Adapting to Climate Change: Natural Resource Management and Vulnerability Reduction

Background Paper to the Task Force on Climate Change, Adaptation and Vulnerable Communities

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LIST OF ACRONYMS

APF	Adaptation Policy Framework (UNDP/GEF)
COP	Conference of the Parties
FAR	First Assessment Report (IPCC)
GEF	Global Environmental Facility
IPCC	Intergovernmental Panel on Climate Change
LDCs	Least Developed Countries
NAPAs	National Adaptation Programmes of Action
NRM	Natural resource management
SAR	Second Assessment Report (IPCC)
TAR	Third Assessment Report (IPCC)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
V&A	Vulnerability and Adaptation
WG	Working Group
IDNDR	International Decade for Natural Disaster Reduction
NFIP	National Flood Insurance Program

EXECUTIVE SUMMARY

The sharpest impact of our changing climate on human systems will be the rise in incidence and severity of climate-related disasters. The two main disciplines concerned with human vulnerability to climate extremes are disaster management and climate change. While disaster managers develop and implement hands-on tools for reducing vulnerability to natural hazards, they have yet to incorporate the implications of climate change into their work. Climate change researchers and policymakers are increasingly focusing on adapting to a changing climate, but have not yet spelled out how to do so with ground-level action. Working from different point of departure, both disciplines have come to a common conclusion, that natural resource mismanagement contributes to the vulnerability of human systems to these hazards, and enhanced management can provide a tool for vulnerability reduction.

In the context of identifying cost-effective climate change adaptation strategies, the targeted conservation of natural buffer systems offers several striking co-benefits:

- Biodiversity conservation
- Poverty alleviation
- Reduced demand for international humanitarian assistance
- Enhanced sink capacity

In these pages, we suggest that protecting the integrity and diversity of nature, while ensuring that any use of natural resources is equitable and ecologically sustainable, provides a "tool kit" from which both disciplines might collaboratively draw to diminish the vulnerability of human systems to climate-related hazards. And we suggest that the case for conservation and restoration of natural spaces might be made more compelling through identification of the protective functions provided by natural systems to communities and nations.

It is alleged that destruction of coastal wetlands, dunes and mangroves may eliminate vital natural shock absorbers for storms, while deforestation can increase the likelihood of flooding. Both traditional communities and modern nation-states have developed disaster risk mitigation tools based on conservation of natural systems that provide 'protective' services. Yet in spite of the intuitive fit between natural resource mismanagement and vulnerability, there is little policy relevant research documenting and rigorously assessing the linkages. This gap in the literature is the basis for the present task force. There is a compelling need for further inquiry, for the compilation of such research that can bridge the divide between disasters, climate change and conservation.

1. INTRODUCTION

1.1 Addressing Global Environmental Change: The Task Force's Mission

"Yet we can use nature as a convenient standard, and the meter of our rise and fall"

- Ralph Waldo Emerson

A central concern in the policy debate over climate change, environmental degradation and recurrent disasters is the capacity of human social and economic systems to prevent, mitigate and recover from climatic hazards. Adaptation to heightened risk, in a context of increased uncertainty and rapid change, requires new concepts and tools. Addressing that challenge is the motivation for this task force.

Global climate change is caused by an intricate chain of both micro and macro social and environmental processes. Addressing it forces us to distinguish global transformations in atmospheric, biospheric and human systems, from other pervasive environmental problems and hazards. Meshed with the problems of scale – what to include – are the problems of complexity – how to account for it. These issues pose formidable challenges for modelling, predicting, and monitoring environmental change[1].

In the face of this complexity, analysts urge decision-makers to apply the "Precautionary Principle". As firm scientific evidence may arrive too late for effective action to take place, uncertainty should not be an excuse for failure to act. While international negotiations aimed at reducing the sources of climate change proceed, efforts to respond to the consequences must likewise be developed and implemented. But what are the best actions to take in responding to the consequences of climate change?

Facing the reality of competing priorities and limited resources, actions are more likely to be implemented if they offer benefits that outweigh the costs. Estimating the benefits of particular measures in response to climate change may be difficult or impossible. For that reason, those measures whose non-climate change-related benefits exceed the costs are the measures most likely to be adopted and implemented. These are options offering co-benefits, and their identification and promotion is a primary goal of this project.

