UNIT 10 VULNERABILITY: ECONOMIC FACTORS

Structure

10.0 LEARNING OUTCOME

After reading this Unit, you shall be able to:

- Understand the economic dimensions of vulnerability;
- The significance of sustainable development; and
- Apprehensions related to climate change.

10.1 INTRODUCTION

A hazard becomes a disaster when its effects exceed peoples' capacity to cope; resultantly, lives and livelihoods are lost and property is destroyed. Poor people are particularly hit because their coping capacity is low. While the traditional perspective on disasters concentrated more on natural resource management on the basis of science and technology, innovations, experience with subsequent disasters has exposed the limitation of the approach. The modern approach, also termed the *political economy* approach, takes disaster planning as an integral aspect of developmental planning where the stress is on identifying and reducing peoples' vulnerabilities through state action. The 'political economy' approach enjoins the state to reduce long-term vulnerabilities of people which are socio -economic in nature through targeted policy and views disasters not just as resulting from natural or unnatural hazards but as a result of a community's socio- economic and political structures and processes (Maskrey, 1989). Vulnerability of a population depends on the social, political and economic conditions that create the predisposition to suffer harm, especially during disasters. Thus the impact of the Orissa Cyclone on the fishing community, living in makeshift huts was much more severe than on those who lived in

'*pucca*' houses or on those with access to savings or loans with which they could replace their lost assets and restart their lives. Similarly, the impact of the earthquake in Gujarat on migrant saltpan workers from neighbouring states was much more catastrophic than the impact on landlords belonging to the dominant and powerful 'patel' community (Palakudiyil and Todd, 2003). Social and economic vulnerabilities have become a part of the analytical assessments of the risk factors.

10.2 VULNERABILITY IN THIRD WORLD COUNTRIES

Disasters affect developing countries with greater severity wherein people lack resilience to fight disasters. Disasters and poverty have a mutually reinforcing relationship. The social group most affected by disasters in addition to environmental deterioration is the poorest section of the population. UNDRO (1976) estimated at the time that 96 percent of deaths through disasters occurred in 66 percent of the world's population residing in the poorest countries. ECLAC/IDB (2000) confirmed this trend upon indicating "it is no coincidence that 95 percent of deaths caused by natural disasters in 1998 occurred in developing countries".

The following table gives a comparative picture across continents categorises the total number of people killed and affected by disaster, by continent (1982-1991; 1992-2001; and 2001).

Table-1

Africa	575,160	144,472,615	40076	136,9
Americas	60,147	62,298,697	79,293	49,27
Asia	328,886	1,494,813,296	463,681	1,774
India	31,679	661,808,091	76,134	460,5
Europe	40,557	6,641289	35,994	22,44
Oceania	1,130	1,486,310	3,319	18,00
Total	1,005,900	1,709,712,207	622,363	2,001

Source: World Disasters Report, 2002

About twenty- five percent of the world's population lives in areas at risk from natural disasters. As can be seen, most of the people affected or killed in natural disasters have been from Africa, Asia and India. The bulk of vulnerable populations belong to poor less developed countries (LDCs) in these continents where vulnerability arising from poverty, discrimination and lack of political representation hampers the development process (Anderson, 1995). Though disaster losses in terms of number of people killed and affected has gone up in Oceania and Europe, over the past few decades (refer table) in absolute terms, relatively, the position has been much worse in Asia, India and Africa. This brings out the correlation between poverty and vulnerability, which has been stressed earlier in previous Units. Despite the fact that, in most LDCs, rural inhabitants still outnumber those in urban areas, there are now more urban dwellers in the Third World

than in Europe, North America and Japan combined (Cairncross, et al., 1990). In urban squatter settlements, population densities may reach 150,000 persons per sq. km, perhaps ten times the level in established areas and orders of magnitude greater than the densities in rich areas (Davis, 1978). Some farmers in the LDCs pay one-third of their crop income to absentee landlords and disasters often exacerbate the poverty gap, as when food prices increase during drought and grain merchants make large profits. In the LDCs these broad and complex socio-economic problems combine with insecure physical environments to create a high degree of vulnerability.

