Theoretical Background of the Research

An environmental hazard is generally defined as an extreme and unusual physical event that inflicts some kind of damage on humans and their physical surroundings. The term refers to all the potential threats facing human society by events that originate in, and are transmitted through the environment (Smith et al., 2009). Extreme natural processes have always been associated with disasters but many of these threats are now so heavily influenced by human actions, including technology and its failures, that they are really ‘environmental’ in scope. The study makes flood an environmental hazard to the domain of potential threat exposed to human society.

Figure 2.1: Dimensions of Environmental Hazard; Tolerance to hazard (left) and Context hazard (right); Source: Adapted from Smith, 2009

Human is less prompt in recognising the hazards imbedded in nature than immediate threats to his life and possession. Probability of an event can be put to a theoretical scale, zero to certainty (0 to 1) just as severity of hazards can be ordered. To poise the overall degree of risk, the relation of probability to hazard can now be used. The study finds that, nevertheless the loss of property, crops or environment can cost people heavily; their own life being in imminent danger compels the gravest of their concern.

Risk which laymen make synonymous with hazard has the other implication of statistical chance of occurrence of fatal event induced by the hazard that is actual source of danger. So, hazard is an engendering agent in nature, be it natural or anthropogenic, while risk can best be viewed as an exposure to the potential agent tending to cause damage. Usually, it is measured as the product of probability and the quantum of loss. The poorer people of the developing countries, being at greater risk, are more vulnerable than the rich in the developed countries. Now, the realisation of hazard into devastating event causing large scale loss of life or essential support is
a disaster that is an actual occurrence rather than a potential threat. It’s a social phenomenon subjects a community to extreme level of suffering and loss. The pursuance of a technology fraught with destructive consequences for meeting the resource needs can end by spelling out such crisis, particularly in developing Third World (Hohenemser et al., 1983).

Human susceptibility to environmental hazards is a combination of physical exposure, or the range of potentially damaging events and their variability at a particular location, and order of human vulnerability, which reflects the breadth of social and economic tolerance to such hazardous events at the same site. This relationship is shown in a simple matrix (Fig. 2.1). Smith et al. (2009) coined the term context hazard. According to them ‘Super hazards’ are driven by forces operating on hemispheric, or even planetary scales and are able to deploy vast amounts of energy and materials to produce sudden, as well as long-term, environmental change. Because these threats are embedded within global-scale processes, they are termed context hazards (Fig. 2.1).

Figure 2.2: Interface of Environmental Hazards; Source: Adapted from Burton et al., 1993

Hazards and disasters are two sides of the same coin; neither can be fully understood or explained from the standpoint of either physical science or social science alone. Hazards and disasters are also inextricably linked to ongoing global environmental change, including the many factors that interact to determine the prospects for sustainable development in the future. Therefore, this more holistic paradigm is variously called sustainable hazard mitigation by Mileti and Myers (1997) and the complexity paradigm by Warner et al. (2002). It looks beyond local, short-term loss reduction, based on quick-fix solutions, and attempts to make a mess of disaster reduction strategies with a realistic development agenda for a rapidly changing world. Environmental hazards exist at the interface between the natural events system (extreme events) and the human use system (technology failures). Hazards, and human responses to them, can influence global change and the chances for sustainable development (Fig. 2.2).

Table 2.1 shows effects of environmental hazards. Tangible effects are those for which it is possible to assign monetary values, such as the replacement of damaged property. Intangible effects, although real, cannot be properly assessed in monetary terms. Direct effects are the first order consequences that occur immediately after an event, such as the deaths and crop loss caused by flood. Indirect effects emerge later and may be more difficult to attribute to the event.
These include factors such as mental illness resulting from shock, bereavement and relocation from the area.

**Table 2.1: Effects of Environmental Hazard**

<table>
<thead>
<tr>
<th>Effects of Hazard-I</th>
<th>Effects of Hazard-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tangible</td>
<td>Direct</td>
</tr>
<tr>
<td>Intangible</td>
<td>Indirect</td>
</tr>
<tr>
<td>Effects of hazard to which it is possible to assign reasonably reliable monetary values; e.g. replacement of damage property.</td>
<td>Those first order consequences that occur immediately after an event, e.g. deaths and economic loss caused by the hazard.</td>
</tr>
<tr>
<td>Effects of hazard, although real, cannot be satisfactorily assessed in monetary terms; – e.g. loss of human life (as considered in the past).</td>
<td>Consequences emerging later and may much more difficult to attribute directly to the event.</td>
</tr>
</tbody>
</table>

**Source:** After Smith, 2001

### 2.1 PARADIGMS OF ENVIRONMENTAL HAZARD STUDY

Environmental hazards are open to many interpretations. The behavioural paradigm and the development paradigm are the two prevalent divisions of interpretation of environmental hazards.