An emerging body of evidence, exemplified by the Abramovitz study (2001), indicates that natural resource mismanagement contributes to the vulnerability of human systems to disaster, and that enhanced management can provide a tool for vulnerability reduction. If so, targeted conservation of particular natural buffer systems will in many circumstances offer no-regrets adaptation opportunities. And the tools for implementing effective management of natural areas have been developed through over a century of experience by conservationists, typified by IUCN-The World Conservation Union and its members.

The goal of this discussion paper is therefore to lay the basis for discussing the following question:

Can targeted natural resource management make a substantial and cost-effective contribution to reducing the vulnerability of human systems to climate-related natural hazards? If so, how?

1.2 Towards a Common Agenda on Climate Change and Disaster Vulnerability Reduction

Today, there are two main disciplines concerned with human vulnerability to climate extremes – those of climate change and disaster management. In turn, these disciplines employ two distinct approaches to the issue of vulnerability.

The climate change arena – broadly speaking, the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC) frameworks, and the array of research and advocacy entities that interact with these – has tended to identify increased human vulnerability to climate extremes as a likely outcome of climate change. As such, it has advised and undertaken research on vulnerability, produced an array of vulnerability assessments, and to a lesser extent, advised and undertaken assessments of climate change adaptation.

Although the climate change community is guiding and encouraging analysis and assessment, its work remains largely scientific and theoretical, and does not yet involve practical, ground level action. In fact, researchers and policy makers in this arena have yet to make concrete and specific recommendations for *how* adaptation ought to be undertaken, and have not actively engaged in responses to specific instances of human vulnerability. Furthermore, the concrete recommendations that have been made have tended to involve large-scale structural adjustments.

The disasters community, on the other hand, which is starkly aware of the rising toll of climate extremes, is directly engaged in developing and applying tools for disaster response and vulnerability reduction. The United Nations' International Decade of Natural Disaster Reduction 1990-2000 (IDNDR) was a multilateral effort to tackle the root causes of vulnerability to hazards, and to integrate disaster management into sustainable development. It emerged not only in response to the rising human and economic costs of disasters, but also in recognition of the potential for these impacts to be reduced through preventative activities[2]. Yet while the IDNDR was successful in raising the prominence accorded to disaster planning, the toll of disasters continued to rise through the 1990s as a consequence of the continuing rise in vulnerability[3].

The disasters community has yet to adequately internalise the very direct implications of a changing climate – i.e., the increased frequency and intensity of extreme climatic events. There are a number of reasons for these unrealised linkages between both communities, some of which will be touched upon below.

The point to be made, however, is that although these two communities have come to use somewhat different language or apply shared terminology in slightly different ways as a result of distinct evolutionary paths, they share a common core objective of reducing human vulnerability to climate-related disasters. To do so, the disasters community speaks of vulnerability reduction measures while the climate change community refers to adaptation options. In essence, they seek the same thing. As such, the work of each could benefit tremendously from increased research and policy linkages between the two. As one authority put it, "recognition [of these linkages] would strengthen action related to global change by focusing attention on the most obvious and devastating manifestations of change – natural hazards and disasters"[4].

Working from different point of departure both disciplines have reached a common conclusion – natural resource mismanagement contributes to the vulnerability of human systems to climatic hazards, and enhanced management can provide a tool for vulnerability reduction.

In these pages, we suggest that protecting and restoring the integrity and diversity of nature while ensuring that any use of natural resources is equitable and ecologically sustainable provides a "tool kit" from which both disciplines might collaboratively draw, to diminish the vulnerability of human systems to climate-related hazards. And we suggest that the case for conservation of natural spaces might be made more compelling through identification of the protective functions provided by natural systems to communities and nations.

This paper explores the following aspects of environmental change, vulnerability and disaster prevention and mitigation:

Section II gives an outline of the relevant streams in the Climate Change Adaptation discussion, highlighting the growing importance of adaptation, and of enhanced natural resource management as a component of adaptation, in that discussion.

Section III explores the tools used by disaster risk managers in grappling with climatic hazards. In particular, it seeks to identify the sources of vulnerability to climate-related hazards stemming from environmental mismanagement.

