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ADAPTATION OPTIONS STRATEGIES FOR HAZARDS AND VULNERABILITY MITIGATION: AN INTERNATIONAL PERSPECTIVE

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Abstract. The broad objective of this special issue of *Mitigation and Adaptation Strategies for Global Change* is to address some of the gaps in our knowledge and understanding of the policies, programs, and measures that might be applied to natural hazards and their impacts in an era of climate change. Given the global impacts of climate change and world-wide pattern of increasing losses from natural hazards we necessarily adopt an international perspective. The specific goals of the special issue are to: (a) encompass experiential aspects, emphasizing current practice of mitigation and its associated measures, and their results; and (b) explore primary or root causes of alarming shifts in human and economic costs of environmental extremes. Special emphasis is placed on how human activities are playing a key role in enhancing vulnerability to NTEE (nature-triggered environmental extremes), quite independently from the anthropogenic causes of climate change. The goals are also (c) to examine costs, risks, and benefits (of all kinds including social, political, ecological) of mitigation, and adjustment and adaptation measures; and (d) analyze policy implications of alternative measures. These components are expected to make significant contributions to policy considerations – formulation, implementation and evaluation. There is much uncertainty about the rate of climate change; however, the fact of increase of the atmospheric temperature in the last century is no longer a subject of scientific or policy debate. Due to such changes in the geophysical parameters, certain types of nature-triggered environmental extreme events are likely to continue to increase. How global warming will affect regional climates and pertinent variables is not well known, limiting our ability to predict consequential effects. This factor poses serious constraints against any straightforward policy decisions. Research findings of the work of this volume reaffirm that human dimensions, specifically our awareness and decision-making behavior, are powerful explanatory factors of increasing disaster losses. Disaster mitigation through addressing human, social, and physical vulnerability is one of the best means for contributing to 'climate change adaptation plans', and sustainable development goals. Recent lessons from various countries have depicted that the formulation of mitigation strategies cannot be exclusively top-down as it requires social, political, and cultural acceptance and sense of ownership. An interactive, participatory process, involving local communities, produces best expected outcomes concerning mitigation, preparedness, and recovery. An emerging consensus is that there is a need to move towards the 'mission' of the International Strategy for Disaster Reduction which aims at building disaster resilient communities by promoting increased awareness of the importance of disaster reduction as an integral component of sustainable development, with the goal of reducing human, social, economic and environmental losses due to natural hazards and related technological and environmental disasters. Sharing of best practices and lessons globally is certain to produce more efficiency and understanding in policy and decision making.

Keywords: adaptation, climate change, environmental extremes, loss, mitigation, policy, resilience, vulnerability

1. Introduction

The focus of this volume is on environmental hazards. Conventionally, environmental hazards have been analyzed in relation to their potential for damage; but actual usage almost invariably is made in terms of an objective geophysical process, such as a flood or hurricane, as 'the hazard'. A pioneering study by Hewitt and Burton (1971) exhibited methods of how such 'damage potentials' can be measured in terms of inherent energy embodied in various types of natural phenomenon, such as a storm or a flood. A deviation of an environmental event, in terms of its energy parameters, from the 'average' or 'normal' trend thus can help to define 'extremity' of a 'natural' process and associated events. In recent years, such a concept has been challenged as it neglects the aspects of human risk and vulnerability (Hewitt 1983; Smith 1999; Blaikie et al. 1994), and human coping capacity (Haque 1997). In the latter terms, an environmental or 'natural' extreme event is one that surpasses the human coping threshold, and the geophysical processes would have unusual characteristics (Hewitt and Burton 1971).

The frequently used distinction between natural and anthropogenic or non-natural extremes events presents some difficulties, and has often been questioned (Cannon 1994). The International Federation of Red Cross and Red Crescent societies have offered a classification of disasters according to the initiating event specified as a 'natural' or 'non-natural trigger' (IFRCRC 1997, 1998). This is useful in making a distinction between the two generic sources of extreme environmental events. In this paper, we are employing this notion in the term *Nature-Triggered Environmental Extremes (NTEE)*, which refers to a relative perspective of geophysical processes and events, in reference to remarkable deviation from the norm, and potential adverse impact on human and other lives, property, assets, and other resources.

As stated above, in both the natural hazards school of research and the climate change school of research, the importance of societal dimensions of hazards, disasters, and vulnerability reduction was recognized only in recent years. Environmental hazards and disasters policies and responses were long dominated by the urgent requirements of disaster relief and humanitarian assistance. Most resources were allocated to responses whereas, for most people in the world, specifically in the developing world, the avoidance of hazards and disasters was closely correlated with minimizing vulnerabilities. In the rush to provide assistance in disaster and emergency situations, the long-term processes of reducing vulnerability were commonly neglected, and the further expansion of human activities in high hazard zones or the lack of adequate building codes and design standards, or the lack of their enforcement could sometimes increase vulnerability. While these problems have by no means been adequately overcome, the work of the International Decade for Natural Disaster Reduction (IDNDR), 1990–1999, has done much to refocus the emphasis on the need for mitigation. Recent efforts by the International Strategy for Disaster Reduction, the activity that evolved from IDNDR, continue this focus for example in its publication *Living with Risk*, which seeks to enhance

understanding of policy and process through a global review of disaster reduction initiatives.

Global warming and other associated environmental changes are serious concerns for all stakeholders that remain highly relevant to disasters and their reduction (Briceno 2004). Measures are needed to enhance our ability to adapt to the existing climate, by determining and reducing current and future environmental change risk and by promoting disaster mitigation as a climate change adaptation strategy.