Poverty is not only impoverishing, but also multiplicative in nature, which slowly destroys the productive capacity of any society, making people progressively more vulnerable. Poverty is cyclic in nature in that poverty is the main factor responsible for uncontrolled population growth which in turn puts pressure on land causing greater fragmentations of land resulting in small holdings which hinders development of capitalist agriculture which is necessary for improving productivity of land through the optimum use of the land resource, and environmental degradation due to activities like shifting agriculture. In the vicious circle of poverty, causes and effects are hard to distinguish, as the effect of one cause is a cause of another, and so on. Besides the impacts (effects) are not single but diverse in nature, which are hard to study and cover in policy. This creates dilemmas, particularly among policy makers, as to which 'end' value to emphasise and which to withhold.

Risk varies according to *occupation, social class, ethnicity, caste, age* and *gender*. The very young and the very old face higher risk of mortality. In many less developed countries (LDCs), as many as fifty percent (50 %) of the population are under fifteen years (15yrs) of age and highly vulnerable to economic exploitation and disease. Older people, especially widows, face difficulty in maintaining their livelihood after upheaval caused by a disaster. Similarly, people with ongoing disabilities or chronic mal-nourishment suffer more from water related diseases common in floods, such as dysentery and cholera. As a result of these factors, the scale of disaster is often a function of human vulnerability rather than the physical magnitude of the event.

Vulnerability to hazards is not just a characteristic of the least developed countries (LDCs). Economic growth in the wealthy countries has increased the 'exposure' of physical and human 'capital' to catastrophic damage. Along with the growing complexity and cost of the physical plant responsible for the world's industrial output, capital development has ensured that each hazard will damage an increasing amount of property unless steps are taken to reduce the risks in cities and on industrial sites. Partly in response to the growing shortage of building land, some of the growth has occurred in areas subject to natural hazards, whilst man-made hazards such as toxic chemicals and the use of nuclear power have added to the potential loss. The availability of increased leisure time has led to the construction of many second homes (for holidays) built in potentially dangerous locations, such as mountain and seashore environments.

The rising technology of the rich countries is normally seen as preventive of disasters as it has provided better forecasting systems and safer construction techniques. However, the more the dependence on advanced technology, greater is the likelihood of loss if the technology fails. New high rise buildings, large dams, building constructions on man made islands in coastal areas, the proliferation of nuclear reactors, the reliance on mobile homes for low cost housing, more extensive transportation (especially air travel) are all examples of trends which have created additional vulnerability to hazard. In all the LDCs, the

interaction of even low-level technology, such as the building of a new road through a mountainous terrain, has increased the danger of landslides through the logging of steep slopes. Some building innovations, such as 'modern' concrete houses have increased potential losses in the event earthquakes (Coburn, et al., 1984). The disastrous release of a toxic chemical at Bhopal, India was directly related to the modernisation effort, which introduced a complex and poorly managed industrial production system into a society unable to cope with it.

Hazard vulnerability may be increased because of rising social expectations, particularly in the Most Developed Countries (MDCs). Air travel is fast becoming a necessity, which has as increased possibilities of fatalities from transport accidents over the past few years. People have become much more mobile in recent years and expect to be transported around the world in minimum elapsed time, irrespective of adverse environmental conditions such as severe weather. Consumers from weather dependent enterprises, such as energy supply or water, expect the same security of service and industry, which has resulted in reduced manning and smaller operating margins for the aircraft industry. Cost cutting usually targets capital expenditure, which includes basic security requirements. These business necessities allow less scope for an effective corporate response to environmental hazards. The Colombia space shuttle disaster was allegedly due to such cost cutting on the part of NASA.

The functioning of the world economy works against the LDCs by reinforcing hazard vulnerability in many ways. Most of the third world's export earnings come from primary commodities for which market prices have either fallen over several decades or remained highly unstable. The LDCs have little opportunity to process and market what they produce and are dependent on importations from industrialised nations of manufactured goods which are often highly priced or tied to aid packages. The WTO regime has further pressurised farmers in the developing world by removing protective tariffs to ensure fair competition in the new globalised set up. The progressive impoverishment of the small-scale farmer, combined with a foreign debt burden that may be many times the normal annual export earnings, takes resources away from long-term development in a process that has been described as a transfusion of blood from the sick to the healthy. The cycle is reinforced when natural disaster destroys local products and undermines incentives for investment. Major disasters, such as the *Sahelian* drought, disrupt not only local economies, but can also bring shortages in neighboring regions, creates inflow of international refugees and stimulate aid programmes to the extent that the repercussions of environmental hazard are truly global.