#### 2.1.1 The behavioural paradigms

This pattern of hazard is founded on the premise that the geophysical extremes are the cause of disaster and structural control of that could provide the cure effectively. Pursuing the USA Flood Control Act (1936), the engineers set forward a set of flood control works. Contemporaneously, White (1945) contended that the non-structural control of flood should be integrated with structural devices to make floodplain management more comprehensive. The approach recognises the role of human activities, such as deforestation, extensive agriculture, overgrazing, development, etc. in aggravating the hazard.

After Hewitt (1983), the behavioural paradigm attaches three thrusts to the model:

1. To contain the extremes of nature through environmental engineering, e.g. embankments, earthquake resistance buildings etc.
2. Modelling and predicting the disastrous events by technical tools like remote sensing.
3. Adoption of disaster mitigation plans and emergency responses as the quick fix remedies following Western interpretation, regardless of quality of environment and human vulnerability.
2.1.2 The development paradigms

This model of interpretation views hazards as socio-economic problems. In the LDCs, disasters arise rather from the workings of the economy worldwide and thereby inducing the marginalisation of the poor than from the impacts of geophysical events of extremity. Unlike the behavioural paradigm, it is seldom hazard-specific and profoundly induced with the views extended by Wisner et al. (2004) who pose disasters as being induced by the confrontation of the two conflicting forces: human vulnerability imposed by socio-economic system and natural processes creating geophysical hazards. The main features are:

1. Causes of vulnerability majorly consist in the economic and political systems that leave the underprivileged marginalised.
2. The social crises—malnutrition, diseases and conflict—pit the vulnerable against unkind environment, where the responses to a disastrous event get constricted by the destitution of resources.
3. Disaster alleviation is constructed with political and socio-economic changes directed to redistribution of power and wealth. Here traditional knowledge and participatory responses are the choice instead of structural measures towards mitigation.

In summary, the development view is based on the theory that disasters spring from under-development arising from political dependency and unequal trading arrangements between rich and poor nations. The poorest sections of society are pressured to over-use the land. Rural overpopulation, landlessness and migration to unplanned hazard-prone areas are then the inevitable outcomes of capitalism, which can be seen as the root cause of environmental disaster. Frequent disaster strikes simply reinforce the inequalities. The political economy of the world is unlikely to be responsive in the immediate future to the most radical demands made by the development lobby. However, the paradigm has been helpful in refining some key concepts, such as poverty and vulnerability, that help to focus attention on the needs of the most disadvantaged members of society, most recently in the MDCs as well as in the LDCs. As a result, human vulnerability analysis and mapping is now routinely undertaken alongside more quantitative risk surveys and geophysical assessments. Humanitarian aid is not a permanent solution to deep-rooted socio-economic problems but any means whereby scarce resources can be delivered more effectively to those most in need is welcome.

2.2 DIMENSIONS OF FLOODING

2.2.1 The Flood Hydrograph

An incessant trend of discharge or water depth against time during a flood event defines the flood hydrograph. In the comparatively rare coastal flood event, water depth rather than discharge is the crucial variable and the flood hydrograph is defined by the tidal curve or, more accurately, by the departure of the observed from the expected tidal curve. If we examine the hydrograph of a river flood (Fig. 2.2.1), during dry period stream flow decreases exponentially (section AX). At such times discharge consists solely in the base-flow which is largely sustained by unsaturated interflow in small, steep, impervious catchments, by groundwater flow in flat, permeable catchments or by a combination of both of these in intermediate catchments. Rainfall begins at time X and the rapid increase of discharge between X and Y results from the generation of quick-flow from the expansion of contributing channel-network areas which are fed from above by infiltrating precipitation and from below by interflow. The hydrograph peak occurs at
time Y, shortly after the cessation of rainfall, and thereafter discharge is largely determined by the amount of water held in storage both on and under the surface of the catchment. The rate of exhaustion of storage is reflected in the shape of the recession limb of the hydrograph (section YB). The early part of the recession will be sustained largely by saturated interflow while the later stages (sections YZ and ZB) will be sustained by the combination of unsaturated interflow and groundwater flow, depending on catchment conditions.

