



CHAPTER ONE

INTRODUCTION

Outline of the Chapter:

Environment

Climate Change

Disasters

Vulnerability

Resilience

Global Impact and Initiatives

Indian Impact and Initiatives

Definitions and Concept

Social Work Response

Conceptual Framework

Introduction of the chapter:

The Introduction chapter is the first chapter of the thesis. It introduces the topic of research with the help of various theories and concepts and finally leads to the conceptual framework.

The chapter starts with an understanding of what is the environment and socio ecological are and how they are falling prey to disturbances due to climate change. It further tries to develop understanding about what is climate change, definition of climate change, what are causes and what are the adverse impacts of climate change. The chapter further focuses on the link between climate change and disaster risk reduction and explains what are disasters, its types, vulnerability in terms of natural disasters etc. It further explains the importance of climate change adaptation and sustainable development.

Further, it tries to conceptualize vulnerability by focusing on vulnerability , its concept, vulnerability to natural hazards and climate change, social vulnerability and different definitions. It also conceptualizes resilience by taking into consideration what do we mean by resilience, social resilience and the importance of the same.

With this in background, the chapter explains the impacts at global level, in Asia and in specifically in India. It also focuses on the social dimensions of climate change and some of the initiatives undertaken by India through research.

Towards the end, the chapter outlines the scope of social work response and social work concerns leading to a conceptual frame work for the present research.

Global Environment and Socio Ecological Systems:

Growing interest in global environmental change has focused attention on the inter-relationships between natural and human systems. Climate change is increasingly accepted as a major issue facing human societies in the 21st century. Climate change is one of the most important global environmental challenges facing humanity with implications for food production, natural ecosystems, freshwater supply, health, etc.

The Second Assessment Report of the Inter-governmental Panel on Climate Change (IPCC) clearly demonstrates that both the ecosystem and the human system will be adversely affected by climate change. The changes in natural systems at alarming rates induced by global warming would cause land degradation and desertification; loss of lands and vegetation; overall decline in tropical forest areas; problem in fresh water storage and delivery infrastructure due to alteration in the timing and amplitude of runoff from snow melt; degradation of wetlands due to alteration of their hydraulics and inundation of low-lying coastal areas due to sea level rise. All such physical effects will result in disequilibrium in the natural and the human systems as well as the existing symbiosis between humans and the nature. As a result, the production and social systems could be seriously disrupted.

The issue of largest importance to developing countries is reducing the vulnerability of their natural and socio-economic systems to projected climate change. Their concerns include increasing food security, reducing freshwater scarcity, protecting the livelihoods of forest dwellers, dry land farmers and coastal settlements and reducing health risks. Social and ecological systems are so complex that our knowledge of them and our ability to predict their future dynamics will never be complete. Social and ecological systems cannot be considered in absence of one another but needs to be understood as related and coupled systems. It is the intersection of the two that ensures sustainable development. In the advent of natural disruption in form of

disasters, it becomes seemingly difficult for both the systems to adhere themselves to their marked boundaries. Social and ecological systems are sufficiently complex that our knowledge of them and our ability to predict their future dynamics will never be complete. Social and ecological systems cannot be considered in absence of one another but must be understood as related and coupled systems. It is the intersection of the two that ensures sustainable development. In the advent of natural disruption in form of disasters, it becomes seemingly difficult for both the systems to adhere themselves to their outlined boundaries.

Climate Change

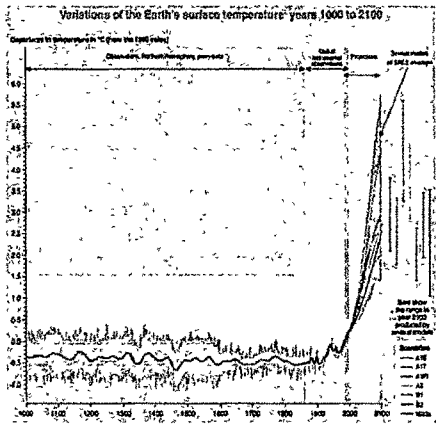
What is Climate Change?

The Earth is the only planet in our solar system that supports life. The complex process of evolution occurred on Earth only because of some unique environmental conditions that were present: water, an oxygen-rich atmosphere, and a suitable surface temperature. Only Earth has an atmosphere of the proper depth and chemical composition. About 30% of incoming energy from the sun is reflected back to space while the rest reaches the earth, warming the air, oceans, and land, and maintaining an average surface temperature of about 15 °C.

The chemical composition of the atmosphere responsible for life is nitrogen and oxygen utilized by animals for survival and only a small percentage is made up of carbon dioxide which plants require for photosynthesis completing the ecological cycle.

Greenhouse gases (for example, carbon dioxide, methane, nitrous oxide, water vapor, ozone), re-emit some of the heat to the earth's surface trapped within the earth's atmosphere each day. If they did not perform this useful function, most of the heat energy would escape, leaving the earth cold (about -18 °C) and unfit to support life.

However, ever since the Industrial Revolution began about 150 years ago, man-made activities have added significant quantities of GHGs to the atmosphere. The atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have grown by about 31%, 151% and 17%, respectively, between 1750 and 2000(IPCC001).



From year 1000 to year 1860 variations in average surface temperature of the Northern Hemisphere are shown (corresponding data from the Southern Hemisphere not available) reconstructed from proxy data (tree rings, corals, ice cores, and historical records). The line shows the 50-year average, the grey region the 95% confidence limit in the annual data. From years 1860 to 2000 are shown variations in observations of globally and annually averaged surface temperature from the instrumental record; the line shows the decadal average. From years 2000 to 2100 projections of globally averaged surface temperature are shown for the six illustrative SRES scenarios and IS92a using a model with average climate sensitivity. The grey region marked "several models all SRES envelope" shows the range of results from the full range of 35 SRES scenarios in addition to those from a range of models with different climate sensitivities. The temperature scale is departure from the 1990 value.

(Source IPCC Third Assessment Report: Climate Change 2001, Synthesis Report)

An increase in the levels of GHGs could lead to greater warming, which, in turn, could have an impact on the world's climate, leading to the phenomenon

known as climate change. Indeed, scientists have observed that over the 20th century, the mean global surface temperature increased by 0.6 °C . They also observed that since 1860 (the year temperature began to be recorded systematically using a thermometer), the 1990's have been the warmest decade.

However, variations in temperature have also occurred in the past - the best known is the Little Ice Age that struck Europe in the early Middle Ages, bringing about famines, etc. It is therefore difficult to determine whether current observations of increasing temperature are due to natural variabilities or whether they have been forced by anthropogenic (man-made) activities.

Scientific studies and projections are further complicated by the fact that the changes in temperature that they have been observing do not occur uniformly over different layers of the lower atmosphere or even different parts of the earth.

The Earth's climate system constantly adjusts so as to maintain a balance between the energy that reaches it from the sun and the energy that goes from Earth back to space. This means that even a small rise in temperature could mean accompanying changes in cloud cover and wind patterns. Some of these changes may enhance the warming (positive feedback), while others may counteract it (negative feedback). Negative feedback (causing a cooling effect) may result from an increase in the levels of aerosols (small particles of matter or liquid that can be produced by natural or man-made activities). Positive feedback may result from an increase in water vapor (because of greater evaporation with temp rise), which itself is a GHG and can further add to the warming effect.

All the factors described above complicate the work of scientists who try to predict the fallout of climate change. Despite these uncertainties, the Third Assessment Report published by the IPCC states, 'there is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities' .

Definition of Climate Change

United Nations Framework Convention on Climate Change (UNFCCC)

definition of climate change: A change of climate, which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods’.

Intergovernmental Panel on Climate Change (IPCC) defines “climate

change” as “a change in the state of the climate that can be identified ... by changes in the mean and / or the variability of its properties, and that persists for an extended period, typically decades or longer”.

Climate Change and Disaster Risk Reduction

Climate change adaptation (CCA) and disaster risk reduction (DRR) have similar aims and mutual benefits. However, to date the climate change and disaster risk management communities have operated largely in isolation from each other – for a number of reasons. This situation must change as a matter of urgency. Adaptation and DRR policy makers, experts and practitioners must communicate and collaborate with each other effectively to ensure a comprehensive risk management approach to development at local, national and international levels of government. This could result in the following benefits:

- 1 Reduction of climate-related losses through more widespread implementation of DRR measures linked with adaptation.
- 2 More efficient use of financial, human and natural resources.
- 3 Increased effectiveness and sustainability of both adaptation and DRR approaches.