10.3 SOCIO-ECONOMIC DETERMINANTS OF DISASTER LOSS

The understanding of the disaster-development interface by the historical approach reveals a pattern in the mode/strategies of coping adopted in a particular time period in history in relation to the level of technological progress achieved and the nature of social relations in the period in that while the industrial society adopted technological tools, the primitive/ traditional relied on superstition. Burton, et al. (1978) examined the 'modes of coping' with natural hazards in relation to *capital wealth*, *technological capacity,* and *organisation of society*. The human adjustment modes are purported to relate to development stages, viz. folk, mixed, industrial and post-industrial. Cuny (1983) advanced understanding of this area of society-nature interface by arguing that the degree of disaster damage inflicted is

a function of the human context as much as the hazard itself. Natural disasters and their consequences are not explained by conditions or behaviour peculiar to calamitous events, but rather that they depend upon the ongoing social order, its everyday relationship to the habitat, and the larger historical circumstances that shape these conditions. The development and disaster relationships discourse requires further development by way of in-depth conceptual and empirical research to reveal further specifications of factors which are relevant and appropriate regarding the phenomena for formulating human action strategies in the context of the social circumstances in which we exist (Hewitt, 1983).

Natural hazards and disasters are seen not merely as extreme geophysical events detrimental to human activity systems, but as a complex mix of *geophysical processes*, on one hand, and *social, economic, and political processes*, on the other. This approach emphasises the need to take into account human vulnerability, particularly in respect to impoverished and marginalised groups that have the least ability to resist, cope with, and recover from natural hazards. 'Natural' and 'Human' dimensions of disasters are so inextricably liked up that these events cannot be understood, to be natural in any straightforward way. Rather, disasters are a complex product of interface between natural and social affairs in which "activities of daily life comprise a set of points in space and time where physical hazards, social relations, and individual choice converge" (Blaikie, et al., 1994).

This approach turns the eye inwards on internal social processes rather than external agents in studying disaster phenomenon (Blaikie, et al., 1994). Hewitt (1997) has explained the distinction of this vulnerability perspective from traditional hazard analysis: "vulnerability involves…the general and active capacities of people; what enables them to avoid, resist, or recover from harm, whereas a hazard perspective tends to explain risk and disaster in terms of external agents and their impacts while vulnerability looks into the internal state of a society and what governs it".

Study of disaster phenomena from an economic perspective needs to take cognisance of processes that determine a system's resilience in the face of disasters. The economic impact of disaster derives from the disruption of flows resulting from damage to and destruction of the physical elements that facilitate them. Knowledge of how destruction and damage affect local economies and reduce income and product is very useful to assess the magnitude of an event, to plan assistance, and to assign priorities to mitigation measures and in recovery processes. The following are some of the factors contributing to economic vulnerability of regions.

Although global gross domestic product (GDP) has increased by a factor of three since 1960, the number of weather-related disasters has increased four-fold, real economic losses sevenfold, and insured losses twelve fold in the same period. These losses have particularly hit developing countries of Asia, where the impacts of climate change are expected to be greatest in terms of loss of life and effects on investment. There is only limited penetration of or access to insurance in developing countries. This situation makes them more vulnerable and is also likely to impair their ability to adapt. The property or casualty insurance segment and small, specialised or undiversified companies have greater sensitivity. Coping mechanisms and adaptation strategies will depend largely on public or international support. Given finite financial resources and international aid, increased climate-related losses would affect financing of disaster losses with development efforts as also their sustenance.

Adaptation to climate change presents complex challenges to the finance sector. Increasing risk could lead to a greater volume of traditional business, as well as development of new risk and financing products (for example, catastrophe bonds). However, increased variability of loss events would result in greater actuarial uncertainty. For the insurance sector the design of an optimal adaptation program in any country would have to be based on a comparison of damages avoided with the costs of adaptation. Other factors, particularly in developing countries with incomplete markets, also enter the decision making process, such as the impacts of policies on different social groups in society, particularly those that are vulnerable; employment generation opportunities; improved air and water quality and the impacts of policies on broader concerns such as sustainability.