Against this background the objective of this special issue of the *Mitigation and Adaptation Strategies for Global Change* is to address some of the gaps in our knowledge and understanding of the policies, programs, and measures that might be applied in dealing with natural hazards (NTEE) and their impacts at a time of rapid climate change. The specific goals of the special issue are as follows: (a) the volume is intended to encompass experiential aspects, i.e., to report and analyze how government and concerned agencies, in policy and strategic terms, have recently addressed various types of risks, hazards and disasters; what has been the nature of policy debate discourse in a specific country or region; and what has been the result of various types of efforts; (b) this special issue also aims at exploring primary or root causes of alarming shifts in human and economic costs of environmental extremes. Special emphasis will be placed on how human activities are playing a key role in enhancing vulnerability to NTEE, outside the anthropogenic interference into greenhouse gases. Exploring the mitigation and adaptation potential in dealing with particular types of NTEE or cumulative hazards, and examining their associated options are the best possible ways to address the emerging problem of alarming loss due to the NTEE. It is believed that critical examination of various alternatives, their feasibility and effectiveness, would help develop effective policies. In addition, identifying the areas of intervention for eliminating and reducing vulnerability and risk is of greater interest among policy and decision-makers; (c) examination of cost, risk, and benefits (of all kind including social, political, ecological) of mitigation, and adjustment and adaptation measures is another goal of the studies of this volume; (d) analyses of policy implications of different measures and options have been regarded as significant aspects of this special issue as they are expected to make significant contributions to policy considerations – formulation, implementation and evaluation.

The discourse of the debate over recent global warming, associated changes in the climatic norms, and the correlation of the enhanced variability of environmental extremes with global atmospheric warming exhibited serious interest and participation from various scientific, regulatory, and other knowledge stakeholders as well as from numerous policy and decision-making quarters. Because of their complexity and non-testable nature, consensual directions on such issues yet could not be ascertained. Nonetheless, several interesting inferences, on which there is no general disagreement, have been confirmed by recent research findings and discussions. These could be synthesized under the following three major inferences.

(i) The atmospheric thermal regime in the last few decades exhibited a trend of consistent rise, particularly in the northern hemisphere (IPCC 2001). The

Intergovernmental Panel on Climate Change (IPCC) 2001 concedes that "an increasing body of observations gives a collective picture of a warming world and other changes in the climatic system" (p. 4). The Panel further asserts that the rise in surface temperature over the 20th century for the Northern Hemisphere is likely to have been greater than that for any other century in the last thousand years.

(ii) The IPCC models projected that increasing atmospheric concentrations of greenhouse gases will result in shifts in temporal variability on all scales (daily, seasonal, interannual, and decadal) as well as in frequency, intensity, and duration of extreme events (IPCC 2001, p.14). The various component features of the geophysical (e.g., volcanic activities, earthquakes, landslides, avalanches) and climatic extremes (e.g., hurricanes, storms, tornadoes, hail-storms, droughts, dry-spells), however, demonstrated mixed and thereby inconclusive trends, with considerable variations at different geographical scale. A recent special journal (i.e., *Natural Hazards*) volume (Khandekar and Gönnert 2003), entitled *global warming and extreme weather: an assessment*, attempted to examine the pertinent questions in the atmospheric spheres, specifically to seek an answer whether there is a link between global warming and extreme weather.

A clear association between global warming and climatic extremes in all areas cannot be established by our current state of knowledge, although several of the climatic features and regions indicate a trend of extreme variability. In the United States, for example, heavy precipitation events have increased during the period of historical records, but for many other severe weather categories, the trends have been downward over the past five decades (Balling and Cerveny 2003). In an analysis of the trends in blizzards on the Canadian Prairies, a significant downward trend of weather observing locations in the most westerly part was noticed (Lawson 2003). This is consistent with other studies that found a decrease in cyclone frequency over western Canada. A decrease in cold spells during 1950–1998 in western Canada was noted by Shabbar and Bonsal (2003) whereas winter warm spells have increased across most of Canada. In a sub-regional context, prediction has been made that, as global temperatures continue to increase, the frequency and magnitude of floods in North Carolina will correspondingly increase in the future (Robinson 2003). As well, evidence from other continents and hemisphere indicates mixed results. By examining, in the context of global warming during the last century, rainfall changes in southern Africa, Fauchereau et al. (2003) concluded that interannual variability has risen since the 1960s. Droughts became more intense and widespread in this part of the African continent. More importantly, they further asserted that teleconnection patterns linked to Southern African rainfall variability shifted from regional to near global after the 1970s. Some macro-regional studies have revealed contrasting or varied patterns. For example, by examining four monsoonal macro-regions, Chase et al. (2003) found no association between reported surface warming and intensity of the monsoon circulations in southeastern Asia, western Africa, eastern Africa,

and the Australian continent. With respect to the proposition that there is a positive correlation between global warming and extreme weather, Khandekar and Murty (2003), in their 'guest editorial' article in the special issue of the *Natural Hazards* journal, concluded that most of the scientific studies "do not suggest an affirmative answer at this time (p. 101)". We find that in the scientific community there is considerable disagreement with regard to the effects of an increase in concentration of greenhouse gases and consequent change in temperature upon the specific component of climatic system (such as, precipitation, wind, storms, cyclones and anticyclones, tornadoes), but there is little disagreement about the certainty of the enhanced temporal and spatial variability of some of these components. This observation signifies the seriousness of the enhanced risk to humans and our resources to NTEE in the future.