Closer collaboration on these issues is particularly critical as governments negotiate on the adaptation pillar of the post-2012 framework under the United Nations Framework Convention on Climate Change (UNFCCC). DRR

must be a key component of the post-2012 framework if an effective, sustainable approach to adaptation is to be achieved.

Disasters

Generally speaking, disaster is an event which gives rise to casualties, loss of property, damage to infrastructure, essential services and means of livelihood on a scale which the affected community cannot cope up unaided. Disasters ruins years of investments in development process. It places new demand for reconstruction and rehabilitation.

The UN defines disaster as "The occurrence of a sudden or major misfortune which disrupts the basic fabric and normal functioning of a society."

The World Health Organization (WHO) describes disaster as an occurrence that causes damage, economic destruction, loss of human life and deterioration in health services on as scale sufficient to warrant an extraordinary response from outside the affected community or the area.

Thus generally speaking, disaster may be termed as an event which causes great loss of life and property. They pose a serious threat to the normal life as well as the process of development. It is an event triggered by natural or man made causes that lead to disruption of normalcy within society. They can be sudden and powerful, damaging national economy and can cause hardship to population and are the largest concerns for most of the nations rendering multi dimensional economic and social consequences for communities affecting human, environmental, domestic ,social, economic and political aura. The impacts are felt at the individual, familial and community level.

Types of Disasters

The High Powered Committee set up by Government of India in August 1999, under the chairmanship of Dr. K. C. Pant has classified disasters into the following major types:

1. Water and Climate Related

Floods, Cyclones, Tornadoes, Hurricanes, Hailstorms, Cloud burst, Heat and Cold Wave, Snow Avalanches, Droughts, Thunder and Lightening, Sea Erosion

2. Geologically Related

Landslide, Earthquakes, Dam failures/Dam bursts, Mine fires

3. Chemical, Industrial and Nuclear Related disasters

Chemical and Industrial Disasters, Nuclear Disasters

4. Accident Related Disasters

Forest Fires, Urban Fires, Mine Flooding, Oil Spills, Major Building Collapse, Serial Bomb blasts, Festival related disasters

5. Electrical disaster and fires

Air, Roads and Rail accidents, Boat Capsizing, Village Fire

6. Biologically related disasters

Biological disasters and epidemics, pest attacks

The disasters can also be classified on the basis of whether they are man made or natural, sudden onset or slow onset etc.

Vulnerability of India to Natural Disasters

The multi hazard map of India depicted in the Vulnerability Atlas of India (BMTPC, New Delhi, India) shows that out of the total geographical area of 32, 87, 263 sq. kms, about 60% of the land mass is prone to earthquakes of various intensities, over 40 million hectares is prone to floods, about 8% of total area is prone to cyclones and 68% of the area is susceptible to drought. Coast line of 8041 km exposed to tropical cyclones. Many parts are prone to Landslides, hailstorm and avalanches. Thus, Indian Subcontinent highly vulnerable to drought, floods, cyclones and earthquakes. Among the 32 States/ Union Territories, 22 are disaster prone.

Disasters	Vulnerable States
E, F, C, D	Gujarat, Maharashtra and West bengal
E, F, D	Andhra Pradesh, Bihar, Haryana, Jammu & Kashmir, Karnataka, Madhya Pradesh, Orissa, Rajasthan, Uttar Pradesh and Goa
E, F	Himachal Pradesh, Manipur, Meghalaya, Nagaland, Sikkim, Tamil Nadu, Kerala, Mizoram and Tripura

Disasters: Cyclone -C; Drought -D; Earthquake-E;Flood-F

Loss due to Natural Disasters

Country profile for Natural Disasters from 1900 – 2006

- No of events*: 513
- No of people killed*: 9,105,799
- Average killed per year*: 85,904
- No of people total affected*: 2,233,336,428
- Average total affected /year*: 21,069,212
- Economic Damage (US\$ X 1,000)*: 35,717,502
- Economic Damage/year (US\$ X 1,000)*:336,958

(*: Reported-Source of data: "EM-DAT: The OFDA/CRED International Disaster Database, Université catholique de Louvain, Brussels, Belgium" / Data version: v06.06)

Key Terminology for Disaster Risk Reduction provided by International Strategy for Disaster Risk Reduction:

Adaptation

The adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.

Contingency planning

A management process that analyses specific potential events or emerging situations that might threaten society or the environment and establishes arrangements in advance to enable timely, effective and appropriate responses to such events and situations.

Coping capacity

It is the ability of people, organizations and systems, using available skills and resources, to face and manage adverse conditions, emergencies or disasters.

Disaster risk

The potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period.

Disaster risk management

The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster.

Disaster risk reduction

The concept and practice of reducing disaster risks through systematic efforts to analyze and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property,

wise management of land and the environment, and improved preparedness for adverse events.

Exposure

People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses.

Greenhouse gases

Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds.

Hazard

A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Hydro meteorological hazard

Process or phenomenon of atmospheric, hydrological or oceanographic nature that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Mitigation

The lessening or limitation of the adverse impacts of hazards and related disasters.

Preparedness

The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions.

Prevention

The outright avoidance of adverse impacts of hazards and related disasters.

Resilience

The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.

Response

The provision of emergency services and public assistance during or immediately after a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected.

Risk

The combination of the probability of an event and its negative consequences.

Sustainable development

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Vulnerability

The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.

Climate Change and Natural Hazards/ Disasters:

Natural hazards by themselves do not cause disasters; it is the combination of an exposed, vulnerable and ill prepared population or community with a hazard event that results in a disaster. Climate change will therefore affect disaster risks in two ways, firstly through the likely increase in weather and climate hazards, and secondly through increases in the vulnerability of communities to natural hazards, particularly through ecosystem degradation,

reductions in water and food availability, and changes to livelihoods. Climate change will add yet another stress to those of environmental degradation and rapid unplanned urban growth, further reducing communities' abilities to cope with even the existing levels of weather hazards.

Climate change increases disaster risk in a number of ways. It changes the magnitude and frequency of extreme events (meaning that coping and response mechanisms and economic planning for disasters based on past vulnerabilities may no longer suffice). It changes average climatic conditions and climate variability, affecting underlying risk factors, and it generates new threats, which a region may have no experience in dealing with. The climate change and disaster management communities need to work together in addressing these issues. If climate change adaptation policies and measures are to be efficient and effective they must build on and expand existing DRR efforts. And if DRR approaches are to be sustainable they must account for the impact of climate change.

Similar Aims of DRR and Climate Change

While their scope and specific interests may differ, adaptation and DRR have very similar aims in terms of seeking to build resilience in the face of hazards. They both focus on reducing people's vulnerability to hazards by improving methods to anticipate, resist, cope with and recover from their impact. In so doing, climate change adaptation clearly focuses on *climate-related hazards*, such as floods, droughts and storms. The disaster risk management community has a long history of dealing with such events, and therefore a wealth of experience relevant to adaptation. Importantly, both adaptation and DRR seek to build resilience to hazards in the context of sustainable development. Climate change adaptation requires the re-shaping and re-designing of development, social and economic practices to respond effectively to new or anticipated environmental changes. Likewise DRR seeks to influence development decision-making and protect development aspirations from environment related risks. The effectiveness of both

adaptation and DRR are limited if they are not viewed within the broader context of sustainable development.

The World Resources Institute (WRI) presents a model of adaptation which helps to illustrate how closely DRR is linked with adaptation. The WRI frames adaptation as a 'continuum of responses to climate change', divided into four types of adaptation efforts, ranging from 'pure' development activities at one end of the continuum to very explicit adaptation measures at the other. The four types of adaptation are:

1. Addressing the drivers of vulnerability (i.e. factors making people vulnerable to harm).
2. Building response capacity (laying the foundation for more targeted actions).
3. Managing climate risk (reducing the effects of climate change on resources/livelihoods).
4. Confronting climate change (highly specialized activities, such as relocating communities in response to sea level rise).

While DRR measures typically fall under the middle two categories of building response capacity and managing climate risk, they can fit into *every category* of the adaptation continuum, addressing drivers of vulnerability as well as confronting climate change.

