UNIT 2 UNDERSTANDING RISK: CONCEPTS AND ELEMENTS

Structure

2.0 LEARNING OUTCOME

After going through this Unit, you shall be able to:

- Understand the concept of Risk;
- Gain general appreciation of the Elements at Risk; and
- Understand Societal Risk Management.

2.1 INTRODUCTION

Disasters play havoc with the lives of people and amount to excessive loss to humanity and infrastructure. Due to disasters, the normal life is thrown out of gear and the existing patterns of regulatory and development administration suffer heavily. The economic, social and psychological dimensions of the wrath of disasters adversely affect the environment around. There are elements at risk with regard to each disaster. Thus, the local communities are required to be prepared to face the aftermath of the disasters effectively.

The first step in this direction is to undertake vulnerability analysis, which brings to light the '*elements at risk'* such as the population, buildings and infrastructure. The most vulnerable members of the community are the expectant and lactating women, single women, children, and old, disabled, handicapped, sick and ailing people. Their special needs have to be kept in view in vulnerability analysis. Likewise, the physical vulnerability of elements have to be recognised by the community for the purpose of initiating specific measures to reduce the extent of losses in their regions. It is imperative to take formal and non-formal measures to equip the community to identify the potential threats in order to cope with the intensity of future disasters (Sahni and Dhameja, 2003).

2.2 CONCEPT OF RISK

In general terms, the word Risk means an apprehension or a threat of something untoward happening. In the words of James Neill, the concept of "risk" usually refers to the probability of loss of a 'valued resource'. The word risk is one of the most notable examples of a word with multiple usages in that a risk may refer to a *chance* or a *probability* ("risk of exposure"), a *consequence* or *impact* ("the risk from smoking"), or a *perilous situation* ("a hazardous waste plant creates a risk"). Interpretations of the word "risk" have evolved linguistically on the basis of involuntary or voluntary events. For example, "danger" is often used to describe an involuntary event, whereas "peril" may be used to describe a voluntary event. Despite the widespread use of the word, no single definition can claim to be universal, and there is little likelihood of a common understanding developing without some conscious effort at establishing a consensus.

From general usage, the term risk has come to be applied more specifically, in that the nature of 'risk' differs with the type of activity under consideration. For example, investment in mutual funds (MFs) is a 'risky' venture. If stock prices fall by 10%, market risk says that MFs are likely to see erosion in their net asset value (NAV-rupee value of a single MF unit, calculated on the value of the underlying assets of the fund less its liabilities, divided by the number of units outstanding, disclosed at the end of each trading day). Risk in the specific context of insurance business implies taking wise investment decisions with correct reading of the market situation to offset probable losses with gains. Usage of the word "risk" in the context of health and environmental risks integrates two ideas; firstly that the situation being discussed has the potential for detrimental consequences; and secondly that there is some improbability associated with the circumstances. There is uncertainty whether a hazardous event will occur; when or where it will occur; who or what will be affected; and the magnitude of the consequences. "Risk", in this sense, includes both the possibility and the character of the detrimental event. A statement of risk based solely on one aspect of risk, such as the probability of occurrence, has been referred to as a single dimensional risk. Financial or insurance risks are primarily single dimensional risks, as are statements on health risks that are restricted to the chance of occurrence (Hamilton and Viscusi, 1999).

In the specific context of disaster management, risk implies application of specialist knowledge on the part of professionals to forewarn of disasters accurately and anticipate the risks involved in citing, land use management and project planning decisions in hazard prone areas so as to prevent/reduce impact of impending disaster(s).

Thus in disaster terminology, Risk is defined as "the likelihood of a specified undesired event occurring within a specified period or in specified circumstances. It may be a frequency or a probability. Often it is expressed in mathematical terms as:

Risk = f (frequency or probability, consequence)

Frequency is usually expressed *as events per year* and probability is a number between 0 and 1. Consequence is usually measured in terms of either money or fatalities. If we constrain ourselves to consider consequence in terms of a single fatality then risk becomes a function of frequency or probability since consequence is a constant (Skelton, 1997).

Understanding risk involves, not deliberating upon the meaning of risk but rather on the way the risk *defines* a particular situation (in terms of events apprehended and the mitigation measures required) {Jacobs}. Accordingly, the understanding of risk in disaster management literature has gradually become more precise in that phenomena that were previously referred casually as hazards, dangers, or uncertainties are now specifically articulated in terms of 'risks'. This implies understanding the precise differentiation between the related concepts of *hazard, risk, disaster, vulnerability* and the processes of disaster management based on these concepts viz. risk assessment/risk analysis, hazard assessment and vulnerability analysis/assessment. As clarified in the first unit, such terminological exactitude is necessitated by the practical concern of conveying to the policy makers in specific terms, the kind and nature of risk (s) involved in a situation(s) or processes to craft specific policy as per needs articulated, and also minimise the process of deliberation preceding policy formulation involving questions such as; *what is the problem, what exactly needs to be done and how?* Though such academic differentiation has been attempted in the previous Unit, the following brief overview would still be necessary/ desirable in the context of this discussion, to proceed with a correct analysis and understanding of the concept of 'risk', the 'elements' at risk, leading eventually to deliberating properly on 'risk management.'

- Hazard is a potentially dangerous situation, for example, a chemical plant or population exposed to a flood prone region;
- Disaster is a hazard leading to a catastrophe in response to the stimulus (human induced or natural);
- Vulnerability is the physical, social, economic, cultural/attitudinal predisposition to hazards. These three, taken collectively and studied along with relevant data regarding possible damage or likelihood of repeat occurrence measure the probable damage for a given frequency of hazard and the risk(s) involved. Hence risk is the harm likely from anticipated event, possibly quantified through comparative analysis of data collected over time and scientific simulation studies. *Quantification or measurement of risk* in disaster management is a complex issue, compared with similar exercises in medical and engineering, simply because events have to be frequent enough to generate adequate data for risk assessment While minor events like floods can be studied and predicted with relative accuracy, attempting the same in case of large scale catastrophic events which are rare in occurrence (September 11 attacks) or which have probably never yet occurred, (melt down of a nuclear reactor) is quite difficult. Estimating the probability of occurrence, the specific damages involved and the extent of damage likely if risk materialises are estimations carried out as *risk assessments*. In disasters like war, information is an early casualty.

Understanding risk involves the governance function of *risk management.* Risk management means reducing the threats posed by known hazards, whilst simultaneously accepting unmanageable risks, and maximising any related benefits. Thus, understanding and managing risks can easily achieve risk mitigation. The process involves analysing the risk(s),

estimating potential effects, *positive* against *negative* and determining its implications for planning.

