

'Environmental Threats in Cold Deserts -- Challenges and the Way Ahead'

Backgrounder for a Consultative Workshop

By the Natural Resources Management and Research & Advocacy Teams at Pragya¹

Nature has two faces. It may be munificent; it may also be destructive. Humankind has always known of the hazards of nature and traditional societies had evolved practices and mechanisms to protect them from the threats of their particular environment. A study of history reveals the major, albeit insidious, role that environmental threats have played in shaping cultures, settlement patterns, development trends and even destruction of societies. Environmental threats are however on the rise worldwide. The severe stress put on the environment as a result of the high-consumption society and inappropriate development models has meant that the flashpoints are more numerous, more frequent, and more intense.

Climate change is as much a cause of the environmental stress as its result. Studies have revealed the strong linkage between climate change and occurrence/intensity of natural disasters. As climate change and anthropogenic pressures on the environment escalate, environmental threats often translate into catastrophic natural disasters, which cause severe disruptions to life and livelihood systems. Global warming, along with shrinking glaciers and rising sea levels, has been responsible for increased frequency of natural hazards, increased intensity of the hazard phenomena and the changing pattern of these hazards over the years. During the 1970s-80s, droughts and famines were the biggest destructive forces in India. However, the situation has been significantly altered, with floods, cyclones and earthquakes dominating (98%) the reported injuries, with ever increasing frequency in the recent years (High Powered Committee Report, 2001). Along with floods, cloud bursts and other such extreme events, India also suffers from acute water shortages, with more and more parts of the country being rendered vulnerable to drought. The steady retreat of Himalayan glaciers as an effect of climate change will also mean disruption of the entire water system and subsequent natural threats.

The death and destruction that occur as a result of natural hazard incidences result from people's vulnerability to the hazard impacts on a scale that overwhelms their capacity to cope without any help. On a long term, climate change induced modifications in baseline weather parameters result in an increase in the frequency and magnitude of extreme events rendering the vulnerable groups even more vulnerable. Often, these communities are exposed to multiple environmental threats and they have partial access and understanding of the tools for environmental threat and disaster risk management and there is a constant need for innovation and learning to cope with the changing pattern of threats at the local level.

Disaster is a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources.

[Source: ISDR Terminology of disaster risk reduction]

Hence, management of natural hazards has gained importance in the context of global climate change, and begun being included as an integral component of sustainable development. The World Conference on Natural Disasters held at Yokohama in May 1994, followed by the adoption of Hyogo Framework for Action 2005-15 during the World Conference on Disaster Reduction in Kobe, Japan, helped in pointing out the necessity of definitive steps for disaster management planning. "Sustainable development, poverty reduction, good governance and disaster risk reduction are mutually supportive objectives, and in order to meet the challenges ahead, accelerated efforts must be made to build the necessary capacities at the community and national levels to manage and reduce risk. Such an approach is to be recognized as an important element for the achievement of internationally agreed development goals, including those contained in the Millennium Declaration." (Hyogo Framework for Action, 2005-2015)

UNDERSTANDING ENVIRONMENTAL THREATS

Natural disasters occur when the communities exposed to the environmental threats are not able to absorb the impacts of an extreme event or fail to recover from it. Comparison of hazard specific relative vulnerability of nations highlight the importance of development processes for translation of an environmental threat into

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disaster risk. Hence there is an increasing need for integrating environmental threat mitigation in development planning to achieve the MDGs.

Threat Classification by Nature of Onset

While some disasters may occur within seconds (earthquakes), minutes (tornadoes) or hours (flash floods), others may take months or years to manifest themselves (droughts). Environmental threats and related natural disasters are therefore classified into two categories based on their nature of onset: (i) Slow Onset Disasters and (ii) Rapid-Onset Disasters.

(i) Slow-Onset Disasters: Slow-Onset disasters like Drought or Desertification are creeping phenomena that make it difficult to determine the onset and end of the event. The duration may range from months to years and no single indicator or index can precisely identify the onset and severity of the event. The impacts are generally non-structural and difficult to quantify. As a result, such events usually do not attract humanitarian or political aid and adequate policy and research interventions. The spatial extent is usually much greater than for other natural hazards, making assessment and response actions difficult. The impacts are cumulative and the effects magnify when events continue from one season or year to the next.

Drought events occur when there is lack of water to satisfy the normal needs of agriculture, livestock, industry or human population and can be classified as Meteorological, Hydrological or Agricultural drought.

Desertification occurs over larger spatial and temporal scales. Also, due to their potentially long duration, the focal point often shifts over time, rendering the need for continuous monitoring of climate and water supply indicators.