Apart from the above similar aims, both the communities also use **Non Structural Measures**. These measures refer to policies, knowledge development/awareness and methods and operating practices, including participatory mechanisms, which can reduce risk and related impacts. These nonstructural measures are well placed to serve both a DRR and a climate change adaptation agenda. The dynamism associated with training and awareness-raising means that people and institutions can apply skills and knowledge in different circumstances as they emerge. With context to **Poverty Reduction and Underlying Risk**, both climate change and disaster

risk management communities recognize and accept that the poor are disproportionately affected by hazards. This is due to a lack of access to the means by which they can improve their resilience, whether this is in economic, social, physical, or environmental terms. So for both adaptation and DRR, poverty reduction and sustainable natural resource management are essential components of reducing vulnerability to hazards and climate change. The approach of Community Based Disaster Risk Management which enables the local communities to participate in adaptation and decision making is already strongly embedded in the DRR community. Both the communities also call for **Mainstreaming in sustainable development**. It is increasingly recognized that adaptation and DRR must be integral components of development planning and implementation, to increase sustainability. In other words, these issues need to be 'mainstreamed' into national development plans, poverty reduction strategies, sectoral policies and other development tools and techniques. At the World Conference on Disaster Reduction in 2005, governments agreed to adopt a mainstreamed approach to DRR. In the policy debate on climate change there has been growing recognition of the importance of adaptation, and within this, the need to improve the capacity of governments and communities to address *existing* vulnerabilities to current climate variability and climatic extremes. This development has taken place in parallel to the shift from disaster management to disaster *risk* management, which is adopting a more anticipatory and forward-looking approach. Climate change adaptation and DRR, therefore, have merging remits and highly significant **converging political agendas**.

Climate Change and Sustainable Development:

Sustainable development has become part of all climate change policy discussions at the global level, particularly due to adoption of Agenda 21 and the various Conventions resulting from the UNCED-1992. The generally accepted and used definition as given by the Brundtland Commission is 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'. Sustainable

development has become an integrating concept embracing economic, social and environmental issues. Sustainable development does not preclude the use of exhaustible natural resources but requires that any use be appropriately offset. Further, sustainable development cannot be achieved without significant economic growth in the developing countries. Three critical components in promoting sustainable development are economic growth, social equity and environmental sustainability. The decline and degradation of natural resources such as land, soil, forests, biodiversity and groundwater, resulting from current unsustainable use patterns are likely to be aggravated due to climate change in the next 25 to 50 years.

For developing countries, the climate benign actions are best driven as a part of the sustainable development priorities derived from the Millennium Development Goals and channelized in national development goals and targets. This approach is well articulated in India's Initial National Communications: 'Since the goals of sustainable national development are favorable to the issue of climate change, the achievement of these goals would accrue a double dividend in terms of added climate change benefits. The cascading effects of sustainable development would reduce emissions and moderate the adverse impacts of climate change, and thereby alleviate the resulting loss in welfare'.

Vulnerability

Vulnerability Concept

The word "vulnerability" is derived from the Latin word **vulnerare**, meaning "to wound." At a very basic level, vulnerability can be defined as "the capacity to be wounded" or the "potential for loss". However, general definitions of vulnerability do not specify the type of loss or the individuals, groups, or societies experiencing loss.

Despite differences in the conceptualization of the term "vulnerability," two main perspectives have emerged. The first major research theme treats

vulnerability as a pre-existing condition and focuses on potential exposure to hazards. Studies conducted in accordance with this perspective tend to assess the distribution of some hazardous condition, the human occupancy of the hazard zone, and the degree of loss of life and property resulting from a particular event.

The second major perspective on vulnerability suggests that not all individuals and groups exposed to a hazard are equally vulnerable; rather, affected people display patterns of differential loss. In addition to exposure to some stress or crisis, this differential vulnerability also depends on the *coping ability* of those affected. Coping ability has been defined as a combination of *resistance* (the ability to absorb the damaging impacts of a hazard and continue functioning) and *resilience* (the ability to recover from losses quickly).

Vulnerability to climate change has always been a major concern of human beings. Since climate change is a multidimensional phenomenon, a single index or definition may not be appropriate and hence composite vulnerability indices that can incorporate economic, social, and environmental dimensions need to be developed.

Definition of Vulnerability:

A. The latest edition of the Oxford Dictionary of English gives the following definition of "vulnerable"

1. Exposed to the possibility of being attacked or harmed, either physically or emotionally,
2. Bridge (of a partnership): liable to higher penalties, either by convention or through having won one game towards a rubber.

The Oxford Dictionary of English provides the following example sentence with the first definition:

"Small fish are vulnerable to predators".

It follows from the definitions and the example sentence that vulnerability is a relative property: it is vulnerability of something to something. In addition, both the definitions and the example sentence make it clear that vulnerability has a negative connotation and therefore presupposes a notion of “bad” and “good”, or at least “worse” and “better”. It also follows that vulnerability refers to a potential event (e.g., of being harmed); not to the realization of this event.

Vulnerability to natural hazards:

Chamber (1983) defined that vulnerability has two sides. One is an external side of risks, shocks to which an individual or household is subject to climate change and an internal side which is defenselessness, meaning a lack of means to cope without damaging loss.

Blaikie *et al.*, (1994) defined vulnerability as the characteristics of a person or group in terms of their capacity to anticipate, cope with, resist and recover from the impacts of natural hazards and states that vulnerability can be viewed along a continuum from resilience to susceptibility.

Vulnerability to Climate Change:

The IPCC's Third Assessment Report (TAR) of the Intergovernmental Panel on Climate Change (IPCC) defined vulnerability as the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. It is a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity" (McCarthy et al., 2001).

Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity. Vulnerability depends on the level of economic development of a country. Vulnerability to climate hazards is changing because of rapidly changing social, economic, institutional, technological, and

governance conditions. Hence, constant adaptation measures need to be considered for the changing situations.

Social Vulnerability

Vulnerability is the exposure of individuals or collective groups to livelihood stress as a result of the impacts of climate extremes and climate change. Social vulnerability to climate change is made up of individual and collective aspects which can be disaggregated, but are linked through the political economy of markets, institutions etc. The indicators of individual vulnerability are the incidence of poverty and the risk of income sources to extreme events. Changes in collective vulnerability are indicated through changes, in distribution of resources within a population, and by institutional changes, which can either enhance security or exacerbate vulnerability

The central insight brought by social scientists to the process of adaptation is that vulnerability is socially differentiated. Vulnerability is not the same for different populations living under different environmental conditions or faced with complex interactions of social norms, political institutions and resource endowments, technologies and inequalities. The causes of vulnerability are related to the environmental threat and fundamentally to the economic and institutional context. Indeed changes in the social causes of vulnerability often happen at much more rapid temporal scales than some of the environmental changes

The idea of social vulnerability to external change and stress is at the centre of much research into human adaptation and interaction with the physical environment. This is particularly the case where social and natural scientists have attempted to explain the role of hazards and of periodic and extreme events within the cycle of resource use. Human life and livelihood is at risk from natural phenomena such as earthquakes, volcanoes, floods, droughts, tsunamis and other hazards with human origins. In these cases vulnerability has been used to describe the state of risk, usually associated with a geographical location rather than with individuals or social groups.

There have been three major approaches to the study of natural hazards. Firstly there are engineering approaches to hazard management which stress objective risk. Secondly a related social science approach stresses the management of such risks by institutions such as governments and markets. A third approach is a critique of both of the previous technical natural and social science approaches, which stresses structural social causes of vulnerability to hazards. Hewitt (1983) and colleagues initiated this third approach in the 1980s, providing a challenge to what they regarded as a dominant view which described the causality of risk from hazards as 'running from the physical environment to its social impacts'. Thus even social science analysis of hazards, up to that point, were primarily 'technocratic' and prescriptive, by incorporating the human element in hazards as an input to designing planning, warning and coping systems. The radical reversal suggested by Hewitt (1983) and others, was to emphasize economic and social structure as a cause of vulnerability, rather than as a contribution to hazard mitigation. The causes of vulnerability to hazards under the Hewitt approach are therefore lack of access to resources: poverty and marginalization translate into vulnerability through the mechanisms of coping behaviour and stress.