Risk management is essentially a function of governance involving policy planning, setting up an organisational framework involving government agencies, private corporate sector and the non- government community action groups, professional associations and outside experts. It is defined as the "systematic application of management policies, procedures and practices" to assess the requirements of risk reduction, through identifying risk and taking stock of constraints, factoring the same in policy, monitoring risk with a view to updating risk assessments periodically developing thus institutionalising a culture of prevention (Guzman, 2005).

The emerging arena of risk management "promotes coordination of functions among diverse skills and disciplines and allows communities to undertake risk management activities that have been considered the domain of the engineering experts"(Guzman, 2005). The detailed process, as explained by the IDNDR ESCAP (1999) consists of the following steps:

- identify the stakeholders exposed to or affecting the risk of the disaster;
- identify public and private property, social systems and environmental elements at risk;
- estimate the disaster risk, i.e. the likelihood and consequences of the disaster;
- assess the acceptability of the disaster risk;
- define disaster risk treatment strategies;
- monitor and review disaster risks and the effectiveness of risk treatment, and
- communication between the community and risk management agencies.

2.2.1 Historical Progression of 'Risk'

The study of Risk is said to have begun during the Renaissance, when all traditional beliefs were subjected to rational critique. The concept of risk flourished since Blaise Pascal's theory of Probability when risk came to be associated with "probability, uncertainty, occurrence or recurrence of events, the consequences of these events and the human choices involved therein. It has since been applied in game, science, engineering, and business, among other areas of socio economic activity. The related concept of 'uncertainty' evolved further when, in 1703, Gottfried Von Leibniz argued that things are not entirely predictable but actually quite uncertain and the uncertainty has to be enquired into for better understanding of natural processes (Guzman, 2005). Today the study of risk is formalised as an academic arena with great practical relevance, denoted by the label, *'Risk Management*.'

In the context of risk, a pertinent idea is that of *locus of control*. Locus of control refers to the origin of causation, that is, whether an event lies outside or within one's control. A person's locus of control belief is also referred to as "attribution". Attribution refers to how people perceive events, that is, whether with a fatalistic attitude or with a belief in human causation. Locus of control determines the cultural or attitudinal vulnerability of a community. As per Guzamann, understanding of risks is what distinguishes the modern

civilisation from the ancient Greek, when natural events were considered visitations of Gods, attributed almost completely to fate. Also, the understanding of hazard, vulnerability, disaster *et al*, was diffused as the terms were interchangeably applied to refer to all kinds of disastrous situations.

Modern civilisation has since inquired into natural phenomena 'rationally' and relied on collective societal action to meet the challenges. The result has been better control over life and growing confidence in human ability to unravel mysterious phenomena. Reducing the risk of disease has been a phenomenal achievement in the last century and a half. As referred in the United Nations Disaster Management Programme (1994), "the average life expectancy of someone born in Europe in 1841 was 35 years. Now in most high income countries it is over 70 years and over 50 years even in the 40 poorest countries." The coin however, has a flip side. Development has brought about new challenges and new risks in that the automobile has cost many lives; energy supplies and industries have introduced new hazards and so on. The scenario as it obtains at present is that risks have been ever present, only the nature of some seems to have changed in that technological risks and those arising from human conflict such as war and terrorism seem to have replaced some of the common ones, like disease. One extraordinary and probably unforeseen as also unexpected consequence of development has been environmental degradation and global warming consequent upon climate change. Natural hazards seem to have got more frequent and also more ferocious, although one could not, with certainty trace the effect(s) to a definite cause(s). Hazards are increasingly manifest now as *compound* and *multiple* phenomena, which has made unraveling and strategising for the same increasingly difficult. Some such uncertainties are recounted as follows by Emmanuel D. Guzman:

1) "Unpredictable global climate changes have a definitive but not fully understood impact on the occurrence and magnitude of disasters precipitated by natural hazards;

2) The combined effects of several natural phenomena aggravate the potential damage;

3) The estimation of probabilities and damage potential depend largely on social and political context;

4) Because of population density and increased use of technologies, natural events trigger secondary impacts released from technologies and other human made facilities, and natural catastrophes interact with technological social and lifestyle risks."

Accordingly, the definition of risk management has been expanded, under the aegis of United Nations to include the notion of uncertainty. "*Risk' is now defined, as the possibility that an expected outcome is not achieved or replaced by another or that an unforeseen event occurs.*" This is a broad view of risk that includes both uncertainty due to future events and the consequences of limited knowledge, information and experience. The understanding has significant implications for policy craft in that it is likely to make the process more inclusive and broad based/ collaborative across disciplines given the recognition of the limitations attendant on limited perspective.

2.2.2 Rationale of Risk

There are a number of significant advantages to be gained by understanding risk and tailoring disaster management policy accordingly. Disaster prevention is a cost effective option as compared to disaster response. F or international scale aid it is important to

take cognisance of local risks and vulnerabilities in affected areas and decide on aid and mitigation measures as per articulated needs in different cultural settings. Disasters also cover large spatial areas and are not limited/ restricted to political boundaries. International and national response to disasters may also create crises or prolong crises or create new risk, if local factors are not understood properly. National and International humanitarian effort, for instance, though indispensable to saving lives, has been seen to sideline local leadership, governance and technical capabilities which are needed for long term resilience. Donor aid can be politically motivated, if inefficiently tailored to local needs. Excess or ill directed supplies may create newer law and order problems or the puzzling situation of *scarcity amidst plenty*.

Considerable cost savings and efficiency can be achieved through sharing of information and experiences in the coordination of disaster management research and policies among concerned countries. This form of cooperation would encourage a consistent effort towards disaster management policies and techniques, which can help reduce each country's exposure to the risks involved in hazards. Wider cooperation among neighbouring countries would facilitate the development of a regional database of disaster related information. Hence understanding flood risk in Bangladesh would benefit a distant land like Brazil that does not have enough information or experience in flood disaster management. Another possible benefit is better correlation in articulated risk parameters across neighbouring countries to develop standard terminology in communication and a common language in disaster literature. Emerging international consensus is in favour of evolving guidelines in consultation with affected countries over a region, stressing cooperation at each stage between neighbouring countries facing similar risks and subject to the same vulnerabilities. Common early warning systems and data collections are needed to ensure better integration in mitigation as also response efforts in case of disasters.

Impacts of globalisation and liberalisation also need to be assessed in the context of risk and vulnerability of regions and populations in poor Third World Countries. For example, rapid liberalisation of agricultural trade may reduce the resilience of the farming communities to hazard impacts. Understanding the political situation as is emerging in the post cold war era also needs to be studied in the context of emerging risks. Famines and droughts have been known to combine with political conflicts to create compound losses (SDR, 2003) in countries as in Sub- Saharan Africa, which needs to be studied as part of disaster management.

