mg L-1, respectively, by the Tamil Nadu Pollution Control Board. A wide variation was observed in the Cr concentration, ranging from 0.6 to 250mg L-1. Among the cations, Na was found in higher amounts followed by Mg and Ca. Excess of Na characterizes the effluent as saline or alkaline depending upon its occurrence in association with Cl/SO4 or CO3/HCO3 ions, accordingly the irrigated soil may develop salinity/sodicity problem. Chrome tanning generally resulted in large amounts of salts (SAR) and chromium contamination in the polluted areas.

Sugar and distillery effluent

Sugar industry is one of the basic core industries in India which offers large employment potential and contributes substantially to economic development. In India there are about 579 sugar mills and 257 distilleries. For the production of 14.5 mt of sugar roughly about 145mt of sugarcane is crushed annually. In addition to about 5.0 mt of pressmud, sugar industries release about 7.5mt of molasses and 45 mt of bagasse as waste materials. Every litre of alcohol produces about 15 liters of effluent (spent wash), which amount to about 9 billion liters of spent wash per annum.

These waste materials contain considerable amounts of plant nutrients as well as organic matter, therefore can be used as a source of plant nutrients and soil amendments. The pressmud generally contains about 1-1.5% N, 2.5 – 3.8%, P2O5, 1-1.5% K2O and 11% CaO. It can effectively be used as soil amendment for the reclamation of alkali soil. Apart from the nutritional values the sugar industry waste, because of high BOD, sugaramine condensed product – (the color) and COD, also pose pollution hazard, which may deteriorate the soil and environmental health. Remote from the pollution effects there is a greater potential to reuse the sugar industry wastes in agricultural through composting technologies. Utilization of biomethanated distillery effluent indicated the omission of K fertilizer from recommended dose of fertilizers and also increased content of soil organic matter and crop yield.

Textile industry effluent

In a textile industry yarn is prepared, woven or knitted and processed. The basic raw materials are cotton, synthesized fibers and wool. During the process of desizing, scouring, and bleaching large volumes of effluents are generated which contain salts and unused bleaching agents (free chlorine, hypochlorite, caustic soda and sodium peroxide etc.). Dyeing is carried out with sodium sulfide, chromate, b - naphthol and sodium nitrite. Therefore, the composite effluents are highly alkaline in nature (pH>9.8) and contain

large amount of Cl and SO4. Appreciable amounts of plant nutrients like N, P, Ca, Mg and K are also present in these effluents.

Sago industry effluent

A sago factory with a capacity to produce 3500 kg starch per day uses 110m3 water day-1. Of this, nearly 87% of water comes out as wastewater after processing. Due to high starch content microbial activity is increased which leads to unpleasant odor (Balagopal *et al.,* 1997). The sago factory wastewater contains appreciable quantities of suspended and dissolved solids with very high electrical conductivity and is acidic in nature.

This effluent irrigated soil has lower apparent and specific gravity and water holding capacity and has slightly higher porosity. The nutrient status is comparatively higher in sago effluent irrigated soils. Use of well water during germination and reproductive stages of tapioca and the sago factory effluent to rest of the crop growth period is recommended where sufficient water is not available.

Impact of other industrial waste waters

In addition to utilizing the wastewaters released from paper, tannery, textile and sago industries, the effluents of fertilizer factory, photo film, viscose factory and zinc smelters can also be used for irrigation. Application of diluted photo film factory effluent slightly inhibited the seed germination, seedling development, reduced the chlorophyll content and carbohydrate and protein synthesis in crops like maize, sorghum etc.

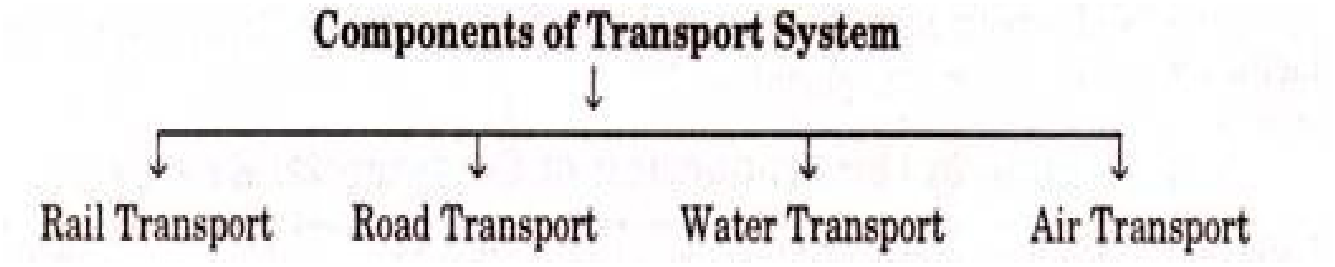
Discharge of fertilizer factory effluent into water bodies cause eutrophication problems, which leads to many disturbances in the human health. Hence, in order to avoid such problems, these wastewaters, which are rich in nutrients, can be effectively utilized for crop production after proper dilution with good quality water. Application of fertilizer factory effluent to the soil resulted in significant increase in nutrient contents of the soil. Irrigation with 2.5 and 5 per cent effluents of fertilizer factory wastewater enhanced the growth and development of rice; however, higher concentration inhibited the growth and development of the crops (Augustine Selvaseelan *et al.,* 2001). Similar to fertilizer factory effluent, effluents of zinc smelter factories when diluted with well water did not affect the growth of common kharif crops. The yield of maize – gram and black gram – wheat cropping sequences in kharif and rabi remained unaltered when zinc smelter effluent was used for irrigation. The study on the effect of various concentrations of dairy effluent on germination of crops revealed that the germination per cent was higher in 25 per cent concentration of effluent and inhibitory effect was observed when treated with 75 per cent and 100 per cent effluent concentrations. Hence, the growth of plants was better in diluted effluent than in raw effluent. Meat processing wastewaters contain high concentrations of nutrients but only low concentrations of heavy metals and other toxic compounds. Hence, the nutrients can be recovered by agriculture or forestry.

The profitable use of wastewaters in agriculture depends on a well-organized irrigation schedule, which must be adapted to the local climatic conditions, soil properties and hydrologic situation. The principle aim is not solely water disposal but also possible supply of nutrients necessary for farming. Application rates, timing with respect to farming cycle, the lay out of the irrigation area with necessary

drainage and crop maintenance are crucial points. A very important requirement is the control of the water quality by pretreatment. Pretreatment also offers the possibilities of pH regulation, control of sanitary hazards, continual monitoring of water characteristics and the management of the system during the rainfall. The impact on the level of groundwater and its quality must be monitored with particular reference to the drinking water obtained from the ground water.

Manmade disasters - Road accidents, rail accidents, air accidents, sea accidents

Introduction: Transport system is the foundation stone of economic infrastructure. It helps in the development of agriculture, industries, trade and commerce. It plays very important role in economy development. It facilitates the mobility of goods and services from producers to consumers. It also helps in removing regional inequalities. Transport system removes the hindrance of place and time. Transport system is known as symbol of civilization. The transport system of a country refers to the different means which carry men and material from one place to another.



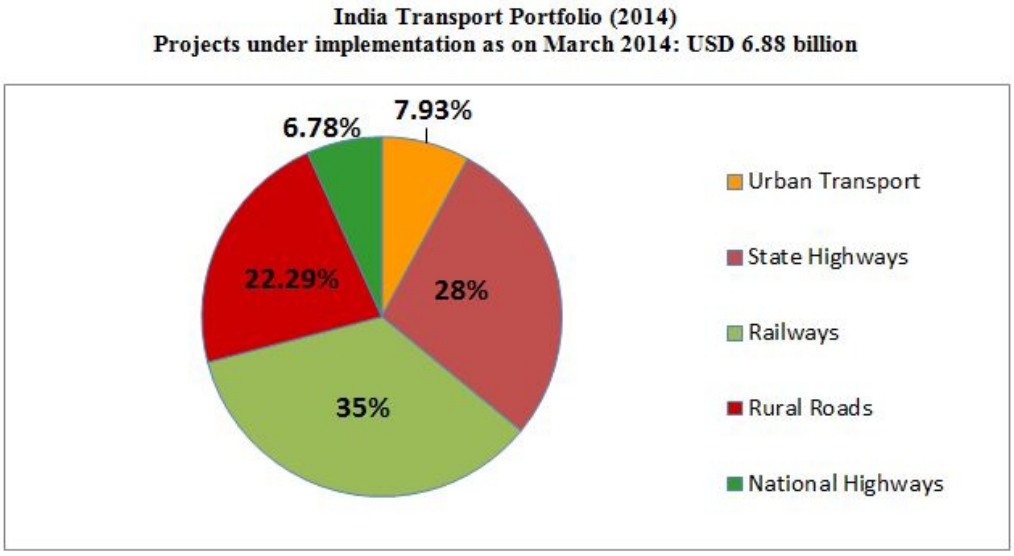
Growth of Transport System in India:

Indian planners gave top most priority to the development of transport system in the country. During the first three plans, allocation to the transport sector was 25 to 28 percent. In the subsequent plans, due to pressing need of industrial sector, allocation for transport system declined. For example, allocation for transport sector in Eighth Plan was 13% and in Ninth Plan, it was 15.2%. The tenth plan proposes to invest 14.8%' of total plan outlay on transport. The following table shows the progress of transport system in India since 1950-51.