It will be clear from this that during a flood event the discharge hydrograph is dominated by the quick-flow component, with a time base XZ and a peak Y. Equally clear is that in most circumstances, flood conditions do not begin immediately as the discharge increases at time X, since the initial discharge increase is either contained within the stream banks or results in water levels getting elevated, but with the raised stream surface still lying below the arbitrary flood level.

**Figure 2.2.1:** River Flood Hydrograph; Inset hydrographs on flashy and sluggish streams; Source: Adapted from Hoyt and Langbein, 1955)

Consequently, the flood hydrograph proper, consisting entirely of quick-flow, may be considered to begin and end when the pre-selected flood level or discharge is equalled on both the rising and falling limbs. Thus, although still peaking at Y it will have shorter defined time base X1Z1. The general form of the flood hydrograph will be greatly modified not only by variations in the nature and intensity of the climatological input but also by variations in the many potential intensifying conditions. Thus, at one extreme the hydrograph may have the low peak and long time base of a sluggish stream, while at the other it may have the high peak and short-time base for a flashy stream.

### 2.2.2 Flood Frequency

Flood frequency shows the measure of probability of occurrence of a flood of a given magnitude. Large floods occur relatively infrequently and have a long average return period or recurrence
interval \((T)\) of perhaps several hundreds of years. Small floods occur frequently, perhaps annually, and therefore, have a very small return period or recurrence interval. The five-year flood \((Q_5)\) and the 100-year flood \((Q_{100})\) can occur at any time, although the former is more likely, having a 20% probability of occurring in a given year, compared to a 1% probability of occurrence for the 100-year flood. This has important repercussions for the encroachment of human activity into flood-prone areas since the floods most likely to have been experienced are the more frequent minor ones whose impact is generally small. Flood frequency is an important concept in the design of many flood-alleviation measures which are constructed to withstand the effects of floods including the design of flood. For instance, minor dams and urban stormwater systems may be built to cope with a flood in design having a return period of only 20 to 30 years, while for major earth dams the flood in design may have a return period of 1000 years. The extent of inundation associated with a given water-surface elevation defines another dimension of flooding, i.e. the flood outline, which expands as water level increases. Floods of given return periods each have a unique outline which, when mapped, represents a valuable planning tool. In 1959 the USGS began a new series of flood outline maps, published as Hydrologic Investigations Atlases, which were used to establish zoning regulations and to minimise encroachment. Burkham (1978) compared the accuracy of the methods used by the USGS. Flood outline mapping by the US Army Corps of Engineers concentrated largely on showing the outlines of floods of selected frequencies, e.g. the Standard Project Flood (SPF), with a return period of about 100 years, and smaller floods (Intermediate Regional Floods) with return periods of between 5 and 50 years. These maps were an integral part of the Flood Plain Information Reports, prepared by the Corps of Engineers under the provisions of the amended Flood Control Act of 1960. They were intended to provide useful information on floods and flood hazards so as to encourage optimum use of flood-prone land and thereby minimise future expenditure on flood alleviation resulting from the improper use of floodplains (Molinaroli, 1965).

2.3 FLOODS AS HAZARD

When a flood, as an extreme geophysical event, occur in a human habitation it may have disastrous consequences like loss of human lives, properties and facilities, and shatter normal activities there. It is use and wont that the geophysical processes are to be held responsible for natural hazards and natural disasters as the terms emphasise. However, it is increasingly recognised that these extreme events which triggers disasters are the origin of what may not be simple and tangible. It is rather socio-economic complexity difficult to interpret. But human beings perceive these eventualities of negative socio-economic consequences as ravaged by nature.

A different group of people with other judgements can have a quite different view of flood risk or losses, and define threats from flooding otherwise (Green et al., 1991). Besides, human activities may locally subscribe to flood risk and, likewise, mitigation measures by human can reduce that. Actual flood risks rise from probability that major risky events occur indefensibly to hit human being.

