
1 MEANING AND CLASSIFICATION OF DISASTERS

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1.1 INTRODUCTION

The International Strategy for Disaster Reduction (ISDR) of the United Nations (U.N.) defines a hazard as “a *potentially* damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.” Hazards could be, natural (geological, hydro-meteorological and biological) or induced by human processes (environmental degradation and technological hazards). Hazards can be *single*, *sequential* or *combined* in their origin and effects. Accordingly, Hazard Analysis entails the identification, study and monitoring of a hazard to determine its potential, origin and characteristics.

A fine line separates environmental hazards and environmental resources, as between *water out of control* (flood hazard) and *water under control* (reservoir resources). The

atmosphere is considered 'benign' when it produces holiday sunshine but 'hostile' when it produces damaging 'loo' (Smith, 1996).

A disaster is a result of natural or man-made causes that leads to sudden disruption of normal life, causing severe damage to life and property to an extent that available social and economic protection mechanisms are inadequate to cope. Even at the outset, the conceptual distinction between 'hazards' and 'disasters' needs to be brought out clearly. Floods, Cyclones, *et al* are events in nature until a configuration of factors, which could be man-made or natural or both, cause the hazard to turn to a disaster. Disaster is the actual occurrence of the apprehended catastrophe.

Disasters proceed by cause-effect due to *endogenous* (inherent) and *exogenous* (external) factors, which combine to *excite* the phenomenon into a large-scale destructive event. Disasters are a result of vulnerabilities, which go on unabated/unchecked over time, which crystallises finally in a destructive event of great magnitude, which is a disaster.

Disaster is disturbance of 'equilibrium' which can be restored/ remedied by proactive policy in this regard. Hence, traditional perception of disasters as natural phenomena outside the realm of human intervention is misconstruing the problem; it is giving way to a 'systems perspective', which encompasses, ecological and social perspective to disasters, whereby disasters are understood as totalising events in which all dimensions of a social-structural formation involving organised human action in the environmental context in which it takes place is studied" (Oliver Smith and Hoffman, 1999). As a society interacts with its environment with its values and perceptions and engages in a series of processes over which it has incomplete control and knowledge of, for example, development and planning processes involving production and distribution of goods over long periods of time; underlying hazards turn to disasters (Oliver Smith, 1999). By systemic understanding, hazard simply acts as a 'catalyst' in that it brings forth underlying tensions that are always present as potential pressures. Systems' perspective is therefore rightly applied to understanding the phenomenon underlying disasters (Watts, 1983).

With this understanding, Disaster Management is an attempt to inquire into the *process* of a *hazard turning to disaster*; to identify the causes and rectify the same through public policy. Administrative factors, such as poor building in an earthquake prone zone, poor land use planning in flood prone areas which lead to housing critical facilities in at-risk zones; allowing habitation in such zones, poor laws that fail to regulate facilities leading to disasters, such as the Bhopal gas leak, general low risk perception among people, more significantly policy-makers that hinders interest articulation for preventive policy for disaster management create conditions that lead to low lying /inherent hazards turning to disasters. This leads us to the issue of sustainable development since study and research in the area of disaster management is increasingly revealing human causatives behind disaster phenomena.

Hence, disaster management is a policy issue. Accordingly, the Tenth Plan included a full chapter on Disaster Management. Hitherto, it had been treated as a subject of 'calamity relief', hence, classified under non-plan expenditure. There has been a policy shift, post Yokohama Conference(1994), in that plan allocations would henceforth be made under respective sector *plan heads* for disaster mitigation. The reasoning is simple; if disasters are inherent in the socio-physical circumstances/environment, their manifestation could be controlled through better management of the environment by reducing the potency of socio- economic and physical variables that contribute to disaster losses over time.

1.2 CLASSIFICATION OF DISASTERS

Disasters are classified as per origin, into *natural* and *man-made* disasters. As per severity, disasters are classified as *minor* or *major* (in impact). However, such classifications are more academic than real as major disasters could simply be events that received relatively more media coverage (Parasuraman and Ummikrishnan, 2005).

High Powered Committee (HPC) was constituted in August 1999 under the chairmanship of J.C.Pant. The mandate of the HPC was to prepare comprehensive model plans for disaster management at the national, state and district levels. This was the first attempt in India towards a systematic comprehensive and holistic look at all disasters. Thirty odd disasters have been identified by the HPC, which were grouped into the following five categories, based on generic considerations:

1) **Water and Climate**

- Floods
- Cyclones
- Tornadoes and hurricanes (cyclones)
- Hailstorms
- Cloudburst
- Heat wave and cold wave
- Snow avalanches
- Droughts
- Sea erosion
- Thunder/ lightning

2) **Geological**

- Landslides and mudflows
- Earthquakes
- Large fires
- Dam failures and dam bursts
- Mine fires

3) **Biological**

- Epidemics
- Pest attacks
- Cattle epidemics
- Food poisoning

4) **Chemical, industrial and nuclear**

- Chemical and Industrial disasters
- Nuclear

5) **Accidental**

- Forest fires
- Urban fires
- Mine flooding
- Oil spill
- Major building collapse
- Serial bomb blasts
- Festival related disasters
- Electrical disasters and fires
- Air, road, and rail accidents
- Boat capsizing
- Village fire

Depending on the type of disaster, a nodal ministry has been assigned the task of coordinating all activities of the state and district administration and the other support departments/ministry. The following table below vividly gives the information:

Type of Disaster/Crisis	Nodal Ministry
Air Accidents	Ministry of Civil Aviation
Civil Strife	Ministry of Home Affairs
Major breakdown of any of the Essential Services posing widespread and protected problems	Concerned Ministries
Railway Accidents	Ministry of Railways
Chemical Disasters	Ministry of Environment
Biological Disaster	Ministry of Health
Nuclear Accident inside or outside the country which poses health or other hazards to people in India	Department of Atomic Energy

Source: *Manual on Natural Disaster Management in India: NCDM, IIPA.*

It is not the classification but the understanding of the term ‘disaster’ itself that is important. As reported in the World Disasters Report, 2004, *heat waves* have been missing from disaster and public health policies, despite mounting death tolls, particularly in Europe. This is probably because sudden high profile disasters, such as earthquakes evoke greater *dread* than road accidents, despite evidence that more people die in road accidents than earthquakes. The higher the dread factor, the more people want action to reduce those risks. During August 2003, between 22,000 and 35,000 people died due to heat waves across Europe. Economic losses totaled over US\$ 13 billion. The challenge

for health professionals and disaster specialists is to raise public awareness of the potential harm caused by extreme temperatures and treat the problem as a disaster.

The *problem of migrants* is another example. They are an important development resource for their home countries, remitting about US\$ 80 billion per year to developing nations (compared to US\$ 50 billion in world aid). But while many opt to migrate, tens of millions are forced to flee life-threatening conditions at home and become refugees. Largely unprotected by international laws and institutions, their plight is a *forgotten disaster*. As observed in the World Disasters Report, 2003, over 175 million people now live outside their countries of birth, double the figure in 1975. Many are economic migrants, who may be fleeing poverty or severe deprivation.