10.3.1 Rapid Urbanisation

Uncontrolled urbanisation appears to be a key factor in the growth of vulnerability, particularly of low- income families living in squatter settlements. The urbanisation process increases pressure on land as migrants from outside move into already overcrowded cities, where the new arrivals have few alternatives other than to occupy unsafe land (Havlick, 1986). But the risk from natural hazards is only a part of the danger that these communities face; there are often far greater and more pressing everyday of malnutrition and poor health. Slum residents often incur greater risks from natural hazards (especially landslide or mudslide) as a result of having to live in closely built structures, which potentially disturb natural land drainage patterns and watercourses. The urbanisation process not only magnifies the dangers of hazard events but also is in itself partly a consequence of a desperate migrant response to rural disasters. There is evidence from Delhi, Khartoum and Dhaka that rural families who have become destitute as a result of droughts or floods have moved to these cities in search of food and work. Thus, lack of income generating opportunities compelled these people to live in squatter settlements and consequently become vulnerable to natural as well as health hazards.

As per United Nation's (1998) estimates, the urban population in Asia is growing at four to five times the rate of the rural population. At this rate, more than 60% of the people in Asia will be living in towns and cities by 2015. An estimated 80% of the increase will occur in developing countries. The number of megacities in Asia would grow to at least 23 of the world's 36 by the year 2015. As per World Bank's estimates (1997), urbanisation is rapid in fast-growing economies of south and Southeast Asia, where the average annual urban growth rate is more than 4%. The current pace and scale of change often strains the capacity of local and national governments to provide even the most basic services to urban residents. An estimated 25-40% of urban inhabitants in developing countries today live in impoverished slums and squatter settlements, with little or no access to water, sanitation, or refuse collection.

Basic infrastructure demand in urban corridors is likely to increase dramatically in the future. Already governments in several developing countries of Asia are introducing suites of acts and laws to ensure provision of adequate public services and minimise adverse effects on surrounding communities and ecosystems. For instance, Indonesia introduced the *Spatial Use Management Act in 1992* for the identification of environmentally sensitive areas, where development activities would be restricted and for improved planning for the location and support of activities such as industrial development. Developing countries in Asia would soon need to develop new priorities and policies that try to address demands created by the increasing number of people in cities while capitalising on the benefits of urbanisation, such as economic growth and efficient delivery

of services. Climate change has the potential to exacerbate basic infrastructure demands of urban inhabitants in many countries of Asia. (The problem of urban slums has been taken up in detail in Unit 11 of the course).

10.3.2 Food Security

A direct correlation is found in developing countries between rise in mortality rates and decreasing income. Therefore, there are more deaths per disaster in low-income countries. There is also direct correlation between vulnerability and environmental degradation. Countries with severe deforestation, erosion, over cultivation and over-grazing tend to be hit hardest by disasters. They live in self-built shelters unable to stand up to strong winds, rain or tremors.

The food security issue is highly dependent on equitable guaranteed access to foods. Equitable access is highly differentiated across populations in the agrarian nations of Asia. This situation is further aggravated by natural disasters such as floods and droughts, which are known to have caused great famines in the South Asian countries. Poverty in many South Asian Countries seems to be the cause of not only hunger but even lack of shelter, access to clean drinking water, illiteracy, ill health, and other forms of human deprivation. Poverty and vulnerability are often closely related. A direct correlation is found in developing countries between rise in mortality and rates and decreasing income.

Crop yields are likely to get uncertain in the coming years due to climate change. As per IPCC, 2001, food security may be a distant dream Rice is central to nutrition in Asia During the 1990s, rice production and productivity in Asia grew at a much slower rate than did population. “Yield deceleration of rice (the annual growth rate declined from 2.8% in the 1980s to 1.1% in the 1990s) in Asia has been attributed to water scarcity, indiscriminate addition and inefficient use of inputs such as inorganic fertilizers and pesticides, and policy issues and the reliance on a narrower genetic material base with impacts on variability; Several other factors also have contributed to productivity stagnation and the decline of rice (lower output/input ratio) in the intensive cropping system (two to three rice crops per year). Key factors currently contributing to the yield gap in different countries of Asia include biophysical, technical/management, socioeconomic, institutional/ policy, technology transfer, and adoption/linkage problems.” (Hazell, 1985; Matson et al., 1997; Naylor et al., 1997).