(iii) One of the most intriguing inferences made recently is that the past few decades, specifically since the mid-1970s, have experienced increasing global economic costs as a result of nature-triggered extreme events (Figure 1) and consequent damages (Munich Re., 2003; Figure 2) and increasing loss of human life in the developing world (Hewitt 1997; Burton et al. 1993). Paradoxically, the trend of increasing global costs due to NTEE was established at a time when the United Nations International Decade for Natural Disasters Reduction

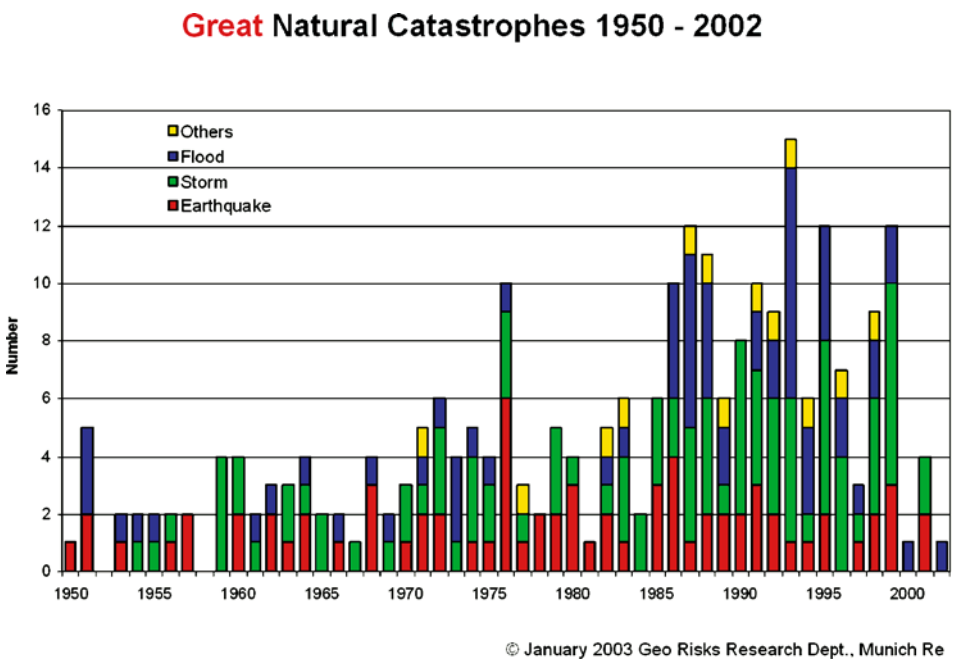

Figure 1. Trend of catastrophic disaster events by type and frequency globally, 1950–2000 Source: Munich Re. 2002.

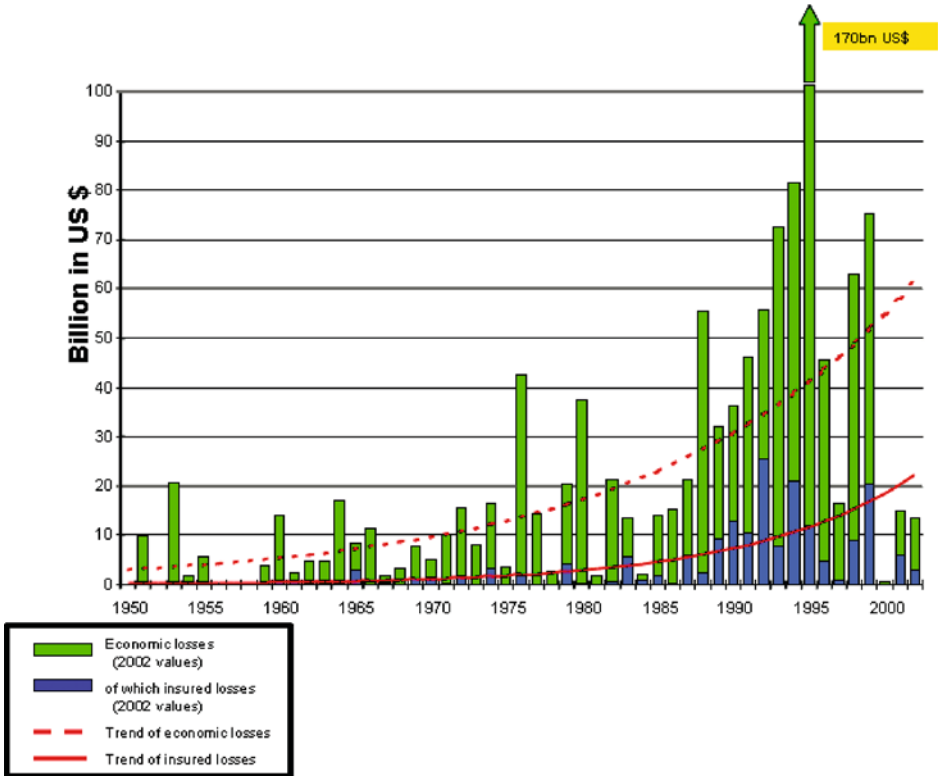

Figure 2. Global trend of economic and insured losses, 1950–2000 Source: Munich Re. 2002.

(INDDR) declared that, through the work in the 1990s, the costs would be reduced by 50% by the year 2000. While no clear pattern of increasing NTEE has been recognized in all atmospheric and geophysical areas, the loss due to increased hazards (physical event and human vulnerability) is clearly showing an incremental trend over time (Figure 2).

Some recent explanations of increasing trends of cost (economic and human) due to NTEE have focused more on the human/social variables as opposed to dominant science and technology oriented approaches which emphasize the geophysical aspects of risk and hazards. It is worth noting some of them here. Etkin (1999) asserts that "though more frequent extreme events in nature may play a role – a large part of the answer [regarding the increasing global cost] certainly lies in the realm of increased social vulnerability" (p. 69). This assertion was strongly supported by a more recent, detailed study of weather extremes in the United States (Changnon 2003).

Changnon (2003) states that the trends in various extreme weather events (not their losses) over the past century exhibit a mix; one trend is upwards (heavy rains-floods), others are downwards (hail, hurricanes, tornadoes, and severe

thunderstorms), and there are unchanging flat trends (winter storms and wind storms). It is argued that these trends do not fit the predictions, based on GCM simulations under a warmer world resulting from increased CO_2 levels that call for weather extremes and storms to increase in frequency and intensity (Kattenberg et al. 1996). The indepth investigations of costly weather events in the U.S. revealed that "changes in society, which has become more vulnerable to weather damages, is a primary cause, not major increase in the frequencies or intensities of most hazards" (Changnon 2003, 287).