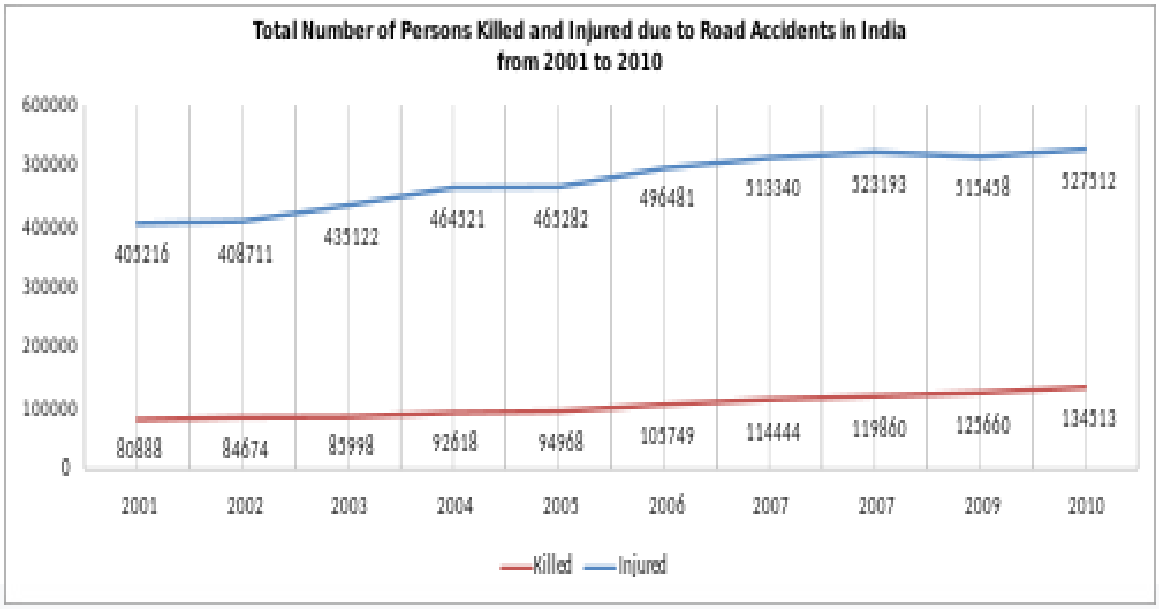
Growth of Transport System in India

S.No.	Transport System	Unit of Measurement	1950-51	1970-71	2000-01
(1)	(2)	(3)	(4)	(5)	(6)
1.	Railway Transport	(*i*) Route length (Km)	53,600	59,800	62,900
		(*ii*) Freight Traffic originating (million tonnes)	93	196	492
2.	Road Transport	(*i*) Road length ('000 km.)	400	915	3420*
		(*ii*) No. of goods vehicels ('000)	82	343	2680**
3.	Shipping	Overseas shipping (million tonnes (GRT)	0.2	2.2	7.0
4.	Civil Aviation	No. of passangers (lakhs)		26	87***

The analysis of the above table shows that road and rail transport system dominate in our country. The water transport and civil aviation are also performing well.



Traffic Collisions in India are a major source of deaths, injuries and property damage every year. The National Crime Records Bureau (NCRB) 2016 report states there were 496,762 roads, railways and railway crossing-related traffic collisions in 2015. Of these, road collisions accounted for 464,674 collisions which caused 148,707 traffic-related deaths in India. The three highest total number of fatalities were reported in Uttar Pradesh, Maharashtra and Tamil Nadu, and together they accounted for about 33% of total Indian traffic fatalities in 2015. Adjusted for 182.45 million vehicles and its 1.31 billion population, India reported a traffic collision rate of about 0.8 per 1000 vehicles in 2015 compared to 0.9 per 1000 vehicles in 2012, and an 11.35 fatality rate per 100,000 people in 2015. According to Gururaj, the top three highest traffic fatality rates per 100,000 people in 2005 were reported by Tamil Nadu, Goa and Haryana, with a male:female fatality ratio of about 5:1. The reported total fatality, rates per 100,000 people and the regional variation of traffic collisions per 100,000 people varies by source. For example, Rahul Goel in 2018 reports an India-wide average fatality rate of 11.6 per 100,000 people and Goa to be the state with the highest fatality rate.



Total number of persons killed and injured due to road accidents, from 2001 to 2010

According to the 2013 global survey of traffic collisions by the UN World Health Organization, India suffered a road fatality rate of 16.6 per 100,000 people in 2013. India's average traffic collision fatality rate was similar to the world average rate of 17.4 deaths per 100,000 people, less than the low-income countries which averaged 24.1 deaths per 100,000, and higher than the high-income countries which reported the lowest average rate of 9.2 deaths per 100,000 in 2013.

Road accidents

Road accidents - India tops world list

India has overtaken China's killing fields. "Nearly 1.05 lakh people die in road accidents in India. It is the highest in the world," Brahm Dutt, secretary of the department of road transport and highways (India) said. Dutt said deaths on Indian roads now exceed casualties on Chinese roads. "We have this dubious distinction".

Most Common Causes of Accident

Determining the causes of the accident is important for the victim, as it has a direct bearing on whether he or she is eligible to receive compensation. Here are some of the most common causes of accident for road crashes. Road accidents can occur due to various reasons. Road accidents are common. While many of them are minor fender-benders, others are major mishaps, often even leading to fatalities. The most common cause of accident in road mishaps is **human error**. Determining the causes of the accident is important for the victim, as it has a direct bearing on whether he or she is eligible to receive compensation.

Here are some of the most common causes of accident for road crashes:

1.**Substance abuse:** Substance abuse such as consumption of alcohol, recreational and prescription drugs is a major offender when it comes to road accidents.

2. **Speeding:** Speeding accounts for nearly a quarter of all automobile accidents.

3. **Road layout and conditions:** The road itself could be one of the causes of accident. Many roads have well-known 'blind spots', where drivers coming from one side cannot see vehicles coming from the other direction until it is too late. Also, roads become slippery during rain, snow, hail, etc. As they wear, they develop cracks and potholes. Conditions such as these can also be causes of accident.

4. **Vehicle failure:** Breakdown of the mechanical components in a car is another reason behind road accidents. The most common mechanical failures involve damage to the tyres and their associated components. In addition, break, axle, and steering wheel failures are associated with accidents.

5. **Driver's fault:** Some accidents are caused purely due to the driver's mistake. Distractions, such as talking on the phone or to co-passengers, calming children or pets in the backseat, or trying to retrieve fallen items are common causes of accident. Aggressive driving and disregarding traffic rules also fall in this category.

Ex: In a major roadside accident, involving a passenger bus and an oil tanker, 32 people have been killed and several other injured, in Sindh province (near Nooriabad town, about 80 km from Hyderabad city) on Sunday, January 23, 2011.

Rail transport

Trains offer one of the cheapest, safest and most convenient modes of transportation. You have the option of either traveling to your destination using a steam engine train or an electric one. Electric trains are not found everywhere as they are only common in highly developed countries like Japan and the United States. However, just like any other form of transportation, the trains are also prone to getting accidents. These accidents are normally rare with most of them being very tragic. These cause severe injuries and multiple deaths.

Train/railroad accidents

Train/railroad accidents are different from regular vehicular accidents like cars, motorcycles or buses. Unlike those other vehicles where you can take some precautions to avoid accidents, your life is mostly on the hands of the train operator during the entire ride.

- The victims in a train accident though are not exclusively passengers.
- They could be: Motorists. Other vehicles like cars and motorcycles can be involved in a train collision in railroad crossings.
- Pedestrians People waiting on a train stop or those near or crossing a railroad can also be struck by an out of control train.
- Employees Railroad workers can also be victims in a railroad collision or any accident during train operations.

Since state laws are not really applicable to railroad employees and they cannot take advantage of workers compensation, they can sue the railroad company for damages through the Federal Employers Liability Act (FELA).

Some of the **common causes of train accidents** are:

Mechanical failure- most people like to believe that machines are indispensable part of the world. However, this is not true as machines can sometimes fail to function the way they are supposed to. Mechanical failure is one of the major causes of the accidents that are caused by trains. These can include broken lights and problems with the engine. To avoid this, the train should be inspected thoroughly on a regular basis by professionals to ensure everything is in order.

Human error- sometimes the accidents are caused by mistakes that are made by humans. This can either be from the driver of the train or miscommunication by the person who handles the lines trains use. Other mistakes can include inappropriate cargo and overloading of cargo. Trains usually travel on different time schedules and this can be confused causing a greasily head on collision.

Improperly managed tracks- the tracks where the trains use can cause the accidents. Sometimes **weather conditions** can cause the accidents. For instance, if it is raining heavily, the engineers and the operators can be derailed from performing their duties because they cannot see the trains ahead. Aside from on the job accidents that injure or kill employees, there are two other common railroad accidents. These are:

Train Crashes

This could be single crashes where the train is removed from the tracks by force; it could be a collision between two trains on the same track; or it could be a collision with another vehicle like a car or with pedestrians.

The most common causes of Railroad crashes are:

- Poor design of railroad crossing leading to limited operator vision
- Failure to blow horns at required distances
- Trains running beyond speed limits
- Malfunctioning crossing arms, warning bells and warning lights
- Absence of crossing guards at dangerous intersections, especially at locations where there is a history of previous crashes

Aviation Accidents (Air Crashes) and its Causes:

The chances of an aircraft crashing due to mechanical problems is statistically very low but given the wide publicity generated by the media, it appears that statistics can appear to be quite misleading. In reality, human error is the primary contributor to more than 70 percent of all commercial airplane accidents. Pilot error is a far more likely cause of an airplane crash than mechanical failure or bad weather conditions. An aviation accident is the worst nightmare of every pilot or passenger that has ever ridden in an aircraft. Although air travel is one of the safest forms of transportation, accidents do happen with dramatic and terrifying results. The causes of these aviation accidents vary greatly depending on specific circumstances and problems that may develop during the flight process.

Descent and landing accidents, taxi and takeoff mishaps, mechanical failures, pilot errors, fuel mismanagement, and poor weather are only some of the many plights that can lead to injuries or death in the sky. Although popular opinion may suggest that aviation accidents are caused by "bad luck", in many situations these incidents can be completely avoided through careful preparation and effective safety techniques. When flight crew and pilots do their jobs correctly, aviation accidents are much less likely to occur. Descent and landing accidents account for 36 percent of all general aviation mishaps and the most common type of accident. There are five stages of the descent and landing process. These include descent, approach, landing, go-around or aborted landing, and taxi. When a problem occurs during any of the five steps, an accident could result. Although not all accidents result in death, there is an increased likelihood of injury and fatalities may occur. Naturally, such consequences of an otherwise typical descent and landing can be incredibly painful for pilots and passengers alike.