There is also increasing understanding of man-made causes behind most natural disasters, which calls for, and has, in fact, effected renewed understanding/perception of disasters. For both natural and man-made disasters, there is increasing evidence to suggest that both are in fact 'policy disasters' rather than the results of nature's vagaries or designs of fate. Increasing evidence suggests that human fallacies, such as inadequate legal framework to regulate hazardous units, have resulted in tragedies like the Bhopal tragedy and the in-house Vizag steel accidents where minor fires and deaths of employees due to mishaps have been reported. Unrestricted felling of forests, serious damage to mountain ecology, overuse of groundwater, changing patterns of cultivation, etc., has precipitated recurring floods and droughts. The spate of landslides in the Himalayas in recent years can be directly related to unchecked exploitation of forests and mountain vegetation and networks of roads that have been indiscriminately laid in the name of development. As articulated in the India Disasters Report (2005), lack of policy restricting tobacco and liquor sale has led to disasters by way of increasing mortality, globally, almost on epidemic proportions. Tobacco related diseases are increasingly incident, such as oral cancer and heart disease in young people under 40. It is apprehended that each year, tobacco causes 3.5 million deaths worldwide, or about 10,000 deaths per day. One million of these deaths occur in developing countries. By 2020, it is predicted that tobacco will become the leading cause of death and disability, killing more than 10 million people annually; thus, causing more deaths worldwide than HIV, tuberculosis, maternal mortality, motor vehicle accidents, suicide, and homicide combined. India has one of the highest rates of oral cancer in the world.

Similarly, experience of floods in Rajasthan (1996) and Mumbai (2005) suggests that more deaths are caused due to epidemic outbreaks following vector proliferation in accumulated waters rather than the natural disaster of the flood itself. This is clearly system failure, rather than nature's 'retribution.'

Experience of droughts in some pockets of Orissa suggests that unimaginative policy shifts, such as precocious exposure of farmers to market competition, falling overall standards of health and nutrition owing to reduced investments in education and health and other system weaknesses were the real causes of mortality rather than the natural feature of lack of enough rainfall. Policy-makers in third world countries allegedly seem to respond more to exogenous policy influences by way of international pressure to liberalise or 'open up' (markets) more than endogenous requirements, which is the real cause behind increasing vulnerability of people to death and disease in relatively impoverished parts of India, such as Orissa and Madhya Pradesh (Alternative Economic Survey, 2004-05).

Disasters, therefore, compel a re-look on developmental planning. It is obvious that the previous developmental policy has given us vulnerabilities in the form of slum creation/

proliferation, insufficient jobs, ecological degradation; though, ostensible growth in sectors, such as, industry, energy *et al* could not be denied. It remains a fact and has to be conceded that the basic needs of a large proportion of India's population have remained unmet despite schemes to provision the same. Though the Government of India, Economic Survey, 2004-05 indicates decline in the number of people below the poverty line (BPL), from 51.3 per cent in 1977-78 to 26.1 per cent in 1999-2000, it conceded that there are wide variations across states. Poverty is spatially concentrated in pockets in backward states such as Orissa though there may have been an overall decline in terms of averages. Figures never tell the complete picture. These are gross estimations, at best averages that give only a broad outlook, not the real details. There is endemic malnutrition and numerous reported incidences of starvation deaths. As per the results of the 55th round of National Sample Survey Organisation, rate of growth of employment on current daily status (CDS) basis declined from 2.7 per cent per annum in 1983-94 to 1.07 per cent in 1994-2000. The decline is largely attributed to stagnation in the agriculture sector. Share of agriculture in total employment dropped from 60 per cent in 1993-94 to 57 per cent in 1999-2000. Most growth has been recorded in the services sector.

Balanced regional development has also remained an unmet goal. Several states and regions in the country, such as Bihar, Orissa, Uttar Pradesh, Rajasthan, are relatively backward and suffer higher incidence of poverty compared to the national average. Noticeably, poverty is also widespread in areas more prone to natural disasters, like flood-prone areas, such as in north Bihar, east Uttar Pradesh, and north Bengal, and drought-prone areas, such as Rajasthan, Marathwada, and north Karnataka.

Poverty is also exacerbated due to excessive resource use/exploitation, which has caused depletion of ecological resources. As per the India Disasters Report, 2005, almost 40 per cent of India's population currently is forced to survive on depleted resources. Driven to desperation, they migrate, which has created the problem of unsustainable cities and a conflict ridden city culture, typically pronounced in slums. Increased pressure has encountered a crumbling local government structure, inept to manage change. Consequently, vulnerabilities have got complicated and harder to understand over time. They are increasingly manifest as conflicts along caste, religious, and ethnic lines and have assumed an endemic nature (Alternate Economic Survey, 2004-05).

1.3 GLOBAL DIMENSIONS OF DISASTERS

Disaster losses have shown an increasing trend, globally, due to urbanisation and increasing population. According to the United Nations, in 2001 alone, natural disasters of medium to high intensity caused at least 25,000 deaths around the world, more than double the previous year and caused economic losses world- wide of over \$36 billion. The data excludes the many small-scale events that have affected local economies adversely, and disturbed the life pattern for perhaps always. Some of the major events were, the Earthquakes that ravaged Gujarat, El Salvador and Peru, floods that ravaged countries in Asia, Africa and elsewhere, droughts that affected regions in Central Asia; Afghanistan, Asia and Central America, Cyclones in Madagascar and Orissa, and floods in Bolivia. Global disaster statistics for 1996-2000 revealed staggering economic costs estimated at US\$ 235 billion and 425,000 lives lost (CRED International Disaster Database).

Disasters caused by natural hazards alone reportedly affected an average of 211 million people per year in the past decade. Asia bears much of the brunt. Nearly half of the

world's major natural disasters, recorded over more than three decades, occurred in the region. As a result, Asia has become the world's most disaster-prone region, involving 80 per cent of the total affected populations, 40 per cent of the total deaths, and 46 per cent of the total economic losses (CRED statistics for 1997-2001).

Disasters have international ramifications in terms of direct and indirect impact (s). Hence is explained the need for concerted action on the part of the international community to tackle regional vulnerabilities. Developing countries have suffered more from disaster events since system capacity to cope with events of such large magnitude is considerably lower as compared to developed countries, and the vulnerability quotient on account of physical social and economic vulnerability of the multitudes, significantly higher. Since 1991, two-thirds of the victims have been from developing countries and just 2 per cent from the developed countries.

Asia is particularly vulnerable to disaster strikes. Between 1991-2000, 5,54,439 people died in Asia compared to 1, 1159 casualties in rest of the world. Within Asia, 24 percent of the casualties occurred in India owing to its size, population and vulnerability. Floods and High Winds account for most deaths in India (Tenth Plan, 2002-07).

Between 1994 and 2003, disasters, both 'natural' and 'technological', claimed 68,671 Indian lives, affected an average of 68 million people every year, and cost US\$1.9 billion annually in direct economic damage. This toll is worse than for the previous decade, so the task of supporting the resilience of Indian communities to disasters has never been more urgent (World Disasters Report, 2004).