Danger of flooding in practice results from a combine of conditions- physical exposure and human vulnerability to geophysical processes. The former reflects the type of flood events that can occur, and their statistical pattern, at a particular site, while the latter reflects key socio-economic factors such as the numbers of people at risk on the floodplain. It is the balance between these two elements, rather than the physical event itself, which defines flood hazard and
determines the outcome of a flood disaster. In Fig 2.3a, variations of river stage through time are plotted in relation to the band of social and economic tolerance available at a hypothetical location. When a river flows to the average level it engenders no hazards and inhabitants perceive that as a resource to furnish them with water of essential use; but, when it overflows and exceeds the significant threshold, extending without the band of tolerance it remains beneficial no longer. Thus, the flows too low and too high mean to bring about a drought and flood hazard respectively. Whatever the expression of impact by hydrograph may be the actual order of flood disaster consists in the vulnerability of the locality.

Figure 2.3a: Sensitivity to flood hazard expressed in relation to the variability of river discharge and the degree of socio-economic tolerance at a site; Source: Modified from Hewitt and Burton (1971)

Rivers, often being in spate without posing significant threat, evoke no emergency response, for low-magnitude and high frequency floods produce both gains and harms to the people under risk. Both the physical exposure and community vulnerability, and their relation can dynamically alter over time.

Figure 2.3b: Schematic illustration of increases in human vulnerability to flood hazard caused by changes in the distribution of flood events and a decrease in socio-economic tolerance at a site; Source: After de Vries (1985)
Fig 2.3b shows several possibilities subscribing to flood risk, and Fig. 2.3b (A) shows the effects of stable band of socio-economic tolerance against constant variables of flows where tendency of higher mean values reading to a higher frequency in which the break-down of tolerance threshold can occur, presumably because of the constricting banks incapable of accommodating a definite volume of flood-flow. Fig 2.3b (B) plots risk widened by an increased variability of flow, against a constant band of tolerance and constant mean value of flow, due to rainstorms intensified by the changing climate regime. Fig 2.3b (C) traces the socio-economic band of tolerance eroding, against river flow regime remaining intact, and encroachment of floodplains leaving more people and properties under threat. Flood risk is relatively incapable of being predicted while system of precise warning in time is yet to develop. So unpredictability remains a major cause of a flood turning out to be disastrous. However, many rivers, particularly in a larger basin, flood so regularly, slowly and predictably that they often leave space for a proportional response. Given, floods occur in the well-identified physiographic setting; they can be precisely traced and warded off structurally or mitigated by other responsive means.

2.4 CAUSES AND CONSEQUENCES OF FLOOD

Fig. 2.4 explains the different factors subscribing to flood. The main flood intensifying conditions may be conveniently grouped into basin, network and channel characteristics, each group having some characteristics which are comparatively stable and there are others which are relatively variable. Heavy rainfall is the most common cause of floods. Rainfalls vary from the semi-predictable seasonal rains over wide geographic areas, which give rise to the annual monsoonal floods in tropical areas, to almost random convectional storms causing flash floods over small basins (Smith, 1996). The magnitude, speed of onset and duration of the flood will then be influenced by factors such as topography, vegetation and soils, river course alteration, land use and urbanisation. Urbanisation worsens floods by reducing the permeability of ground surfaces and increasing run-off rates (Parker, 1999). Flooding can also clearly take different forms ranging from regular waterlogging of ground after rainfall through more severe but relatively predictable seasonal flooding to catastrophic flood events that overwhelm coping capacities and constitute disasters. Handmer et al. (1999: 126) suggest that the term can cover ‘a continuum of events from the barely noticeable to catastrophes of diluvial proportions’. However, it is important to recognise that there is no clear distinction between mild and severe forms of flooding – the same event can have differential effects on neighbourhoods and even households (Blaikie et al., 1994).

Inundation along some of the low-lying floodplains adjacent to major rivers can be both widespread and long in duration (Zillman, 1999). Nowhere is this more dramatic than the case of the Ganges–Brahmaputra–Megna river system in Bangladesh where ‘110 million people are relatively unprotected on the floodplain of southern Asia’s most flood-prone river system’ (Smith, 1996: 258). But risks are also great for settlements in small river basins subject to sudden flash floods and along low-lying shorelines where storm surges associated with cyclones can produce sea flooding of several metres in depth (Parker, 1999; Zillman, 1999).