Accidents at Sea

According to insurers' statistics, 80% of oil tanker accidents which cause oil spills at sea are a result of human errors: badly handled manoeuvres, neglected maintenance, insufficient checking of systems, lack of communication between crew members, fatigue, or an inadequate response to a minor incident causing it to escalate into a major accident. From a more practical point of view, analysis of the circumstances surrounding accidents demonstrates the high proportion of spills due to groundings and collisions. **Collisions** are generally due to manoeuvring errors, especially in poor visibility and/or busy

shipping traffic areas. Groundings are also often a result of manoeuvring errors, often made worse by high winds, challenging currents and bad weather.

The **grounding** of the Sea Empress at the entrance to Milford Haven port, Wales (Great Britain) is one such example. The ***Sea Empress*** oil spill occurred on 15 February 1996. Over the course of a week, 73,000 tons of crude oil spilled into the sea. The spill occurred within the Pembrokeshire Coast National Park - one of Europe's most important and sensitive wildlife and marine conservation areas. It was Britain's 3rd largest oil spillage and the 12th largest in the world at the time However, equipment failure is a more common cause of groundings than of collisions. The grounding of the oil tanker the Braer in the Shetland Islands, Scotland (Great Britain) (1993), resulting from seawater entering into a fuel tank, causing engine failure, is a classic example of technical failure.

Oil spills

Oil wastes that enter the ocean come from many sources, some being accidental spills or leaks, and some being the results of chronic and careless habits in the use of oil and oil products. Most waste oil in the ocean consists of oily storm water drainage from cities and farms, untreated waste disposal from factories and industrial facilities, and unregulated recreational boating. It is estimated that approximately 706 million gallons of waste oil enter the ocean every year, with over half coming from land drainage and waste disposal; for example, from the improper disposal of used motor oil. Offshore drilling and production operations and spills or leaks from ships or tankers typically contribute less than 8 percent of the total. The remainder comes from routine maintenance of ships (nearly 20 percent), **hydrocarbon** particles from onshore air pollution (about 13 percent), and natural seepage from the seafloor (over 8 percent).

Examples of Large Spills.

The largest accidental oil spill on record (Persian Gulf, 1991) put 240 million gallons of oil into the ocean near Kuwait and Saudi Arabia when several tankers, port facilities, and storage tanks were destroyed during war operations. The blowout of the *Ixtoc I* exploratory well offshore Mexico in 1979, the second largest accidental oil spill, gushed 140 million gallons of oil into the Gulf of Mexico. By comparison, the wreck of the *Exxon Valdez* tanker in 1989 spilled 11 million gallons of oil into Prince William Sound offshore Alaska, and ranks fifty-third on the list of oil spills involving more than 10 million gallons. The number of large spills (over 206,500 gallons) averaged 24.1 per year from 1970 to 1979, but decreased to 6.9 per year from 1990 onwards.

Damage to Fisheries, Wildlife, and Recreation

Oil spills present the potential for enormous harm to Deep Ocean and coastal fishing and fisheries. The immediate effects of toxic and smothering oil waste may be mass **mortality** and contamination of fish and other food species, but long-term ecological effects may be worse. Oil waste poisons the sensitive marine and coastal organic substrate, interrupting the food chain on which fish and sea creatures depend, and on which their reproductive success is based. Commercial fishing enterprises may be affected permanently. Wildlife other than fish and sea creatures, including mammals, reptiles, amphibians, and birds that live in or near the ocean, are also poisoned by oil waste. The hazards for wildlife include toxic effects of exposure or ingestion, injuries such as smothering and deterioration of thermal insulation, and damage to their reproductive systems and behaviors. Long-term ecological effects that contaminate or

destroy the marine organic substrate and thereby interrupt the food chain are also harmful to the wildlife, so species populations may change or disappear.

Coastal areas are usually thickly populated and attract many recreational activities and related facilities that have been developed for fishing, boating, snorkeling and scuba diving, swimming, nature parks and preserves, beaches, and other resident and tourist attractions. Oil waste that invades and pollutes these areas and negatively affects human activities can have devastating and long-term effects on the local economy and society. Property values for housing tend to decrease, regional business activity declines, and future investment is risky.

Long-term Fate of Oil on Shore

The fate of oil residues on shore depends on the spilled oil's composition and properties, the volume of oil that reaches the shore, the types of beach and coastal sediments and rocks contacted by the oil, the impact of the oil on sensitive habitats and wildlife, weather events, and seasonal and climatic conditions. Some oils evaporate, disperse, emulsify, weather, and decompose more easily than others. The weather and seasonal and climatic conditions may accelerate or delay these processes.

In 2000, several thousand penguins were affected by a fuel oil spill after the iron-ore carrier *Treasure* sank off South Africa. Many oil-soaked birds were cleaned and released. Oil waste that coalesces into a tar-like substance or that saturates sediments above the surf and tide level is especially persistent. Efforts to remove the oil and clean, decontaminate, and remediate an oil-impacted shoreline may make the area more visibly attractive, but may be more harmful than helpful in terms of actual recovery.

Combustible Dust Awareness - Quick Guide

Dust Explosion

A dust explosion happens when combustible dust is suspended in air and ignited (catch fire). It causes very rapid burning with a release of gaseous products and subsequent pressure rise. The resulting explosive force can damage plant, property, and people. Dust explosions can be classified as either primary and secondary

Primary Explosion

Primary explosion occurs in a confined atmosphere such as in a storage silo, or enclosed part of the manufacturing plant. After detonation, the wave can damage and often rupture walls, allowing burning dust and gases from the explosion to be expelled into the surrounding area.

Secondary Explosion

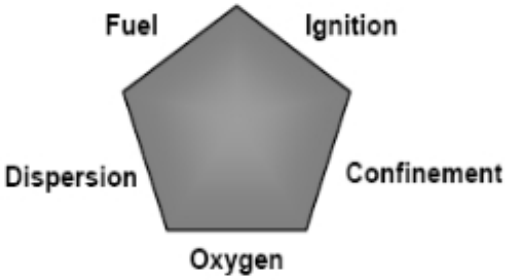
The primary explosion used to disturb settled dust that may have accumulated. Once airborne, this dust can support a larger explosion; this is referred to as a secondary explosion. Secondary explosions can results in severe damage to surrounding plant /buildings. All large scale dust explosions result from chain reactions of this type. There may be a chain reaction of many explosions caused by the initial explosion

Required Conditions

- The dust must be combustible.
- The dust cloud must be in the Minimum Explosive Concentration (MEC) for that particular dust.
- There must be sufficient oxygen in the atmosphere to support and sustain combustion.
- The dust must be dry.
- The dust must be confined.
- There must be a source of ignition

Explosion Safeguards

Safeguards need to be activated to control the chances of a dust explosion. These safeguards are prevention, housekeeping dust control, eliminating fugitive dust (dust leaking from other sources), keeping the environment clean, and eliminating as many hazards as possible. Continuous housekeeping and sanitation and regularly scheduled bearing service should be top priorities at all grain elevators and flour and feed mills.



Many insurance companies insist on strict housekeeping, sanitation, and preventive maintenance atm insured elevators. Grain, broken kernels, and grain dust accumulate in the leg boots and should be cleaned out periodically. Some elevators install easily removable doors on leg boot side panels for quick, easy cleanout.

Fires represent a major concern for many industries, including grain and feed mills, and result from many different causes. The end result of a fire, however, is always the same: personal injury, death, or loss of property.

The first and most important step in fire prevention is establishing a program to prevent fires from starting. This is particularly important in the feed and grain industries because of the potential for explosions and the track record of this industry for fires. A comprehensive fire prevention program not only addresses housekeeping issues, but also addresses all work activities in which the conditions for starting a fire are present such as hot work, electrical machinery, belts and drives, and grain dryers.

Recognizing Dust Hazards

All employees should be trained in hazard recognition.

- Conduct general facility-wide appraisals of dust explosion possibilities on a periodic basis.
- Conduct internal and external audits in order to identify potential explosion hazards.
- Encourage a preventative attitude among employees for eliminating dust explosions.
- Have employees and supervisors identify explosion hazards through job hazard analyses (JHAs).

Dust Control Methods

Methods for controlling grain dust accumulations include the following:

- Vacuum areas where dust accumulation is constant due to the job task being performed.
- Wash down procedures where hoses and water can be used to remove accumulated dust.
- Choke feeds to control the flow of grain and grain dust.
- Dust control systems such as filters or cyclones.

Fire and Explosions

Fire is a threat indoors and outside, and in urban and rural environments. It can arise from natural and technological sources, and puts life, property and natural resources in danger.

Urban fires are blazes spreading through structures, posing danger and destruction to property. These fires include any instance of uncontrolled burning which results in structural damage to residential, commercial, industrial, institutional or other properties in developed areas.

A wildfire is an uncontrolled fire spreading through vegetation, posing danger and destruction to property. Wildfires can occur in undeveloped areas and spread to urban areas where structures and other human development are more concentrated.

While some wildfires start by natural causes like lightning, humans cause four out of every five wildfires. Debris burns, arson or carelessness are the leading causes of wildfires. As a natural hazard, a wildfire is often the direct result of a lightning strike that may destroy personal property and public land areas, especially on state and national forest lands. The predominant danger from wildfires is the destruction of timber, property and wildlife, and injury or loss of life to people living in the affected area or using the area for recreational facilities.

Explosions are rapid and powerful combustion of fuels. They can be caused by the buildup of flammable gases, combustible materials, grain dust or by explosive devices.

Preparedness

(What to do before a structural fire or explosion)

- Install fire/smoke and carbon monoxide detectors in your home, and purchase multi-purpose (Class ABC) fire extinguishers for your home and vehicle. Check detectors and fire extinguishers monthly.
- Review emergency evacuation procedures in your home and workplace. Identify emergency exits and where fire extinguishers are located.
- When traveling, choose a hotel or motel that is on the U.S. Fire Administration's "Hotel/Motel Fire-Safe List." This ensures that the hotel is properly outfitted with smoke detectors and automatic sprinkler systems. Search for Fire-Safe hotels/motels.

Response

(What to do when an explosion occurs)

- Take shelter against your desk or a sturdy table.
- Exit the building ASAP. Do not stop to retrieve possessions.
- Do not use elevators.
- Check for fire and other hazards like weakened floors and falling debris.
- If you are trapped in debris, do not light a match. Cover your mouth to prevent inhaling dust. Whistle or tap to get the attention of rescuers.