2.3 ELEMENTS AT RISK

Elements at risk are the *property, resources, people and infrastructure* likely to be affected adversely during disasters, referring to all animate and inanimate objects likely to suffer harm in the event of a disaster. Besides these tangible elements, intangible elements also need to be accounted for, such as the mental health of sufferers, the impact on the environment, cultural impact of migrations, etc. Though elements at risk to different types of disasters are the same, certain specific elements may be at risk from certain types of hazards may be identified. The tangible and intangible vulnerable elements in case of different hazards are identified as Principal Vulnerable Elements by SEEDS INDIA. The same are articulated thus: [P.T.O.]

Principal Vulnerable Elements (Primer on Natural Hazard Management, OFDA, 1991)

	Tangibles	
Floods	Everything located in flood plains and tsunami areas. Crops, livestock, machinery, equipment, infrastructure, weak buildings, etc.	Socia struct artifa
Earthquakes	Weak buildings and occupants machinery and their equipment, infrastructure, livestock, contents of weak buildings, etc.	Socia struct artifa
Landslides	Anything located on at the base of steep slopes or cliff tops, roads and infrastructure, buildings on shallow foundations,etc.	Socia struct artifa
Strong Winds	Lightweight buildings and roofs. Fences, trees, signs, boat fishing and coastal industries. Crops and Livestock,etc.	Socia struct artifa
Technological Disasters	Lives and health of those involved on or near the vicinity. Building, equipment, infrastructure, crops and livestock,etc.	Destr cultu popul

The role of science and technology in disaster mitigation is currently being emphasised in accordance with the *All Hazards Approach* to disaster management. This approach implies that a level of technical and administrative preparedness can develop expertise to tackle all kinds of natural and man made disasters, including terrorism. Hence all knowledge should be assimilated in a 'clearing house agency' or networked through a focal point and more funds committed to scientific research to ensure comprehensive preparedness to handle any kind of emergency that might present itself. The focus is on science and technology, the intent being to take full advantage of available scientific knowledge and administrative expertise, bring it under one umbrella, translate technology to application whenever /wherever possible and take a long term perspective to disaster management (SDR, 2003).

The following principles guide this effort as per the Interim Report of the Subcommittee on Disaster Reduction, National Science and Technology Council: Committee on the Environment and Natural Resources, United States:

1) Invest in fundamental science in broad areas that show promise for meeting end user requirements;

2) Where possible, emphasise the transition of scientific research and development to technology application and deployment;

3) Leverage existing knowledge of natural and technological hazards to advance the achievement of homeland security goals in reducing disaster risks associated with terrorism;

4) Involve partners (from local and international) to ensure that expertise and practical knowledge from the field informs the development of the framework;

5) Ensure that science and technology is deployed in a manner that allows it to be absorbed and assimilated quickly at the state and local levels by drawing upon and integrating the expertise of social and behavioural scientists; and

6) Enhance effectiveness of existing programmes through improved coordination and interagency collaboration.

From *an all hazards perspective*, certain major categories of 'elements at risk' from *all types* of human made and natural disasters can be identified as follows:

Infrastructure

Infrastructure includes communication infrastructure, viz. electrical poles, connecting wires, roads, bridges, etc., buildings, including housing infrastructure, small businesses, industrial houses and critical facilities like hospitals, and important government offices. The latter are termed *critical* facilities because damage to these facilities puts the situation beyond control and even escalates the disaster, for example, if electrical wiring is disrupted during a catastrophe, many more people are likely to die of electrocutions, or if drainage pipes break down or essential services like hospitals are affected, disaster situation would be harder to control. Damage to critical facilities also leads to technological disasters due to failure of the basic infrastructure of the system or the release of potentially harmful substances like release of oil, radioactive materials or hazardous chemicals into the air, water and/or land. Such incidents may happen accidentally or may be intentional acts of sabotage. For effective disaster recovery, such facilities have to be made as perfectly disaster resistant as possible and services therein as efficient and accountable as could be possible. Hence technology has to focus on earthquake proofing and flood proofing of critical facilities on a priority basis. For example, America is affected frequently by oil spills, building fires, large wild fires in states of Colorado, Arizona and Oregon, besides Hurricanes and Tornadoes, with the fresh threat now of Terrorism. Disasters have disrupted almost every sector of the American society, including industry, agriculture and forestry, transportation, schools, hospitals, insurance, recreation, tourism, telecommunications, water, power and military installations. Conservative estimates indicate that over $20 million may have been lost in the year 2002 alone. Budgeting for disasters is also difficult since disaster costs fluctuate annually and money cannot always be diverted to disaster management efforts from regular development tasks (Sub-committee on Disaster Management, Interim report, 2003, America).

People

Growth in cities has been capital- intensive. Population pressure, commercial considerations, and inadequate legislation to prevent improper land use in hazard prone areas has led to a compound hazard situation where many factors have interacted to put populations at risk from natural and man made hazards. In such a situation, development itself has

become a cause of vulnerability of people. More buildings are likely to suffer damage, which would mean more loss of life and property from natural hazards. Even otherwise, people are vulnerable to climate change induced health risks consequent on general environmental degradation and global warming due to unchecked emission of green house gases, deforestation and loss of flora and fauna. Air pollution has led to increased incidents of respiratory diseases and typical forms of cancer, particularly, lung and skin cancer apart from reported incidents of dengue fever, brain fever, cholera, malaria, diarrhea, malaria and food poisoning. Loss of livelihood and disruption of normal life are some of the other hazards faced long after disaster impact has subsided.

In the man- made hazards category, of particular note, are technological and chemical hazards, which lead to mortality in large magnitudes, as was evident during the Bhopal Gas Tragedy. In poor countries that are particularly vulnerable to natural hazards like floods, earthquakes and cyclones, interest articulation has been found to be ineffective as 'passive publics' have been unable to voice their concerns effectively, which has meant inadequate interest articulation for policy. Passive attitude is directly related to lack of awareness of disaster issues among people, presence of other pressing concerns like poverty and unemployment that call for attention and lack of institutionalisation of the interest articulation in the form of lobby and pressure groups in traditional societies. Particularly vulnerable are the poor and marginalised sections of society who are forced to inhabit hazard prone areas and also lack resilience in the face of disasters.

Environment

Schools and businesses had to be shut down in Malaysia, because of severe air pollution and breathing problems caused by forest fires in the Indonesian Sumatra islands. The fires help clear land for cultivation in Indonesia. A brown haze has been created over the Indian Ocean, which has enveloped, besides Malaysia, Singapore, Australia and Thailand. Scientists fear it can travel half way round the globe in a week. The World Health Organisation says sir pollution in major South East Asian countries and Chinese cities is among the worst in the world, killing about 500,000 people each year while the global failure is an estimated 800,000 deaths. There endorses the imminence of international cooperation such as that envisaged in the Kyoto protocol. On a regional basis, Indonesia needs legislative protective measures and Malaysia needs to examine if its palm oil plantations in Indonesia are contributing to the haze factor (TOI, 28th August 2005).