Within the social sciences, at least within geographical approaches to hazards, this third conceptualization of hazards has gained greater credence. This credence is reflected in later work by Kaspersen et al. (1995), who review the concepts surrounding vulnerability in the context of an assessment of critical 'regions at risk' from environmental change. They conclude that vulnerability 'appears to be emerging as the most common term in ... discussions of the differential susceptibility of social groups and individuals to losses from environmental change'

The origins of the use of vulnerability to describe the state of society environment interactions under stress lead to a number of general observations on vulnerability which can be applied in the climate change context. Vulnerability has an historical and time dimension; is related to economic aspects of livelihood and land use; power and political dimensions

are important in contextualizing vulnerability; individuals and groups exhibit differential vulnerability; and extreme events are the key climate change context. Thus vulnerability for individuals or groups can change over time; is differentiated between and within groups through their institutional and economic position; and is affected by environmental change. Existing policies and practices in agriculture, forestry and coastal resource management, as well as the inequitable distribution of productive resources, in themselves can have perverse effects of increasing vulnerability, and hence can be 'maladaptive'. Stress, under this definition, is associated with unplanned disruption and can incorporate the coping and recovery aspects of vulnerability.

Definition by different authors and researchers

1. Social vulnerability is the exposure of groups or individuals to stress as a result of social and environmental change, where stress refers to unexpected changes and disruption to livelihoods. This definition emphasizes the social dimensions of vulnerability, in contrast to the predominant views on vulnerability to the impacts of climate change which concentrate on the physical dimensions of the issue. (W. Neil Adger 98-02)
2. Social vulnerability to climate change is defined as the exposure of groups or individuals to stress as a result of the impacts of climate change and related climate extremes. Change in social vulnerability from its baseline level incorporates notions of economic development, as well as adjustments to livelihoods based on adaptation to climatic conditions, and changes in institutional and political structures. If institutions fail to plan for changing climatic conditions and risks, social vulnerability increases. It is helpful to disaggregate social vulnerability into the two distinct aspects of individual and collective vulnerability in order to clarify the scale issue and the unit of analysis. (W. Neil Adger CSERGE Working Paper GEC 98-02)

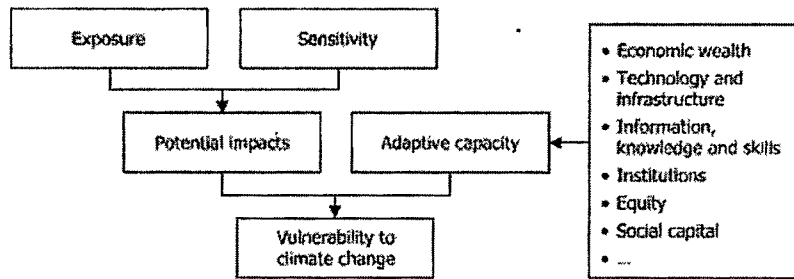


Figure 1 Graphical representation of the conceptualisation of vulnerability to climate change in the IPCC Third Assessment Report.

3. UNEP(1999)

Vulnerability is a function of sensitivity to present climatic variability, the risk of adverse future climate change and capacity to adapt...The extent to which climate change may damage or harm a system; vulnerability is a function of not only the systems' sensitivity, but also its ability to adapt to new climatic conditions.

Resilience

What is Resilience?

Nearly all of the literature refers in one manner or another to various works by C.S. Holling. His single most important work, as cited by the resilience literature, is his 1973 article "Resilience and Stability of Ecological Systems", where the author defines resilience as "a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables". In 1986, Holling refines this definition and defines resilience as "the ability of a system to maintain its structure and patterns of behavior in the face of disturbance". Holling offers up a third definition in *Barriers and Bridges to the Renewal of Ecosystems and Institutions*, which builds on the first two, stating that resilience is the buffer capacity or the ability of a system to absorb perturbations, or the magnitude of disturbance that can be absorbed before a system changes its structure by changing the variables and processes that control behavior. (Holling et al., 1995 cited in Adger, 2000).

Stuart Pimm's 1984 article on the stability of ecosystems offers the only other moderately cited definition without strong affiliation to the work of C.S. Holling. He defines resilience as the measure of the speed of a system's return to equilibrium following a perturbation.

Social Resilience

Social Resilience is measured by the time it takes for a community (or organization) to rebound from a natural (or man-made) hazard. The longer it takes a community or organization to "bounce forward" after a natural or man-made hazard, the greater the risk of damage to the social fabric that holds a community or organization together. Similar to the notion of "broken families", the effect of psychological or relationship dysfunction reaches beyond the economic impact of that lack of functioning.

With an increase in urbanization, and decrease in the ability of the nuclear family unit to be self sustaining and supporting, it is up to the private sector and faith based organizations to provide the redundancy that is needed to expedite recovery from hazards. The role of government would be to provide assistance to those not receiving it from other sources. This strategy is particularly important in the developing world.

Social Resilience includes:

1. **Redundancy** through overlapping social networks
2. Strengthening **response capacities**
3. Supporting **self-organization**
4. Fostering **learning and education**
5. Encouraging **adaptation**

Using a "Human Impact Preparedness" lens which focuses directly on people-needs (rather than on technology or infrastructure) organizations of all types can prepare and mitigate the effects of hazards on their various stakeholders and thus support and ensure increased Social Resilience. Enhancing Social

Resilience requires cooperation and collaboration of all stakeholders: private sector, government (public sector), Non-Governmental Organizations (NGO's) and other community organizations (such as faith based organizations).

Increasing the strength of a society is about increasing the strength and scope of the internal connections between the people, organizations and environment that form that society. Moving away from the doctrine of independence to embracing a culture of *interdependence* is the key to both harmony and development.

Social Resilience, is measured by time. Specifically – how long would it take for the community to respond to the event, self organize and incorporate the lessons learned before returning to a [new] normal way of functioning. The amount of time it takes to recover from an occurrence of a hazard affects not only the economic viability of a community, but also its social fabric or “glue” that keeps it together. The longer it takes to recover, the more likely it is that the community will break up – because of people leaving, economic stagnation, and rampant psychological and emotional distress.

It is also a reflection of the reality that the longer it takes to move from response to rebuilding and reconstruction, the more deleterious and long lasting the negative effects of the disaster will be. In the field of human trauma it is known that while people need some amount of time to recuperate from traumatic events, they should try to resume their regular or necessary activities as soon as possible.

Two definitions that are especially comprehensive are the following:

- ...“the ability to face internal or external crisis and not only effectively resolve it but also learn from it, be strengthened by it and emerge transformed by it, both individually and as a group.” (Brenson-Lazan, 2003).
- “The resilience of an eco-system is its capacity of absorb disturbances while maintaining its behavioral processes and structure. It can be defined as the

capacity to buffer perturbations, to self-organize, and to learn and adapt.” (ResAlliance.org).

These definitions include four main components: Response, Self-Organization, Learning, and Adaptation. These components apply equally to all social units – from individuals, through families to communities or organizations. Moreover, they necessitate voluntary participation by all involved: one cannot force or require an individual to be resilient. Rather, resilience is the outcome of developing those four components. While poverty reduction (the cornerstone of reducing social vulnerability) is a complex process involving factors beyond the individual or even a community, developing Social Resilience is a grassroots process that does not require an intervention on a macro level. Social Resilience can be achieved at the level of the individual family, isolated village or at the other end of the spectrum – a mega-city.

In the social sphere, Social Resilience assumes a certain amount of redundancy. Traditionally, the redundancy was created through family ties. People were cared for by their extended family when in need (e.g. Disaster, illness, old age). With the phenomenon of migration to more urban areas, that system of Social Resilience cannot always provide support. In these situations the creation of redundancy is expected of the central or local government which is supposed to take care of the citizens and residents when they cannot care for themselves. With globalization, population migration and other social phenomena of the late 20th century we need to rethink the way in which redundancy and Social Resilience are achieved. An increasing number of people are living in urban areas (at least 50% of the world population by some estimates), and thus are exposed to different types of social ties. Faith based communities, workplace communities, neighborhoods, dwellers of high-rise buildings all can provide the redundancy necessary for Social Resilience. Of this list, the first two have a particular vested interest in Social Resilience. Most (if not all) organized religions have as part of their tenets a moral code calling for social responsibility.

Similarly, most (if not all) companies and businesses depend on people for their functioning and revenue. It seems logical then that those organizations (faith based and businesses) should be involved in the process of enhancing Social Resilience. Not just out of a sense of social responsibility, but out of a realization that Social Resilience is critical and essential to their continued viability. A business will cease to function if it does not have employees, customers or suppliers. Even if it has all three, the longer the disruption to operations, the more money the business will lose. Similarly, a faith based community will fail its constituents if it does not offer social support. With many more alternatives in an urban setting, worshipers are more likely to choose a community offering them organized, practical and sustained support in times of crisis and disaster.