(ii) Rapid-Onset Disasters: The Rapid-Onset disasters are characterized by the sudden and acute intensity of the impacts over a short period. The severity of these events is usually quantified by the loss in terms of human lives and property. Owing to its nature of onset, they do not give people adequate time to prepare for the impacts. Rapid-Onset disasters are of two categories:

- Hydro-meteorological Disasters
- Geo-physical Disasters

Hydro-meteorological disasters produce the largest numbers of total affected people in Asia, while geo-physical disasters produce the largest numbers of people killed. Both Hydro-meteorological and Geo-physical hazards can be single, sequential or combined in their origin and effects.

Hydro-meteorological Disasters: These are natural processes or phenomena of atmospheric, hydrological or oceanographic nature, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hydro-meteorological hazards include: floods, rain induced debris and mud flows, tropical cyclones, storm surges, thunder/hailstorms, rain and wind storms, blizzards and other severe storms, drought, desertification, temperature extremes, sand or dust storms, slippage due to permafrost thawing, and avalanches. Intensity scales, i.e., physical parameters describing the severity of the hazard, have been developed for most of these events. For major hydro-meteorological hazards, WMO has developed standards for monitoring and reporting of the phenomena.

Geo-physical Disasters: They originate from natural earth processes or phenomena. Geological hazard includes internal earth processes of tectonic origin, such as earthquakes, geological fault activity, tsunamis, volcanic activity as well as geomorphic processes such as mass movements: landslides, rockslides, rock-falls, avalanches, surface collapses etc. Landslides, subsidence and similar hazards can at times be predicted and the impact reduced or even averted with scientific systematic studies and adoption of appropriate remedial measures. The mass movements occurring at greater pace are more dangerous e.g. rock-falls, which often occur without any warning.

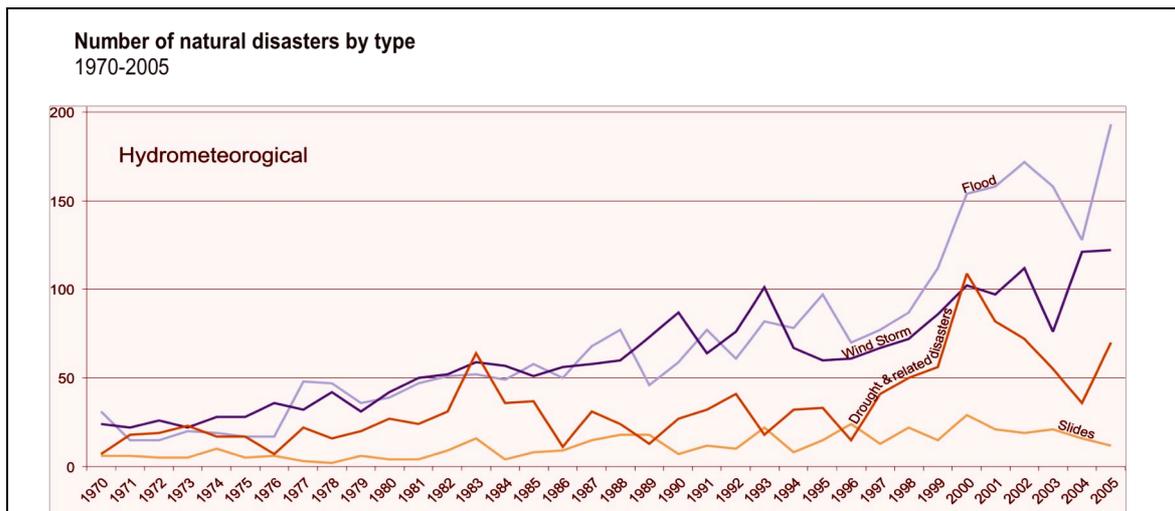
A sudden disaster typically has short impact duration and immediately evident direct effects, but it may have limited indirect effects. In contrast, a slow developing disaster has long impact duration and typically few noticeable immediate direct effects. However, we must also comprehend that it is the long-lasting culmination of direct and indirect effects that reinforce one another until a breaking point which may appear suddenly and give the impression of the occurrence of a rapid onset disaster.

Disaster Impacts

Studies show that countries with low and medium human development levels experience considerably more serious human and economic losses (ADRC-Natural Disasters Data Book-2006), and within these the