Air and water pollution have been acute in India due to uncontrolled industrialisation, inadequate legislation to control industrial activity, and unwillingness on the part of concerned 'stakeholders' (industrialists, politicians and administrators who are often partners or controllers of such businesses) to abide by such legislations. The reason is obvious. If policy makers themselves are the involved interests, public interest often becomes a camouflage for private interest. In public administration literature, the difference between public and private interest is particularly stressed. In such cases, the theoretical distinction diffuses; solution gets rather difficult, much to the disquiet of public administration specialists.

Nature of Risk

Though the elements at risk are largely the same for all types of hazards, the nature of damage inflicted is different in case of different hazards. For example, a hurricane would uproot poles and electrical wires and disrupt long-range communication in particular. Volcanic ash ejected into the atmosphere poses deadly danger to aircrafts, even miles

away from the eruption. Landslides pose serious threat to distribution systems, transportation, as well as to infrastructure that supports fishermen, timber harvesting, and mining and energy production. Erosion and sedimentation events following heavy rainfall or wild fires cause additional billions worth damage, impair quality of water supply, and decrease soil productivity in upland areas as per American disaster reports. Similarly, floods and earthquake prone areas would need to protect buildings primarily, particularly those housing critical facilities. Ensuring earthquake –resistant construction and flood proofing of buildings are some recommended measures that can increase the capacity of these facilities/'elements' to withstand extreme impacts. Other mitigation measures include building regulations, byelaws, legislation to regulate land use, project-citing decisions etc. to reduce the vulnerability of elements at risk. Considerable empirical effort is needed is to identify elements at risk in each case, as aforesaid, and also the *type of damage* likely in the event of different hazards to common elements at risk, especially in multi-hazard prone areas. In other words, both floods and cyclones would affect electric poles, but the type of damage inflicted would depend on the nature of the impact, which would be different in each case. Hence areas susceptible to particular hazards would need to identify specific elements at risk, assess likely damage and institute desired partnership between specialist professional and government agencies to undertake targeted structural mitigation measures. Partnership of non-governmental and community associations is desired to meet other social vulnerabilities that increase disaster impact. Economic vulnerability is tackled by short-term measures such as insurance and tax incentives, etc., and long term measures such as generating sustainable livelihood options to augment income and employment in the economy (non-structural mitigation measures).

Significance of Understanding Elements

As explained in the International Decade for Natural Disaster Risk Reduction (IDNDR) and ESCAP regional meeting, "all the elements that contribute to risk must be carefully identified and the order of their importance established. The elements can also be evaluated with respect to their potential to cause damage to existing development. Once the major hazards are identified, the risk analyses will aim to determine their magnitude and frequency. Disaster risk management involves the assessment of hazard and vulnerability."

As explained in the draft of the ESCAP meeting, Hazard Assessment is concerned with defining the properties of the hazard and its direct effect. For example, tropical cyclones pose three threats, namely, wind, flood and storm surge. The intensity of a tropical cyclone is measured by its wind characteristics, which are described by velocity and direction. Evaluation of the hazard associated with cyclones therefore involves the measurement of wind direction, velocity and frequency at a number of meteorological stations. Similarly, the assessment of the flood hazard involves the identification of:

- flood behaviour;
- topography, and
- population at risk.

Such information can be combined and depicted on a map, which gives a visual description of the areas at risk, the elements at risk, nature of risk and the steps required to meet the contingencies involved. For hazard evaluation of storm surge, it is necessary to determine the frequency of intense winds, the topography of the continental shelf and adjacent coastline and the normal tidal behaviour.

In evaluating the relationship of hazards to the elements at risk, it is important that the analysis is applied to the entire disaster episode, "encompassing onset, response, and aftermath and recovery phases." Different sets of 'elements at risk' will emerge in the different phases of the disaster episode. For example, the threat to life and limb of the disaster prone residents is an issue during the response phase, while the rapid return of the water supply, sewerage and communication systems to serviceability is an issue during the recovery phase.

2.4 REQUIREMENTS IN RISK ASSESSMENT

Understanding Risk in the context of disaster management entails probing the physical, social, economic and cultural/attitudinal vulnerabilities of communities at risk, which increase susceptibility to harm. To understand the multi faceted nature of risk, a technical analytical process, variously described as hazard assessment, vulnerability analysis and risk analysis is undertaken which provides insight into the nature of hazard, its damage potential, the risks involved, ways to mitigate the same, and the constraints (if any) that exist, and charting out the feasible/ desirable course of action.

Risk assessment is a technical evaluation process that seeks to answer all of the above questions. Models in risk assessments have been preponderant in addressing the economic dimension. Economic perspective involves 'rational judgements' based on the cost benefit criterion, whereby utilities should be maximised out of any situation and losses minimised. The classical exposition of this concept is found in Frank Knight's book where he defined the term risk as "measurable uncertainties." The criterion of calculability is the most important feature of the economic determination of risk. Previously such assessments were limited to entrepreneurial behaviour. It has subsequently been extended to examining the potential harmful effects of new technology on people and the environment. Such extension of the 'rationality' criterion to issues affecting peoples' lives has been widely criticised as severely 'bounded' by lack of knowledge regarding all possible outcomes of a decision because of lack of complete understanding of the nature and likely effects of a move on the people.

Restricting risk estimation in disaster management to economic cost- benefit analysis would restrict risk assessment to considering only the policy planners' perspective, neglecting other parties' involved. The approach to risk assessment should therefore be more inclusive in that cognisance should be taken of moral judgments involving protection of life liberty and property of the people involved. According to Scutter, ethical and juridical liability/responsibility of official agencies to assess risk causing or exacerbating risk behavior in crucial decision-making should also be tailored into risk assessments. Such a move would encourage informed decision-making, especially in the matter of public policy where the accountability is to 'diffused publics' rather than an identifiable stakeholder.

Risk assessment may be taken as an integrated approach, which incorporates disaster management techniques and approaches towards vulnerability reduction. To deal with the vulnerability of physical structures and systems and the economic and social systems, a number of approaches and steps are recommended. Creation of proper awareness about disasters and their mitigation feasibility, education and training of personnel, land use zoning and promulgation of building codes, guidelines and bylaws, disaster resistant new constructions as well as retrofitting and strengthening of existing buildings, structures and systems, are all the steps towards reduction of vulnerability and mitigation of risk.