(What to do during a structural fire)

- Stay low to the floor and exit the building as quickly as possible.
- Cover your nose and mouth with a wet cloth.
- When approaching a closed door, use the back of your hand to feel the lower, middle and upper parts of the door. Never use the palm of your hand or fingers to test for heat: burning those areas could impair your ability to escape a fire (i.e., ladders and crawling).
- If the door is NOT hot, open slowly and ensure fire and/or smoke is not blocking your escape route. If your escape route is blocked, shut the door immediately and use an alternate escape route, such as a window. If clear, leave immediately through the door. Be prepared to crawl. Smoke and heat rise. The air is clearer and cooler near the floor.
- If the door is hot, do not open it. Escape through a window. If you cannot escape, hang a white or light-colored sheet outside the window, alerting fire fighters to your presence.
- Heavy smoke and poisonous gases collect first along the ceiling. Stay below the smoke at all times.

Recovery

(What to do after a structural fire or explosion)

- Seek immediate medical attention for treatment of smoke inhalation, burns or other injuries.
- Emergency shelter and assistance is available from the Red Cross and Salvation Army.
- Contact your insurance company to have damage assessed and to file a claim.

Preventing the Next Campus Shooting

(Case studies taken from http://www.entrepreneur.com/tradejournals/article/171142115_1.html)

AT 7:15 A.M. ON APRIL 16, Virginia Tech Police received an emergency call alerting them to go to a dorm room in West Ambler Johnston Residence Hall. Once there, officers found two bodies in a fourth floor dorm room; they turned out to be students Ryan Clark and Emily Hilscher, both of whom had been killed by multiple gunshots.

That shooting was labeled "an isolated incident, domestic in nature."

Two hours and 11 minutes later an e-mail was sent by university police to faculty, staff, and students. It said simply that a "shooting incident occurred at West Amber Johnston [Residence Hall] earlier this morning. Police are on scene and are investigating. The university community is urged to be cautious and are asked to contact Virginia Tech Police if you observe anything suspicious or with information on the case."

That was 9:26 a.m. At 9:45 a.m., police received another emergency call to respond to Norris Hall, an engineering building north of the crime scene. Police arrived to find the front doors chained shut. By the time it was over, student Cho Seung-Hui had murdered 30 more people and ended his own life in what became the worst school massacre in U.S. history.

Shootings on U.S. campuses are rare. Among the 2,618 accredited four-year colleges and universities in the United States, there have been only six shooter incidents since 2000. But even that low number is too many. The question now before university and security professionals is: What policies and procedures can reduce the threat of such an incident and how can institutions best prepare to respond if one does occur?

The massacre at Virginia Tech has once again brought campus security under intense scrutiny. Though it is still early to draw specific lessons from how VT handled the incident, it is useful to look generally at policies and procedures in place at other universities as well as at advances in technology that facilitate emergency communications.

Threat Reduction

The most important preventive measure universities can implement is to identify potentially violent students as early as possible by establishing a behavioral threat assessment program, says Chief Steven Healy, director of public safety for Princeton University, president of the International Association of Campus Law Enforcement Administrators (IACLEA), and a member of ASIS International's Educational Institutions Council.

Institutions should endeavor to implement programs that can assess threatening behavior, but they should be aware of two problems. One, standards do not exist. Two, privacy issues can hinder what can be done with the information, which, perhaps, was a factor in the VT case.

Unfortunately, there are no national standards governing threat assessment teams or protocols, but both the FBI and the U.S. Secret Service have reports outlining behavioral threat assessment methodologies distilled from previous school shooter incidents. The FBI, for example, suggests that the likelihood of a

student carrying out a threat can be evaluated using four prongs: personality traits and behavior, family dynamics, school dynamics and the student's role in those dynamics, and social dynamics. Institutions that wish to establish such programs can look to the findings from both agencies for guidance.

They can also learn from institutions that have already developed programs, such as the University of Maryland.

Maryland developed its behavioral threat assessment program ten years ago after a student threatened to kill a teacher. In the Maryland program, once a threat or threatening behavior comes to the attention of the police, an officer questions the person who made the complaint or witnessed the threatening behavior. The threatening student isn't questioned at this stage, but police will check whether the subject has a criminal history or whether the office had any previous encounters with this person, says Major Cathy Atwell of the University of Maryland's Department of Public Safety.

Special officers trained in behavioral threat assessment techniques will contact relevant university departments, such as resident life and student conduct, for more information on the student.

The information obtained is then entered into a software program, which tabulates risk and helps officers determine whether they should intervene.

Officers also consult the relevant administrators to discuss their options. This becomes an ad hoc behavioral threat assessment team. For instance, if a complaint were generated out of resident life, the police officer would meet with the department director of resident life, the vice president of student affairs, and the director of the residence hall where the complaint started. It all depends on where the case comes from, says Atwell.

[ILLUSTRATION OMITTED]

After consulting, the team decides if a student has broken the code of conduct. If so, the case goes to the campus judicial board, which will take the requisite disciplinary action. It has the power to suspend or expel the student and can even restrict a student's access to particular places, such as a residence hall.

If the student is not in violation of the code, a course of action is laid out. If the team is worried a student is suffering psychologically, they may have the counseling center call the student in. "We transport at least ten, sometimes 20, students a semester for emergency evaluation," says Atwell.

Most of the time students get a warning, either by the police or a relevant university administrator, such as the dean. Atwell described a few examples where the person that was threatened, or felt threatened, was allowed to confront the threatening student as a police officer stood by.

The university also has a Behavioral Evaluation and Threat Assessment Resource Group (BETA) team at the university level that meets monthly, but it can convene when needed to discuss both individual cases and big picture trends.

Established in 2005, the team is composed of five members representing the counseling center, the mental health service, the office of student conduct, and the head of the police's behavioral threat assessment team. It provides a forum for information sharing and makes recommendations to those who bring cases or concerns before it.

Its recommendations are not binding, however. It is a consultative body, says Dr. Jonathan Kandell, assistant director of counseling center and chair of the BETA team. It helps provide guidance and best options, but it's up to the official who brings the problem before them to decide what to do next.

The BETA team was created when the university realized that some problem students were sliding through the cracks. The team allows people in the campus community to bring attention to students exhibiting threatening or erratic behavior. It also allows members to discuss problem students and consult with colleagues on whether they have received similar complaints about a particular student. For example, if the team is hearing complaints about a student from the residence halls and student discipline hears that same student is acting out in class while the police have arrested the student for public drunkenness, the team can connect the dots and make a more informed recommendation about next steps.

The BETA team also watches trends. Not surprisingly, the trend since the incident at VT has been a dramatic increase in incident reports of students acting unusually. It's a result of heightened awareness and concern.

Kandell has already given a talk to one of the university's colleges about recognizing and evaluating threats, and he expects the BETA team to support educational activities university wide that will raise awareness of threatening behavior, while promoting tolerance of other's idiosyncrasies to avoid excessive reporting.

Behavioral assessments are also discussed at freshman orientation, where undergraduate advisors act out skits that incorporate safety and security issues. "Virginia Tech is going to change how we all talk about things," says Gerry Strumpf, director of the orientation department and an orientation course instructor.

In addition to the basic en masse orientation, the university offers freshmen additional orientation courses, which students take in small groups of about 20. Strumpf says that this not only gives time to impart more information, but it also gives the instructors a chance to get a reading on the incoming students.

The orientation class, she believes, provides a great place to identify troubled students. "You know you pick up on troubled students. I have walked many a student down to psychological services, and I'm not the only one doing it."

Faculty members and teacher's assistants who run the orientation course are getting additional training in the wake of the Virginia Tech incident to help them spot troubled students and instruct them on what to do to assist their classmates.

Awareness on the part of students can be a powerful tool. Often shooters tell someone their plans ahead of time, "even if only 20 minutes before," says Charles Burdick, a security consultant at iXP who was incident commander at Columbine High School in Littleton, Colorado, at the time of the 1999 shooting.

For example, tragedy was averted at a high school in upstate New York in 2001 when students tipped off teachers that senior Jeremy Getman was carrying weapons. When Getman was searched, police found an arsenal in his gym bag consisting of "14 pipe bombs, three smaller bombs, a propane tank, a sawed-off shotgun, a .22-caliber pistol, and a book bag full of ammunition." Getman had threatened a girl earlier that day.

Privacy. As the Virginia Tech incident shows, even when a student is identified as a threat, privacy laws erect legal barriers to accessing and sharing personal information that can be pivotal in making the correct behavioral threat assessment. During a congressional hearing a week after the Virginia Tech massacre, witnesses discussed two laws that preclude notification of disturbed behavior to relevant parties.

The Federal Educational Rights and Privacy Act of 1974 (FERPA) protects student records from the prying eyes of parents. The only time the university can allow parents to access student records is "in connection with an emergency ... if the knowledge of such information is necessary to protect the health or safety of the student or other persons."

Colleges and universities complain that FERPA doesn't explain what constitutes an emergency adequately enough, so they play it safe to avoid liability. Moreover, any divulgence of a student's mental health information by a university counseling center violates mental health ethics and licensing codes.

Another piece of legislation protects students' privacy as well. The Health Insurance Portability and Accountability Act (HIPAA) prevents mental health facilities from sharing patient information with the educational institution a patient attends. Regardless of whether a mental institution deems a student a threat, it can't provide that information to the university. HIPAA also bans sharing mental health data with parents unless the student signs a waiver. Dr. Russ Federman, director of counseling and psychological services at the University of Virginia, testified that "conflicts between FERPA, HIPAA, and mental health licensing codes need to be lessened." The Report to the President on Issues Raised by the Virginia Tech Tragedy has since weighed in, noting "there is significant misunderstanding about the scope and application of these laws." And Pennsylvania Congressman Tim Murphy (R-PA) has sponsored legislation to clarify FERPA and make it easier for schools and universities to notify parents if their child is suicidal or has shown homicidal tendencies.

Response Capabilities

Because prevention can never be 100 percent, campuses must also be prepared to respond to an incident. Though at this writing the formal reviews of the Virginia Tech incident have yet to be concluded, the tragedy will likely be remembered for highlighting two critical response issues:

* The importance of campus security and police readiness to respond to active shooter situations

* The value of coordination and cooperation for first responders at the campus level.