We would like to argue that, irrespective of an established synoptic causal link between global atmospheric warming and accelerated environmental extremes, the aspects of mitigation of nature-triggered environmental extremes (NTEE), and of adaptation of our built environment (including infrastructure, transportation, housing) require immediate policy attention. Neither the smaller communities nor the countries in general can afford to bear astronomical human and economic costs and shocks. This is more critical in light of the current global economic structure and trend, which are closely linked, dynamic, and competitive.

2. Conceptualizing Mitigation and Adaptation

Natural hazards and disasters have a long history of study and debate, and policies on managing the impacts have been in existence for decades. By contrast, climate change has only recently emerged on the international and national environmental agenda. Therefore, it is not unexpected that different technical languages have developed. Prominent among the concepts and terms that cause confusion are the words adaptation and mitigation. It is therefore felt necessary to provide operational definitions of these terms so that their usage in this volume is clearly understood.

In the natural hazards community, mitigation is defined as the wide array of actions that can be taken to reduce vulnerability. In the language of the United Nations Framework Convention on Climate Change (UNFCCC), the reduction of carbon dioxide and other GHGs and carbon sequestration in soils and biomass is referred to as 'mitigation'. Also, in the climate change world, the idea of vulnerability reduction is called 'adaptation'. Such varied usage of terms makes communications between the natural hazards and climate change communities difficult. Moreover, in terms of natural systems, many are now defining adaptation as 'building resilience' and 'increasing capacity' within ecosystems to cope with change. Ecologists also define adaptation slightly differently – it is defined in the evolutionary sense – which can add to the overall confusion and demand a careful assessment of the context in which terms are used.

Where the focus is on creating safer, more resilient communities, discussions and documents routinely use such concepts as reducing risk, reducing vulnerability, natural disaster reduction, and hazard reduction without drawing distinctions and assuming understanding. Such terms and concepts expand the lexicon of risk

management and can provide helpful distinctions, if they are well explained and placed in context. The purpose here is not to discuss these terms in detail, but rather to note the need for clarity in literature addressing issues related to hazards and the risks they pose to humans. Underlying all such terms is the desire to better understand human exposure and, from this knowledge, influence decisions towards achieving safer communities for all populations.

The key words in the natural hazards/climate change dialogue are almost identical in meaning, except that disaster mitigation refers to all kinds of disasters, including non-natural disasters and those natural disasters that are not climate-related, such as earthquakes, tsunamis, and other geophysical events. Such definitional differences and subtleties are an integral part of the research domain, irrespective of the subject or discipline. However, it is worth noting this anew, when we endeavor to shed light on more complex issues.

Mitigation policies and strategies concerning hazards and disasters, with a natural-trigger, of all types (geophysical, climatic, biological and others) are the thematic subject of the studies of this special issue. In the 'disaster management' context, 'preparedness' and 'response' are often considered 'mitigation'. However, 'preparedness' and 'response' actions are chiefly geared toward readiness for dealing with expected or sudden or imminent events. In contrast, 'mitigation' implies sustained, deliberate measures, implemented well in advance of the event to avoid or reduce the impact of hazards and impending disasters. The usage of the term to depict the same meaning varies from country to country or region to region. For example, the above concept is accepted by most North American institutions, whereas in Australia and Japan, 'loss-reduction' is used. In order to maintain a consistency in this issue, the above concept of mitigation was given to the authors to be used as an operational definition and individual authors were allowed to use their own terms and concepts, only if there were specific clarifications given prior to their application in the text. Adaptation generally refers to reforming, restructuring, and reorganizing for the purpose of making a phenomenon suitable for a new situation, context and need, and from this perspective, adaptation has an evolutionary connotation. Burton et al. (1993) categorized adaptation to NTEE into biological and cultural groups. In this Special Volume, the latter is principally relevant as it involves deliberate or incidental human efforts to adapt to changing environmental conditions and risks.

3. Risk, Loss Potential, Mitigation, and Adaptation

Recognizing the limits of modeling generalization, we present in Figure 3 a schematic flow diagram depicting the processes involved in the interface between natural environment and human society, within which hazards, vulnerability, and risk exist. The model is designed to offer a sequential, but not linear, determination of driving forces, features involved, outputs, iterative processes, and feedback

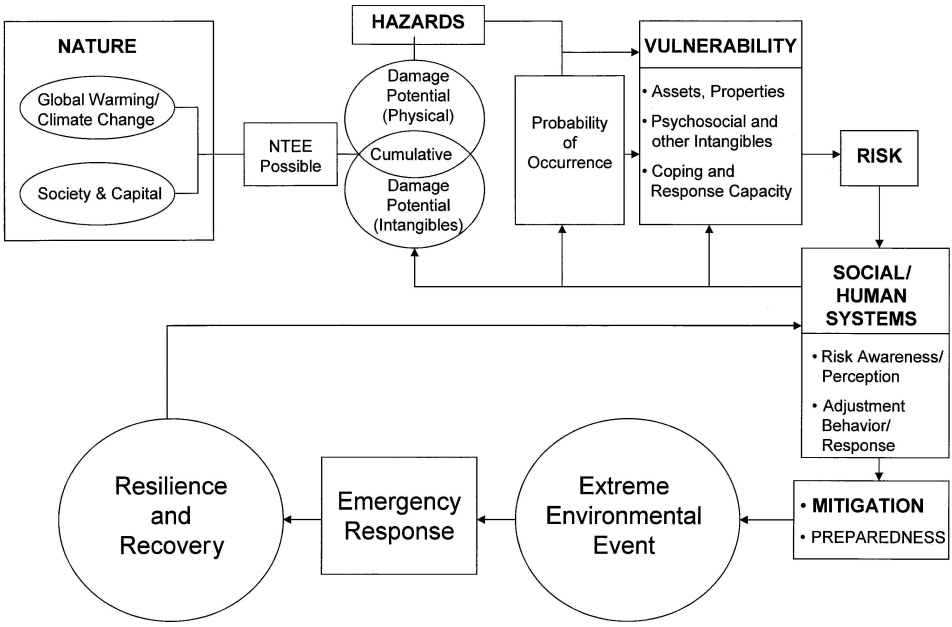

Figure 3. The process of human vulnerability to NTEEs.