The most promising policy options according to the IPCC to ensure food security are the following:

- Breeding of new crop varieties and species (heat- and salt-tolerant crops, low-water-use crops)
- Maintenance of seed banks, liberalisation of trade of agricultural commodities, flexibility of commodity support programs, agricultural drought management
- Promotion of efficiency of irrigation and water use and dissemination of conservation management practices
- Trans-national cooperation to promote sustainable water resources management and flood risk management
- Rehabilitation of degraded forests and watersheds (such strategies can enhance biodiversity conservation and provide source of livelihood for many poor forest and upland watershed dwellers)

- Strengthening of biophysical and socioeconomic resources and resource use-related databases for natural and social systems and focused research to further our understanding of the climate-ecosystem-social system interaction. Data and information generated through these activities will be useful not only for designing appropriate mitigation and adaptation measures but also for management planning and decision-making.
- Strengthening horticulture and floriculture options, fisheries, and other alternate livelihoods.

Opportunities for assured and remunerative marketing at micro enterprise levels should promote equitable use of available food resources and, generally, improve public health infrastructure to tackle diseases anticipated with climate change, like UV-B radiation exposure, vector borne diseases etc. that are more likely to affect the vulnerable sections of society to develop capacities and resilience of communities.

10.3.3 Vulnerability of Backward Sections of Society

The destruction of forests, several other aspects of economic development have directly disturbed the tribal environment. One of them is the process of industrialisation. Forest regions are rich in mineral wealth. In many states establishment of industries, hydroelectric projects and mining operations have led to large-scale displacement of the tribal.

In the Singhbhum and Ranchi districts of Jharkhand, for instance, a large number of tribes have been displaced to establish heavy industries. In the mines of Andhra Pradesh, Jharkhand, Orissa, Chhatisgarh, and Madhya Pradesh, most of the unskilled workers are local tribal wage earners who have lost their forest and agricultural land to the extension of the mines.

A Planning Commission study team, which did a state wise survey of the impact of the developmental programmes on the tribes, suggested that the adverse impact of the industrialisation on tribes ought to be minimised by providing the displaced tribes with *land- for- land* and *house- for - house*. The team has also suggested that before establishing a project in the tribal area, the needs for skilled labour for the project should be assessed and training programmes started to train the local tribes. Otherwise, there is an influx of the non-tribes and the local people become a minority in their own land.

Class relations and structures of domination are crucial for explaining vulnerability of disadvantaged sections. They determine levels of ownership and control over assets and means of production, together with the resultant livelihood opportunities, which may be already inadequate to provide basic needs, indicated in the household budget.

It is also crucial to understand *differential vulnerability* of populations depending on gender. In general terms, economic and cultural systems are male-dominated, and allocate power and resources in favour of men. In relation to flood hazards, this may mean that women, who in most ‘normal’ situations have to work harder in rural agricultural and domestic activities, disproportionately carry the effort put into disaster recovery.

10.3.4 Extreme Events Induced Vulnerability

Power politics is involved in loss/gain of floods following floods. In floods, there is a physical process by which land is destroyed by the erosive capacity of the flood streams, and recreated in the areas where silt is deposited as sediment-laden waters are slowed down. The route of rivers in flood across the countryside, if unconstrained by human constructions, will be through new routes provided by the lowest-lying land. Rivers carve

new channels in this way, often kilometers away from their previous course. Those, people whose land is lost in the process are unlikely to have access to the compensation in the form of land to replace it. They should therefore get other types of aid. Yet others may find that fortuitously, the river has abandoned a channel near them, making it possible in time to colonise the water logged land.

Flood hazards impart a variable impact on people according to vulnerability patterns generated by the socio-economic system they live in. Those who are vulnerable to a hazard are unlikely to be able to move against the process, which has generated their vulnerability, so that after a hazard's impact they are yet more vulnerable to similar and other hazards.