Till date, risk assessment techniques have been applied mostly to potential industrial hazards and to the assessment of environmental health risk. The assessment of *ecological risk* is still not as common, although methods are increasingly being tested and applied, often in conjunction with environmental cost-benefit analyses (for example, in forestry project involving a combination of production and conservation activities, or in the assessment of impacts on natural habitats of water diversions). The main reason for this ecological risk is that the relationship between different human activities and ecological 'chain reactions' in different environmental settings is still subject to great uncertainty. Consequently, there is some resistance towards applying the methodology on a systematic basis. Disaster management institutions will continue to encourage and expand the use of environmental risk assessment and seek to contribute to the development and refinement of risk assessment techniques and their application to new areas.

2.5 SOCIETAL RISK MANAGEMENT

Disaster risk management takes community as the target group and regions as the unit of operation for interest articulation, voluntary activity and implementation of policy wit regard to disaster prevention preparedness and mitigation. Legislators, administrative agencies, local self-governing institutions and community level associations are involved in disaster management activities at the community level. By the above understanding, societal risk management involves value judgements in that a choice(s) may often be presented between economic utility and human welfare. Retrospective judgement of a decision on utility or welfare argument as also 'choice' regarding the desirability/feasibility /practicability of a policy (s) may not be easy given the imperative nature of both requirements. The objective of sustainable development is to strike *the needed balance*, which in other words can be explained as *societal risk management*. Societal risk management involves 'political choices' in resource allocation decisions which have distributional impacts involving, *authoritative allocation of values* in that certain values (interests) get emphasised to the exclusion of certain others in the process of sieving and sifting of alternative courses, arriving at the final choice(s). For example, a chemical plant is bound to lead to economic gain that could lead to spiraling growth in related sectors and overall spurt in the Gross National Product (GNP) but would create environmental susceptibilities or potential hazardous conditions. The 'elements' at risk in this case would be human health, environmental degradation, specifically air and water pollution overtime, and large scale loss of life in case a mishap occurs (example, Bhopal Gas leak). Such policy choices involve significant questions concerning welfare economics in that tangible and intangible gain and losses have to be studied, in relation to one another to identify the gainers and the losers in each case in order to strike the balance always in favour of *net social welfare*.

Rudimentary concepts are beginning to emerge in disaster welfare economics though they are still at the conception stage. Cost estimations are presently being attempted on three chief bases, signifying three chief requirements of cost assessments. Cost assessment by the *welfare economics* criterion are based on the idea of 'consumer surplus', that is' apart from property costs to firms and households consumers face changes in welfare due to changes in the availability of certain market products, changes in environmental quality, changes in the availability of recreational sites, and stress. Effort is needed to incorporate such non-monetary aspects of disasters in cost-benefit analyses. Computing costs on basis of an *accounting framework*, economists attempt to make cost assessments consistent with the format of national accounts since information is readily available on a systematised

basis. Input- Output (I/O) analysis and computation of General Equilibrium can be easily done on the basis of data presented under accepted cost heads.

Cost assessments need also to cater to *macro economic* requirements. Macro economics is concerned with the larger issues of inflation, poverty, unemployment and income levels in the economy. There are important resource allocations decisions involved in rebuilding houses, infrastructure and machinery and equipment, which will obviously divert money away from spending in other potential areas. According to Veen Aan Van, questions to be asked are; how does the economy deal with this shock? what is the net effect on unemployment, government deficit, and inflation, and what other macro economic implications and those involving international politics are involved?

There is need for an integrating framework to address the issues involved in each of the three aforesaid approaches. Efforts of economists are currently devoted to achieving such integration. From all the three perspectives however, estimation of secondary or indirect impacts of disaster are considered important. One emerging theory of loss assessment is that to assess the value of the loss by either taking the *stock value* (capital lost) or the *flow value (*impact on business transactions*)* into account corresponding concepts being direct costs and primary and secondary indirect costs. Direct costs relate to loss of land, capital and machinery, (thus to stocks), and primary indirect costs to business interruption (which means a flow). Moreover, secondary indirect effects relate to 'multipliers' in the economy since every singular impact leads to spin- off effects in related sectors. Building economic resilience implies minimising such 'flows' or spin off effects by creating *inertia* in 'flows.' Disaster spending/losses would involve primary and secondary impacts. Mitigation Planning has to be directed to minimising such secondary impacts on the economy. The magnitude of indirect effects depends on:

- the availability of alternative sources of supply and demand;
- the duration of the disruption; and
- the possibility to extend production, given the constraints.

Such information is vital for better accounting and also for macro economic policy. Another problem is that there is lack of a common framework in literature on different kinds of natural hazards, for example, floods, hurricanes and earthquakes. An exception is the disaster handbook by Hewitt (1997), who centers his ideas on the concept of risk. Very little attention is paid to the structural and economic effects of large-scale disasters (Veen Aan Van, 2005).

Risk management approach is based on the application of conventional and tested risk management techniques for specific sectors/ areas. This approach covers developing the scope of the process; collecting detailed information on existing approaches; identifying hazards/vulnerabilities/risks; evaluating the probability, nature, and magnitude of the risk; formulating a strategy to reduce the risk; making working plans to implement the strategy; structuring a plan for verifying and evaluating the management of risk.

Risk society produces and seeks to legitimise the very hazards, which are beyond the control of its institutions concerning areas of science, politics, industries, market and capital.

The entry into risk society occurs at the moment when the hazards, which are now decided and as a result produced by society, weaken and/or cancel the established safety

systems as per state's existing risk calculations. In contrast to the early industrial risks, nuclear, chemical, ecological and genetic engineering risks:

- Can be limited in terms of neither time nor place;
- Are not accountable according to the established rules of causality, blame and liability; and
- Cannot be compensated or insured against (Beck, 1996).

When examining environmental risks it is immediately apparent that there are no times, spaces or places outside of 'nature', just as there are no positions from which a media person may objectively observe such risks.

In response to identified risks, individuals and groups have historically used a number of techniques for reducing or mitigating adverse health effects of a facility/resource. These include the following:

- Avoiding or eliminating the risk, such as prohibiting the use of a potentially dangerous object or substance;
- Regulating or modifying the activity to reduce the magnitude and/or frequency of adverse health effects, such as, by constructing dams, levees, and sea walls;
- Reducing the vulnerability of exposed persons and property, example, by requiring the use of the safety devices, by elevating buildings in floodplains, by immunising the population, by implementing quarantine laws, or by establishing disaster warning systems.
- Developing and implementing post-event mitigation and recovery procedures, for example, by establishing search and rescue teams, stock piling food, providing first-aid training, or providing fire extinguishing equipment and services.
- Instituting loss-reimbursement and loss-distribution schemes through such mechanisms as insurance systems or incentives pay schedules for high-risk activities.