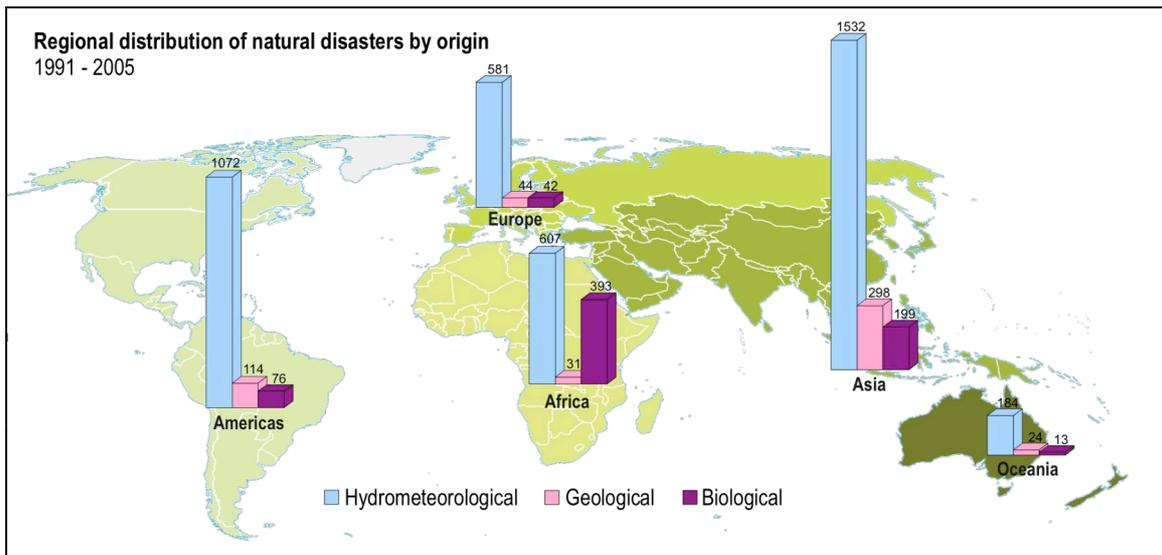
marginalized groups, poor and women, are the greatest sufferers of environmental threats. Female Human Development Index in relation to disasters derived from the HDI, reveal that countries with lower female human development account for the most human suffering, and tend to have higher concentration of death and disaster affected people. Though real economic losses from disasters are higher in developed countries due to highly developed physical structures and economic establishments, the losses are more crucial for developing nations if viewed in proportion of the Gross National Incomes of the nations. In order to demonstrate how development contributes to risk and vulnerability, UNDP has developed the Disaster Risk Index (DRI), which allows calculation and comparison of hazard disaster risks of the nations. Indices are developed for all the nations according to the degree of exposure and relative vulnerability. However, the DRI refers exclusively to death tolls and ignores risk to livelihood and economy due to lack of data.

Findings by the Centre for Research on the Epidemiology of Disasters (CRED) indicate that instances of Hydro-meteorological and Geological disasters in the world have increased over the decades during the last century.



Source: ISDR Disaster Statistics

The statistics also highlight that Hydro-meteorological disasters account for 76% of all the natural disasters, while Geo-physical disasters comprise only 10% (1991-2005), with Asia being the most affected by the Hydro-meteorological disasters. **India** ranks eighth among top 50 countries for total amount of reported economic damages due to all natural disasters (1991 - 2005).



Source: ISDR Disaster Statistics

Environmental hazards tend to cause maximum disruption of the socio-political and economic fabric of the most vulnerable communities. Women and the children are of the worst affected, accounting for >75% of persons displaced due to natural disasters. In addition to usual effects of the disaster events, women are also vulnerable to reproductive health problems, and increased cases of sexual and domestic violence. Moreover,

they have to assume the role of primary caretakers for affected family members, which increases their emotional stress and workload. The physically disabled are also at disadvantage due to their physical restrictions, underestimation of disability-specific supplies, medications and medical equipment during relief operations. Similarly, the ageing population remains one of the most neglected groups owing to their increasing 'invisibility' and marginal position in societies. In crisis situations, where service provision and allocation of resources are often inequitable, this often results in the older people being deprived of resources critical for survival and good health.

ENVIRONMENTAL THREATS IN HIMALAYAN COLD DESERTS

Himalayan Cold Deserts, a Unique Ecosystem: Formed due to the rain shadow effect of the towering Himalaya mountain range, the cold deserts of the Himalayas comprise the Trans-Himalayas that lie across the main Himalaya and are part of the vast Tibetan plateau, and the inner dry valleys within the main Himalayan range. It is a unique region, composed of different river valleys amidst high mountain ranges, the elevation of inhabited areas ranging from 8,000 ft. to 16,000 ft. It has highly arid conditions with annual rainfall averaging 279 mm; the bulk of the precipitation is in the form of snow received during a long, freezing winter when temperatures reach -32°C. Water resources are minimal with glacier-fed streams being the sole source for human use. Although the soil is not very productive and vegetation is very sparse, the region boasts of several rare, valuable species.