loops in a generalized fashion. It is also formulated in the context of the recent trend of global warming and its associated effects upon climatic variables and all major aspects of human spheres. One of the principal objectives of this model is to delineate the place of 'mitigation' efforts as part of human coping and adaptation mechanisms to environmental risks.

A 'hazard' is generated and determined by the potential for damage, both tangible and intangible, by an extreme environmental event. Thus, it is preconditioned by the presence of the human domain. In academic and professional usage, hazards often refer to an objective feature of geophysical processes, without accounting for the damage-potential. In this context, Hewitt (1983) suggests that although "[f]ew researchers would deny that social and economic factors or habitat condition other than geophysical extremes affect risk . . . [t]he direction of argument in the dominant view relegates them to a dependent position" (p. 5). We would like to stress that indirect loss as well as damage of intangible resources could surpass damage of tangible and measurable resources due to a disastrous event. In addition, although the concept of cumulative damage potential was introduced by Hewitt and Burton (1971) three decades ago, and 'cascading effects' of catastrophic events have been noticed for many years, serious attention to these aspects has been lacking.

Human risk is considered in terms of chance or probability of a particular hazard actually occurring. For example, a severe earthquake event measured at 7.0 on the Richter scale has the potential to cause damage of $20 billion of assets and property

in a large city like Vancouver (Canada), and is thereby recognized as a hazard to the inhabitants of the city. However, this perspective does not reveal anything about the chance of occurrence of a severe earthquake in Vancouver. The product of impact potential (i.e., damage and loss) with probability of occurrence of an extreme event indicates the nature and magnitude of risk. Nonetheless, former dimension (damage and loss potential) requires an indepth analysis of 'vulnerability' to loss to reveal actual overall risk.

Since the early 1980s, there has been a growing acknowledgment of the significance of people and society at large and their relationships to hazards in terms of total hazard risk (Mitchell 1989; Blaikie et al. 1994; Varley 1994; Hewitt 1997; Haque 1997). Vulnerability has been generally conceptualized as a pre-existing condition or state defined by a set of negative attributes that cause people or communities' susceptibility to loss (Berry 2002). The early definition of vulnerability focused primarily on the loss-propensity (e.g., UNDRO 1982; Kates 1985; Bogard 1989), such as UNDRO (1982) has viewed vulnerability as "the degree of loss to a given element or set of elements at risk resulting from the occurrence of a natural phenomenon of a given magnitude". In such a concept, the hazard event is being regarded as the primary cause of loss, with people or communities characterized as 'victims', passive actors that are subordinate to the hazard (Berry 2002). Contributions to critical literature led a rapid evolution and shift in conceptualizing and usage of the term vulnerability to hazards and loss. Since the early 1990s, the focus shifted to human community and people's living conditions, social and economic resources, livelihood patterns and, more importantly, social, economic and political power. It thus embodied a consideration of resilience, and an element of empowering human agents. As Blaikie et al. (1994) have clarified:

> By vulnerability we mean 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. It involves a combination of factors that determine the degree to which someone's life and livelihood are put at risk by a discrete and identifiable event in nature or in society.

In order to measure vulnerability and make it operational, Ohlson (2003) categorized it into 'exposure to physical events' and 'effects on the human adaptive capacity'. The former aspect focuses on the degree of loss to a given element or set of elements at risk while the latter dimension concentrates more on societal 'band of tolerance' (Smith 1999) and human capacity to cope and adapt to environmental fluctuations and changes.

Risk can be determined by examining the probability of occurrence of the event, along with measuring asset inventory and liable resources (Figure 3). In the risk transference process, awareness (hazard identification) and perception of the environment would function as important intervening variables (Etkin 1999). Potential victims, individually or collectively, tend to determine their behavior to

take into account perceived "acceptable levels of risk". Purposeful measures may be taken to avoid or mitigate the adverse impact of extreme environmental events. Preparation to respond to impending disasters is linked more to an assumption of the onset of the event.

'Emergency' refers to a relative time-space conjuncture, and is largely dependent upon the state of danger, anticipation, preparedness, and more importantly, coping capacity of a system. In a broad sense, emergency is a situation or an occurrence of a serious nature, developing suddenly and/or unexpectedly and demanding immediate attention. This is generally of limited duration. Societal adjustments to disasters and emergencies function as negative feedback into the response sub-system, which takes place during and after the recovery phase. For example, following the 1997 Red River Valley flood in Manitoba (Canada), public institutions collectively have undertaken the largest mitigation in the history of the province through expanding an existing floodway system. Gulkan's study in this volume has revealed that, in Turkey, by contrast, governments have missed an opportunity to reduce future loss by implementing a stricter building code policy following the 1999 earthquake.

It is important to point out that structural (primarily engineering) mitigation measures can only deal with the aspects of physical vulnerability of people, property and assets, and thus are inadequate to encompass the full spectrum of disaster mitigation. It is an utmost necessity to underscore the significance of the societal effects of environmental hazards and disasters, particularly the implications of disastrous events on socioeconomic recovery and ability to respond to future events.