Introducing a greater degree of redundancy into prevention and mitigation of the impact of hazards reduces the pool of people who are dependent solely on governments , NGO's and other organizations for care, thereby facilitating a greater efficiency in response to hazards.

To effectively enhance *Social* Resilience one needs to focus on the *social* and psychological factors which are inextricably intertwined. An important aspect of this approach is the adoption of a decentralized component to enhancing Social Resilience – much of this process is a local, bottom-up approach, rather than the traditional top down approaches. In this respect it differs from many of the policies aimed at reducing social vulnerability. Many such programs are dependent on central governance to assist in attaining the goals. Social Resilience is developed community by community. Assistance from centralized or local government is of secondary importance. As long as there is buy-in from organizations in the community – employers, businesses, faith based organizations, community groups, etc. -- one can efficiently and cost-effectively enhance the ability of communities to “bounce forward” after a potentially devastating event.

Social dimensions of vulnerability to climate change are predominantly about the internal side—that is, what assets, institutions, and relationships do

people have to deal with these external threats, and how in turn will their social organization be affected? Social vulnerability is assessed at the level of individuals, households, or groups, but incorporates factors that exist at local, regional, national, and sometimes global scales. The concept therefore relates to the ability of individuals or groups to act within the social, political, and environmental contexts in which they live.

If vulnerability determines the extent to which individuals or a community will potentially suffer from climate-related events, then resilience is the ability to manage and adapt. It incorporates the notions of self-organization and the ability to learn, cope, and maintain future options. Rather than a concern about how to stop, change or minimize impacts, resilience is the ability to manage change. People's resilience or capacity to manage and adapt to change is determined by both their assets—including the amount and quality of knowledge and labour, physical and financial capital, and social relations and networks—and the services they can access—such as transport and communication, access to credit, markets, and emergency relief and recovery systems.

One important asset that can prevent households from becoming more vulnerable is the ability to act collectively through strong community networks, known as social capital. The strength or weakness of social networks affects how a community collectively manages natural resources and systems, resolves disputes, distributes benefits, and takes advantage of new opportunities.

Therefore, the presence or lack of social capital influences a community's ability to confront poverty and vulnerability. Strong social capital can potentially enhance the resilience of both social and natural systems.

Global Impact and Initiatives

Impact of Climate Change on the world:

Severe storms, floods and droughts since the eighties have served as reminders that climate change is a global problem. The most dramatic change has been in the temperature, with measurement records suggesting that warming by 0.3-0.6 °C has already taken place since the 1860s. The last two decades of the 20th century were the warmest in this period.

Over the next hundred years, the earth's surface temperature is projected to increase by 1.4 to 5.8 °C which will be greater than that experienced over the last 10 000 years.

Climate changes have occurred in the past, but always gradually, over thousands of years, giving ecosystems time to adapt. The rapid change that is currently taking place will leave ecosystems vulnerable. The large quantities of water locked in the polar ice caps and glaciers will be released as a consequence of warming. This, together with an increase in the thermal expansion of the oceans, will make the global mean sea level rise by 9 cm to 88 cm.

The effects of global warming are difficult to quantify because of the complicated relationships between air temperature, precipitation quantity and pattern, vegetative cover and soil moisture. However, it is likely that the frequency, intensity and duration of storms and other extreme weather events could increase.

Climate change is likely to have an impact in the following ways (IPCC)

- By the 2080's, substantial dieback of tropical forests and grasslands is predicted to occur, particularly in parts of South America and Africa.
- The availability of water in the rivers of Australia, India, southern Africa, South America, Europe and the Middle East is expected to decrease.
- Cereal yields in Africa, the Middle East and India are likely to decline.

- A rise in sea level could inundate and erode coastal areas, increase flooding and salt-water intrusion; this will affect coastal agriculture, fisheries and aquaculture, freshwater resources, human settlements and tourism.
- The incidence of water-borne diseases, heat stress and vector-borne diseases such as malaria is expected to increase.

Impact of Climate Change on Asia

All developing countries facing the problems of population and economic growth will be put under even greater stress as a result of these impacts. Asia's sustainable development will be challenged as climate change compounds the pressures that rapid urbanization, industrialization, and economic development have placed on natural resources. One of the main issues will be the availability of adequate fresh water, which by the 2050s will be a concern for possibly more than one billion people. The continued melting of glaciers in the Himalayan region is projected to increase flooding and rock avalanches and to adversely affect water resources in the next two to three decades. Asia's coastal areas, and especially its heavily populated delta regions, will become even more prone to increased flooding because of both rising sea levels and river flooding. More heat waves will increase the number of deaths, particularly among the elderly, the very young, or among people who are chronically ill, socially isolated or otherwise especially vulnerable.

- Increased drought in some regions will likely lead to land degradation, damage to crops or reduced yields, more livestock deaths, and an increased risk of wildfire.
- Such conditions will increase the risks for populations dependent on subsistence agriculture, through food and water shortage and higher incidence of malnutrition, water-borne and food-borne diseases, and may lead to displacements of populations.
- Increased frequency of high precipitation in some regions will trigger floods and landslides, with potentially large losses of life and assets. These events will disrupt agriculture, settlements,

commerce and transport and may further increase pressures on urban and rural infrastructure.

- Increases in the number and intensity of very strong cyclones (typhoons and hurricanes) will affect coastal regions, with potentially large additional losses of lives and assets.
- Sea-level rise, coupled with coastal storms, will increase the impacts of storm surge and river flooding and damage livelihood systems and protective ecosystems. Low-lying settlements may become unviable, which may result in increased potential for movement of population and loss of infrastructure.
- Higher temperatures and melting glaciers may cause glacial lake outbursts that could flood downstream settlements.

The Third Assessment Report (2001) identifies various key adaptive capacity and vulnerability constraints of various regions. The developing countries of the Asian region have been identified as most vulnerable to climate change related impacts due to their poor adaptive human systems. The following major vulnerability factors are mentioned for Asia:

- Extreme events have increased in temperate and tropical Asia, including floods, droughts, forest fires, and tropical cyclones.
- Decreases in agricultural productivity and aquaculture due to thermal and water stress, sea-level rise, floods and droughts, and tropical cyclones would diminish food security in many countries of arid, tropical, and temperate Asia; agriculture would expand and increase in productivity in northern areas.
- Runoff and water availability may decrease in arid and semi-arid Asia but increase in northern Asia.
- Human health would be threatened by possible increased exposure to vector-borne infectious diseases and heat stress in parts of Asia.

- Sea-level rise and an increase in the intensity of tropical cyclones would displace tens of millions of people in low-lying coastal areas of temperate and tropical Asia; increased intensity of rainfall would increase flood risks in temperate and tropical Asia.
- Climate change would increase energy demand, decrease tourism attraction, and influence transportation in some regions of Asia.
- Climate change would exacerbate threats to biodiversity due to land-use and land-cover change and population pressure in Asia. Sea-level rise would put ecological security at risk, including mangroves and coral reefs.
- Poleward movement of the southern boundary of the permafrost zones of Asia would result in a change of thermokarst and thermal erosion with negative impacts on social infrastructure and industries.

Indian Impact and Initiatives

Generic Impact

In India, climate change could represent additional pressure on ecological and socio-economic systems that are already under stress due to rapid urbanization, industrialization, and economic development. With its huge and growing population, a 7500-km long densely-populated and low-lying coastline, and an economy that is closely tied to its natural resource base, India is considerably vulnerable to the impacts of climate change.

Most countries in temperate and tropical Asia, with India being no exception, have already felt the impact of extreme climate events such as droughts and floods. The intensity of extreme rainfall events is projected to be higher in a warmer atmosphere, suggesting a decrease in return period for extreme precipitation events and the possibility of more frequent flash floods in parts of India, Nepal, and Bangladesh (Lal M, Meehl G A, and Arblaster J M. 2000).

- Increases in temperature and seasonal variability in precipitation are expected to result in more rapid recession of Himalayan glaciers. In fact, the Gangotri glacier is already retreating at a rate of 30 meters a year.
- An increase in rainfall is simulated over the eastern region of India but the northwestern deserts may see a small decrease in the absolute amount of rainfall.
- Warmer and wetter conditions would increase the potential for a higher incidence of heat-related and infectious diseases. The incidence and extent of vector-borne diseases, which are significant causes of mortality and morbidity in tropical Asia, are likely to spread into new regions on the margins of present endemic areas as a result of climate change.