Flooding is by no means a phenomenon solely of negative consequence. Pelling (2001) notes that there are even some who make financial gains from, otherwise damaging floods ranging from labourers contracted to clear waste and raise yards to those national and local institutions sustained by the external resources directed towards mitigation.
Figure 2.4: Causes of floods and flood intensifying conditions; Source: Adapted from Ward, 1978
But, more fundamentally, floods bring widespread economic and environmental benefits (Blaikie et al., 1994; Smith, 1996; Handmer et al., 1999). Floods can irrigate and fertilise fields, flush out salts and toxins from soils and watercourses, and recharge reservoirs. In many regions, annual flooding sustains current levels of agriculture. People may have different terms to distinguish beneficial floods from the destructive ones. This antagonistic nature of flood impact is crucial to recognize. It helps explain why many residents of developing countries take an ambivalent attitude toward flood events, and partly underpin the logic of policies of ‘living with floods’ rather than attempting to prevent them through large scale engineering interventions.

But more frequent flood events of a lower magnitude can bring serious damage and disruption by ruining crops and causing food scarcities, disrupting infrastructure and access to services, suspending business activities, and exacerbating health risks in homes and local environment (Blaikie et al., 1994; Smith, 1996; Parker, 1999). Moreover, the floodwaters persisting means that people may continue to face those disruptions and troubles for weeks and even months on end. Most low-income residents of developing countries do not have a realistic option of moving elsewhere (Ahmed and Ahmed, 1999).

Even in the case of extreme flood events, people may not move far from their homes. A study of the devastating flood in Mozambique in 2000 shows that in many areas displaced people were accommodated in local schools (Christie and Hanlon, 2001). One of the most significant effects of flooding that are difficult to quantify is the impact on health (Kolsky, 1999). Handmer et al. (1999: 127) argue that effects ‘on human health in developing countries, and especially among the residents of informal settlements’ are a particular concern over any increase in flooding that might result from climate change. As well as the physical threat from flowing water, flood events can increase risk of water-borne pathogens, vector-borne diseases and snakebites. Outbreaks of epidemic may be associated with the spreading of waste by floodwaters, disruption of safe water supplies and the waterloggings in low-lying areas creating breeding grounds for mosquitoes (Blaikie et al., 1994; Stephens et al., 1994; Kolsky, 1999). A study of flood hazards in poor districts of Manila, Philippines, suggests that floods expose people to respiratory infections, skin allergies and gastro-intestinal illnesses, leaving children most at risk (Zoleta-Nantes, 2000).

Existing environmental health problems such as blockages to drainage channels, poor sanitation systems and dumping of solid waste worsen the prevailing infections (Cairncross and Ouano, 1990). At the same time, disruption of medical facilities and the increased demand on their resources can reduce peoples’ access to necessary treatment and medication (Yahmed and Koob, 1996; Rashid, 2000). Also important to note are the potential mental health impacts of flooding resulting from stress (Durkin et al., 1993) and the impact of inadequate nutrition following lowered incomes and failure of food distribution systems (Blaikie et al., 1994; IPCC, 2001). Some such effects may not become manifest for a long time past the event of flood.

2.5 HUMAN VULNERABILITY TO FLOODS

As far as the study concerns, the term, vulnerability stands crucially significant, and hence needs to be defined in discrete terms. It’s a comprehensive notion in the relevance. Resilience, realiability etc. are the other terms that require, though subordinately, conceptual interpretation in the context. Vulnerability has a commonplace meaning: being prone to or susceptible to damage or injury. Vulnerability means the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard (Blaikie
et al., 1994). It involves a combination of factors to determine the degree to which someone’s life and livelihood is put at risk by a discrete and identifiable event in nature or in the polity.

Human vulnerability is a more comprehensive term and was viewed by Timmerman (1981) as the degree of people’s losing in resistance offered by a social system to the impact of a hazardous event. In turn, resistance depends on either resilience or reliability.

- **Resilience** defines the measure of ability to absorb and recover from the impact of a hazardous event. Traditional resilience is common in the LDCs where disaster is a normal part of life and group coping strategies stand highly significant.

- **Reliability** reflects the degree of protection offered by the devices against hazard. This approach is often associated with the MDCs where advanced technologies ensure a high degree of day-to-day reliability for most urban services. There is now a growing awareness that built-up environments require to be even more resilient and sustainable if they are to withstand the stress of hazardous events in future (Bosher et al., 2007).

Human vulnerability can be assessed on a variety of scales. As for risk, it is a universal problem. This is because aspects of vulnerability can affect anyone. By definition, all vulnerable people are located in areas somehow physically exposed to natural or technological hazards. But the highest vulnerability is a characteristic of the poorest people of the LDCs (Smith et al., 2009). The most vulnerable people worldwide tend to be concentrated in two population groups:

- urban dwellers from the informal settlements and inner-city slums of the most rapidly sprawling cities, often living in unsafe homesteads on steep slopes or near dangerous industrial sites, and exposed to hazards like earthquakes, landslides, flash floods and fires.