Prehistorically, humankind has evolved with limited control over the natural forces for most parts of their evolutionary path, but with cultural and technological development such relationships changed phenomenally. Both evolutionary and dramatic discoveries, inventions, and subsequent innovations were significantly involved in influencing such changes. Since the Industrial Revolution, our capacity to manipulate natural laws and forces accumulated dramatically. As well, human impact on the environment has generated newer kinds of risks, often resulting in catastrophic disasters. In today's postmodern society, our challenges have shifted from preparing and responding to hazards and impending disasters to undertaking deliberate actions to avoid and/or reduce their adverse effects. Public and institutional policies formulated by the concerned public and private agencies to prevent and mitigate risks and hazards, stemming from Mother Nature and its forces, have exhibited clear evidence of cost-effectiveness and net positive results. As well, it is important to formulate strategies and action and to implement plans in innovative ways in order to mitigate and adapt to emerging environmental changes and challenges.

As illustrated above, a very disturbing trend with respect to loss due to nature-triggered disasters has been depicted by several contemporary studies (Munich Re. 2003; Etkin 1999; Burton et al. 1993; Figures 1 and 2). It is evident, first, that in the developed world, despite considerable technological and organizational

advancements, the economic and social loss due to NTEEs has been increasing over the last hundred years (the magnitude of loss of human lives decreased significantly). Secondly, in the capital-poor, developing countries, loss of human lives and injuries have been rising during the last century. Given this scenario, the importance and role of an exploration into diverse concepts and experience in formulating and implementing mitigation and adaptation related policies and programs in various parts of the world cannot be underestimated. Sharing of such experiential learning and futuristic policy, planning, and management ideas, in the context of similar and dissimilar geophysical, ecological, and socio-cultural and economic backgrounds, can be a very effective means for advancing our knowledge and of addressing serious issues of threats to lives, properties, and resources. It is critical in this type of exercise to generate and share ideas to develop and examine various options for avoiding, reducing, and recovering from loss due to NTEE, so that appropriate policy guidelines and measures can be formulated.

It is important to reiterate three features:

(i) According to Munich Reinsurance Company (2003), the numbers of NTEE, specifically floods and windstorms, have increased since 1976, and their associated economic losses including insured losses have more than doubled by 1995 (crossing the US $50 billion per year mark; Figure 2). Notably, 2001 experienced more than US $55 billion loss due to NTEE.

(ii) IPCC findings reaffirm the above pattern, revealing projected increased risks of floods and droughts in many regions of the world. Specifically, based on high resolution modeling studies, the Panel has indicated an increase over some areas in the peak wind and precipitation intensity of tropical cyclones.

(iii) The International Federation of Red Cross and Red Crescent Societies (IFRRCS 2003) recorded a trend of considerable increase in deaths and injuries throughout Asia, Africa, and Latin America during the recent decades, despite a rapid economic growth in many countries. Haque (2003), in his investigation of selected southeast and south Asian and Pacific island nations, registered a positive correlation between development indicators and disaster loss. One plausible explanation is the tendency of denial by elites of society of risky locations, on the one hand (Etkin 1999, p. 73–74), and increased poverty in both developing and depressed regions, on the other (Haque 1997, 2003). Globally, in 1960 the richest fifth population received 30 times the income of the poorest fifth; the ratio by 1997 rose to 60 (Brown et al. 1998; cited in Etkin 1999, p. 73). Blaikie et al.'s (1994) 'pressure and access' model explains this feature by arguing that social processes largely determine the site, location, technological and cultural tools and other tangible and aesthetic resources. Thus, the social systems "create the conditions in which hazards have a differential impact on various societies and different groups within [the] society" (p. 46). Haque (2003) further asserts that if adequate risk assessment and measures are not undertaken during resource use and decision, such as during project design and implementation, development activities will lead to

increasing susceptibility because of the accumulation of infrastructural and non-monetary establishments over time.

4. Mitigation is Linked with Vulnerability and Resilience

Institutional approaches to environmental risk and hazards during the post World War II era have been dominated by efforts to modify the 'natural event systems' (i.e., geo- and bio physical variables) to minimize the physical parameters of events (Burton et al. 1999; Hewitt 1994). In cases where the scope for modifying the physical processes was limited (such as earthquakes and hurricanes), emphasis by the dominant 'technological-fix' school was placed upon appropriate land-use planning, introduction to building codes, improved weather forecasting, regulatory intervention in natural resource use, and engineering modification so that NTEE could be resisted or contained. Given the fact the scope for effective human interventions into the geo- and biophysical events to prevent so-called extremity is restricted in several areas, emerging new realities complicate the challenges further. In the context of recent global warming and possible climate change, McBean presents the case of tornado risk as an example of climatic hazards. He concludes that risk-management strategies should assume more frequent events in the future, and argues that mitigation strategies for NTEE will always be dealing with risk. With climate change bringing a new set of risks, each with its uncertainties, the risk manager, policy and decision maker have new challenges. Since NTEE like tornadoes have considerable impacts and divert resources towards mitigation and recovery, changing NTEEs are a significant factor affecting economic growth and social development.

Several studies incorporated in this volume have challenged the dominant approach to risk and hazards mitigation in which the underlying goal is to "fix" natural processes or resource use (land-use) pattern, building structures, and warning systems and communication means. Indepth research in Australia (Anderson-Berry and King), Brazil (Branco et al.) and Canada has revealed a strong association between effective hazards mitigation and addressing societal and physical (i.e., location-related) vulnerability of local communities, and taking responsibility in terms of collective and individual response-behavior. Anderson-Berry and King view mitigation strategies and measures as a disparate component of hazards as they are linked with both 'resilience' and 'vulnerability'. Based on the findings from a longitudinal, empirical investigation in the tropical cyclone-prone northern Australian communities, they assert that mitigation efforts must be built on strengths and target weaknesses and limitations. The study offers a method for measuring and ranking both vulnerability and resilience, and thus indicating community capacity to mitigate the impact of the hazard. As individuals and communities must bear the primary responsibility for their own hazard mitigation efforts through knowledge, awareness, preparation, and appropriate response-behavior, the role

and focus of public and private institutions should be to assist or directly determine those strengths and weaknesses of resilience and vulnerability for ultimate elimination or mitigation purposes.