(Source IPCC Third Assessment Report: Climate Change 2001 -Impacts, Adaptation & Vulnerability, Chapter 9, Human Health; Chapter11, Asia; Chapter 4, Hydrology and Water Resources)

Sector-wise impacts in different regions of India

Water resources

Study of one large catchments in the western Himalayas (the Chenab, a tributary of the Indus) show that the average snowmelt and glacier-melt contribution to the annual flow is 49.1%; a significant proportion of runoff is derived from snow in the dry season, when water demand is highest. Climate change-related increases in temperature also could increase the rate of snowmelt and reduce the amount of snowfall, if the winter is shortened. If climate change does alter the rainfall pattern in the Himalayas, the impacts could be felt in the downstream countries-that is, India and Bangladesh. Catchments in Nepal supply about 70% of the dry-season flow of the Ganges River, and tributaries of the Brahmaputra River originating in Bhutan supply about 15% of the total annual flow of that river. If climate change disrupts these resources and alters mountain hydrological regimes, the effects will be felt not only in the montane core of Tropical Asia but also downstream, in countries that depend on this water resource.

Forests and biodiversity

Mangroves may be affected by climate change-related increases in temperature and sea-level rise. Although the temperature effect on growth and species diversity is not known, sea-level rise may pose a serious threat to these ecosystems. In Bangladesh, for instance, there is a threat to species in the three distinct ecological zones that make up the Sunderbans-the largest continuous mangrove area in the world. If the saline water front moves further inland, *Heritiera fomes* (the dominant species in the landward freshwater zone) could be threatened. Species in the other two ecological zones (*Excoecaria agallocha* in the moderately saltwater zone and *Ceriops decandra* in the saltwater zone) also could suffer. These changes could result in economic impacts: Direct employment supported by the Sunderbans is estimated to be in the range of 500,000-600,000 people for at least half of the year (ESCAP, 1987), and a large number of these people - who are directly employed in the industries that use raw materials from the Sunderbans (e.g., woodcutting; collection of thatching materials, honey, beeswax, and shells; fishing) - may lose their sources of income.

Using climate scenarios generated by ECHAM3, Achanta and Kanetkar (1996) have linked the precipitation effectiveness index (PEI) to net primary productivity of teak plantations in Kerala State, India. They estimate that a projected depletion of soil moisture would likely cause teak productivity to decline from 5.40 m³/ha to 5.07 m³/ha. The productivity of moist deciduous forests also could decline, from 1.8 m³/ha to 1.5 m³/ha.

The Ganges-Brahmaputra delta is one of the world's most densely populated areas, and the combined effects of subsidence and sea-level rise could cause serious drainage and sedimentation problems, in addition to coastal erosion and land loss.

Wildlife

The Rann of Kutch in India supports one of the largest Greater Flamingo colonies in Asia (Ali, 1985; Bapat, 1992). With sea-level rise, these salt

marshes and mudflats are likely to be submerged (Bandyopadhyay, 1993), which would result in decreased habitat for breeding flamingoes and lesser floricans (Sankaran et al., 1992). In addition, about 2,000 Indian wild asses in the Rann of Kutch could lose their only habitat in India to rising sea level (Clark and Duncan, 1992).

Agriculture

In a study done in Madhya Pradesh by Lal et al., (1999) it was found that the yield of soyabean would vary from -22 % to + 18 %. This was done by assuming a scenario with no adaptation with +2,+4°C rise; ± 20 , $\pm 40\%$ precipitation and included the direct effect of CO₂.

In a study in northwest India, Lal et al. (1996) also found that reductions in yield resulting from a rise in surface air temperature offset the effects of elevated CO₂ levels; the projected net effect is a considerable reduction in rice yield.

Coastal areas

Major delta areas of Asia are likely to be subjected to stresses associated with sea-level rise, changes in water regimes, saltwater intrusion, siltation, and land loss. Low-lying coastal cities will be at the forefront of impacts; these cities include Shanghai, Tianjin, Guangzhou, Jakarta, Tokyo, Manila, Bangkok, Karachi, Mumbai, and Dhaka, all of which have witnessed significant environmental stresses in recent years.

Health

During 1987-1990, kala azar (black fever or visceral leishmaniasis) reached epidemic form in the Indian state of Bihar and spread rapidly to surrounding areas. WHO (1996a) estimated that about 110 million people were at risk from kala azar. Major endemic foci are reported in border areas between India (states of Bihar and West Bengal), Bangladesh, and Nepal. In Bangladesh, kala azar already has reached epidemic form; the most vulnerable populations are poor and rural cattlekeepers. In a warmer climate, the

incidence of kala azar also may increase (IPCC 1996, WG II, Section 18.3; WHO, 1996b).

Drought-affected areas

In India, chronically drought-affected areas cover the western parts of Rajasthan and the Kutch region of Gujarat. However, drought conditions also have been reported in Bihar and Orissa. These drought disasters are more frequent during years following ENSO events. At least half of the severe failures of the Indian summer monsoon since 1871 have occurred during El Niño years. In the event of enhanced anomalous warming of the eastern equatorial Pacific Ocean, a higher frequency of intense extreme events across Asia is possible.

Other Incidences

India being a young developing country is facing the challenge of maintaining the pace of development and saving its environment /natural resources so as not to be one of the eminent polluters contributing to climate change. The Indian philosophy talks about need based use of resources so that a green earth can be passed on to its generations. But with the increasing population, there is a dearth of resources both material and non material. In India, there are pockets like the sunder bans, the Himalayas, the costal regions, the desert cities like Badmer, etc which have started witnessing the ill effects of climate change. The communities residing in these areas have been adapting to the situation over centuries but now the rate of change calls for a system to deal for the drastic effect on the communities residing in these areas. Examples are the displaced communities from the Sunderband islands which are witnessing submergence of island habitat due to Sea Level Rise. Similarly apple orchards owners in Himachal Pradesh are facing livelihood problems due to change in the climatic conditions and are citing examples of vanishing apple trees. There are more communities at risk due to the increased incidence of extreme weather events in terms of increased cyclonic frequency in coastal regions, heat waves in Andhra Pradesh, Chattishgarh and Orissa, flooding especially in the eastern region, drought situations in the

entire country and similar increased incidence in the weather related disasters.

Social Dimensions of Climate Change

The Social Dimensions of Climate Change – Differentiated Impacts:

The impacts of climate change will be overlaid onto existing vulnerabilities of both the rural and urban poor and excluded, such as vulnerability to seasonality, to poor health and to market fluctuations (e.g. food and fuel price volatility). Poor communities are not homogenous however, and it is important to understand the differentiated social impacts of climate change based on gender, age, disability, ethnicity, geographical location, livelihood, and migrant status. Some specific examples include:

Gender and climate change

Men and women have distinct roles in water use and management, leading to different needs and priorities. Climate change will increase the time taken to collect water in rural areas, a task mainly done by women and girls, due to traveling greater distances to find water. In urban areas, water collection is also an issue as women and girls may spend hours queuing for intermittent water supplies

The Elderly and climate change

The elderly are likely to be particularly vulnerable especially where social protection is limited or non-existent. They are at high risk from climate change related impacts like heat stress and malnutrition and in rural areas can face restricted access to healthcare, as they are often unable to travel long distances to the nearest health facility

Children and climate change

Children are at highest health risk from inadequate water supplies during drought, and also predicted changes in vector-borne diseases. They are also at highest risk of malnutrition, with long-term implications for overall development. Children may also be at risk of early entry into work and

exploitation in order to cover lost income from agriculture. Understanding the intra-household dynamics around how age and gender influence resource access and time expenditure, and anticipated impacts of shocks, is critical for addressing future adaptation needs.

Initiatives by India for climate impact

India, as a Party to the United Nations Framework Convention on Climate Change (UNFCCC) that is a Global Treaty to consider what to be done to reduce global warming and cope with the inevitable temperature increases, accords great importance to sustainable development and climate change. India accords high importance since large populations in India are directly dependent on the climate sensitive sectors. In its recent Initial National Communication to the UNFCCC, India identified the following climate change related impacts as important for the country:

- Water stress and reduction in the availability of fresh water due to potential decline in rainfall.
- Threats to agriculture and food security, since agriculture is monsoon dependent and rain-fed agriculture dominate in many states.
- Shifts in area and boundary of different forest types and threats to biodiversity with adverse implications for forest-dependent communities.
- Adverse impact on natural ecosystems, such as wetlands, mangroves and coral reefs, grasslands and mountain ecosystems.
- Adverse impact of sea-level rise on coastal agriculture and settlements.
- Impact on human health due to the increase in vector and water-borne diseases, such as malaria.
- Increased energy requirements and impact on climate-sensitive industry and infrastructure.