Escalating Pressures on Cold Deserts: Cold deserts are characterised by a fragile ecosystem, a complex interplay of climatic and geomorphological processes, and limited natural resources. The unpleasant face of development and increasing biotic pressure in recent years have brought the natural resources and the traditional systems of management of these areas under severe strain. The Himalayan cold deserts have been historically vulnerable to climatic extremes and the vulnerability is increasing due to climate change and the communities residing in these need special attention in the light of the greatly enhanced levels of risk from multiple environmental threats. The pattern of global warming is more pronounced at high altitude zones, especially those in the tropics and sub-tropics – up to 3 to 5 times faster than in other areas. Since the mid-1970s the average air temperature in the Himalayan region has risen by 1°C. This is twice as fast as the 0.6°C average warming for mid-latitude northern hemisphere over the same time period (IPCC, 2001). The impacts of climate change in these high altitude terrains could be far-reaching and competition for natural resources will increase. Climate change may induce disturbances and shift hazard zones beyond the known extents of occurrences. The precipitation pattern varies widely across the Himalayas. The monsoon effect decreases to the West, and the Trans-Himalayan region situated in the rain shadow of the greater ranges and massifs are less affected by the monsoon (Dannevig, 2005). Studies indicate a definite reduction in snowfall in the region over time, snowfall events oscillate in 2 important ways: (i) reductions in the amount of snowfall and (ii) changes in the timing of snowfall. There is also a shift in the distribution of rain across time with a significant increase in the number of cloudy days. Local perceptions further reveal that the temperature distribution has undergone a significant shift in addition to an overall increase in temperatures (Vedwan and Rhoades, 2001). Climate change has also brought in a new threat of increasingly frequent environmental disasters, among them being droughts, flash floods, and Glacial Lake Outburst Floods (GLOFs) which cause immense destruction to life and property.

Natural Hazards in Cold Deserts

The Himalayan cold desert region is vulnerable to multiple environmental threats and associated disasters due to its geographical position and socio-economic characteristics. The Himalayan cold deserts are experiencing a rapid rate of desertification that is fast depleting the little vegetation and rendering large tracts of land barren and vulnerable to enhanced erosion. Thinning ice caps and receding glaciers – impacts of global warming on the Himalayan ecosystem – have caused streams to diminish and springs to dry up, and a reduced flow in the rivers. Inhabitants of cold deserts, typically dependent on natural resources for consumption and livelihoods, are faced with severe natural resource stress and associated impoverishment, as a result. Nearly 67% of the glaciers in the Himalayan and Tianshan mountain ranges have already retreated in the past decade. Of the 5,218 Himalayan glaciers, most are likely to vanish within 40 yrs, as a result of global warming.

The area has always been prone to frequent natural hazards, both of a meteorological and geophysical origin, such as snowstorms, avalanches, landslides, and earthquakes. Climatic volatility is on the increase today and the inhabitants of cold deserts are faced with recurrent droughts and frequent snowstorms and blizzards. Landslides

and avalanches, often triggered by these climatic hazards, cause tremendous damage to inhabitants and lead to breakdown of public infrastructure as well. Severe snowstorms in the winter of '97-'98 affected more than a quarter million mobile pastorals in the Tibetan Plateau region including the Western Indian Himalayas; it led to the death of more than 3 million heads of livestock and hundreds of families lost their cattle. Flash floods occur frequently in Jammu & Kashmir and Himachal Pradesh due to cloudbursts and excessive rainfall, landslide dam bursts and rapid snow/glacier melts. However, documentation of the flash flood events, and others are not adequate. (Managing Flash Floods and Sustainable Development in the Himalayas – Status Report of Flash Flood Events and Mitigation Management in India – ICIMOD 2006). Such events have caused loss of life and property and pushed the clock of development back by decades in several stretches of Kinnaur and Lahaul & Spiti districts of Himachal Pradesh.

As atmospheric temperatures continue to rise, a rapid meltdown of the permafrost and glacial runoff is accelerating soil erosion and associated natural hazards in the region. The escalated pace of glacial melt has also created a new terror for the Himalayan people – GLOFs! The high altitude Himalayan region has more than 5,000 glacial lakes, many of which are at risk of rupturing their walls due to rapid snow melt, earthquakes or a breach of terminal moraines. The flood (GLOF) that would result could impact up to 10,000 people, their property, land, bridges and other infrastructure. The frequent episodes of rapid-onset disasters and the associated loss to life and property have increased insecurity among the inhabitants of cold deserts. There have been several incidents of glacial lake outbursts with catastrophic floods for hundreds of kilometers downstream, some with even trans-boundary impacts. At least 12 GLOF events have been recorded since 1935 in the Tibetan area of the Himalayas alone.

The Himalayan cold deserts are among the most critically affected by severe impacts of climate change, and the lives and livelihoods of its communities are at risk from multiple and escalating levels of environmental threats. These areas have however received very little development attention, in spite of their increasing vulnerability. Most policies and funds tend to flow to the most visible hotspots, and the extreme remoteness of the region obstructs it from grabbing the much-needed attention. There is a clear need for first of all, acknowledging the marginal worlds such as the Himalayan cold deserts as urgently requiring attention and ensuring a flow of resources and interventions at global and national levels, and a special place in the environmental/climate change/disaster management policy-space. It also requires the delivery of a package of solutions that recognizes the inalienable right of cold desert communities for a secure and equitable life while protecting the ecological integrity of a region that is highly vulnerable.