By reflecting the theoretical propositions of Anderson-Berry and King, Branco et al.s' empirical study in northeastern Brazil demonstrate that the provision of shared responsibility and a 'grass roots' approach to mitigation can strengthen community resilience and reduce vulnerability. The study attempts to spelling out the utmost significance of non-structural mitigation measures, along with other alternatives. It is recommended that although rainwater harvesting to mitigate drought hazards *per se* is a structural measure, without community participation such a labour-intensive option would not be feasible. By examining the Canadian perspectives, Pearce makes a strong case advocating for a crucial need of community involvement for risk, hazards, and disasters mitigation. In order to substantiate her arguments, Pearce presents a community case from western Canada in her paper. The study concedes that formulation of mitigation strategies and measures is preconditioned by a successful Hazards, Risk and Vulnerability (HRV) analysis. It further adds that public participation is an important element in ensuring that community and region-based HRV analysis is meaningful.

In the developed world in general, disaster mitigation traditionally has been an 'academic' concern with limited relevance to policy issues. As discussed above in detail, nonetheless, since the mid-1970s the staggering public and private (mainly insurance) cost raised new questions and interest regarding cost-effectiveness and other feasibilities (political, social, cultural and others) of risk and hazards mitigation. Research yet to be done to demonstrate, with conceptual substantiation and empirical evidence, that mitigation would make sense in many projects when realistic choices are assessed and decisions are made for net social and economic gains against human and economic investments. Through his contribution to this volume, Ganderton argues that the fundamental principles of benefit-cost analysis of disaster mitigation should guide the decision generation system. However, finally, pragmatic response decisions, with good practice in project evaluation, should be made considering a broad spectrum of choices that go beyond monetary value.

A similar message is echoed by Etkin and Stefanovic as they claim that NTEE induced losses are largely attributed to human behavior that creates vulnerable communities. Hence, in order to eliminate or reduce vulnerability and mitigate the risk of disasters, it is necessary to consider underlying values – i.e., peoples' world view and their nature of interaction with the natural domain. Rather than illustrating the natural domain as villain against human on world stage, they argue for advancing disaster mitigation through a process that will place greater emphasis on human interactions with and reliance upon the natural world, and the development of community resilience. In order to attain the goal of sustainability of all forms of life and the balance between living and non-living elements of our ecosphere, Etkin and Stefanovic provocatively suggest a paradigm change, towards an eco-ethical approach to NTEEs and their losses. Furthering a similar postulation, Mileti and

Gailus call for an adoption of interdisciplinary (i.e, interconnected and overlapping rather than cross- or trans-disciplinary) approach to risks and hazards to effectively prevent and/or minimize loss and ensure sustainable development. The findings of a team of more than 100 expert academics and practitioners, who participated in the Second Assessment of hazards research and application in the United States (terminated in 1998) have suggested that losses from hazards and the inability to comprehensively reduce losses of all types have been the result of sectoral, discipline-based development approach as well as narrow cultural premises and attitudes towards the natural environment, science, and technology. Mileti and Gailus's analysis of impact of the Second Assessment on the research and applications community is suggestive of the complementary role of knowledge-stakeholders, managers and field practitioners.

Democratic political systems, which are predominant mode of governance in North America, Europe and many other nations of other continents, are usually thought to represent and be accountable to their citizens. Accordingly, the development of risk, hazards and disasters management policies, like other policies, is often thought to be generated, although indirectly, by the public. In reality, under such system, elected representatives are responsible for initiating appropriate public action programs. Yet, while public involvement does occur in many aspects of disaster and emergency management policy in the democratic world, many quarters tend to criticize current institutional norms and practices concerning public safety, security, risk-reduction and emergency responses as 'superficial' and thereby inefficient. Due to lack of accountability of public representatives, the complexity of issues and processes, and different access to financial and technical resources enjoyed by competitive interests are just some of the barriers that discourage effective public involvement. A movement, which may partly be triggered by such criticisms, by the public institutions towards effective public participation in the development public policy is noticeable. In order to present such a case, Valeriah Hwacha reports on the processes and outcomes of the efforts of the Government of Canada, through the Department of Public Safety and Emergency Preparedness Canada in conducting consultations with provinces, territories and stakeholders to develop a national disaster mitigation strategy (NDMS). The Strategy aims at enhancing Canada's capacity to prevent as well as mitigate disasters and their associated losses before they take place and promoting the development of disaster-resilient communities. Hwacha clarifies why and how, in the NDMS process, stakeholders have recommended to create a robust national emergency management system, and agreed that a policy direction towards mitigation will be a wise investment in the country's future.

Serious shortcomings of contemporary democratic political and decision-making systems, in which regimes possess limited term of governance, in adopting long term mitigation strategy are recognized, although implicitly, by Gülkan in Turkey. Polat Gülkan has been directly involved in developing and implementing Turkey's national disaster recovery and reconstruction, and rehabilitation policies

and programs, yet he reveals his frustration in influencing them to adopt an effective mitigation strategy. He argues that following a disaster, such as an earthquake or catastrophic flood, a window of opportunity is created for policy makers to undertake long term mitigation measures that would benefit individual and collective interest immensely. The experience in Turkey following the 1999 earthquake shows a disappointing characteristic – an absence of a comprehensive, unified disaster management approach embodying mitigation strategies to reduce the future toll of NTEE. The country as a whole exhibited an admirable success in reconstruction and immediate recovery from the earthquake disaster but risk from and vulnerability to future NTEE were not accounted for in the national policy decisions. The study implicitly indicates that the preoccupation of decision-makers with a goal of demonstrating immediate, visible, results of policy and program implementation is a major hindrance to the formulation and implementation of a national, sub-national or regional mitigation strategy.