It also appears to be sparking a revolution in public safety technology at U.S. colleges and universities.

Active- shooter. Before the 1999 Columbine High School massacre, the response to a gunman on campus was similar to that of a plane hijacking. Authorities would surround the building, deny access or exit, and then try to negotiate an end to the situation. Everything changed once Eric Harris and Dylan Klebold made their high school a killing zone before shooting themselves.

In 1999, Burdick was not prepared for Harris and Klebold's behavior at Columbine. He likened them, and now Cho, to suicide bombers. "What we're dealing with is a very strange mentality that is so difficult for the normal person to comprehend."

This realization triggered a reevaluation. Standard operating procedure for active-shooter situations is now for officers on the scene to make entry as soon as possible and try to neutralize the threat.

In an active-shooter situation, officers are trained to respond to gunfire, bypassing everything else, even the wounded, to get to the shooter and stop him before he kills another person, says John Gnagey, executive director of the National Tactical Officers Association. An active shooter response ideally takes four officers to enter a building so as to have a 360- degree circle protecting all sides. The decision of when to enter is situational and dependent on intelligence.

But the Virginia Tech massacre--in which more than two hours passed between incidents-- revealed a problem: How do you know whether a potential active shooter is still loose unless gunshots are heard? Should the discovery of even a single person shot dead on campus be treated as an active-shooter situation that could cascade into a larger incident?

Cho had taken a two-and-a-half hour break to mail his multimedia manifesto before resuming his rampage at Norris Hall. The police officers investigating the Virginia Tech case, as noted earlier, treated the first two bodies as "an isolated incident, domestic in nature."

If that was standard operating procedure at the time, should it be going forward? The university and college community is grappling with that issue now and examining options for alternative responses to single shootings where the shooter remains at large.

Coordination. The most important part of any response happens before the incident even begins. It's what Burdick calls governance or "defining and documenting relationships between responders before an incident occurs." As Columbine made clear--and what 9-11, Hurricane Katrina, and Virginia Tech have reinforced--an emergency event may need a large emergency response.

"We used to be able to handle most incidents with local neighbors--one or two communities away--and suddenly we're getting into these larger responses and units are coming in from hundreds of miles away," he says.

To ensure a seamless integration of all responders within a clear chain of command during such events, all universities should integrate into the National Incident Management System (NIMS) and adhere to the Incident Command System (ICS) within it.

NIMS ICS is the federal government's emergency response framework. It ensures that all responding agencies, from the local level up, can work together and communicate in a domestic crisis. Whether it is a tornado, a terrorist attack, or an active shooter on campus, NIMS ICS is a standardized, framework for ensuring interoperability between responders so that they can deal with anything.

As a part of NIMS ICS, campuses should execute memorandums of understanding (MOU), which are cooperative agreements for mutual help, with other agencies from the local to the federal level. These agreements outline the roles and responsibilities of each responding agency in an emergency.

For instance, some campuses are patrolled by contract security officers, while others are protected by sworn or non-sworn police officers or both. At some campuses, police officers carry guns; at others, they don't. Some campuses are philosophically opposed to having an armed police presence, says John Matthews, executive director of the Community Safety Institute. Nationwide, only 20 universities have SWAT teams, according to Gnagey.

The VT incident, which shows the need for a quick response, may lead to a reevaluation of that approach as well. Meanwhile, if an active shooter situation arises at a campus with contract security or

unarmed police officers, that campus will want MOUs with local police and other jurisdictions to ensure that they can get immediate assistance from personnel with the firepower they lack.

Daniel Pascale, commander of security operations at Rutgers University, says smaller institutions like community colleges can also use MOUs to work out arrangements for temporary housing of students off campus. Through a MOU, "A small community college that has 750 to 1,500 students may actually be able to relocate their students to another facility that's in close proximity, but unaffected by an emergency."

NIMS ICS is also valuable because it establishes a unified command system rather than a single command system. That means that if an incident occurs on campus, a representative from the university will have input into all decisions made by the unified command. With this team approach, campus security remains a part of the decision making process. Before, the local police department or another jurisdiction could swoop in and take complete control of the incident, says Bernard Gollotti, senior associate vice president of public safety at Drexel University and vice chairman of ASIS International's Council on Educational Institutions.

After the institution has developed its plans and worked out MOUs with appropriate parties, it should test how everything and everyone will work together. A tabletop exercise is a good option for testing the plan. This dry run helps responders rehearse what is expected of them.

As a part of the practice, the institution and its MOU partners can ensure that everyone will be using the same terminology, speaking a common language to avoid confusion in an actual incident. The interoperability of equipment should also be tested.

Technology

In responding to an emergency at a university, the exchange of information among responders is critical, as is the ability to notify students, faculty, and staff of an imminent danger regardless of where they may be at the time. Technological advances in communications are making both types of responses much more feasible than in the past.

At Drexel University in Philadelphia, Pennsylvania, Gollotti's campus security team has been beta testing a new PDA-like device, produced in collaboration with Drakontas--a company composed of former Drexel researchers. Gollotti described the communications system as the technology of the popular counterterrorist show "24" made real.

The device is for use by the security team; it allows team members to track each other using GPS; they could also exchange text messages, photos, videos, and floor plans between handheld devices, enhancing the team's ability to maintain situational awareness. The most innovative element would be the ability to use white board video technology, the same used by sportscasters to write on-screen during game telecasts.

The tactical implications of this technology are endless. Gollotti explains: "So if you're going to breach a door on the north side [of a building], you can draw that out on the handheld and send it to everyone else. And if we want to concentrate on another particular area [of a building], you can send a photo or a line drawing or a floor plan and say these are the areas you need to look at."

He says Drexel and Drakontas are working on technology that speaks directly to Columbine and Virginia Tech. By strategically placing cameras inside a building at critical surveillance locations viewable

by remote monitors and directly on a handheld device, campus security could gather intelligence and make an informed decision about what strategy would be best for the situation.

That type of intelligence, if it had been in place at Virginia Tech, might have alerted police to the fact that the doors were chained, and it would have helped them to see where exactly Cho was--a significant advantage when planning tactical deployment.

Johns Hopkins University in Baltimore already employs a smart CCTV system to monitor the campus; computer software conducts behavioral recognition scans that can identify 20 different characteristics, such as whether someone left a suspicious package behind. Any such events cause an alarm to alert security.

Mass notification. Virginia Tech has spurred a flurry of interest in mass notification systems that would help institutions get out the word about an imminent threat. Most attention has been paid specifically to short message service (SMS) text messaging capabilities via cell phones because of the ubiquity of those devices. "There's one statistic that says 90 percent of all college students now have cell phones," says Pascale.

Interestingly enough, some campuses already had SMS text messaging capability, but students hadn't opted in because they didn't feel the need or because they were unaware that the program existed.

But that was before Virginia Tech. Now, campuses are adapting fast to the voracious demand from students and parents for text messaging services.

Drexel University has expanded its mobile communications system to include SMS text messaging and is now doing a "big push" to let students know it's available, says Gollotti.

Drexel and Drakontas are also working on two-way text messaging between their dispatch command center and students. This would allow a student caught in a dangerous situation to text message campus security without a sound. "In light of the Virginia Tech incident, we believe that two-way text messaging could provide vital information related to student safety during a crisis," says Gollotti.

Many other campuses are looking at outside solutions.

Services such as e2Campus and Connect-ED provide a Web-based, fully hosted system that allows students, faculty, and staff to provide multiple points of contacts using in either voice or text massage form. The system uses landlines, cellular phones, e-mail, PDAs, RSS, or TTY/TTD.

These vendors maintain the contact information in their database and use multiple servers across the nation to push out the information to ensure that a designated administrator can send thousands of messages and have them received in minutes regardless of whether certain servers are down in the area. (See sidebar, page 56, for the six characteristics of a highly effective mass notification system.)

In situations such as Virginia Tech where the assailant is in a certain place, these systems can also send targeted messages to individuals in a particular location to warn of danger. Other solutions include public alert systems that use sirens or recorded voice messages to alert the campus community. At the University of Iowa, sirens were installed to warn students of tornadoes.

Some colleges face additional communication challenges, but technology is helping there as well. For example, Gallaudet University, in Washington, D.C., is the preeminent college for deaf and hearing

impaired students in the nation. The university needed alternatives to the traditional voice messages and audible alerts.

Gallaudet uses text messaging services, e-mails, and regular Web updates. But it has also purchased 30 rolling electronic signs that will be placed strategically throughout the campus to warn students of emergencies.

Perspective

Tragedies such as Virginia Tech elicit increased public attention to campus safety and security, but it's important to step back and make sure that any policy and procedural changes are wellthought-out.

For example, because Cho chained the doors to Norris Hall shut, Gollotti now expects campuses to look into and develop policies and procedures regarding alternative points of entry to buildings in case major access points are denied. That's not a bad idea, according to Gollotti, but it's also important to look more holistically. Security changes should not only be made piecemeal in reaction to each new event.

And for all the talk of what campuses can do to provide for the safety and security of their students in emergencies, it's important for students to realize that staying safe is mostly in their own hands.

Murders on campus are rare, averaging 16 per year, according to the Department of Education. Students are much more likely to die from alcohol-related injuries than at the hands of a fellow student.

Matt Harwood is a staff editor at Security Management.

RELATED ARTICLE: Six Tips for Evaluating Mass Notification Systems

Institutions that plan to buy new systems that would make it easier to notify students, faculty, and staff of a threat or emergency situation should consider these six tips, provided by Chief Steven Healy, director of public safety for Princeton University and President of the International Association of Campus Law Enforcement Administrators.

1. Capacity. The vendor you choose must have the demonstrated capacity to send out thousands of messages, voice or text or both quickly.
2. Security. Students, faculty, and staff are entrusting the university with their personal contact information; therefore, the vendor must have policies and procedures to ensure data security.
3. Customer Service. Is customer service 24/7, 7 days a week, 356 days a year? If not, don't bother.
4. Experience. What type of experience and track record does the company have sending messages or providing mass notification to customers? How long has it been in the market? Talk with other directors of campus security and see which company they've contracted with and whether they would endorse their current provider.
5. Assessment. This may be the most critical criterion. Can you check which messages reached their destination and which didn't? Does the system make multiple attempts to reach people when the initial attempt fails? Do you get a report back? What is the depth of the reporting function? Can you identify the people not reached so that you can get up-to-date contact information from them?
6. Market specialization. The education market poses unique challenges, such as the need to comply with applicable federal laws and regulations compliant, so stick with those companies proven reliable by other educational institutions.