1.4 OVERVIEW OF NATURAL DISASTERS IN INDIA

India's Key Vulnerabilities as articulated in the Tenth Plan, (2002-07) are as follows:

- Coastal States, particularly on the East Coast and Gujarat are vulnerable to cyclones.
- 4 crore hectare landmass is vulnerable to floods
- 68 per cent of net sown area is vulnerable to droughts
- 55 per cent of total area is in seismic zones III- V, hence vulnerable to earthquakes
- Sub- Himalayan sector and Western Ghats are vulnerable to landslides.

The succeeding text analyses in brief vulnerabilities to specific natural hazards in India (Menon and Kalmadi).

A) Floods

Seventy five per cent of rainfall is concentrated over four months of monsoon (June - September) as a result of which almost all the rivers carry heavy discharge during this period. The problems of sediment deposition, drainage congestion and synchronisation of river floods compound the flood hazard with sea tides in the coastal plains. Brahmaputra and the Gangetic Basin are the most flood-prone areas. The other flood-prone areas are the northwest region of the west flowing rivers like Narmada and Tapti, Central India and the Deccan region with major east flowing rivers like Mahanadi, Krishna and Cauvery. While the area liable to floods is 40 million hectares, the average area affected by floods annually is about 8 million hectares.

B) Droughts

India has a largely monsoon dependant irrigation network. An erratic pattern, both low (less than 750 mm) and medium (750 - 1125 mm) makes 68 per cent of the total area vulnerable to periodic droughts. A 100-year analysis reveals that the frequency of occurrence of below normal rainfall in arid, semi-arid, and sub-humid areas is 54-57 per cent. Severe and rare droughts occur in arid and semi-arid zones every 8-9 years. The semi-arid and arid climatic zones are subject to about 50 per cent of severe droughts that cover generally 76 percent of the area. In this region, rare droughts of most severe intensity occurred on an average once in 32 years and almost every third year was a drought year.

C) Cyclones

India has a long coastline. There are two distinct cyclone seasons: pre-monsoon (May-June) and post-monsoon (October-November). The impact of these cyclones is confined to the coastal districts, the maximum destruction being within 100 Km. from the centre of the cyclones and on either side of the storm track. Most casualties are caused by coastal inundation by tidal waves, storm surges and torrential rains.

D) Earthquakes

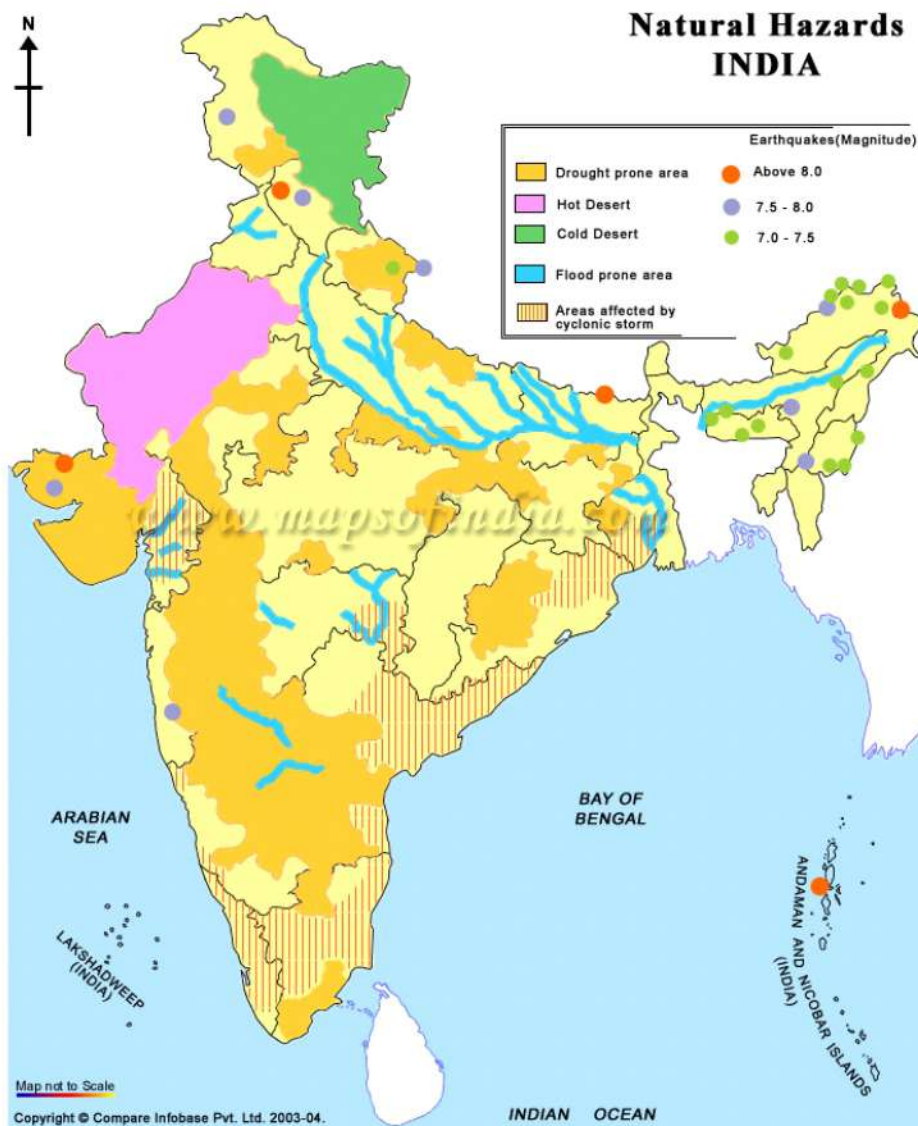
The Himalayan mountain ranges are considered to be the world's youngest fold mountain ranges. The subterranean Himalayas are geologically very active. In a span of 53 years, four earthquakes exceeding magnitude 8 on the Richter scale have occurred in this region. The peninsular part of India comprises stable continental crust. Although these regions were considered seismically least active, an earthquake that occurred in Latur in Maharashtra on September 30, 1993 of magnitude 6.4 on the Richter scale caused substantial loss of life and damage to infrastructure.

E) Landslides and Avalanches

The Himalayan, the northeast hill ranges and the Western Ghats experience considerable landslide activity of varying intensities. River erosions, seismic movements and heavy rainfalls cause considerable activity. Heavy monsoon rainfall often in association with cyclonic disturbances results in considerable landslide activity on the slopes of the Western Ghats.

Avalanches constitute a major hazard in the higher reaches of the Himalayas. Parts of the Himalayas receive snowfall round the year and adventure sports are in abundance in such locations. Severe snow avalanches occur in Jammu & Kashmir, Himachal Pradesh and the Hills of Western Uttar Pradesh. The population of about 20,000 in Nubra and Shyok valleys and mountaineers and trekkers face avalanche hazard on account of steep fall.

The following map gives the multi-hazard vulnerability of the Indian landmass.



Source: Compare InfoBase Pvt. Ltd.

1.5 OVERVIEW OF MAN-MADE DISASTERS

Man-made disasters refer to non-natural disastrous occurrences that can be sudden or longer term. Sudden man-made disasters include structural collapses, such as building and mine collapse, when this occurs independently without any outside force. In addition, air disasters, land disasters and sea disasters are all man-made (International Red Cross).