10.3.5 Developmental Projects Induced Vulnerability

Dams can also create several hazards, which are very significant but not so well known. Scientific research conducted at several large reservoirs has revealed the possibility of earthquakes being triggered due to the impounding of massive amount of water in dams. Seismic tremors have been recorded at these reservoirs. Earthquakes can also occur due to the existence of active faults, or discontinuities in the underground rocks along which movement may take place or due to the existence of fissures through water seepage into the earth.

In a study titled Reservoirs and Earthquakes, authors Harsh Gupta and B.K.Rastogi have cited about thirty cases "where the initiation or enhancement of seismic activity has been well evidenced following the impounding of reservoirs behind large dams."

The reality of these hazards was highlighted after the devastating earthquake, which struck Koyanagar, 450-km southeast of Mumbai on December 10, 1967. This region had long been a non-seismic zone, but had experienced a series of tremors after the impounding of water in the Koyna dam reservoir in 1962. In the 1967 earthquake, nearly 200 lives were lost, 1500 people were injured and thousands were rendered homeless. More than 80 percent of the houses in Koyanagar were either completely destroyed or become uninhabitable. The city of Mumbai and its suburbs were also rocked. The generation of electricity from the Koyna hydel works was badly affected, paralysing Mumbai's industry.

Whether a dam will collapse or not during an earthquake depends on several factors. Factors include the type of foundation rock, its vibration characteristics and the presence or absence of faults or recent seismic activity. Such factors are normally taken into account in preparing the design of a dam. Even though the Koyna dam actually moved in the 1967 earthquake, the huge structure did not collapse.

A more sensible approach is to thoroughly investigate a site where a large dam is to be constructed for site risks as part of the environmental impact analysis. The need for caution is especially great in regions that are known to be geologically unstable, such as the Garhwal Himalaya. The Tehri dam, which is being constructed, is one such example. Similarly, extremely careful evaluations will be necessary for the many reservoirs planned in the Brahmaputra river system in northeast India. Seismologists have predicted high probability of strong earthquake in this region in the next few years.

There are also cases of bad designing and poor quality of construction leading to dam bursts. The worst dam disaster in India was the Machu dam burst in Gujarat in 1979. Several hundred people were killed and the town of Morui along with several villages was destroyed by the floodwaters. According to the Consumer Education and Research

Center (CERC), Ahmedabad, the dam was designed based on an outdated empirical formula. The Central Water and Power Commission had thrice asked the state government to use a more scientific formula. State government sources however maintained that the dam failed due to extremely heavy rainfall and floods in the spillway. In March 1981, the present government of Gujarat summarily wound up the inquiry commission appointed to look into the cause of the disaster. The CERC filed an appeal against the government's decision in the Gujarat High Court on the basis that the public had a right to know the findings of the commission.

There are several cases of seepage in various dams across the country. Disbursing reports have appeared about the Barna dam near Bhopal and the Bargi dam near Jabalpur, both in Madhya Pradesh. The Somasila dam across the Pennar River in Andhra Pradesh has also developed cracks in the spillway. The well of water that is unleashed when a dam, reservoir or a tank bursts, packs tremendous force that can wipe out everything in its way. Even a relatively small tank burst, such as the one on October 19, 1980 at Gopinatham in Karnataka, was devastating. The two million, cubic meter capacity tank had been built in November 1980 at a cost of Rs. 40 lakh. Within minutes of its breach, the entire village of Gopinatham with a population of few thousands was wiped out, leaving over 40 dead and the rest homeless.

The state government was quick to call this a 'natural calamity' blaming a sudden storm that had hit the area a few hours earlier. A later investigation by the state public accounts committee concluded that corrupt officials and contractors were responsible for shoddy workmanship and that proper maintenance could have averted the tragedy.