- rural dwellers, almost three-fourth of the poorest section of world’s population and who suffer ongoing food insecurity due to increasing environmental degradation and climate change, and are exposed to hazards like floods, droughts and famines.

Key causes of vulnerability are:

**Economic factors**-Those people lacking capital and other resources, such as land, tools and sources of earning livelihoods are most vulnerable. Access to information and the availability of a social network which enable people to mobilise support from outside the household can be significant too. The poorest people may appear to have little to lose when disaster strikes. Most of the poorest people in the world with fragile existences in rural areas have got few earning skills or opportunities.

**Social factors**- Age and gender are significant factors of vulnerability. The very young and the very old are more prone to risk. In the Bangladesh cyclone disaster of 1970, over half of all the deaths were suffered by children below 10 years of age, who comprised one-third of the population (Sommer and Mosely, 1972). Works on earthquake disasters show that survivors over 60 years of age and females are most likely to have severe physical injuries and that females also suffer most from psychiatric disorders (Peek-Asa et al., 2002; Chen et al., 2001). Older people, particularly widows in the LDCs, face difficulties in providing for their livelihood in the wake of disaster. Even in the MDCs older people with disabilities face problems in emergency evacuation and living in public shelters following the event (McGuire et al., 2007). Ethnicity can be another factor when linguistic and religious divides may subvert the security of minority groups.
The combine of social and economic factors can add to risk from environmental hazards. For example, resulting ill-health, especially from communicable diseases, can prevent people from earning a living. During July 1993 flash floods generated by monsoon rains struck a densely-populated rice-growing area in southern Nepal and killed over 1,600 people (Pradhan et al., 2007). A survey of over 40,000 residents showed that the fatalities concentrated in certain groups. The crude fatality rate for all household residents was 9.9 per 1,000 persons but those most likely to die were children, females, those of low socio-economic status and those living in under poor sanitation. Over 70 per cent of houses were built of thatch and those living in such houses were more than five times more likely to die than those in a cement/brick house because many thatched houses were either washed away or rendered uninhabitable.

**Political factors** - The role of government is crucial because incompetence and corruption produce common lapses including a weak organisational structure (everything from poor roads to untrained civil servants) and deficient welfare programmes (including inadequate housing and health provision, combined with low nutritional status). Events constraining with unsustainable hordes of refugees, internal strife (tribal warfare, ethnic cleansing) or external warfare (border disputes with neighbouring countries) may be a feature creating large numbers of refugees and disrupting the distribution of food or other aids. Since 1990 more than 70 million people have been displaced, either within their own countries or abroad. In some countries, even the national governments control little more than the capital city whilst the more remote rural areas are left to fend for themselves.

**Environmental factors** - Unsustainable natural resource handling is a major problem. Most of the rural poor are dependent on traditional rain-fed agriculture and are at risk because of climate change. The unregulated use of land and water resources together with widespread illegal practices can result in severe environmental degradation. The collapse of traditional agriculture and irregular slumps in market prices increase the threat of seasonal food shortages. In many countries, most of the land holdings are too small to maintain livelihoods. Consequently, over half of the population is malnourished and has no access to safe water or domestic sanitation. People with chronic undernourished suffer worse from water related diseases after floods, such as dysentery.

**Geographical factors** - Many poor remote rural areas are deprived of the public scrutiny and aid monitoring. The people most vulnerable to disaster often live in relatively inaccessible parts, like the small island, remote villeges etc.

Some form of environmental hazard has to be in our surroundings and the severity of the hazard impact is often a function of human vulnerability rather than the physical magnitude of the event. However, the concept of vulnerability remains difficult to assess in practical terms. Several methodologies are available to the humanitarian agencies responsible for determining vulnerability in the field but there is little agreement on their use. In some cases, conflicting findings are obtained at different scales – for example, for macro-scale (regional) assessments as opposed to micro-scale (household) assessments. According to Darcy and Hofman (2003), ideal judgements about people at risk should based on relatively objective outcome indicators for key factors, such as mortality, morbidity or malnutrition – or longer-term outcomes such as mental disorders (Salcioglu et al., 2007). These, however, may be of no avail in an urgent relief to be extended.