RELATED ARTICLE: SYNOPSIS

The massacre at Virginia Tech has once again brought campus security under intense scrutiny. Though it is still early to draw specific lessons from how VT handled the incident, it is useful to look generally at policies and procedures in place at other universities that may reduce the threat of such an incident or improve the response if one does occur.

One approach that merits greater consideration is the use of behavioral threat assessment teams, like the one at the University of Maryland, which can help campuses identify students that may pose a threat to themselves or others.

On the response side, training in active shooter responses is expected to get more attention. Colleges and universities are also advised to integrate their own plans into the National Incident Management System and the Incident Command System. Doing so helps to ensure that everyone responding is using the same terminology and coordinating their actions.

Technology also has a role to play. A revolution in public-safety technology is making it easier for security and police to alert the campus community through mass notification systems when there is an emergency or potential danger on campus. These tools are also facilitating first responder communications.

While these efforts are all important, it also helps to keep the threat of a shooter in perspective. On-campus shootings are extremely rare; students are far more likely to die from drinking too much than at the hands of a fellow student.

How to Deal With Bomb Threat Checklist

BOMB THREAT PROCEDURES

This quick reference checklist is designed to help employees and decision makers of commercial facilities, schools, etc. respond to a bomb threat in an orderly and controlled manner with the first responders and other stakeholders.

Most bomb threats are received by phone. Bomb threats are serious until proven otherwise. Act quickly, but remain calm and obtain information with the checklist on the reverse of this card.

If a bomb threat is received by phone:

1. Remain calm. Keep the caller on the line for as long as possible. DO NOT HANG UP, even if the caller does.
2. Listen carefully. Be polite and show interest.
3. Try to keep the caller talking to learn more information.
4. If possible, write a note to a colleague to call the authorities or, as soon as the caller hangs up, immediately notify them yourself.
5. If your phone has a display, copy the number and/or letters on the window display.
6. Complete the Bomb Threat Checklist immediately. Write down as much detail as you can remember. Try to get exact words.
7. Immediately upon termination of call, DO NOT HANG UP, but from a different phone, contact authorities immediately with information and await instructions.

If a bomb threat is received by handwritten note:

- Call _____
- Handle note as minimally as possible.

If a bomb threat is received by e-mail:

- Call _____
- Do not delete the message.

Signs of a suspicious package:

- No return address
- Excessive postage
- Stains
- Strange odor
- Strange sounds
- Unexpected delivery
- Poorly handwritten
- Misspelled words
- Incorrect titles
- Foreign postage

Refer to your local bomb threat emergency response plan for evacuation criteria

DO NOT:

- Use two-way radios or cellular phone. Radio signals have the potential to detonate a bomb.
- Touch or move a suspicious package.

BOMB THREAT CHECKLIST

DATE:	TIME:
TIME CALLER:	HUNG UP:
PHONE NUMBER WHERE:	CALL RECEIVED:

Ask Caller:

- Where is the bomb located? (Building, floor, room, etc.)
- When will it go off?
- What does it look like?
- What kind of bomb is it?
- What will make it explode?
- Did you place the bomb? Yes No
- Why?

Exact Words of Threat:

_____

_____

_____

Information about Caller:

- Where is the caller located? (Background /level of noise)

_____

- Estimated age:

_____

- Is voice familiar? If so, who does it sound like?

_____

Other points

_____

Caller's voice	Background Sounds	Threat Language
Female	Animal noises	Incohorent
Male	House noises	Message read
Accent	Kitchen noises	Taped message
Angry	Street noises	Irrational
Calm	Booth	Profane
Clearing throat	PA System	Well spoken
Coughing	Conversation	
Cracking voice	Music	
Crying	Motor	
Deep	Clear	
Deep breathing	Static	
Disguised	Office Machinery	
Distinct	Factory Machinery	
Excited	Local	
Laughter	Long Distance	
Lisp		
Loud		
Nasal		
Normal		
Ragged		
Rapid		
Raspy		
Slow		
Slurred		
Soft		
Slutter		

Any other information:

What to do in a medical Emergency?

Chest pain, choking, bleeding, fainting, seizures. If an emergency occurs, how would you react? Do you know the first steps of first aid? People are often hesitant to get involved in an emergency situation. It's not so much they don't want to help. They're worried they won't know what to do. After all, emergencies can happen anywhere -- at a game, on a city street, at the grocery store, at home. What should you do?

The Basics

Call 112. We routinely hear from paramedics summoned to a residence, for what neighbors thought was an emergency, to find out everyone's fine. There are never hard feelings about that. Paramedics expect that as part of the job. We'd much rather show up and find the person in good health at home than be called too late and things have spiraled out of control."

Stay calm. We›ve all heard stories about the Good Samaritan who gets hit by a car while trying to help someone else. Creating another accident or another victim complicates things much more -- almost more than not getting involved. If you can't help safely, you shouldn't help, it's important that you stay calm, make sure you're not putting yourself or anyone else in jeopardy, then attempt to help.

Start CPR. Even people who have never taken a CPR course can be directed by a dispatcher to do CPR. In developed countries, many 911 dispatchers are trained to teach CPR over the phone. You can do chest compressions without even doing mouth-to-mouth. ... It's better than doing nothing."

5 Common Emergencies

Imagine these common situations. Here's what to do:

Emergency 1: Dizziness, Fainting. You›re sitting at a game, maybe in the airport. A guy says he doesn›t feel well. «If he tells you -- a perfect stranger -- that he feels weak, ill, or dizzy, you should be dialing 112. He needs medical attention. There are many medical causes for these symptoms, like a heart condition, diabetes, low blood sugar, pregnancy, heart attack, or it could be heat-related.

While you wait for paramedics to arrive:

Check alertness: Ask, "Are you OK?"

If they respond, ask 'Do you know where you are?' Ask things to determine level of orientation. If they become unresponsive, check for pulse, check to see if they're breathing. If you're by yourself, you have to find someone to help you."

Check breathing: Listen for breathing through the nose, watch the chest for rise and fall. Take a pulse, either at the wrist or neck. If they are breathing and have a pulse, you should stay with them to offer support. Again, 911 can help you figure out how to take someone's pulse.

Start CPR: If the patient isn't breathing and does not have a pulse, start CPR.

Make the patient comfortable: "If this person has been out in the heat, move them to a shady spot. If they're sweating, pour water over their skin,. Elderly people or very young children are more prone to

heat-related conditions. “If they’re awake, give them fluids to drink.

Emergency 2: Chest Pain. If someone grabs their chest and says «my chest hurts,» assume it›s a heart attack. Chest pain is a heart attack until proven otherwise. That’s how we look at it in the ER world. A 17-year-old can have a heart attack. Anyone can have a heart attack.

Plan of action: Dial 112. Then check airway, breathing, circulation (ABC). Are they breathing? Do they have a pulse? If not, start CPR.

The sad thing is, people get scared if they don’t know CPR, they don’t want to do the wrong thing. The most important thing -- if someone is not breathing -- is to position their head with the chin up, get their tongue out of the way (so the airway is open), then start doing chest compressions.

Emergency 3: Choking. You›re talking at the dinner table, and someone starts coughing. When does it become an emergency? “When they’re coughing, it’s OK, because there is air movement, they are breathing. If they’re not making any noise whatsoever, their face is getting red, you need to do the Heimlich maneuver. At that point, they are not breathing.

Caution: “If they’re coughing, doing the Heimlich can make it worse. Also, hitting a choking person on the back can make the situation worse -- the food may go back into the windpipe. “They need to work it out themselves; leave them alone, until they reach a point where there’s no airway noise.”

Emergency 4: Bleeding. When someone cuts their finger, they think they’re going to bleed to death. People don’t understand that there are nine units of blood in the body. The parts of the body that bleed a lot are the scalp, fingers, and toes. A nosebleed can bleed a lot. But they won’t bleed to death.

Nose bleeding can have a serious cause, like high blood pressure, or they can be caused by chronic nose-picking. If someone with high blood pressure has a serious nosebleed, you›re looking at potential disaster.

Rule of thumb: When something scares you, call ambulance or go to the hospital. We can say whether it’s an emergency or not.

A cut tendon may be more problematic than the bleeding. It may need to be closed with sutures, or they may never be able to use that finger again.

Don’t make a tourniquet: We don’t use tourniquets anymore. “They cause too much damage to tissues. We advise putting direct pressure on the site. Even if it’s a partial amputation, put a rag around it, hold it tight.

Emergency 5: Seizure. The symptoms of seizures vary. The person may fall down and/or make erratic movements. Or their head might jerk and eyes flutter. This can happen to children who have a high fever, to someone with epilepsy, or when someone is having a stroke.

Any seizure warrants medical attention. Call 112. While waiting for paramedics, make sure the person does not hurt themselves. “If they fall down, get everyone away from them. Don’t get near them; they could hurt you. Don’t try to put something in the person’s mouth (as used to be advised); it›s too dangerous. Also, watch the clock -- how long the seizure lasts.

GLOBAL AND REGIONAL ORGANIZATIONS WORKING IN DISASTER MANAGEMENT

Asian Disaster Preparedness Center, Bangkok

ADPC is a non-profit organization supporting the advancement of safer communities and sustainable development through implementing programmes and projects that reduce the impact of disasters upon countries and communities in Asia and the Pacific. ADPC was established in 1986 at the recommendation of the UN Disaster Relief Organization – now known as the UN Office for the Coordination of Humanitarian Affairs (UNOCHA) – as an outreach activity of the Asian Institute of Technology in Bangkok, Thailand, with the aim of strengthening the national disaster risk management systems in the region. In 1999, ADPC became an independent entity governed and guided by a Board of Trustees (21 members representing 15 countries). ADPC develops and implements disaster risk management programmes and projects by providing technical and professional services in formulating national disaster management policies, capacity building of disaster management institutions, programme design for comprehensive disaster risk management, post-disaster assessment, public health and emergency management, land-use planning, disaster-resistant construction, and the planning of immediate relief response and subsequent rehabilitation activities.