MANAGEMENT OF ENVIRONMENTAL THREATS

Preventing changes in the environment with potentially negative impacts and mitigating and responding to human pain and misery from natural hazards have been a priority and a continuing effort by governments of all nations. State and non-state agencies have traditionally focused on emergency responses, rushing in humanitarian relief to victims of disasters. The escalating frequency and growing magnitude of natural hazard linked disasters and their impacts, have led scientists and policymakers evolve management frameworks and programmes to address causal elements of natural hazards. This however has tended to be domain-specific, climatologists working on management of climate change and disaster management specialists on disaster mitigation and relief.

Climate Change: While climate change is a natural process of evolution, the damaging pace and nature of the change is primarily human-induced. Mitigation interventions are aimed at reducing these adverse impacts of human actions and lifestyles on the atmosphere and primarily involve ways to reduce CO₂ emissions. The key protagonists for the search for and institution of emission-reduction methods are governments of nations and international treaties and policies at the national level. The development of technologies and practices that reduce human impacts on the atmosphere, as well as their adoption by citizens, are of course contributions by the larger society towards mitigation of climate change.

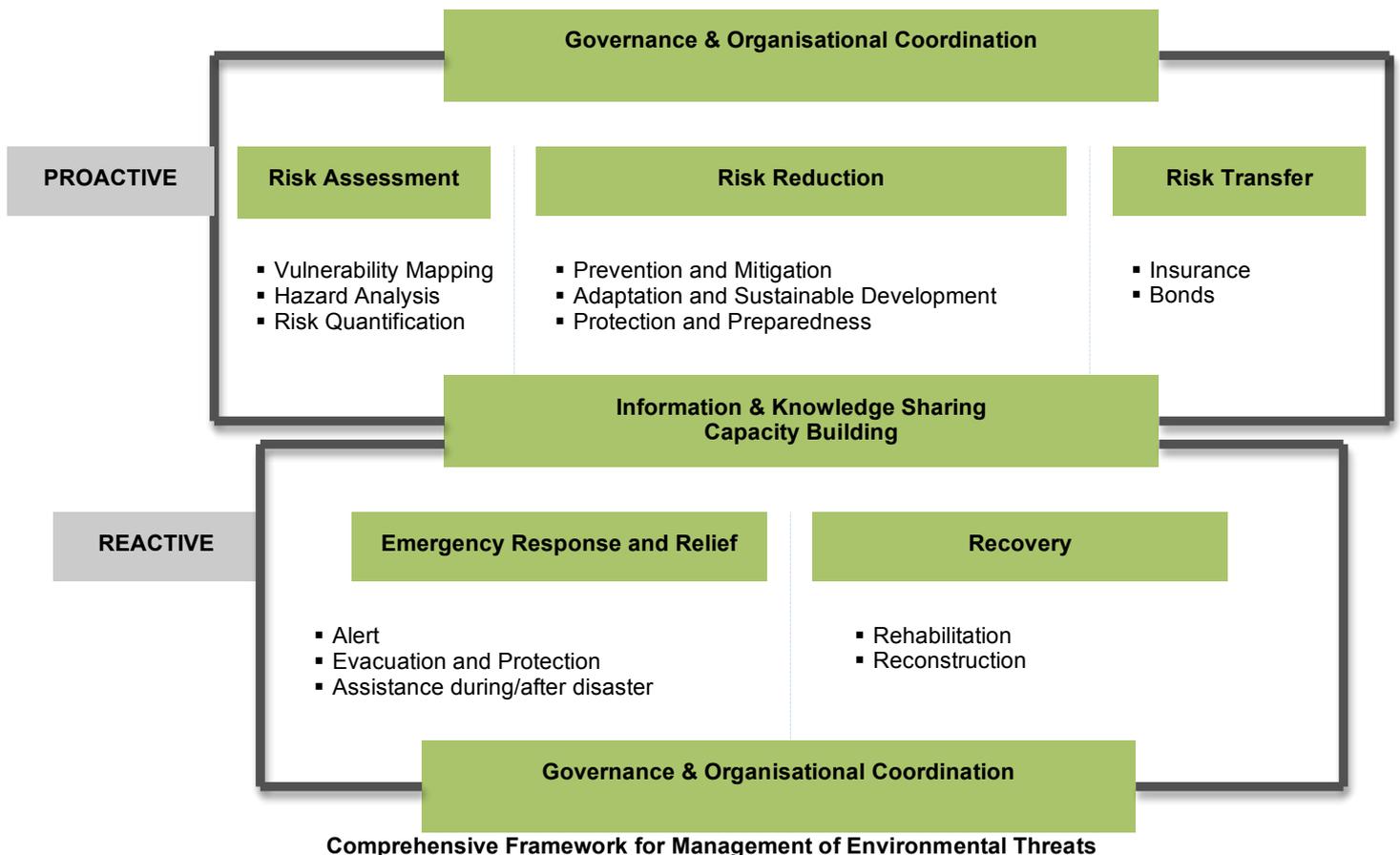
It is however understood that in spite of mitigation efforts, some degree of climate change is bound to occur, and human beings in their lives and livelihoods would feel its impacts. IPCC's 2001 Assessment Report shows that some level of climate change (hence, the associated increase in environmental threats) is inevitable irrespective of emission reduction strategies. Hence, adaptation is deemed as an essential strategy to complement the emission reduction efforts. This would call for raising the adaptive capacity of human beings and institutionalizing alternate lifestyles/livelihoods that enable survival and progress in a changed climate regime. Adaptation measures tend to lie more with individuals and communities and interventions are seeking to build