2.5.1 Risk Management Components

The options available to any society or its administrative and executive bodies to manage risks may, for simplicity, be categorised under the three following headings (Somers, 1995):

1) Educational

2) Economic

3) Regulatory

Each of the above may be applied in conjunction with others. The policy option, the one most immediately associated with government action should be regarded as encompassing the whole range of regulations from Acts of parliament to guidelines, recommendations, and codes of practice issued from time to time. The techniques used to implement these options are varied and diverse in that they can range from subsided technology, to hazard identification, to media publicity.

The educational approach can serve to make producers, workers, and the general public aware of the risks so that they make provision for reducing or avoiding these risks. Public

information programmes can enhance health promotion by advocating sensible life-styles such as not smoking cigarettes, having safe sex, limiting fatty foods and regular exercise. Governments can strengthen the impact of these programmes through advertising in the media to vulnerable groups. Community leaders and role models, for example, doctors, film actors or sportsmen can reinforce these messages through examples. Workers can be educated in the hazards of chemicals by courses, posters, films, and by the explicit labeling of chemical products. Similarly, consumers can be made aware of the need to handle the pharmaceuticals, household chemicals, pesticides, and garden products with due care and attention. Positive reinforcement, by publicity, can be given to those manufacturers who show corporate responsibility by the safe and judicious treatment of their products, both within and outside their plants.

Economic options provide both positive and negative incentives to measures for control of hazards. The 'polluter pays' is a principle espoused by the Organisation for Economic Cooperation and Development (OECD) with the intention of maintaining equitable trading practices by encouraging polluters to reduce emissions. Other economic instruments include pollution control delay penalties, market emission permits and subsidies for environment friendly production technology. In the first case, schedules are established in which the maximum allowable emissions are decreased over time. Subsidies such as grants for pollution abatement equipment may be used as monetary incentives for pollution control. Tax deductions, rebates and credits all play a part in the fiscal policy of a government's economic control of hazardous products.

2.6 PERCEPTION OF RISK

Every society as also group within that society has its own *perception* of risk, that is, the priority a society attaches to hazards that confront it. Significant groups involved in such decisions are (Coburn et al, 1994):

- The general public;
- Their political representatives; and
- The experts, communicators and managers.

Experts are repositories of facts while elected representatives have the authority to make value judgements. Such judgments are informed judgements in that they are based on the facts made available by the experts. However, the extent to which expert advice tendered is heeded depends on the pressure exerted by the public. This depends on the awareness quotient of the general public who are generally found to be ignorant and passive with regard to disaster related issues as also other welfare concerns. In practice the desirable state of affairs does not obtain, since experts are constrained by lack of sufficient data; politicians with other 'commitments'. Even within concerned groups, mentioned above, perception of risk differs in that experts are given more to statistical analyses, politicians to more ideological judgements, not to mention the differing perceptions among specialists regarding how risk is correctly conceptualised! As far as people are concerned required level of risk perception is quite low in developing countries. Psychological insight into the process of risk perception as it partakes in the mind is a challenging area of research involving social psychology. While certain groups make judgements based on objective criteria, certain others judge more subjectively. Even within groups given to objective scientific analyses, yardsticks and criteria adopted differ widely. There is no uniform theory as yet that explains risk perception satisfactorily.

2.6.1 Role of the Media

As mentioned in the preceding paragraph, expert opinions and those of the lay 'representatives' of people do not often coincide. This shifts focus to the third important party involved, the people. Researches conducted in U.S.A. have revealed the crucial impact of the media on risk perception among the general public, most of whom have not had any direct encounter with a disaster. Their knowledge of disasters comes from secondary sources, primarily the media. Surveys were conducted requiring people to judge the frequency of various causes of death like diseases, accidents and natural causes. In Oregon county people were found to know the frequent and most lethal causes of deaths, but tended to overestimate causes/events that were more frequently reported in the media. For example, accidents were wrongly construed as causing as many deaths as disease though in fact, the latter account for 15 times more casualties than the former. It was also found that certain rare events, like air crashes, oft repeated in the media created impressions in the viewers' memory who perceived them as threat more than they actually were reported frequency being less (DMTP, 1994).

In underdeveloped regions of the world, people are more at risk than they realise since they remain largely unaware and uninformed. This is not to discount local indigenous knowledge, which derives from observance of natural phenomenon through generations and development of folklore with deep insights. They learn to catch signals in nature indicating possible rains, storms or typhoons. There would still be the desirability of integrating local knowledge with modern warning systems to achieve better success in disaster mitigation and response. All this gives the mass media a leading role in sounding social alarm, furthering response effort post- facto as also creating awareness of disasters through academic deliberations in normal times. Post disaster, the media gives vivid accounts of horror, generating sympathy, intellectual quest, and 'communitarianism' on the part of people, which furthers the reconstruction and rehabilitation efforts. There is palpable positive 'social capital', activated/produced by the media. Warnings are also best disseminated through the instrumentality of the media, as it remains the most widely accessed medium of communication/ interface between official agencies and the general public.

It is not only in times of emergency that the role of the media assumes significance. The role of the media is important in disaster prevention in that they generate awareness of weather related phenomenon in the lay public and foster an overall culture of prevention. It has been observed that the general level of education and awareness of disasters in people in the western world is much more than in the third world countries. The difference in perception is explained by the attention paid by the media to weather related programmes. For similar impact in India, synergy is desired between professionals and the media, which can produce meaningful progammes on disaster management. Such a synergy has been found to be lacking in India though there is no dearth of knowledge or professionals/ institutions in the subject (Sikka, 2001). The presentation of weather news seems more glamorous and much less professional though the task should rightfully be entrusted to specialist professionals, properly educated in the subject. They should also be required to collect data themselves and carry and convey a professional outlook. In the western media, as contrasted with the Indian, phenomenon like the *El Nino* are regularly studied and accorded prime time coverage. Even scientific field experiments are widely reported upon. A recent example was the Indian Ocean Experiment or the INDOEX, which was carried out in 1998 to study the effect of long distance transport of pollutants from the Asian continent. The event though widely publicised in the western

media, failed to catch the attention of the Indian media even though India was an active participant in the international event. Such lack of interest could be attributed to lack of expertise in disaster management among media professionals themselves. The scientific community probably felt diffident for fear of being misreported. It is opined that the performance of this crucial sector could be improved by developing trained cadres within the media and establishing the much-needed collaboration between professionals with expertise and giving regular footage to weather related events, telecasting regular panel discussions with subject specialists on television for the benefit of the viewer (Sikka, 2001).