Section IV seeks to identify some of the opportunities for targeted Natural Resource Management to reduce vulnerability to climate-related hazards, outlining the substantial co-benefits that can be realized through such an approach.

2. HUMAN RESPONSES TO CLIMATE CHANGE: ADAPTATION

2.1 The Scale and Nature of Global Environmental Change

At the dawn of the 21st Century, the scale of human induced changes to atmospheric and biospheric processes over the last century has had discernable impacts on climate patterns and life forms on the planet. Smil (1993) distinguishes three major aspects of global environmental change:

- The changing composition of the atmosphere;
- The loss of biodiversity and onset of a global extinction crisis; and
- The declining availability of critical resources and services.

Scale shifts are a crucial aspect of any analysis of global environmental change. Some phenomena are occurring at a planetary scale, such as shifts in the Earth's radiation balance and decline in stratospheric ozone. Other processes are taking place at the regional, national and local scale. These include soil erosion and salinisation, depletion and pollution of aquifers, deforestation and biodiversity loss.

Many sources of environmental change are rooted in local patterns of resource extraction and utilization, yet in aggregate have a global impact. Human induced environmental change is arguably affecting the climate and biogeochemical cycles of our planet, cycles that are critical to sustaining life on Earth.

This chapter concerns itself primarily with the international science and policy debate surrounding the likely consequences of, and measures for responding to, increased atmospheric concentrations of greenhouse gases due to human activity. The chapter provides an overview of the history and evolving direction of adaptation debates within the climate change policy and research context, laying the groundwork for subsequent discussion on the integration of natural resource management tools into emerging adaptation strategies.

2.2 Responding to Climate Change: Mitigation and Adaptation

In the face of climate change the global community, nations and local communities are undertaking action along two primary tracks: **mitigation** – the process of reducing greenhouse gas emissions and, thereby, associated climate change; and **adaptation** – the process of adjusting in response to, or in anticipation of, climate change.

Adaptation is not a new concept. Traditionally employed by ecologists, it has referred to the evolutionary process by which living organisms mould into a new environment. By broadening the scale of reference, the concept of adaptation can be used to describe how systems, both natural and human, evolve over time when faced with environmental changes. Most spontaneous or autonomous adaptation has taken place as part of the evolutionary process through which biotic communities have migrated or modified their structure and function in order to accommodate shifts in temperatures, rainfall, available nutrients and habitat.

Box 2.1: Adaptation and Adaptive Capacity

Adaptation is the process of adjusting in response to, or in anticipation of, changed conditions. In the climate change context, more specifically, it is adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts.[5]

Adaptive Capacity, according to IPCC WG II, is the "potential or ability of a system, region, or community to adapt to the effects or impacts of climate change".[6]

In anticipation of foreseeable shocks, vulnerable communities have long employed adaptive measures. Today adaptation is considered a central element in societies' efforts to cope with the expected shocks and climatic shifts associated with climate change.[7] In the climate change context, adaptation can take the form of autonomous, reactive, or anticipatory action. **Autonomous adaptation** to climate change is essentially an unconscious process of system-wide coping, most commonly understood in terms of ecosystem adjustments.[8] **Reactive adaptation**, as the name implies, involves a deliberate response to a climatic shock or impact, in order to recover and prevent similar impacts in the future. **Anticipatory adaptation** involves planned action, in advance of climate change, to prepare for and minimise its potential impacts. Such actions can aim at enhancing the buffering capacities of natural systems in the face of climate extremes.

In assessing the economic efficiency of alternative adaptation strategies, analysts distinguish between 'no-regrets' and 'co-benefits' measures. **"No-regret" strategies** are those measures reducing vulnerability whose non-climate change-related benefits exceed the costs of implementation. They are desirable whether or not climate change is taking place. An example would be to reduce vulnerability to current climate-related variability and extremes, such as through flood-control structures, most likely also reducing vulnerability to shifts in risk due to climate change[9]. **"Co-benefit" strategies**, on the other hand, are designed specifically to reduce

climate change-related vulnerability while also producing corollary benefits that are not related to climate change.