A major element of concern in developing a national mitigation policy is the lack of adequate recognition of local and/or regional issues, problems, and cultural perspectives. The overriding interest and pressure groups are usually successful in designing or strongly influencing public policy development, which unfortunately would augment geographical, ethnic, racial, and other societal inequities unless they are addressed forcefully. Using northern Canada as a regional case study, Newton et al. analyze the current perspectives of NTEEs that are likely to be influenced by climate change. The study reveals that, in the societal and policy domains of the Canadian North, the place of the greenhouse gas emission is not a crucial issue. Newton et al. finally provide a rationale behind the need for more comprehensive adaptive strategies to complement the current tendency to focus on the mitigation primarily of greenhouse gases produced in the Canadian North.

5. Conclusions

To synthesize, we find that, although there is much controversy around climate change, especially whether there is a permanent shift from the expected climatic fluctuations and variability, the fact of warming of the atmospheric temperature in the last century is no longer a subject of scientific or policy debate. The agreement on the later subject has been profoundly influenced by the real-time observations, since the 1950s, of global surface temperature, notably in the Northern Hemisphere. Due to such changes in the geophysical parameters, certain types of nature-triggered environmental extreme events are likely to continue to increase. How global warming will affect regional climates and pertinent variables is not well known, which substantiates the fact that our ability to predict precisely consequential effects is limited, and poses serious constraints against straightforward policy decisions.

The trend of global average annual economic loss, both insured and uninsured, due to NTEE exhibits an alarming upward trend. While it was less than US $20

billion during the 1970s, by the year 2000 the average loss per year was more than US $70 billion. In exceptional years, for example, in 1995, it reached as high as US$167 billion. If a full-cost accounting of these phenomena is attempted, the numerical figures concerning loss due to NTEE would multiply in a compounding manner. Such a sudden colossal, economic setback is not only a threat to sustainable development and prosperity, but also hampers our societal resilience considerably. The established and dominant perspectives of disaster are deeply embedded in response and relief. The authors of this book collectively have placed a call for a shift of emphasis from response and relief (management-focus) to "preparedness, mitigation and prevention within the context of sustainable development towards reducing our collective risk and vulnerability to natural hazards" (Briceno 2004).

Research findings of the work of this volume reaffirm that human dimensions, specifically our awareness and decision-making behavior, are powerful explanatory factors of increasing disaster-losses. It has been recently recognized widely that many regions of the world are rapidly accumulating large, latent risk burdens and increasing vulnerability through the concentration of low-income population in risky areas, the loss of ecological resilience to withstand NTEEs, generation of the momentum of rapid urban and economic growth, rural-urban migration, and the loss of social safety nets. A disastrous event thus exposes cumulative tensions of risk, unleashing the levels of impact that supercedes local, regional, and national coping capacities. Disaster mitigation through addressing human, social, and physical vulnerability is one of the best means for contributing to 'climate change adaptation plans' and sustainable development goals.

Conventional disaster response approach has a historical background in civil defense and application of a 'command and control' approach to dealing with emergencies and immediate recoveries. However, recent lessons from various countries have depicted that the formulation of mitigation strategies cannot be top-down as it requires social, political, and cultural acceptance and sense of ownership. An interactive, participatory process, involving local communities, produces best expected outcomes concerning mitigation, preparedness, and recovery. An emerging consensus is that there is a need to move towards the goal of the International Strategy for Disaster Reduction. Sharing of best practices and lessons globally is certain to produce more efficiency and understanding in policy and decision making. In the words of the Director of the Inter-Agency Secretariat of the ISDR, Salvano Briceno:

> We need to harmonize our efforts towards sustainable development plans and poverty reduction initiatives to include disaster risk assessment as an integral component, increasing investment in reducing risks and vulnerabilities towards the achievement of the Millennium Development Goals and the Johannesburg Plan of Implementation for Sustainable Development. Disaster reduction is both a humanitarian and development concern that must be considered as one of the core responsibilities of the international community at large (2004, p. 3).

We find that there is a reasonable volume of literature that advocates in favor of vulnerability, hazard, and disaster reduction. At the policy level, linking disaster mitigation efforts with vulnerability and poverty reduction is still illusive. Portraying specific cases that help establish the fact that mitigation works, in economic, social and political sense, is needed to influence policy and decision makers. Such show-cases should be developed, in the first place, for convincing exhibition to the public, stakeholders, and institutional representatives.

Finally, the 'top-down' and 'command and control' approaches conceal within the assumptions that extreme environmental events are essentially the breakdown of the normal functions of our society and economy and, as crisis, are essentially a deviation from the order of the established structures (Hewitt 1983, p. 29). The restorations of order and so-called 'normal' conditions become the primary mission of crisis and disaster management, relief, and reconstruction. We would like to assert that this notion fails to determine the principal factors of disaster, that is, the impact of NTEE upon society and the economy. In addition, the efforts in prevention and mitigation of hazardous events, by modification of the geophysical processes, have dominated the policy, planning, and decision-making until the recent past. However, the serious limitations of such views were widely recognized, as such geophysical and engineering approaches failed to shift disaster loss downward. The chapters below depict that, for their effectiveness, the risk, hazard, disaster mitigation and management must embody human concerns – vulnerability, resilience, and spirit – along with geophysical processes. Without such a change, mitigation of disasters will remain a fallacy rather than a reality.

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