Research Carried Out in India

A. Vulnerability of Indian Agriculture to Climate Change

Pooling the expertise of TERI (The Energy and Resources Institute), India; CICERO (Centre for International Climate and Environmental Research, Oslo), Norway; and IISD (International Institute for Sustainable Development), Canada, this collaborative research project is funded by the Government of Canada through the Canadian International Development Agency and by the Government of Norway through the Ministry of Foreign Affairs. The project commenced in April 2001, and concluded in March 2004.

B. Vulnerability and Climate Change: An analysis of the Eastern coastal districts of India

Unmesh Patnaik and K. Narayanan, Department of Humanities and Social Sciences, Indian Institute of Technology Bombay, India. The study aims to build a vulnerability index and rank the various coastal districts of these highly vulnerable states in terms of their performance on the index.

C. Community-level Climate Change Adaptation Case Study from Gujarat:

The Graduate School of Global Environmental Studies, KYOTO UNIVERSITY, Japan. The goal of this study was to study the interrelationship of environmental impacts, and suggests possible mitigation measures as policy options, and prepare a community adaptation model. The study was conducted in close cooperation with a wide range of stakeholders, which included: national government (National Institute of Disaster Management), state government (Gujarat State Disaster Management Authority) and district governments (Porbandar and Kutch district offices), and non-government organizations (SEEDS and KMVS).

Social Work Response

Scope for social work response in India

India has strong reason to be concerned. Climate change is projected to impact tropical countries more negatively than temperate ones. As a tropical country, our geography is our destiny. India's 7500 km coastline will be particularly hard-hit by storm surges and sea-level rise displacing millions, flooding low-lying areas, and damaging economic assets and infrastructure. The encroaching salt water will poison fields and make coastal agriculture unviable, deepening the crisis that is already full blown in India's farm sector. These impacts alone could severely test India's governance systems and its institutional and social resilience. Unless dealt with effectively they could also quickly turn into political challenges.

For the 700 million people in rural India who are dependent on the most climate-sensitive sectors for their livelihoods - agriculture, forests and fisheries - the future brings declining crop yields, degraded lands, water shortages and ill health. It also brings confusion and helplessness as people lose their traditional capacity to 'read' the weather and adjust accordingly.

When the rains do not come and when the natural world does not behave as it should, societies which have survived by observing the world and adapting to it lose essential coping skills.

Climate change, at a most profound level, disempowers by rendering traditional knowledge useless. How this will affect identity and culture amongst India's tribal and indigenous communities is something we are yet to properly understand. As for the more tangible impacts of climate change: floods, droughts, heat waves, cyclones, storm surges, displacement, disease and pestilence... these are not just projections for a distant future. The future is now. Phenomena consistent with climate change projections for India can already be seen across the country. 2007 has brought 'wild weather' to South Asia with the worst floods in living memory and 20 million people displaced.

Islands and villages in the Bay of Bengal have been lost to sea-level rise causing a drift of ecological refugees to cities such as Kolkata. The Super Cyclone of 1999 – our equivalent of Central America's Hurricane Mitch – wreaked havoc on Orissa, knocking decades off its development and killing more than 30,000. Heat waves across the country have caused untold deaths and human distress. Diseases such as malaria and dengue have increased their geographical range to metropolises such as Mumbai. Rising temperatures and a retreating snow-line in Himachal have fatally affected its once-legendary apple industry and crippled local economies.

The rapid melting of the Himalayan glaciers - the source of our major river systems - is a cause for particular alarm. Latest IPCC estimates suggest that they may shrink to one-fifth of their volume within a few decades. Initially this may cause floods as the waters melt - and then a water crisis of unprecedented proportions as the rivers dry. Seven of the world's major river basins originate in the Himalayan and Tibetan plateaus. They are the source of water for 40% of humanity. China, India, Nepal, Bhutan and Burma all share these borders. If the rivers do run dry, a more serious cause of regional destabilization can scarcely be imagined. When it happens, it will make India's current water conflicts such as between Karnataka and Tamil Nadu over the Cauvery look like a walk in the park in comparison.

But this is not only a story of human impact. It is estimated that up to 50% of the country's flora and fauna could be threatened, with at least a quarter of our biodiversity lost.

For a country with such a long and mythic self-identification with our plant and wildlife, the loss of our natural heritage will carry both socio-cultural as well as significant livelihood implications on the various communities residing in the region.

What should be the Social Work Response?

Thus the issue of social vulnerability of these communities at risk is of utmost concern. There are issues of livelihood, health, education, social problems and so encompassing most of the communities, households and individuals. Thus the already vulnerable communities are about to become more vulnerable as drawn out by research studies done on the eastern coastal region of India. Since India is a vast country with cultural and social diversities, social vulnerability needs to have local solutions since adaptation will have to be in terms of prevailing community in these diversified regions. Apart from the geographical locations and demography, there are other aspects which make social vulnerability more complex.

Thus as a social work professionals, there is a need to develop a social vulnerability and resilience index or indicators for the various communities at risk which would be a tool for the policy makers, development practitioners and community workers to refer to when intervening on issues of climate change. The researcher firmly believes that the social work profession can really enable communities to act as guides from their vast experience of adaptation and contribute in generating social vulnerability and resilience indices or indicators for the communities residing in our country. The adaptation practices of the vulnerability can act as guidance for the larger community for them to become more resilient.

Social Work Concerns:

Research across the globe has increasing awareness about the contribution of social aspects in vulnerability analysis and resilience as a tool of adaptation and mitigation for Disaster Risk Reduction.

Due to the climate change faced by the entire world today, countries like India where there are evidential facts of increase in extreme events, drought spells, increase in sea level rise, heat waves etc as an impact of global warming is an issue of great concern. Researchers across the globe are more in

agreement that social dimensions of vulnerability analysis and resilience have long been neglected. So far, more importance has been provided to physical and economic dimensions of vulnerability which has failed to adapt or mitigate different the effects in the communities. There is an increasing felt need for covering the societal or social aspects without which the research of vulnerability and resilience as tool for adaptation and mitigation is unable to produce the desired results.

India has a very complex nature of social fabric with people coming from different diversified backgrounds in terms of religion, caste, culture, class, beliefs etc. All this has resulted in a complex web of inter and intra social relationships, social institutional arrangements, formal and informal networks of relationships etc. There is already registered vulnerability in terms of resources due to conflict of resources resulting from excess stress and large pool of utilizes. More over, unlike developed countries where there are more resources then utilizes, it is not possible to have additional forces to meet the demands of crores of people. But it is marked that due to existing vulnerabilities due to lack of resources both material and non material, impact of climate change would render many communities more vulnerable. There is conflict not only at International, Regional or state level, but it will finally penetrate more into the social fabric at community, household and individual levels. The poor are expected to be worst sufferers. Also the vulnerable are likely to be more vulnerable and hence the adverse impact of climate change is likely to beget the achievement or fulfillment of the Millennium Development Goals aiming at social and sustainable development.

The top down approach has not worked well in reducing the risk of disasters because it fails to take into account the social vulnerability and resilience. There is a clear cut differentiation and integration of disaster risk reduction and climate change research which is an integral part of sustainable development. It can be short term or long term. One of the ways to adapt and mitigate is to take into consideration the social resilience at community, household and individual levels.

The Conceptual Framework:

Disaster Risk Reduction and Climate Change Adaptation:

Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) are interconnected thematic areas which both deal with common themes and address similar issues such as the impact of extreme weather events on vulnerable people as well as aim to reduce this vulnerability. Adaptation to recent and expected Climate Changes implies three tasks in particular: first adaptation to gradual changes, such as changes in average temperature and sea level rise, secondly reducing and managing the risk linked to extremes weather related events, such as cyclones, floods etc. Thirdly, address the shifts of climate zones which might subject some regions to risks which previously had not been experienced. Climate Change and Climate Change Adaptation (CCA) became the subject of particular attention in the wake of the IPCC Fourth Assessment Report (AR4) in 2007, which confirmed that the geographic distribution, frequency and intensity of natural hazards will be significantly altered by Climate Change. The AR4 report called for strategies for adaptation to Climate Change, and made reference to the increase in disasters and the relevance of disaster risk management. On the other hand, in the last few years, the UN International Strategy for Disaster Reduction (UNISDR) and the UN Framework Convention for Climate Change (UNFCCC) have stressed the need to link goals, strategies, frameworks, measures, tools and funding at the institutional and political levels. Under the Hyogo Framework for Action (HFA) endorsed by the United Nations General Assembly, member states are expected to promote the integration of risk reduction and adaptation to climate change strategies. The 2007 Bali Action Plan acknowledged the linkages between DRR and CCA through its calls for enhanced actions on adaptation, including disaster reduction strategy consideration and means to address loss and damage associated with climate change impacts in developing countries. It is an acceptable fact that to mainstream disaster reduction and climate change adaptation in country development strategies in order to minimize vulnerabilities to natural hazards.