adaptive capacity at the micro-scale and local level. However, many of the nations are more focused on international negotiations on climate change, rather than devoting serious attention for adaptation strategies.

Disaster Management: Disaster management has tended to be attuned to the nature of the disasters, while preparedness for emergency responses, including evacuation and relief, have been the focus for sudden onset disasters. Development programmes that seek to prevent disaster occurrence have been the thrust of policies and interventions addressing the slow-onset disasters such as droughts. The distinction is beginning to blur however. Due to increasing concern rising from climate change, there has been a shift of focus from “reactive response to losses and/or disasters” towards “developing resilience to probable hazards”. A more planned approach that blends development programmes with emergency and relief responses is beginning to emerge. India’s Five Year Plans too have traditionally not included issues related to management and mitigation of natural disasters. The general guidelines have been limited to the concept of ‘calamity relief’ - essentially a non-plan item of expenditure. Nonetheless, in recent years, movements towards hazards preparedness have started. Measures designed and implemented at the community level are gaining importance as well, particularly for strengthening of communities to better respond to crisis situations and cope with disaster events. However, there has always been a general reluctance to humanitarian assistance for slow onset disasters unlike the ‘shocks’ and ‘trigger events’. They fail to generate a significant response for among the larger community.

A Comprehensive Framework

When addressing the vulnerability of rural communities, especially those in remote areas such as the Himalayan cold deserts, there is a need to draw together these two sets of constructs – of Climate Change (Mitigation and Adaptation) and Disaster Management (Development and Humanitarian Responses). A focus on **Environmental Threats** would allow a holistic addressing of all natural hazards, climate change associated and otherwise. This is especially because rural communities do not, in general, have a high degree of exposure to other forms of threats, such as industrial hazards, that cities have a high exposure to, that are however not related to forces of nature. An integrated response strategy for environmental threats involves - identification and assessment of likely hazards, developing resistance (through prevention, mitigation), building resilience and the adaptive capacity, and creating preparedness along with an implementation framework for post-disaster measures including emergency response, relief and reconstruction.



Goals of the Comprehensive Framework for the Management of Environmental Threats:

- 1) Retard/reverse trends of damage to the environment.
- 2) Improve adaptive capacity of socio-ecological systems.
- 3) Prevent disasters and mitigate risk of occurrence.
- 4) Protect, build resistance and mitigate impacts of disasters.
- 5) Enhance resilience of socio-ecological systems.

Key Constructs

A. Risk Assessment

Risk Assessment is a methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend (ISDR Terminology of disaster risk reduction). The process is based on appraisal of technical features such as location, intensity, frequency and probability of disasters and analysis of the physical, social, economic and environmental dimensions of vulnerability and exposure under various risk scenarios.

- **Vulnerability mapping** is the systematic study for assessing the impact of various factors on the physical and social environment.
- **Hazard Analysis** refers to identification, in depth study and regular monitoring of potential hazards to determine its likelihood of occurrence, origin, characteristics and nature of impact. This facilitates the administrators to delineate the hazard prone areas, generate scenarios based on magnitude, intensity, frequency etc for preventive actions and prioritize the activities for mitigation efforts.
- **Risk Quantification:** Vulnerability is defined as the extent to which a community, structure, service, or geographic area is likely to be damaged or disrupted by the impact of a natural hazard. Exposure is the total value of elements at-risk, usually expressed in terms of human deaths and value of the properties that can potentially be affected by hazards. These help in quantifying the environmental threats.

B. Risk Reduction

Disaster Risk Reduction involves the systematic process of administrative decisions, organization, and implementation of strategies to develop and improve coping capacities of the society/communities to lessen the impacts of natural hazards and related environmental threats. Risk reduction comprises all initiatives, including structural and non-structural measures to avoid (prevention) or reduce the occurrence of disasters and to limit (mitigation and preparedness) the impacts of disasters within the broad context of sustainable development.