Far from simply 'reflecting' the reality of environmental risks, it follows that media dialogue provides codified (rule-bound) definitions of what should count as the reality of the environmental risks. This constant, always dynamic process of mediation is achieved primarily in ideological terms, but not simply at the level of the media text. Indeed, it is our argument, that in modern societies it is virtually impossible even to begin to think through the following 'relations of definition', identified by Beck (1998) without recognising the centrality of the media to these processes:

- Who is to determine the harmfulness of products or the danger or risks? Is the responsibility with those who generate those risks, with those who benefit from them, or with public agencies?
- What kind of knowledge or non-knowledge about the causes, dimensions, actors, etc, is involved? To whom does that 'proof' have to be submitted?
- What is to count as sufficient proof in a world in which we necessarily deal with contested knowledge and probabilities?
- If there are dangers and damages, who is to decide on compensation for the afflicted and on appropriate forms of future control and regulation?

All this gives the mass media a leading role in sounding social alarm and helping contain the impact as well as furthering research in policy through academic deliberation. Media gives vivid accounts of the horror, generating sympathy, intellectual quest, and 'communitarianism' on the part of people, which is especially evident during reconstruction and rehabilitation activities. There is exemplary positive 'social capital' visible.

2.7 ACCEPTABLE RISK

The extent to which a society invests in risk reduction measures does not depend so much on its vulnerability to risks but rather on the level of risk perception among decision makers and the public. Higher the level of perceived risk in society, more the likelihood of the government factoring risk into policy. Risk reduction measures would be adopted only after risk exceeds the acceptable or the tolerable limit; technically referred to as the *threshold.* But how is that threshold arrived at/determined? Determination of acceptable level of risk is a complex issue in that variables affecting judgement include the general level of public comfort, previous exposure to a hazard, the dread factor, public pressure, risk perception in political circles, level of professional expertise available in the country, relevant facts deduced from analysis and understanding of susceptibilities, informed political choices et al, would all be factors in determining acceptable levels of risk in the society *in a given set of circumstances*. Decision-making in this regard is likely to be based on subjective judgement(s) on the part of policy makers, more than rational choices.

Moreover, certain risks might entail the incentive of concomitant benefits such as fertile igneous soil near a volcano, alluvium in flood prone areas, tourism and hotels trade in coastal areas etc. Acceptable risk may also involve trade off between short term and long-term benefits. Moreover, knowledge would be constrained since all possibilities regarding risk and benefits could not possibly be known by human cognition. What is the yardstick? By common sense, if benefits outweigh costs, desirably with consideration of the temporal dimension (short term/long term consequences) and the scale of such dimension (how farther away in time), the level of acceptable risk will be known. Distinction is made between *voluntary risks* that are risks taken on willingly because benefits far outweigh costs, such as sport and recreational activities and *involuntary risks* or risks taken on in ignorance. Voluntary risks are largely acceptable, and involuntary, unacceptable though the degree of feasibility would depend on a number of factors. Research into identification of variables that affect acceptability of risk is an ongoing effort involving specialists, academics and practitioners in the area. It has been deduced following researches attempted so far that the availability of 'facts' or information about a hazard is directly correlated with the level of perception and whether policy making is attempted in the area. To reiterate, the above discussion highlights the centrality of the media function in raising the level of risk perception in societies. (Disaster Management Training Programme, 1994). The task of political communication is ascribed to the elected representatives of the people in a democracy. Political communication implies interface with the people, which results in information transfer and education of the masses from/ through the informed elite. This process makes democracy meaningful.

Risk Evaluation

Risk evaluation, (DMTP, 1994) is the "social and political judgement of the importance of various risks by the individuals and communities. This involves trading off perceived risks against potential benefits and also balancing scientific judgements against other factors and beliefs."

By evaluating the risk of various hazards to which the country is liable or potentially liable, it becomes practicable to formulate strategies to mitigate the impact of hazards in a cost-effective way. If a community is especially vulnerable to a particular type of disaster severe risk treatment measures may be required to reduce the disaster risk to acceptable levels.

Comparative Risk

Comparative evaluation of disaster risk as against other concerns determines to large extent whether society decides to take action to mitigate certain risk. Awareness of risk from disasters is unlikely to be high in poor countries where diseases and food shortage are more pressing concerns. Even villages in the hazardous mountain valleys of Northern Pakistan, regularly afflicted by floods, earthquakes and landslides are not alive to the imminent requirement of disaster mitigation. Protection against disease and irrigation failures takes precedence. On the other hand, California, though quite low on the vulnerability index, has initiated disaster mitigation because disasters are considered an important issue area. (DMTP, 1994). The other important factor that affects disaster mitigation is resource constraint, as disasters need fund commitment, which may be difficult as disasters are an uncertain phenomenon. The general trend observed over the years is that awareness of disaster mitigation rises with economic advancement, better education and participation of the community and increasing vulnerability of urban areas due to capital-intensive growth.

Societies in transition from an agrarian to an industrial economy are expected to develop awareness of some of the new environmental risks they face. It would be important however, for developing economies to become aware of the fact that development can disrupt traditional culture by replacing local knowledge with modern 'ways of doing things'. Possible areas of interference are siting, land use, building practice, community defenses and agricultural practices to name a few. As per the warning sounded by international experts (Coburn, Sspence, Pomonis in Disaster Management Training Programme, 1994) replacements of indigenous practices may be a costly option. Hence, understanding of traditional risk mitigation strategies and building on them through integration with modern engineering techniques rather than replacing them would be advisable.

2.7.1 Risk Estimation

The formula used for risk estimation based on a UN definition attributes risk to three components: "the *hazard occurrence probability*, the *elements at risk* (in this case the population) and their *vulnerability*". (Coburn, et al. 1991). By multiplying the frequency of hazards by the population affected, the measure of *physical exposure is* obtained. This figure represents the average number of persons yearly affected by a specific hazard. For example in Philippines, around 77% of the population live in regions affected by tropical cyclones, but the average number of cyclones yearly equals 5.57, hence the physical exposure is calculated as 428% (5.57 x 77%). Such estimations, though crude, serve the academic purpose of inquiry into causes behind 'differential vulnerabilities' of people residing in different regions, on a country wide or global scale to articulate policy with regard to that region. For example, on the basis of the risk estimation provided above, a definite correlation has been found between the level of development and vulnerability of the populace. It is Asia and the Pacific region that has been affected most by disasters. In the last three decades or so, more than thirty lakh people have lost their lives in disasters. According to the World Disasters Report of 2000, during the decade 1990-99, the loss of life was a little below 6 lakhs in the world, of which nearly two thirds was in Asia. In monetary terms the loss was estimated at 741 billion US dollars of which 55% was caused in Asia; 43% of disasters occurred in Asia in this period (Dhar, 2002).