Role of Community Based Disaster Preparedness in Disaster Risk Reduction:

Disaster management meant different for different players. For many decades prior to Major catastrophes like Orissa Super Cyclone (1999), Gujarat Earth quake & West Bengal Floods (2000) disaster management for respective state governments was to emphasis on early warning, evacuation, post disaster compensation, rehabilitation, shelter construction, i.e., basically reactive.

There are many models of disaster risk reduction and disaster management. While the traditional ones focused on the relief and recovery, the much more modern ones focused on the rehabilitation and preparedness ones. One such model was CBDP (Community Based Disaster Preparedness). While preparedness is vital in reducing the loss of lives, more important is changing the context of communities that make them vulnerable. The context in this case is their risky habitations, poor housing and sanitation conditions. They are in this context due to abject poverty, lack of health awareness and education. Sustainability of disaster preparedness lies in addressing these vulnerability conditions and changing their context, while organizing them to deal with disasters.

Initiator	Focus	Strategies	Activities	Scope and work area
Oxfam Since 1998	Address Factors of Cyclone & Flood Disaster Vulnerability	Community Empowerment, Multi stakeholder Involvement, Vertical & Horizontal expansion of disaster preparedness	Contingency planning Task force groups Formation, Livelihood promotion Disaster risk sharing Health, hygiene promotion, housing and drinking water.	Disaster (1996) affected communities in Communities in Coastal Andhra Pradesh, Orissa & Gujarat with a special focus on most marginalized communities.
UNICEF Since 2000	Address survival needs of communities in the first few weeks after massive flooding. Sustaining these initiatives with or without NGO intervention	Create equal ownership of Government & Communities. Use SHGs as entry point. Integrate with polio eradication programs, NGOs provide facilitation support and training.	Contingency Planning. Task force groups Formation, Family survival, child survival and pregnant woman survival kits. Promotion of low cost life saving kits, <i>Machans</i> , <i>elevated tube wells</i>	Communities affected by floods in the year 2000 in West Bengal
UNDP Since 2002	Local Level Risk Management	Capacity building to Institutionalize DRM systems in government	Multi-hazard preparedness and mitigation plans for DRM at State, district, block, village and ward levels	169 districts of 17 selected most multihazard prone States of India
CUBA Since 50 Years	Culture of Preparedness	Development model that reduces disaster risk	Appropriate legal Framework, National and local level contingency plans. Creation of social and human capital Disaster preparedness in schools & colleges	Entire country which faces hurricanes every year

The process of CBDP involves undertaking a needs survey of the villages as the initial step. This needs survey is based on the past experiences of the village when it faced a cyclone or when it had floods. This is ascertained with village meetings and discussion with different sections of the community including women. It is followed by community coming together to articulate its own strengths and weaknesses with respect to a disaster situation. Within this process, the community identifies threats and needs during a disaster e.g. cyclone, and plans a disaster management plan in response to these. The plan includes:

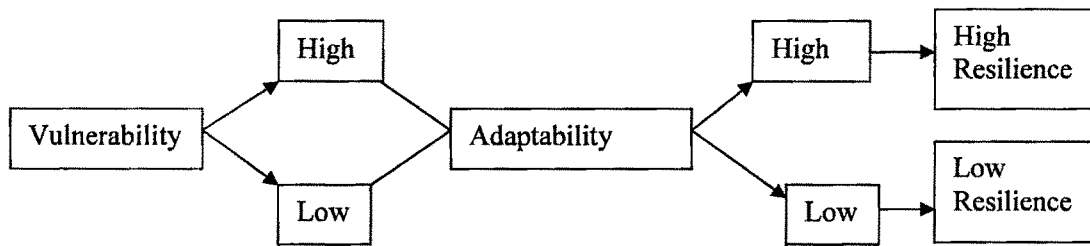
- Developing an area map,
- Identifying vulnerable areas and families,
- Discussing the past history of disasters,
- Developing contingency actions, and
- Forming key action groups.

This leads to preparation of community contingency plan and the task force. To develop the village contingency plan, the villagers come together and make a map of the village. On this village map, they then list the vulnerable population e.g. population with disability. They mark village assets such as boats, fishing crafts, etc. Community infrastructure, including shelters to be used in times of emergency, drinking water facilities, etc. also finds their way into this contingency map. The community then identifies the specific weather hazards it faces during a cyclone, such as winds, heavy rains, floods, mudslides and so on. This helps it determine what is at risk during these weather patterns – cattle and livestock, valuable family documents, houses and weak structures, livelihood assets such as boats, nets, stores of dry fish, pump sets, looms, standing crops, water bodies and so on. They also mark evacuation routes. These are useful for marking safe evacuation routes that will not be disrupted in the case of a cyclone. The community decides which family goes where and by which route to avoid crowding and panic. The community also identifies the existing health and sanitation facilities that can be used in the event of a cyclone. A very important aspect is the mobilization of village level contingency funds to be used in the case of a cyclone. The

village task force generally consists of Cyclone warning group, Shelter management group, Evacuation and rescue group, First aid and medical group, Sanitation group, Relief group and Patrolling group. It also calls for multi stakeholder participation, awareness and training in the entire process right from the community level to the block/taluka/tehsil to the state level encompassing community representatives in form of people, NGO, CBOs, VO, government officials, corporate, educational institutions, health personnel etc. The main Herculean task however is integrating disaster preparedness into developmental planning. CBDP or CBDM provides a wide scope for such integration since it's a down up approach. Disaster risk reduction calls for collaborative action and commitment by all important stakeholders—the government, NGOs, communities, media and the academic community. Disaster preparedness helps reduce risk only when it is adapted in to daily lives consciously and consistently. CBDP is an effective tool for ensuring this kind of integration at the community level

Vulnerability and Climate Change Adaptation

Picking up this thread, looking at the field of Climate Change impacts and initiatives, apart from the initiatives being taken at the global platform mainly in terms of carbon rate emissions and a boost to green technology and renewable energy, it is at the community level, at the grass root that not only the coping capacity in terms of disaster risk reduction that is the key, it's the adaptability that makes the main difference. Adaptability helps build the resilience of a community, a household or an individual. The need however is establishing multi stakeholder platforms for adaptation that should be linked to national platforms for disaster risk reduction which have, in many cases, been shown to form an important mechanism to ensure a multi-stakeholder dialogue and a multidisciplinary approach. A key factor is the concept of **Vulnerability or Exposure**. Vulnerability assessment is seen as an essential element in risk assessment. Second is the **Sensitivity**, third is **Adaptive Capacity**. The combination of the three would say whether a particular community is vulnerable or resilient.



As shown in the figure, whether the vulnerability is high or low, if adaptability is low, it will result in low resilience but if the adaptability is high, it will result in higher resilience in the long run. This is because adaptability brings about a change in attitude based on transformational learning.

Based on the discussion so far, the present study takes into consider the following factors also:

Exposure in term of in terms of identified hazards, history of disasters, damage, loss of lives, damage/loss of personal property, damage /loss of livelihood tools and short term and long term impact.

Community vulnerabilities, vulnerable groups or population, warning and forecasting systems, traditional knowledge, depletion of resources, changes in coastal area, major changes in living after change and disaster preparedness.

Community resources in term of infrastructure and services related to housing, water, sanitation, health, basic infrastructure, education and skills, amenities, occupations, income groups and legal services.

Community resilience in terms of, risk knowledge, disaster recovery, diversity: in terms of livelihood and resource dependency (coastal and marine), supplementary and alternative livelihoods; knowledge and learning from changes, adaptability: in terms of vision and leadership, demographic changes (migration); and Self Organization: in term of linkages and networks.

This framework is an effective way of understanding the vulnerability or resilience enhancing factors. When two communities are compared, it provides which community is more resilient.