The countries in Asia region are densely populated and are low-income economies. Recurrent disasters, specifically, road and rail accidents, fire outbreaks, deaths of pavement dwellers due to heat and cold wave conditions etc., cause serious setback to the developmental process; in fact disasters and development have a chicken and egg relationship in that one is in fact the primary cause of the other. For example, disasters exacerbate poverty conditions in affected regions; and the poor are the worst sufferers in disasters. The fast pace of growth and expansion without comprehensive understanding or preparedness in urban planning, for instance, has brought forth a range of issues that seek urgent attention at all levels. Local administrative weaknesses have allowed the situation

to get out of hand. Institutional weaknesses have created system vulnerabilities over time. In the absence of mitigation measures, growing numbers in our population are at risk of prospective hazards, such as air accidents, boat capsizing, building collapse, electric fires, festival related disasters, forest fires, mine flooding, oil spills, rail accidents, road accidents, serial bomb blasts, and fires. The safeguards within existing systems are limited and the risks involved high. The situation with regard to road accidents is particularly acute.

A comprehensive document prepared by the Transportation Research and Injury Prevention Programme (TRIPP) brings out the magnitude of the problem in India and abroad. It gave the first official data of accidents in 2002, recording 80,118 deaths and 342,200 injuries on Indian roads but conceded at the same time that many cases went unreported and that 1,200,000 required hospitalisation. Of the worldwide annual average of 700,000 road accidents, 10 per cent occur in India. The latest annual statistics indicate that over 80,000 people are killed on Indian roads. These figures do not reflect the human suffering and social problems caused by accidents. Nearly three lakhs per year sustain injuries.

Financial losses are staggering. A decade's worth of saving the Rs 50,000 million estimated loss in traffic accidents every year could finance building 7,000 km long, six lane national highway at today's rates. The figures are always on the increase, which corresponds to the tremendous increase in the production and sale of motor vehicles (Moorthy and Karnick, 2005).

Nuclear, Chemical and Biological threats are apparent in the present scenario. Deliberate international terrorism or accidental secondary fallouts can be fatal. There has been considerable agitation in India of late over advanced countries dumping hazardous waste in India. This falls within the realm of international relations. Rapid and effective response as also mitigation policy needs intensive research and laboratory support in this regard to frame convincing legislation, which can ensure internal security without jeopardising external relations with foreign countries. Globalisation would have to be effectively managed through legislation regulating Multi-national and Transnational corporation activity, especially with regard to safety precautions for hazardous facilities. EIAs or environment impact assessments are already underway in India. There is need for better implementation of the same. A good EIA needs good data support to base arguments on, which is presently lacking. Acknowledging the need, Environmental Information Centre (EIC) has been set up to serve as a professionally managed clearing house of environmental information that can be used by MoEF, project proponents, consultants, NGOs and other stakeholders involved in the process of environmental impact assessment in India. EIC caters to the need of creating and disseminating organised environmental data for various developmental initiatives all over the country. Regarding oil spills, experts opine that satellite imagery should be used to mark out vulnerable areas and mitigation measures put in place, as for example, restricting habitation in the areas.

In India, the man-made disaster category also includes communal riots, which affect parts of India periodically, as in the wake of the Babri Masjid demolition or unabated violence against Dalits, the sub-ethnic North-East tangle, and others. Vulnerability studies in this regard would require empirical unearthing of facts with regard to the socio-economic profile of the regions with a view to pinpointing the exact cause (s) of recurrent violence in the area (s). In this regard, generation of awareness among communities, strengthening/generating positive social capital proactively, through measures like mustering opinion in support of measures to ameliorate the situation, lending active state support to social

workers involved in movements towards the same would be some of the desirable activities.

Health is a major factor in disaster management efforts. As reported in the World Disasters Report, 2004, across southern Africa, HIV/AIDS is combining with food insecurity, poverty, worsening health care, dirty water and sanitation, uncontrolled urbanisation and common disease to create an unprecedented disaster that conventional intervention can no longer contain. The problem is no less acute in India, where figures of actual and potential victims keep rising. The pace of improvement in health services does not compare favourably with countries in East Asia and Latin America where life expectancy is almost as good as developed countries. This is because inter-sector linkages between sanitation, nutrition, poverty alleviation, education, drinking water supply *et al* have not been duly explored. In states where such linkages obtain for historical reasons, or as a result of deliberate effort in this regard on the part of the government, results in health improvement are significantly better than other states. Hence, emphasis in the tenth plan was on improved logistics with regard to drug supply and diagnostics and exploring systems of health care financing so that essential health care is available to all at affordable cost (Tenth Plan).

As per the Red Cross, long-term man-made disasters refer to civil strife, civil war and international war, which are equally pertinent policy concerns. On a national level, this involves war-like encounters between armed groups from the same country, which take place within the borders. Such outbreaks of war, besides threatening national security, may pose large-scale medical problems such as epidemics, lack of water, accumulation of rubbish, displaced persons, refugees, food shortage, hunger etc. Our country has been plagued by civil strife in Kashmir and North-East particularly, besides South India and West Bengal, occasionally. Tensions with neighbouring states have been persistent. As solution has evaded attempts in this regard, the emphasis in diplomacy has currently shifted to 'management' of the problem with a view to normalising relations on other counts such as commerce *et al* instead of insisting on solving persistent political issues, for instance, the Kashmir issue with Pakistan, first.

Scenario with regard to preparedness, with respect to both internal and external problems, however, need not be too pessimistic, since, theoretically, transport accidents, terrorism *et al* have hitherto not been considered, 'disasters' *per se*; on account of increasing losses from such events however, the term 'Disaster' today is more inclusive in that the above enumerated are being counted disasters, leading to mitigation policy in this regard and urgency with which they need to be reviewed. This is significant from the point of view of Risk Perception in the sense of resource allocation and prioritisation in development planning. Considering the seriousness with which they are being studied/perceived, comprehensive mitigation plans expectedly, would now be built into wider development planning for the future. The World Health Organisation says India scores high on a number of criteria for disaster-readiness. The country also earned praise from a global study for its immediate response to the tsunami disaster. India is among the five countries in South Asia that meet many of the criteria for disaster-preparedness and have a legal framework in place for the purpose, says the World Health Organisation (WHO).

The other four countries categorised by the WHO as having adequate levels of disaster-readiness are Bangladesh, Indonesia, Sri Lanka and Thailand. India, Myanmar, Sri Lanka and Thailand also have a legal framework in place.

Disaster management is now part of plan commitments, which means it is already a frontline development issue/priority, which improves its position with respect to resource allocation.

Also, awareness generation is already being attempted with regard to retrofitting and earthquake resistant structures *et al*, which is a positive development. It also means government strategy towards disaster mitigation envisages active cooperation of people, which has been advocated as an essential requirement by concerned world bodies, like the United Nations Development Programme (UNDP) and the International Red Cross.

Items high on agenda for administrative reforms, as articulated in the Tenth Plan, henceforth, for overall/comprehensive disaster management, would be, *development of capacity at local levels* through effective decentralisation, *improvement in law and order administration*, through modernisation and training, *urban development* with a perspective of disaster mitigation planning involving all stakeholders.