As per United Nations' estimates, in 2002 alone, there were more than 500 disasters, which killed more than 10,000 people, affected 600 million others and caused $55 billion in total damages and $13 billion in insured losses. Recent trends show increasing vulnerability of people round the world because of skewed development practices, environmental degradation and break down of natural protection mechanisms like forests and wetlands. The number of people at risk has been growing by almost 70 to 80 million per year. More than 90 per cent of population growth is in the developing world, among people with the smallest share of resources and the biggest share of exposure to disasters. Public policy in these countries has not 'factored' disaster risk into developmental policy adequately. In technical terms, risk perception in these countries has been low because of other pressing problems like chronic underemployment, poor public health and education, over population and unemployment, which need to be attended to. That asserts in no uncertain terms that risk assessment based policy is an imperative requirement, especially in developing countries like India, where magnitude of disasters and loss suffered as a consequence of it is much greater.

Precise quantification of vulnerability is difficult, despite claims to the contrary. . The phenomenon of natural hazards turning into disasters is also getting increasingly intractable in that complex socio- economic reasons account for them. Both general causes as well

as specific causes of vulnerability of a particular community or region need to be addressed through public policy. As revealed by the United Nations, disasters in recent years have shown increasing evidence of being caused by human action rather than natural forces. Such human forces have been identified as unsustainable developmental strategies, which have increased the socio economic vulnerabilities of people on the one hand and converted natural resources, such as water and air into hazards. It is now feared that achievement of developmental objectives of poverty reduction, education and health for all people etc. may itself become hard due to the imminent threat of disasters. Besides, in the specific context of climate change (global warming due to green house gas emissions) and associated phenomenon of sea level rise and desertification, scientific efforts have remained limited to theoretical expositions. Practical implementation has not been much in evidence.

Implementation strategies also need revision. Strategies to reduce climate related risks are institutionally dispersed. There is need for integrated disaster risk management across institutions as also along the temporal dimension in that past events and future threats need to be studied and correlation drawn for effective strategy formulation for future disaster risk reduction. There is little synergy between objectives and implementation of disaster management strategies in that effort is dispersed across agencies. There are different departments for instance dealing with disaster management and climate risk management (UNDP, 2005). There is imperative need for proactive policy formulation towards disaster mitigation. As revealed by the United Nations, disasters in recent years show increasing evidence of having been caused by human action rather than natural forces. Such human forces have been identified as unsustainable developmental strategies, which have increased the socio economic vulnerabilities of people and turned natural resources, such as water and air to hazards. It is now feared that achievement of developmental objectives of poverty reduction, education and health for all etc. may get difficult due to the imminent threat of disasters. Understanding of hazards is getting complicated in that complex socio economic reasons are behind them, which are hard to unravel even by scientific investigations.

In the specific context of climate change (global warming due to green house gas emissions) and associated phenomenon of sea level rise and desertification, scientific efforts have remained limited to theoretical expositions. Practical implementation has not been much in evidence.

Strategies to reduce climate related risks are also institutionally dispersed. There is need for an integrating framework for studying hazards and vulnerabilities for concerted action to combat the threat. There is need for integrated disaster risk management across institutions as also along the temporal dimension in that past events and future threats need to be studied in relation to one another and correlation drawn for effective strategy for disaster risk reduction. Moving a step further, attempt should be made to bring together as integrated international risk reduction framework, which analyses regional susceptibilities of peoples and regions.

Despite positive indicators from the United Nations such as declaring the present decade as the international decade for disaster risk reduction, disaster management continues to be limited to disaster response and recovery rather than disaster mitigation built into development policy despite evidence of successful attempts towards the same in Asia, Latin America African and the Caribbean.

There are still different departments dealing with disaster management and those dealing with climate risk management. There is little synergy between objectives and implementation of disaster management strategies in that effort is dispersed between various agencies.

The preferred disaster management system should integrate the following elements (IDNDR, ESCAP regional meeting, 1999):

- "the individual management measures;
- the roles and responsibilities of all stakeholders;
- the disaster management plan and the disaster emergency plan;
- the resource management considerations and programmes;
- where applicable, the concept of comprehensive land-use planning based on total watershed management principles."

The objectives of the overall management system should ensure that:

- "disaster management matters are dealt with having regard to community safety, health and welfare requirements;
- public information is freely available on the likely extent and nature of possible future hazards;
- all reasonable measures are taken to alleviate the hazard and damage potential to existing properties at risk, and there is no significant growth in future hazard and damage potential resulting from new developments;
- appropriate forecasting and warning systems exist, and emergency services and government assistance are available in the event of future disasters;
- the disaster management system is managed having regard to social and economic costs and benefits to individuals as well as the community at large."

The ultimate goal of integrated disaster management should be to limit the hazards and damages to socially acceptable levels, to promote environmental enhancement and to provide disaster warning, response, evacuation and recovery from the onset to the aftermath of the disaster.

2.8 CONCLUSION

Appropriate risk management depends on the accurate risk assessments following understanding of the concept of Risk, the vulnerabilities involved and the nature and extent of exposure to hazard/hazards. Risk assessment is a technical area of expertise in disaster management, in which experts from the field of scientific research, particularly relating to earth sciences are involved. Presently, the significant administrative issues relating to risk assessment is granting enough say to the specialists in the public administration decision hierarchy as against generalists concerning disaster mitigation policy planning. The issue of generalists and specialists is an old public administration issue area, which needs to be resolved in the interest and context of the emerging specialist public administration services like disaster management and rural development.

2.9 KEY CONCEPTS

Risk Assessment : The technical process of evaluating the likely damage in the face of apprehended disaster. Risk assessment involves mathematical probabilistic analysis, and GIS based mapping to understand the causes and likelihood of a particular hazard. Risk Assessment is undertaken separately for floods, cyclones earthquakes landslides and droughts and also other forms of natural and man made disasters.

Risk Management : It denotes strategies to mitigate disaster threat. It involves planning at the state level to build coping capacity through planned development strategies. Development cannot be sustainable if the effects of natural and manmade hazards are not taken into account in the process of development. To consider these effects it is necessary to apply Risk Management programmes and this application needs highly qualified management or policy-makers t and effective institutional framework of implementation to be successful.

Risk Reduction : Risk reduction requires reduction of hazard proneness or vulnerability to reduce the impact of a specific hazard or multiple hazards based on the assessment of vulnerability of the region. Risk reduction has currently gained emphasis post Yokohama strategy of mainstreaming risk reduction in the development process to reduce risk to life and property.

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2.11 ACTIVITIES

1) What do you understand by Risk? Give suitable examples of elements at Risk in specific disasters your locality.

2) Societal risk management involves value judgements in that a choice(s) may often be presented between economic utility and human welfare. Comment.

3) On the bases of your experience substantiate how risk assessment is a technical area of expertise in disaster management.