- **Mitigation:** Mitigation refers to interventions aimed at reversing/retarding the environment damaging trends and thus the potential of occurrence of associated natural hazards. It also refers to measures taken to counter and reduce the impacts of disasters. Mitigation measures would include engineering/structural measures (such as provision of quick drainage facilities, check dams, weirs, etc., for flood proofing) as well as non-structural measures and tools (e.g. flood plain zoning, information portals) to avoid or limit the adverse impact of natural hazards and related environmental disasters. Early warnings and conscious developmental planning are deemed as key elements for preventive planning.
- **Prevention:** These include activities to provide outright avoidance of the adverse impact of hazards and minimize related disasters and promotion of "culture of prevention". Depending on social and technical feasibility, concentrating on preventive measures is useful in disaster prone areas. These could include protecting existing or rehabilitating degraded environmental systems that have the capacity to reduce natural hazards.
- **Adaptation:** This involves measures aimed at strengthening of Coping Capacity and Resilience of the communities and the region as a whole. Coping capacity is that by which people or organizations use available resources and abilities to face adverse consequences of a disaster. This involves managing resources, both during normal as well as crises situations. Resilience is the capacity of a system, community or society to adapt, by resisting or changing in order to reach and maintain an equilibrium level. This is the degree to which the social system is capable of organizing itself through learning from past disasters to improve risk

Early warning systems include:
understanding and mapping the hazard; monitoring and forecasting events; disseminating clear warnings to political authorities and local population, undertaking appropriate actions in response.

reduction measures.

- **Preparedness:** Disaster Preparedness may be described as (a series of) measures designed to organize and facilitate timely and effective rescue, relief and rehabilitation operations in cases of disaster. Measures of preparedness include among others, setting up disaster relief machinery, formulation of emergency relief plans, training of specific groups (and vulnerable communities) to undertake rescue and relief, construction of protective infrastructure, stockpiling supplies and earmarking funds for relief operations. It includes pre-disaster activities and measures to ensure effective response to the impact of hazards, including communication of timely and effective early warnings, and temporary evacuation of people from threatened locations.

Community Based Disaster Risk Reduction

Over the years, the element of community-based management has gained considerable significance in disaster response. Considerable efforts are underway to form and strengthen community-based organizations at grassroots levels to combat disasters. It includes awareness-raising activities to foster behavioural change towards a “culture of risk reduction” among the common people, increasing levels of consciousness about risks and how people can act to reduce their exposure to hazards.

This approach integrates the vast experience of the local people in local problems and their traditional knowledge, and helps in developing community spirit required during the calamities.

C. Risk Transfer

This refers to insurance and reinsurance coverage for both physical damage and interruption in business/other economic activities that entitle cash compensation immediately after a disaster. Along with the monetary assurance, insurance brings in quality in the infrastructure and “a culture of safety” (e.g. through regulations regarding building codes, norms, guidelines, quality materials in construction etc).

D. Relief & Reconstruction

In spite of the paradigm shift from ‘reactive response’ to ‘developing resilience to probable hazards’ as an adaptation agenda to climate-change implications, reactive measures remain vital. Relief and Recovery measures comprise the post-disaster Reactive measures.

Relief: Relief is the provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term, or protracted duration (ISDR Terminology of disaster risk reduction). A successful relief measure should be able to respond immediately to the comprehensive needs of the victims of disaster and maintain minimum standards and equity in relief. While addressing the relief requirements, focus should be placed on the special needs of the children, women, aged and the disabled. Hence, monitoring and evaluation of the activities become critical.

Recovery: Recovery measures (rehabilitation and reconstruction) involve decision-making and measures undertaken after a disaster event with the intent of restoring the pre-disaster living conditions or improving of the life and livelihood of the disaster affected people. It also includes encouraging and facilitating necessary adjustments to reduce disaster risk. In India, the basic responsibility for undertaking rescue, relief and rehabilitation measures generally rests with the concerned State Governments with the Central Government playing a supportive role.

Disaster events wreck havoc by increasing poverty, increasing the number of vulnerable populations, and have significant other socio-economic, political, psychological and gender impacts. Gender issues shape the human response to disasters. Studies show that women are most vulnerable to the social impacts of the disasters, and hence, integration of gender issues should receive a major focus in disaster management and preparedness for environmental threats. Well-developed coordination mechanisms need to emerge between different levels of government, between various departments dealing with disaster response; government, private sector and NGOs; international agencies and different countries.

Level of environmental threats and occurrence of natural disasters are not bound by political boundaries. Disaster preparedness and relief measures depend on international cooperation between neighbouring countries as most of the hazard prone stretches along major rivers and mountain chains spread across these neighboring countries. Hence, universal cooperation and use of state of the earth technology, along with sustainable policy decisions are essential for dealing with environmental threats and associated disaster risk.