Asian Disaster Reduction and Response Network

In February 2002, the Asian Disaster Reduction Centre (ADRC) Kobe and UNOCHA, in Kobe, with the assistance of the ASEAN Foundation, brought together more than 30 NGOs from across Asia to discuss the need for a network of NGOs for disaster reduction and response in Asia. As a result, the Asian Disaster Reduction and Response Network (ADRRN) was formed. This loose body of NGOs was consolidated in December 2003, and in June 2004, the structure, content and direction of the ADRRN was clearly formulated and implemented.

The **objectives** of ADRRN are to:

- Develop an interactive network of NGOs committed to achieving excellence in the field of disaster reduction and response;
- Raise the relevant concerns of NGOs in the Asia-Pacific region to the larger community of NGOs globally, through various international forums and platforms;
- Promote best practices and standards in disaster reduction and response; and Provide a mechanism for sharing reliable information and facilitating capacity building among network members and other stakeholders. Website: http://www.adrrn.net

Asian Disaster Reduction Centre, Kobe Japan

The United Nations has been promoting the International Decade for Natural Disaster Reduction throughout the 1990s to reduce damage from natural disasters worldwide through international cooperative initiatives. On the basis of the lessons from the Great Hanshin-Awaji Earthquake, the need to promote multinational disaster reduction cooperation in the Asian region was stressed at the ministerial-level Asian Natural Disaster Reduction Conference held in Kobe City in December 1995, attended by delegates from

28 countries in Asia and other regions. Subsequently, ADRC was established in Kobe, Hyogo Prefecture, to facilitate exchange of disaster reduction experts from each country and concerned bodies, accumulate and provide disaster reduction information, and carry out research in multinational disaster reduction 15cooperation as the focus of this initiative. The symbol of the ADRC, which portrays a man embracing the Earth with his arms extended to reach all corners of the world, represents its commitment to creating a worldwide cooperative information network. The symbol expresses ADRC's goal of a fully developed unification of information networks and human power. Website: http://www.adrc.or.jp

Australian Tsunami Warning System

The Australian Tsunami Warning System provides tsunami warning services for Australia based on seismic information from the Pacific Tsunami Warning Centre, Japanese Meteorological Agency and Geoscience Australia on earthquakes. Other potential triggers for tsunami are volcanic eruptions, underwater landslides and meteorites. Currently there is a four-year project (2005–2008) to upgrade this service by enhancing the seismic monitoring network and sea-level monitoring network, in addition to the modelling of seismic events, tsunami propagation and coastal inundation. This is a cooperative project between the Bureau of Meteorology, Geoscience Australia and Emergency Management Australia. Website: http://www.ema.gov.au/agd/ema/emainternet.nsf/Page/Tsunami_Warning

Duryog Nivaran

(South Asian Network for Disaster Risk Reduction)

In 1995, the Duryog Nivaran network was established to fill a void in cross-border dialogue and experience sharing among organizations, governmental or otherwise, working in the world's most disaster-prone region, South Asia. It promotes an alternate perspective towards disasters, be they natural or man-made. This perspective points out that people affected by disasters are more than mere victims, but rather partners in their future development and well-being. The network's activities are information sharing, building a concerned media, research and grass-roots community action. It is already involved in disaster management research work in Bangladesh, India, Nepal, Pakistan and Sri Lanka.

The key objectives of **Duryog Nivaran** are:

Provide an opportunity for national and regional organizations in South Asia to strengthen their capacity and carry out effective disaster mitigation and development activities by sharing information, learning from each other's experiences and providing 16support for each organization's activities; Make the case for an alternative perspective by analyzing existing interventions and demonstrating, through research and action, other approaches that challenge the existing paradigm; and Carry out specific activities to influence decision makers in government, donor agencies and NGOs. Website: http://www.duryognivaran.org.

Global Disaster Information Network

The Global Disaster Information Network (GDIN) is a voluntary, independent, selfsustaining non-profit association with an interest in facilitating the provision of disaster warning and management-related information to its various stakeholders such as governments, international organizations, industry, academia, donor organizations and NGOs. It is committed to assist disaster managers in finding the information they need, particularly when other means have failed, develop unique information-sharing

procedures that augment the existing system, promote the development of new disaster information technologies and foster professional development.

GDIN originated in the US in 1997, based on experiences with the G7 and the UN. However, the international community quickly decided at the first GDIN Conference in Washington that it would be an international project that operates in partnership with all sectors and it is not owned by any one entity. Now, it operates as an informal international body with members from all sectors. GDIN has facilitated the development of fresh GIS products based on remote sensing for Viet Nam, Mozambique and Turkey.

It has also developed textual reports on infectious diseases in Afghanistan and a well regarded paper on anthrax. Website: http://www.gdin.org

International Charter for 'Space and Major Disasters'

Satellite imagery is very expensive and not affordable by most developing nations without their own space programmes. In the event of a natural or man-made disaster, space technology data should be readily available for developing nations that do not have or cannot afford their own space programmes.

Following the UNISPACE III conference held in Vienna, Austria in July 1999, the European and French space agencies initiated the idea of an International Charter for 17'Space and Major Disasters'. The Canadian Space Agency, National Oceanic and Atmospheric Administration, Indian Space Research Organization, Argentine Space Agency, Japan Aerospace Exploration Agency and the United States Geological Survey have also joined the Charter at later stages.

The International Charter aims at providing a unified system of space data acquisition and delivery to those affected by natural or man-made disasters through Authorized Users. Each member agency has committed resources to support the provisions of the Charter and thus is helping to mitigate the effects of disasters on human life and property. Website: http://www.disasterscharter.org

Pacific Disaster Center

The mission of the Pacific Disaster Center (PDC), established after Hurricane Iniki caused heavy destruction to the Hawaiian island of Kauai, is to provide applied information research and analysis support for the development of more effective policies, institutions, programmes and information products for the disaster management and humanitarian assistance communities of the Asia-Pacific region and beyond.

Central to achieving these objectives is providing unique and valuable geospatial and disaster-related information through a web-based data system for international, regional, national and local information access and dissemination. Through the use of the PDC web-based information system, disaster managers can develop both situational awareness and appropriate responses before, during and after disaster events. These responses range from the assessment of hazards and risk to managing risk through mitigation, preparedness, response, recovery and reconstruction.

In one of its projects, the PDC has entered into a contract with the National Disaster Warning Center (NDWC) in Thailand to provide technical assistance to NDWC in order to enhance its disaster management capabilities, systems and practices. Under this contract, PDC and its partners – Lockheed Martin Information Technology, Sun Microsystems and Environmental Systems Research Institute – will provide NDWC with technical solutions, systems integration and human resources training to achieve

its strategic objective of establishing a scalable and world-class disaster management and emergency communications facility.

The project, funded through a grant by the US Trade and Development Agency, will help build Thailand's capacity as part of the US government's broader support for an Indian Ocean tsunami warning system. Website: http://www.pdc.org/iweb/pdchome.html

Partners in Technology

The objective of Partners in Technology International (PACTEC) is to support any nation's effort to build communications capacity in case of an emergency. It provides assistance to establish or improve two-way communications where reliable telephone service is unavailable. PACTEC purchases, installs, and maintains HF/VHF radio networks and satellite communications connectivity. PACTEC installs and administers computer networks for email, web-based communications and applications. PACTEC also provides training for local technicians who can then operate and maintain PACTEC communication systems.

PACTEC has already undertaken work in Afghanistan, Indonesia, Kazakhstan, Lao PDR, Mauritania, Morocco and Senegal. PACTEC is in the process of spinning off a new non-profit organization to be called the Disaster Relief and Strategic Telecommunication Infrastructure Company, http://www.drasticom.net. and Website: http://www.pactec.org

Relief Web

Relief Web is an on-line gateway to information (documents and maps) on humanitarian emergencies and disasters. It provides timely, reliable and relevant information as events unfold, while emphasizing the coverage of 'forgotten emergencies' at the same time. Relief Web was launched in October 1996 and is administered by UNOCHA. The Relief Web portal has seen steady growth in usage. In 2002, Relief Web received 1.5 million hits per week, and in 2004, the site received approximately 1 million hits a day. Shortly after the Indian Ocean tsunami disaster of December 2004, it received 3 million hits a day on average.

Over 70,000 users subscribe to Relief Web's email services. It operates from three time zones to ensure that its news items are updated around the clock and posts about 150 maps and documents daily from over 2,000 sources. These are then categorized and stored in a searchable database containing a large number of such items dating back to 1981. Website: http://www.reliefweb.int

APDIP

The **Asia-Pacific Development Information Programme (APDIP)** is an initiative of the United Nations Development Programme (UNDP) that aims to promote the development and application of information and communication technologies for sustainable human development in the Asia-Pacific region. APDIP aims to meet its goals by focusing on three inter-related core areas: (i) policy development and dialogue; (ii) access; and (iii) content development and knowledge management.

APDIP collaborates with national governments, regional, international and multi-lateral development organizations, UN agencies, educational and research organizations, civil society groups, and the private sector in integrating ICTs in the development process. It does so by employing a dynamic mix of strategies – awareness raising,

capacity building, technical assistance and advice, research and development, knowledge sharing and partnership building. http://www.apdip.net

APCICT

The **Asian and Pacific Training Centre for Information and Communication Technology for Development** (APCICT) was established by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) in 2006 to strengthen the efforts of the member countries of the UNESCAP to use ICT in their socio-economic development through building the human and institutional capacity for ICT. APCICT is located in Incheon, Republic of Korea.

APCICT aims to build capacity of policy makers, project managers and trainers, and conduct research on human resource development in the field of ICT that will support the training programme. The ultimate goal of the centre is to reduce the digital divide in the region.