2.3 Climate Change Adaptation: Where do we Stand Today?

It is only quite recently that adaptation has begun to gain footing as a central focus of both research and debate. The climate change research and policy arena is a complex collection of actors with a rich and compelling history. Broadly speaking, the climate change arena of the 1970s could be defined by climatological research; during the 1980s, the climate research orientation was blended with a new focus on mitigation options; during the 1990s, a third element – impact, or vulnerability assessment – was added. After years of being relegated to the peripheries of climate change discussions, adaptation issues were given greater attention through a number of key developments in 2001. Among these were:

IPCC Third Assessment Report

Initial development (under UNDP/GEF) of new adaptation assessment guidance known as the Adaptation Policy Framework (APF); and

The Marrakech Accord, which created three new funds to assist developing countries to adapt to climate change.

Mitigation and the question of how greenhouse gas emissions will be reduced has unquestionably been the predominant focus of the climate change policy and research arenas.[10] Addressing climate change begins first and foremost with determining how to slow or prevent its onset, and thus with the mitigation of greenhouse gas emissions. The practical result is that adaptation has not been adequately dealt with, even in light of the consensus that certain climate change impacts are unlikely to be averted, regardless of mitigation efforts.

Why has this been the case? At the simplest level, the **process and actions of adaptation are generally seen as a response to vulnerability,** and as such, it has been necessary for the research and policy communities to gain a handle on the potential impacts of climate change, and on the range of societal vulnerabilities to these impacts, in order to translate these findings into adaptation measures. In recent years, the growing breadth and sophistication of climate models, impact assessments and related literature has provided the basis for more concrete statements regarding impacts and vulnerability. In addition, there has been a perception that if the industrialised nations – the primary polluters – were to invest in adaptation efforts, this would indicate a *fait accompli* on a changing climate change, and lessen pressure on these nations to move ahead with mitigation measures.

Box 2.2: Vulnerability and Sensitivity

Vulnerability defines the extent to which climate change may damage or harm a system; this depends not only on the system's sensitivity, but on its ability to adapt.[1]

Sensitivity is the degree to which a system will respond to a given change in climate; it measures, for example, how much the composition, structure, and functioning of an ecosystem will respond to a given temperature rise.[1]

A recent example of improvements in assessing vulnerability can be found in the 1998 IPCC report entitled the *Regional Impacts of Climate Change: An Assessment of Vulnerability* (Watson *et al.*, 1998), which expanded upon the IPCC's Second Assessment Report (SAR) and its synthesis of impact assessments. This report provided detail on key sectoral vulnerabilities (e.g., ecosystems, water resources, food production, human health) within each region, and outlined a range of implications of these vulnerabilities.

While the SAR did not undertake concrete adaptation recommendations, it stressed an important observation – namely, that many systems are poorly adapted to *today's* climate and climate variability, and that an important starting point for climate change adaptation would be to tackle the so-called "win-win" or "no-regrets" options that strengthen resilience of these systems to today's conditions. It also echoed earlier suggestions that building sectoral resilience should be thought of as part of the broader sustainable development process.

Nonetheless, strides in vulnerability research did not bring concrete adaptation issues to the fore of climate change discussions. Within the research and policy community, adaptation has been thought of as the second step in the larger process of Vulnerability and Adaptation Assessment, a component of each country's National Communications. In the mid-1990s, several new guidelines were developed in support of the National Communications process, and in particular, in support of Vulnerability and Adaptation (V&A) Assessment.[11] Box 2.3 provides an overview of the steps recommended by IPCC in its 1994 Technical Guidance on the V&A assessment process.

Even at this time, while the guidance and modelling tools for assessing vulnerability were becoming quite rich, that available for generating adaptation options was comparatively weak.[12] According to the available guidelines, adaptation assessment consisted mainly of identifying sector-specific adjustments – often large-scale and structural – and of conducting econometric cost-benefit analyses to select the most suitable among these.