Management of Environmental Threats in the Himalayan Cold Deserts

The Himalayan region contains one of the most dynamic and complex mountain systems in the world, and one that is extremely vulnerable to global warming². Climate change is gradually and powerfully changing the ecological and socio-economic landscape in the Himalayan region. It is therefore imperative for environmental decision makers and managers to revisit and redesign research agendas, development policies, and management and conservation practices, and develop appropriate technologies. The mitigation of carbon emissions should be a responsibility shared between citizens and the private sector in the mountains, as elsewhere. Adaptation and mitigation measures intended to cope with climate change can create opportunities as well as offset the dangers of a warming planet; but they must be identified and adopted ahead of, rather than in reaction to, dangerous trends. Policies should be ‘adaptation friendly’³.

The cold deserts of the Himalayas need specially focused research and a concerted effort at environmental threat management, especially in the context of climate change. Historically, the remoteness and inaccessibility, the geographical spread and low population concentration, along with the cultural distinctiveness of these regions, has led to their isolation. Development policies and schemes applied to them have been the same as those applied for hot, arid regions, disregarding their uniqueness and its implications on policy. At the same time, development trends are leading to increasing degradation of the cold desert environments. Much remains to be done to make cold desert communities capable of managing environmental threats.

Key Issues

1. **Extreme vulnerability to environmental threats of magnitude:** As mentioned, the Himalayan cold deserts are highly vulnerable to severe impacts of climate change and associated disasters. Topographic influences tend to trigger a chain of related catastrophic events in case of rapid-onset disasters making the region multi-hazard prone at a given time. For example: an earthquake triggers off a landslide, leading to damming of natural river channels, further resulting into a catastrophic flood as the dam breaches under water pressure. Geotectonically active mountains add to the concerns.
2. **Remoteness and inaccessibility makes response difficult:** The region has a harsh climate with severe, snow-bound winters during which it is completely cut-off from the rest of the world. Most of the region is inaccessible because of its difficult terrain (steep slopes and villages located above 8000 feet. Poor road infrastructure and lack of adequate communication facilities compound the problem and add to the inadequacy to cope with disasters.
3. **Low adaptive capacity of the socio-ecological system:** The mountain communities in the region depend almost entirely on the limited natural resources for sustenance. An arid climate and fragility of the ecosystem results in low carrying capacity. Short growing season and negligible annual precipitation makes recovery and adaptation difficult for the traditionally agro-pastoral mountain communities.
4. **Inadequate preparedness:** Although aware of the risks, the communities are unable to adapt themselves due to lack of scientific knowledge and appropriate training. There is lack of awareness that disaster can be minimized by proper scientific measures. Communities see disaster events as a natural phenomenon over which they have no control. Excessive dependence of the community on the government poses a huge challenge for community based disaster management and effective implementation of required measures.
5. **Political and geopolitical pressures hold up preparedness and response:** State attention is lower because of the peripheral location of the region and the low density of population. The disaster events are also frequently of a transboundary nature, for example, GLOFs, and require international cooperation for effective response.

As a distinct biome, cold deserts need specially focused research and a concerted effort in terms of natural

² Bandyopadhyay and Gyawali, 1994 cited in Eriksson et al., 2008

³ Eriksson, M., Jianchu, X., Shrestha, A. B., Vaidya, R., Nepal, S., Sandstrom, K. 2008. The changing Himalayas–Impact of climate change on water resources and Livelihoods in the Greater Himalayas

disaster management, especially in the light of their vulnerable ecosystems and high susceptibility to natural disasters. The physical manifestations of climate change in the mountains include locally, possibly regionally, extreme increases in temperature and in the frequency and duration of extreme events. To reduce uncertainty about the rate of climate-induced changes in the Himalayas, we need well-equipped baseline stations, long-term monitoring, networking, open data exchange, and cooperation between all Himalayan countries.

Besides, climate change is not new to Himalayan people. During very long time periods every aspect of life has been adapted to, or stressed by, changing temperature regimes, water availability, and extreme events. Mountain people have lived with and survived great hazards such as flash floods, avalanches, and droughts for millennia. Building on this capacity to adapt and strengthening the socio-ecological system in the face of climate change is extremely important and an important step in achieving sustainable livelihoods. Adaptive policies and major efforts to reverse the human drivers of climate change have to be incorporated into all sectors: land use, water management, disaster management, energy consumption, and human health. The authorities, while strengthening the existing relief measures will also have to take specific and urgent interventions to make the communities more resilient to the increasing environmental threats.

Good science based on credible, salient, legitimate knowledge can often lead to good policies in the context of climate change and mountain specificities, and vice versa. Scientific knowledge is useful, but limited and full of uncertainties on the complex Himalayan scale. Multiple, sometimes contrasting, perspectives merge together in decision-making processes. In such processes, scientists have to generate new knowledge with reduced uncertainty to facilitate a fact-based dialogue. In such processes, international cooperation is essential for the transfer of technology from outsiders to locals, to build regional cooperation into a global programme, and to develop the capacity to downscale important results to the regional scale.