1.6 VULNERABILITY PROFILE OF INDIA

Vulnerability is defined as *“the extent to which a community, structure, service, or geographic area is likely to be damaged or disrupted by the impact of particular hazard, on account of their nature, construction and proximity to hazardous terrain or a disaster prone area”*. The concept of vulnerability therefore implies a measure of risk combined with the level of social and economic ability to cope with the resulting event in order to resist major disruption or loss. This susceptibility and vulnerability to each type of threat will depend on their respective differing characteristics. The 1993 Marathwada earthquake in India left over 10,000 dead and destroyed houses and other properties of 200,000 households. However, the technically much more powerful Los Angeles earthquake of 1971 (taken as a benchmark in America in any debate on the much-apprehended seismic vulnerability of California) left over 55 dead.

Physical Vulnerability

Physical vulnerability relates to the physical location of people, their proximity to the hazard zone and standards of safety maintained to counter the effects. For example, people are only vulnerable to a flood because they live in a flood-prone area. Physical vulnerability also relates to the technical strength of buildings and structures to resist the forces acting upon them during a hazard event. The Indian subcontinent can be primarily divided into three geophysical regions with regard to vulnerability, broadly, as, the Himalayas, the Plains and the Coastal areas. The topographic and climatic characteristics of each region make them susceptible to different type of disasters (study along with map given in the text).

Socio-economic Vulnerability

The degree to which a population is affected by a calamity will not purely lie in the physical components of vulnerability but in *contextual*, relating to the prevailing social and economic conditions and its consequential effects on human activities within a given society.

Disparate capacities of people are exposed during disasters, which explains differential vulnerability/losses, which are explained in disaster literature as socio-economic vulnerabilities. Disaster effects are seen to be directly proportionate to the poverty gap and poverty

intensity in the society/location as it is the poor that normally live in high concentration in marginal areas (unstable slopes, flood plains) with little infrastructure and fewer resources to cope. Research in areas affected by earthquakes indicates that single parent families, women, handicapped people, children and the aged are the particularly vulnerable social groups.

Bad land use planning in seismic and flood prone zones; unplanned and inadequate developmental activity in high- risk areas is a cause for increased losses during disasters. One million houses are damaged annually in India apart from high human, social and other losses. Urban growth and concentration of limited resources are realities of our times, while the rural sector faces lack of access. This compounds the problems of disaster vulnerability, especially during earthquakes. Informal settlements that house most of the urban and rural poor give way easily to physical stress, during earthquakes and floods, causing large scale fatalities during disasters such as earthquakes and floods. Single scale event fast turns into a compound phenomenon as the infrastructure gives way, leading to fire breaks, deaths due to electrocution, besides making response ever more difficult.

Following steps are imperative for the vulnerability assessment and preparedness in high-risk zones:

- Identification of various hazard prone areas. Preparation of detailed vulnerability profiles, mapping food insecurity, aviation hazard, landslide hazard etc.
- Vulnerability and risk assessment of buildings
- Developing disaster damage scenarios
- Developing technical guidelines for hazard resistant constructions
- Upgrading of hazard resistance of existing housing stock by *Retrofitting*, and
- Crafting techno-legal regime to be adopted for infrastructure development.

1.7 ENVIRONMENTAL CONCERNS

Nature is an abundant resource but indiscriminate and rampant exploitation creates threat of destruction. The balance in nature, between man, animal and resources must be maintained/nurtured. Oil spills; forest fires or nuclear leaks can cause widespread and irreparable damage to the environment. Time cycles to renew these resources are long and therefore measures for safety, maintenance and containment have to be strengthened.

Some of the environmental concerns are discussed as follows:

D) Global Warming & Extreme Climate

Global warming is going to make other small local environmental issues seemingly insignificant, because it has the capacity to completely change the face of the Earth. Global warming is leading to shrinking glaciers and rising sea levels. Along with floods, India also suffers acute water shortages. The steady shrinking of the Himalayan glaciers means the entire water system is being disrupted; global warming will cause even greater extremes. Impacts of El Nino and La Nina have increasingly led to disastrous impacts across the globe.

Scientifically, it is proven that the Himalayan glaciers are shrinking, and in the next fifty to sixty years they would virtually run out of producing the water levels that we are seeing

now. This will cut down drastically the water available downstream, and in agricultural economies like the plains of Uttar Pradesh (UP) and Bihar, which are poor places to begin with. That, as one may realise, would cause tremendous social upheaval. Similar would be problems in the coastal areas where sea level rise would inundate large tracts. Some of the islands would get submerged.

The changing environmental equilibrium as well as the diverse geographical setting of the region is leading to extreme weather conditions, often emerging as disastrous phenomena. A large number of deaths are periodically reported due to heat or cold waves, mostly from northern and coastal states of the country.

II) Agro-forestry

Sustainable management of the natural resources, of land, water and vegetation is essential to provide livelihood and environmental security. Ever-increasing demographic pressures coupled with developmental activities are causing tremendous pressure in the utilisation of these resources, leading to various kinds of ecological disasters, such as droughts, floods, cyclones, landslides, mine spoils, siltation of reservoirs, deterioration of water bodies, loss of biodiversity etc. In recent times, India has witnessed large-scale disasters such as frequent floods in the Indo-Gangetic and Brahmaputra flood plains, cyclones of the east coast and Gujarat, earthquakes of Uttarkashi, Latur, Jabalpur, Chamoli and Gujarat; and small-scale hazards, such as landslides in the Himalayan range, forest fires and desertification. These natural disasters have not only affected the economy but also taken a huge toll of human life. The increasing frequency of these disasters is the outcome of excessive biotic and abiotic interferences, which have resulted in considerable degradation of our natural resources.

Large scale deforestation across the globe in general, and under-developed as well as developing countries in particular, coupled with faulty management practices have resulted in various kinds of environmental degradations, such as wind and water erosion; physical and chemical degradation of soil, water and biodiversity; and global warming. Deforestation is a slow onset disaster that contributes to other cataclysmic disasters. The rapid rate of deforestation in the tropics is the key factor in increasing the frequency of flood disasters. The greatest and the most immediate danger of deforestation is that gradually diminishing forested areas contribute to or worsen other types of disasters, such as accelerated soil erosion, floods, drought and desertification. Deforestation of watersheds, especially around smaller rivers and streams increases the severity of flooding, reduces stream flows and dries up springs during dry seasons and increases the load of sediment entering the waterways. Most hazards in the Himalayan region emanate primarily from the natural processes of geologic, hydrologic and physiographic nature but are greatly affected by human interventions. Ever increasing demand for food and fodder has resulted in conversion of forests and exploitation of fragile and marginal lands into agriculture, migratory grazing and shifting cultivation practices. Mining and other human activities have led to over-exploitation of natural resources and consequent occurrence of ecological disasters. Rapid degradation of the Himalayan ecosystem is posing a potential danger to the greenery of the Indo-Gangetic basin, causing sporadic floods in some areas and droughts in others. As a result, more than half of the geographical area of the country is now partially exposed to various forms of land degradation processes, such as water and wind erosion, salinisation, water logging, flooding, ravines, shifting cultivation, mining, quarrying, landslides etc. About two-thirds of the 142 million ha of agricultural land in the country is drought affected and about 40 million ha area is prone to flooding, of which

about 8 million ha area gets annually flooded. It is estimated that about 56 per cent of the country is susceptible to earthquake damages.