In addition, APCICT provides programmes for the training of trainers and exchange of trainers and experts; advisory services on ICT-related human resources development to UNESCAP members and associate members; and analytical studies related to human resources development in ICT, including identifying training needs and sharing good practice in human resources development programmes and training methods. http://www.unapcict.org

The **Tsunami Society**, otherwise the **International Tsunami Society**, is a professional society for the research of and dissemination of knowledge about **Tsunami**. The society was founded in Honolulu, Hawaii in 1982. The International Tsunami Society sponsors professional level meetings with local government officials to promote public safety awareness, disaster preparedness and the implementation of early warning systems.

Every two years, the society holds its International Scientific Symposium. Tsunami researchers and scientists from all over the world attend sessions at the symposia.

The society publishes an open access, international journal known as *Science of Tsunami Hazards* (ISSN 8755-6839), which is available to the scientific community free of charge. (Note: Only few major organizations are indicated here, for more information, refer textbooks).

World Bank Supports India's Effort to Mitigate Risks from Natural Disasters

The World Bank recently approved a $255 million assistance for the National Cyclone Risk Mitigation Project (I) (NCRMP-I) in support of the first phase of the National Cyclone Risk Mitigation Program.

The objective of the program is to help India mitigate the risks and vulnerability of its people to natural disasters, especially cyclones. The first phase is financed through a Credit from the IDA (International Development Association), complemented with $64 million from the Government's budget. India is highly vulnerable to natural hazards, particularly earthquakes, floods, droughts, cyclones and landslides.

Studies indicate that natural disaster losses equate up to 2 percent of India's GDP and up to 12 percent of federal government revenues. About 5,700 kilometers of India's coastline is exposed to severe cyclones and approximately 40% of India's population lives within 100 km of the coastline. Analyzed data for the period 1980-2000 indicates that on an average, annually, 370 million people are exposed to cyclones in India.

The aim of the project (NCRMP-I) is to improve early warning and communication systems; enhance capacity of local communities to respond to disasters; improve access to emergency shelters, evacuation, and protection against cyclone related hazards such as wind storms, flooding and storm surge in high risk areas; and strengthen disaster risk management capacities at the central, state and local levels. The program is expected to include at least three phases. **Phase I** includes the states of Orissa and Andhra Pradesh. **Phase II** will be open to the remaining high risk states or other coastal states that are ready to join. Rest of the coastal states will be covered under **phase III**. Each of the new phases will be appraised and approved separately to confirm the implementation readiness. This phased approach will help incorporate lessons from the earlier phases as well as include new ideas and advancements in technology in the management of risks. "As climate change and variability become more pronounced, hazard events are set to grow, both in terms of frequency and intensity. The project aims to mitigate the risks and vulnerability of coastal communities to cyclone and other hydro meteorological hazards by reducing the social, economic and financial impacts of future disasters." India's response to two of the biggest disasters in this current decade, the Gujarat earthquake and the Asian tsunami, has been efficient and very effective. Through this period, India has made great strides in moving from reactive emergency response to being proactive in implementing disaster preparedness and risk reduction initiatives. India enacted the Disaster Management Act in 2005 and established the National Disaster Management Authority and State Disaster Management Authorities. The credit is provided by the International Development Association (IDA), the World Bank's concessionary lending arm and has 35 years to maturity and a 10-year grace period.

Institutional Structure of Disaster Management in India

National Disaster Management Authority

The National Disaster Management Authority (NDMA), headed by the Prime Minister of India, is the Apex Body for Disaster Management in India. The setting up of the NDMA and the creation of an enabling environment for institutional mechanisms at the State and District levels is mandated by the Disaster Management Act, 2005.

Evolution of NDMA

Emergence of an organization is always an evolutionary process. Establishment of NDMA has also gone through the same processes. Towards this aim, the Government of India (GOI), in recognition of the importance of Disaster Management as a national priority, has set up a High-Powered Committee (HPC) in August 1999 and also a nation committee after the 2001 Gujarat earthquake, for making recommendations on the preparation of Disaster Management plans and suggestion effective mitigation mechanisms. The Tenth Five-Year Plan Document also had, for the first time, a detailed chapter on Disaster Management. Similarly, the Twelfth Finance Commission of India was also mandated to review the financial arrangements for Disaster Management.

On 23 December 2005, the Government of India enacted the Disaster Management Act, which envisaged the creation of the National Disaster Management Authority (NDMA), headed by the Prime Minister of India, and State Disaster Management Authorities (SDMAs) headed by respective Chief Ministers of the States, to spearhead and implement a holistic and integrated approach to Disaster Management in India.

Roles and Responsibilities

NDMA as the apex body is mandated to lay down the policies, plans and guidelines for Disaster Management to ensure timely and effective response to disasters. Towards this, it has the following responsibilities:-

- Lay down policies on disaster management;
- Approve the National Plan;
- Approve plans prepared by the Ministries or Departments of the Government of India in accordance with the National Plan;
- Lay down guidelines to be followed by the State Authorities in drawing up the State Plan;
- Lay down guidelines to be followed by the different Ministries or Departments of the Government of India for the Purpose of integrating the measures for prevention of disaster or the mitigation of its effects in their development plans and projects;
- Coordinate the enforcement and implementation of the policy and plan for disaster management;
- Recommend provision of funds for the purpose of mitigation;
- Provide such support to other countries affected by major disasters as may be determined by the Central Government;
- Take such other measures for the prevention of disaster, or the mitigation, or preparedness and

capacity building for dealing with the threatening disaster situation or disaster as it may consider necessary;

- Lay down broad policies and guidelines for the functioning of the National Institute of Disaster Management.

Organization

National Disaster Management Authority has been constituted with the Prime Minister of India as its Chairman, a Vice Chairman with the status of Cabinet Minister, and eight members with the status of Ministers of State. Each of the members has a well defined functional domain covering various states as also disaster specific areas of focus and concern. To carry out the mandated functions, NDMA has evolved a lean and professional organization which is IT-enabled and knowledge based. Skills and expertise of the specialists are extensively used to address all the disaster related issues. A functional and operational infrastructure has been built which is appropriate for disaster management involving uncertainties coupled with desired plans of action.

The concept of the organization is based on a disaster divisions-cum-secretariat system. Each member of the Authority heads disaster-specific divisions for specific disaster and functional domains. Each member has also been given the responsibility of specified states and UTs for close interaction and coordination.

The NDMA Secretariat, headed by a Secretary is responsible to provide secretarial support and continuity.

National Disaster Response Force (NDRF)

The Disaster Management Act, 2005 has mandated constitution of National Disaster Response Force (NDRF), a Specialist Response Force, for the purpose of specialized response to natural and man-made disasters. This Force will function under the National Disaster Management Authority which has been vested with its control, direction and general superintendence. This will be a multi-disciplinary, multi-skilled, high-tech force for all types of disasters capable of insertion by air, sea and land. All the eight battalions of National Disaster Response Force (NDRF) are equipped and trained for all natural disasters including four battalions in combating nuclear, biological and chemical disasters.

The DM Act, 2005 has made the statutory provisions for the constitution of the National Disaster Response Force (NDRF) for the purpose of specialized response to natural and man-made disasters. According to Section 45 of the Act, the Force has to function under the general superintendence, direction and control of the National Disaster Management Authority (NDMA) and under command and supervision of Director General, NDRF. Though the units of this Force were nominated in 2003, it is only after the establishment of NDMA that their training and equipping were vigorously pursued. In lieu with the Section 44 (i) of the Act that states NDRF a specialist force, the force is gradually emerging as the most visible and vibrant multi-disciplinary, multi-skilled, high-tech force of the NDMA capable of dealing with all types of natural and man-made disasters.

Present Organisation

At present, National Disaster Response Force (NDRF) is about constituted of eight battalions, two each from the BSF, CRPF, CISF and ITBP. Each battalion will provide 18 self-contained specialist search and rescue teams of 45 personnel each including engineers, technicians, electricians, dog squads and medical/paramedics. The total strength of each battalion is approximately 1,149.

All the eight battalions are being equipped and trained to combat all natural disasters including four battalions in combating nuclear, biological and chemical disasters.

Raising of two more NDRF battalions at (Patna), Bihar and (Guntur), Andhra Pradesh has been approved by the Government and NDMA has initiated necessary actions for the same.

Deployment

These NDRF battalions are located at nine different locations in the country based on the vulnerability profile to cut down the response time for their deployment. During the preparedness period/in a threatening disaster situation, proactive deployment of these forces will be carried out by the NDMA in consultation with state authorities.

State Disaster Management Authority

In pursuance of the provisions under Sec. 14 of the Disaster Management Act, 2005, the Governor of Mizoram is pleased to constitute the State Disaster Management Authority for Mizoram with the following composition with immediate and until further orders:

1	The Chief Minister	Chairperson
2	Minister, Relief & Rehabilitation	Vice-Chairperson
3	Minister, Planning & Programme Implementation	Member
4	Minister, Finance	Member
5	Minister, PHE	Member
6	Minister, Rural Development	Member
7	Minister, LAD	Member
8	Minister, Health & Family Welfare	Member
9	Minister, PWD	Member
10	Chief Secretary	Chief Executive Officer (Ex-Officio)

The terms of office of the State Authority shall be 3 years.

Powers & Functions

1. Subject to the provisions of the Disaster Management Act 2005, the State Authority shall be responsible for the following:
2. Lay down the state disaster management policy
3. Approve the State Plan in accordance with the guidelines laid down by the National Authority
4. Approve the disaster management plans prepared by the State Govt. Departments
5. Lay down guidelines to be followed by the State Govt. Departments for the purpose of integration of measures for prevention of disaster and mitigation and their development plans and projects and provide necessary technical assistance therefore.
6. Coordinate the implementation of the State Plan
7. Recommend provision of funds for mitigation and preparedness measures
8. Review the development plans of different State Govt. Departments and ensure that preventions and mitigation measures are integrated there in.

9. Review the measures being taken for mitigation, capacity building and preparedness by the State Govt. Departments and issue such guidelines as may be necessary.
10. Lay down Guidelines for providing standards of relief to persons affected by disaster in the State, provided that such standards shall be in no case be less than the minimum standards in the Guideline laid down by the National Authority.
11. Subject to ex-post facto ratification by the State Authority, the chairperson shall be in case of emergency, have the power to exercise all or any of the powers of the State Authority.
12. The State Authority shall meet as and when necessary and at such place and time the Chairperson of the State Authority may think fit.

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