Dams have ruined vital forests in catchments areas. According to one estimate, 490,000 hectares was denuded for dams between 1951 and 1976. Large forest tracts in the Himalayan hills and the Western Ghats have been razed. Downstream impacts are even more ruinous. People suffer from reduced access to clean water, fish, grazing land, timber fuel wood and wild fruits and vegetables and are deprived of annual floods that irrigate their fields. Acquifer recharge is impaired and wells wither. Furthermore dams and other flood control schemes annihilate riparian species. The Farrakka barrage adversely affected fisheries between Farrakka and Allahabad. The Stanley dam decimated hilsa (McCully, 1996) in the Cauvery as did the Ukai dam on the tapi The Sardar Sarovar Project is likely to devastate the Narmada hilsa fishery, probably the last productive one in India. When dams obstruct a river, the protection provided to acquifers and soil by the outward fresh water flow disappears and tidal waves invade the rivers. Large reservoirs and the irrigation they bring in command areas elevate subsoil water, changing the levels of calcium and trace metals and boosting fluorosis. Reservoirs and canals can cause three water related epidemics, malaria, schistomiasis and Japanese Encepahlitis.

Himanshu Thakkar (2000), gives the following recommendations regarding each threat involved with large dams.

a) *Regarding flash floods and dam bursts*: Disaster Management plan of each such project must be made in participation with local stakeholders and shared with them. Effort should be to establish well defined criteria of dam operations, institute reviews to learn lessons from past examples independent national dam disaster panel set up to inquire into dam disasters and assign responsibility, provide access to local communities on operation criteria and maintain relevant records of dams.

b) *Seismic Threat:* Independent experts must thoroughly investigate a site where a large dam is to be constructed for potential earthquake hazards as part of the environment impact analysis (EIA). The information should be made public well in advance.

c) *Upstream Impacts*: Least displacement options should be explored; peoples' participation in decisions in this regard is a must. A national rehabilitation policy in the context of development administration is desirable.

d) *Forests:* All social and environmental costs must be included in the cost benefit analysis. Full cost of projects, its value for all communities dependent on it and for society in general, as well as compensatory costs thereof must be made part of such analysis. All least cost options should be explored. The compensatory afforestation plans with identification of lands must be made before the project gets sanction.

e) *Downstream Disasters:* Damage to fisheries, salinity ingress, water woes, water pollution is sources of the possible damages.

Such problems should be anticipated and included in the preparedness/mitigation plan at the preparatory stage. The government should not wait for activism on the part of civil society groups to take note of hazards that are of its own making.

f) *Command Area Impacts*: The appraisal should include all possibilities of water logging and salinity that the irrigation project may cause. The entire drainage system must be planned in advance and such planning should be made part of any dam project. Information about likely impact on agriculture or cropping pattern should not be held back from the farmers. Alternatives that do not lead to occurrence of water logging and salinity must be must be taken up in the first place instead of such large projects.

g) *Health Impacts:* Lessons learnt through past experiences should inform decision making in the future. Endemic disease should not be allowed to recur. Administrative measures such as locating health facilities in hazard prone areas would serve the cause of disaster mitigation.

10.4 CONCLUSION

Regions of the Asian continent differ widely in their biophysical characteristics hence in their physical vulnerability to climate change. Different regions also experience highly differentiated social vulnerability. Adaptation strategies therefore will be differentiated across regions and sectors, depending on their vulnerability profiles. Interregional cooperation, recession of political hostilities to build conducive climate for dialogue in the spirit of post modernism is vital for sustenance of the planet. Development concerns and the need for environmental protection should e reconciled in the interest of good quality of life. Since disasters retard development, an 'economic impact analysis' should retrospectively be attempted to devise strategies for effect mitigation from future events.

10.5 KEY CONCEPTS

Biophysical **:** The word bio- physical refers to constituent factors of soil and climate, natural flora and fauna, which make up/, determine 'properties' of a system. The usage employed is, biophysical characteristics, which

differentiate or distinguish eco systems in different parts of the world.

Salinity Ingress : Salinity ingress implies increased concentration of salts of alkali metals and magnesium, which disturbs the natural chemical properties of soil. Salinity results when extra salts (compositions of acids and bases) get retained in the soil (not flushed naturally by rivers) making it less productive.

Seismic : Seismic implies related to 'tectonic movements.' Seismic activity involves heavy shaking of the earth causing large scale dismantling of the infrastructure on the surface and disruption of life and economy, ordinarily referred as an earthquake.

10.6 REFERENCES AND FURTHER READING

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10.7 ACTIVITIES

1) Discuss vulnerability in third world countries with special reference to India.

2) Examine how rapid industrialization has increased vulnerability.

3) Examine relative vulnerabilities in the third world and the developed world.