Human population of India has already crossed the one billion mark and the livestock population has reached a figure of 445 million. The per capita availability of cultivated land has declined over the years from 0.53 ha in 1950 to 0.15 ha in 2000 and is expected to further reduce to 0.12 ha by 2015 A.D. owing to population pressures. The requirements of food grains, fodder and fuel wood by 2015 A.D. have been estimated at 275 million tonnes, 1083 million tonnes and 235 million m³, respectively to meet the requirements of 1225 million human and 600 million livestock population indicating a shortfall of 73 million tonnes, 570 million tonnes and 195 million m³ of food grains, fodder and fuel wood at the current level of production. Besides, tremendous pressure on limited forest resources (63 million ha) and over-exploitation of land resources, particularly the marginal lands, might further aggravate land degradation and jeopardise sustainability of these resources beyond retrieval. Agriculture is the mainstay of the rural population in the country. There has been a spectacular increase in food production since independence, which has increased four times from 51 million tonnes in 1950-51 to 203 million tonnes in 2000-01 against three-fold increase in population. However, uneven development of agriculture across regions and also among different sections of the farming community has widened the disparity between resource-rich and resource-poor farmers and has resulted in low levels of productivity, especially in rainfed areas and degradation of natural resources. Of the 142 million ha cultivated area in the country, 63 per cent (89 million ha) is rainfed which accounts for only 45 per cent of the total food production while 37 per cent irrigated area (53 million ha) contributes 55 per cent to the national food basket. Moreover, agriculture on marginal and fragile lands in the hilly regions has resulted in enormous soil loss. The government has therefore, accorded high priority to holistic and sustainable development of rainfed areas.

Diversification of land use systems is a necessary strategy for providing a variety of products for meeting varied requirements of the people, insurance against risks caused by weather aberrations, controlling erosion hazards and ensuring sustainable production of the land on a long-term basis. Agro- forestry is a viable alternative to prevent and mitigate natural disasters. Besides, agro-forestry may be one of the important tools for disaster management. Agro- forestry may be defined as a technique of growing food crop annuals in association with woody perennials to optimise the use of natural resources, minimise the need for inputs derived from non-renewable resources and reduce the risk of environmental degradation. Agro- forestry, a multiple use concept of land management, is also capable of meeting the present challenges of shortage of fuel wood, fodder, fibre, timber, unemployment, environmental degradation, protection and improvement of wastelands and agriculture land. It has immense potential to ensure stability and sustainability in production and to provide ecological and economic security. In India, agro- forestry practices are dovetailed in the various developmental programmes/schemes in the Five Year Plans of Government of India, either to prevent natural disasters or to overcome the problems of the affected people during and after natural disasters. These programmes include, Flood Control/Management Programmes, Multi-purpose River Valley Projects, Agriculture Development Programmes, Integrated Rural Development Programmes (IRDP), and National Watershed Development Programme for Rainfed Areas (NWDPPRA), Forestry Development Scheme, Drought Prone Area Development Programme (DPADP) and Desert Development Programme (DDP). In other words, agro- forestry has a wide and diverse potential to protect the environment in varying agro-climatic situations. The major environmental functions of agro-forestry may be summarised as:

- Control of soil degradation
- Control of desertification
- Flood control
- Drought moderation
- Reduction in the pollution of groundwater resulting from high inputs of fertilizers
- Increasing biodiversity in the farming system and watershed scale
- Increasing food security and thereby reduce pressure on land resources
- Checking deforestation and its associated impact on environment
- Reducing pressure on forests through on-farm supply of fuel wood, fodder and other forest products
- Reduction in the build-up of atmospheric carbon dioxide and other greenhouse gases
- Disaster prevention, rehabilitation and reconstruction.

III) Urban Risks

India is experiencing massive and rapid urbanisation. The population of cities in India is doubling in a period ranging just two decades according to the trends in the recent past. It is estimated that by 2025, the urban component, which was only 25.7 per cent (1991) will be more than 50 per cent. The Ninth Five Year Plan estimates India's population size, by 2011, to be 1178.89 million with an urban population share of 32 per cent. A characteristic feature of the urbanisation process is the increasing 'metropolitanisation' leading to the creation of huge urban agglomerates.

The trend indicates the continued urbanisation and metropolitanisation in the decades to come. Some of the urban agglomerations today accommodate more than 10.0 million people. Their number and sizes will continue to grow. Such concentration trends in the Indian demographic scenario would surely subject its cities to greater risk of damage to life and property in the event of a disaster.

Urbanisation is increasing the risks at unprecedented levels; communities are becoming increasingly vulnerable, since high-density areas with poorly built and maintained infrastructure are subjected to natural hazards, environmental degradation, fires, flooding and earthquake. Urbanisation dramatically increases vulnerability, whereby communities are forced to squat on environmentally unstable areas such as steep hillsides prone to landslide, by the side of rivers that regularly flood, or on poor quality ground, causing building collapse.

Nature of Risks

Most prominent amongst the disasters striking urban settlements frequently are, floods and fire, with incidences of earthquakes, landslides, droughts and cyclones. Of these, floods are more devastating due to their widespread and periodic impact. Fires have more localised effects but are very frequent in urban areas, leading to heavy losses of life and property.

Studies indicate that the loss of life and property due to floods has been increasing over the past decades. The prime reason for this is unplanned urban growth on the banks of

the rivers and in other low-lying areas in the vicinity. The 2005 floods of Maharashtra bear testimony to this. Heavy flooding caused the sewage system to overflow, which contaminated water lines. On August 11, the state government declared an epidemic of *leptospirosis* in Mumbai and its outskirts (Wikipedia, 2005). These kinds of disasters can only be averted with the help of disaster conscious urban planning and development in flood sensitive areas.

Fires have emerged as a critical issue in urban planning due to the rising frequency of fire incidents leading to huge losses. Fires are very common in slum and squatter settlements in large cities and in high-rise buildings. Fire fighting capabilities are indeed very essential, but these are mostly curative measures. More importantly than these, preventive measures are required to address this critical issue, effectively and efficiently. Hence, for efficient control and management of fire disasters, it is essential to have, and implement, proper land use zoning, land sub-division, and building regulations.

1.8 DEVELOPMENT vs ENVIRONMENT

Developmental activities compound the damaging effects of natural calamities. The floods in Rohtak (Haryana) in 1995 are an appropriate example of this. Even months after the floodwaters had receded, large parts of the town were still submerged. Damage had not accrued due to floods, but due to water-logging which had resulted due to peculiar topography and poor land use planning. Ad-hoc land use decisions are a common practice in our system due to immense demand/ pressures for/on scarce land supply. In Punjab, highly chemicalised canal irrigation has led to large-scale salinisation and water-logging as well as groundwater contamination. In other parts of India, mega development projects like dams displace millions of people from their homes, and submerge tens of thousands of forest acreage and fertile soil. In a parallel development, many of these large dams with their massive reservoirs may have induced or enhanced seismicity in quake-rocked areas such as Koyna in Maharashtra.

Disasters have come to stay in the forms of recurring droughts in Orissa, the desertification of swaths of Gujarat and Rajasthan, where economic depredations continuously impact on already fragile ecologies and environmental degradation in the upstream areas of Uttar Pradesh and Bihar. Floods in the plains are taking an increasing toll of life, environment, and property, amplified by a huge population pressure.

The unrestricted felling of forests, serious damage to mountain ecology, overuse of groundwater and changing patterns of cultivation precipitate recurring floods and droughts. When forests are destroyed, rainwater runs off causing floods and diminishing the recharging of groundwater. The spate of landslides in the Himalayas in recent years can be directly traced to the rampant deforestation and network of roads that have been indiscriminately laid in the name of development. It is by now a well-established fact that human-made structures, including canals, dams and embankments, have worsened the flood situation in the country (Menon and Kalmadi).

Destruction of mangroves and coral reefs has increased the vulnerability of coastal areas to hazards, such as storm surges and cyclones. Commercialisation of coastal areas, particularly for tourism has increased unplanned development in these areas, which has increased disaster potential, as was demonstrated during the Tsunami in December 2004.

Risks due to Environmental Stresses: Example of Delhi

Every ninth student in Delhi's schools suffers from Asthma. Delhi is the world's fourth most polluted city. Each year, poor environmental conditions in the city's informal areas lead to epidemics. In 1995, 423 lives were lost due to dengue fever. Delhi faces air pollution problems due to three major sources: transport, domestic, and industrial sectors. The maximum contribution is from vehicles (72%), which are growing rapidly. There are many factors associated with urban growth pressures. The current population of Delhi is about 13.8 million and is estimated to rise to 22.42 million by 2021. The major cause anticipated for this rise is the high in-migration rate due to better employment opportunities in Delhi in comparison to neighbouring states. The number of registered vehicles has also increased nine-fold since 1970/71. This rise in registered vehicles is primarily due to the increase in personalised vehicles, which in turn has resulted in high pollution loads and large-scale congestion in Delhi. The fast rising trends of industrialisation and trade and commerce has almost increased the per-capita income of Delhi by 60 per cent since 1993-94.

Delhi has one of the highest road accident fatality ratios in the world. In many ways, Delhi reflects the sad state of urban centers within India that are exposed to risks, which are misconstrued and almost never taken into consideration for urban governance.

Pressure on land for housing purposes has increased. Agriculturally productive land is being used up for residential purposes, which is affecting agricultural employment and productivity adversely. There is much cultivable wasteland lying fallow and proposed to be acquired for industrial activity in the future. Water is a major worry. The Delhi government is eyeing groundwater resources of surrounding areas in Uttar Pradesh, such as Meerut, which could mean political trouble in coming times. Engineers contend that water in Meerut if left unutilised could go saline and affect good water further. Arguments on the other side would have their own logic.

According to the State of Environment Report for Delhi (SoE 2001), sustainable development is the most important concern in Delhi's current environmental crisis. As per SoE (state of environment) reporting, Delhi lacks an integrated system and a relevant database to measure the environmental quality, to manage it, and also to evaluate the effectiveness of the management actions. Until such knowledge gaps are plugged, the action plans to ensure a sustainable Delhi cannot be initiated.

Safety Factor for Human Existence

The quality of life of an individual is determined largely by socio-economic and the physical environment. From a different perspective, enhancing quality of life necessitates minimising frequency and intensity of disturbances to average human existence. The core issue therefore, is to reduce the vulnerability of the community. It is also obvious that the nature of the vulnerability of the community is largely dependent on the social structures, the physical structures and the economic assets.

The core issue therefore becomes promoting measures that ensure safety of individuals against such vulnerability, which often gets manifested as hazards in form of accidents, illnesses and other factors that could contribute to mortality.

Need for Action

In the contemporary context, a broader approach is required which not just looks into

technology, adaptability and the cost aspects but also on how these aspects could be imparted effectively to the community. The users in general need to appreciate the high priority that needs to be given to *safer living*.

The urban planning, development and management processes have traditionally been dealt with in a sectoral manner. The safe city concept, particularly due to its participatory approach, would try to bring about strategic integration of various urban sub-sectors and present an integrated development framework. This is a need that has also been stressed by the National Commission on Urbanisation Working Group on Physical Planning in India, in stating that, “it also provides for checking costs compared to the benefits of alternative packages of projects aiming at pragmatic goals and permits a much tighter and more efficient implementation control and evaluation of large scale innovations”.

Risk reduction efforts need to be based as much in urban governance and management as in *urban planning*. Good urban governance includes the state, but transcends it by including the private sector and civil society. All three are critical for sustaining human development. The state creates conducive political and legal environment. The private sector generates jobs and income and civil society facilitates political and social interaction, mobilising groups to participate in economic, social and political activities. Because each has its weaknesses and strengths, a major objective of our support for good governance is to promote constructive interaction among all three.

Significantly, post- modernism is impacting urban planning in developed countries. While modernism dictated city design to increase industrial efficiency and tackle housing shortage in the twentieth century, the intangibles like isolation, alienation, and stratification of cities *et al* were ill-considered. This led to high-density settlements around industrial areas. Modern cities developed globally in the post- war period as part of the construction boom. Not much thought was given to city planning, rather to money minting by the construction sector. Indigenous practices were sidelined, indigenous wisdom ill-considered. This went along with developments in mass transportation, which furthered the trend. Post- modern is a converse trend. It seeks to rediscover the city in its historical heterogeneous form so as to revisit the golden age where people had enough space for health and recreation. City is not uniform but variegated; an expression of diverse cultures and traditions that subsist within it. To explain post-modern impact on urban planning in the words of David McLeod: “In the case of post-modernist planning, “pluralistic” and organic” strategies are sought for dealing with urban development. Under this “new” way of thinking, urban development is a “collage” of highly differentiated spaces and attention is given to “other worlds” and “other voices”. In the context of urban planning, post-modernism implies a shift to “participatory planning processes and to compact urban forms, appreciation of historic spaces and return to traditional urban forms (as opposed to modernist belief in the supremacy of new forms); a search for urbanity, urban identity and cultural uniqueness (in lieu of modernist functionalism and efficiency); mixing of compatible land uses and flexible zoning (rather than orderly land use segregation, enforced through strict zoning); pursuit of human use pedestrian friendly, higher density, urbane compact forms” (Arbor, 2003). The arguments draw mainly on Ingelhart’s (1997) theory of post-modernism in cultural ‘transition’.

Some key ideas on post-modernism could be summarised as: diversity in the landscape, local context; renewal and regeneration, and coping with conditions. Within the framework of safe urban planning and management, the traditional wisdom of urban planning that was evolved during the historic Vedic period in India needs to be revived and imbibed in the

current practices. The concept of the 'Vastu Purusha Mandala' that dealt with the habitat space as a living organism was very conscious of the fragile relationship between development and environment, and this consciousness led to design and development parameters that were far safer than those followed today. It is especially pertinent, as high-density settlements increase, and so do the quantum of likely losses. Housing has not taken the disasters perspective in structural stipulations adequately. Interestingly/conspicuously, old architecture still manages to withstand earthquakes in old city areas.

Goodchild (1990) has prepared an extensive chart of the differences between *Modernism* and *Post-Modernism*. Parts of it can be selected to highlight differences between these two approaches to planning.

DIFFERENCES BETWEEN MODERNIST AND POST-MODERNIST APPROACHES TO PLANNING

DIFFERENCES BETWEEN MODERNIST AND POST-MODERNIST APPROACHES TO PLANNING		
	MODERNIST	POST-MODERNIST
CONCEPTS OF THE CITY	the city as an object; as mass housing	the city as landscape, as an expression of social diversity
THEMES IN URBAN DESIGN	continued emphasis on lower densities and sunlight; functional zoning; mixed flats and housing	more diversity, more emphasis on local context, mixed land uses
THEMES IN STRATEGIC PLANNING	redevelopment of slums; controlled expansion through suburbs, new town and greenbelts	renewal and regeneration, containment
DECISION MAKING STYLE	comprehensive, either blueprint, "unitary" (1940's-1960's) or "adaptive"	piecemeal, "coping with conditions"

Urban populations are growing rapidly and the situation is most alarming, since it is taking place in the absence of well-planned and structured settlements. The civic services and the general quality of the settlements is of an abysmally low standard, as a result of which, the urban communities are being subjected to an ever increasing risk of natural as well as technological disasters. In such a situation, the only viable way to a safer living is through preparedness to face disasters, since hazards cannot be completely controlled. This requires concerted efforts on part of the government agencies, voluntary organisations, and most importantly, the community itself. Risk awareness has to be created, and preparedness plans formulated, so that the urban populace may live a safer life.

It has been realised that with the introduction of relatively simple, effective, risk reduction measures (those which 'reduce vulnerability and increase capacity') into existing urban improvement practices, and those which involve communities in decision-making, degrees of protection can be afforded within the most vulnerable urban settlements, which in the long-term contribute to both protecting lives and enhancing livelihoods, thus reducing poverty.

1.9 CONCLUSION

Disaster is an unwelcome guest. It disrupts normal life and puts the developmental targets out of gear. Disasters can result from natural or man-made causes or a combined effect of both. The impact of disasters are felt more strongly when the affected community is more vulnerable, either in terms of physical exposure or vulnerable socio-economic conditions. Therefore, disaster management is a *public administration issue*, since disaster mitigation has to be achieved in time through public policy. In line with post-modernism, sustainability of progress/ development is being accorded primacy, currently. It could be termed as coming full circle in some ways. Thus development, as is the perception now, in itself may not be sustainable if it runs counter to environmental concerns. Environmental concerns are therefore gaining importance, since environmental factors are increasingly having the adverse impact of the frequency and intensity of disastrous events. Sustainable development is being considered largely in terms of sustainable city growth. More than rural development, it is urban development that has to be stabilised/regulated through well-meaning/planned policies. Rural development partakes by way of spin-off effects from public good externalities from nearby/surrounding urban areas, as rightly pointed out in the Tenth Plan. Areas of concern are urban risks, since the concentration of populations in urban areas is constantly increasing with inadequate corresponding investment in safety measures. Disaster management needs to be seen in a developmental context and pre-emptive action needs to be taken to reduce the impact of disasters.

1.10 KEY CONCEPTS

Biological Hazards

: Processes of organic origin or those conveyed by biological vectors, including exposure to pathogenic micro-organisms, toxins and bioactive substances, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Examples of biological hazards are outbreaks of epidemic diseases, plant or animal contagion, insect plagues and extensive infestations (ISDR).

El Nino

: As explained in the Discovery Encyclopedia (*Series One*), in a year with normal weather pattern winds blow westward and push the warm surface water towards the western Pacific Ocean leading to upwelling of cold water from lower levels in Ocean. In some years when the winds weaken, warm water spreads almost over the entire tropical Pacific Ocean This warm water prevents the upwelling of cool, nutrient rich deeper water along the east coast of the Pacific. Fish die and severe climate change takes place. Rain follows the warm water eastwards causing drought in Southern Asia and Australia and Floods in North and South America.

Environmental risks

: Release of industrial effluents in rivers, green house gases in the atmosphere, et al pose environmental

risks like release of harmful chemicals in water bodies that harm aquatic life, contaminate drinking water, disturb the PH balance of soil *et al.* Excess of Green house gases lead to global warming that is manifest and increasingly being talked about now.

Geological hazard

- : Geological hazards include internal earth processes or tectonic origin, such as earthquakes, tsunamis, volcanic activity and emissions as well as external processes such as mass movements: landslides, rockslides, rock falls or avalanches, surface collapse, expansive soils and debris or mud flows. Geological hazards can be single, sequential or combined in their origin and effects floods, debris and mud floods; tropical cyclones, storm surges, thunder/hailstorms, rain and wind storms, blizzards and other severe storms; drought, desertification, wild land fires, temperature extremes, sand or dust storms; permafrost and snow or ice avalanches (ISDR).

Hazard

- : A precise definition of hazard is difficult. The International Strategy for Disaster Reduction (ISDR) has defined hazard as a potentially damaging physical event, phenomenon or human activity that may cause loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards have both natural and human components. For example, flood problems may be exacerbated by fluctuations in climate, such as increased storm frequency, and also by certain human activities, such as land drainage and deforestation. The loss of life caused by a tropical cyclone will depend to some extent on storm severity but it can be greatly reduced by means of a warning system. Attempt has continually been made to employ science and technology to harness nature and evolve better living conditions.

Hydro meteorological hazards:

These hazards are of *atmospheric, hydrological or oceanographic nature*. Hydro-meteorological hazards include: floods, debris and mud floods; tropical cyclones, storm surges, thunder/hailstorms, rain and wind storms, blizzards and other severe storms; drought, desertification, wild land fires, temperature extremes, sand or dust storms; permafrost and snow or ice avalanches. Hydro-meteorological hazards can be single, sequential or combined in their origin and effects (ISDR).

La Nina

- : La Nina is the reverse of El Nino. At the end of December, westbound winds get stronger than usual,

pushing warm water further west than normal. As a result, there is enhanced upwelling of cold sea water. This action allows hurricanes crossing the Atlantic to move farther west and to become more powerful than usual. However, La Nina is generally good for the Indian summer monsoon.

- Man-made disasters** : Accidents, chemical spills nuclear disasters are man-made disasters since they are caused by human activity.
- Natural disasters** : Floods, Cyclones, Earthquakes, etc. are natural disasters since they originate in natural phenomenon/processes.
- Physical vulnerability** : Vulnerability of the landmass to natural hazards such as earthquakes owing to natural factors is explained as physical vulnerability. Vulnerability of the physical landscape as well as the infrastructure is included in physical vulnerability.
- Socio-economic vulnerability** : Poverty predisposes people to disaster losses/suffering. The poor mostly inhabit flood prone/multi-hazard prone areas. These areas are cheaper to access and also provide certain advantages like fertile land near volcanoes and flood plains. Poverty also reduces resilience to epidemics that hit an area along with/in the aftermath of a disaster.
- Urban risks** : Risks created due to specific conditions in the urban environment are termed urban risks. For example, threat of fire outbreaks, epidemics due to congestion and poor drainage in slums are urban risks.