Box 2.3: IPCC Seven Steps for Assessing Climate Change Impacts and Adaptations[13]

1. Define problem (including the study area, its sectors etc.)
2. Select method of assessment most appropriate to the problems
3. Test method/conduct sensitivity analysis
4. Select and apply climate change scenarios
5. Assess biophysical and socio-economic impacts
6. Assess autonomous adjustments
7. Evaluate adaptation strategies

The national assessments were completed in the late 1990s and were similarly thorough in assessing vulnerability, but tended to say little about adaptation.[14] Those that did address the question of adaptation tended to focus on sector-wide adjustments and "hard" infrastructure measures, such as seawalls and groins in preparation for increased storm surge. According to the *Third Assessment Report (TAR) 2001* "only a small fraction [of adaptation assessments] include comprehensive and quantitative estimates of adaptation options and their costs, benefits, and uncertainty characteristics".[15]

This deficit in adaptation assessment, cited by many countries, did not go unnoticed by the research community, inter-governmental support programmes, the IPCC or international negotiation process. Partly as a result of this, the late 1990s saw a marked growth in the adaptation literature, an increase in institutional attention toward the issue (e.g., within GEF, UNEP, UNDP, World Bank).[16]

Likewise within the UN Framework Convention on Climate Change (UNFCCC), Article 3.3 of the Framework states that:

"The Parties should take precautionary measures to anticipate, prevent or minimise the causes of climate change and mitigate its adverse effects. Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing such measures, taking into account that policies and measures to deal with climate change should be cost-effective so as to ensure global benefits at the lowest possible cost."

How this is to be accomplished is dealt with in broad, non-specific terms, most notably, in Articles 4.1, 4.4, 4.8, and to a lesser extent, 4.9. In Article 4.1 ("Commitments"), Parties to the Convention, "taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances", agree to perform the following activities, related to adaptation:

(b)....Formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing […] measures to facilitate adequate adaptation to climate change; […]

(e)....Cooperate in preparing for adaptation to the impacts of climate change; develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods;

(f)....Take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions […] with a view to minimising adverse effects […] of projects or measures undertaken by them to mitigate or adapt to climate change; […]

In terms of assistance to poor countries: Article 4.4, dealing broadly with funding, commits developed country Parties to "assist the developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects". Listing a number of types of countries that should be considered particularly vulnerable, Article 4.8 calls for developed country Parties to "give full consideration to what actions are necessary under the Convention, including actions related to funding, insurance and the transfer of technology, to meet the specific needs and concerns of developing country Parties arising from the adverse effects of climate change and/or the impact of the implementation of response measures".

The first mention of adaptation as an expenditure goal came at the third Conference of the Parties. At that meeting, UNFCCC Parties agreed to the Kyoto Protocol, which defined the Clean Development Mechanism (CDM). Within the CDM, financing is to be made available to assist developing countries that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation. At the next meeting in Buenos Aires in 1998, governments decided funding could be made available to developing countries to prepare for adaptation activities.

Box 2.4: Initial Guidance from COP-1 on Adaptation (11/CP.1)[17]

"Stage I: Planning, which includes studies of possible impacts of climate change to identify particularly vulnerable countries or regions, and policy options for adaptation and appropriate capacity building.

Stage II: Measures, including further capacity building which may be taken to prepare for adaptation as envisaged in Article 4.1(e).

Stage III: Measures to facilitate adequate adaptation, including insurance and other adaptation measures as envisaged by Articles 4.1(b) and 4.4."

Following the broad political compromise reached in July 2001, Governments decided to establish three new funds to assist developing countries with adaptation at UNFCCC COP7. The following three funds are part of the Marrakech Accord:

Special Climate Change Fund, operated by the GEF with guidance to the Convention, to finance adaptation, technology transfer, in energy, transport, industry, agriculture, forestry and waste management.

Least Developed Countries Fund, operated by the GEF with guidance to the Convention, to support National Adaptation Programmes of Action (NAPAs, described below).

Kyoto Protocol Adaptation Fund, resourced by the share of the proceeds on CDM project activities, to finance concrete adaptation projects and programmes

Box 2.5: The Kyoto Protocol Adaptation Fund

In Bonn, July 2001, the Conference of the Parties agreed to the following parameters of an adaptation fund:[18]

1. An adaptation fund shall be established to finance concrete adaptation projects and programmes in developing country Parties that have become Parties to the Protocol.

2. The adaptation fund shall be financed from the share of proceeds on the clean development mechanism project activities and other sources of funding.

3. Annex I Parties that intend to ratify the Kyoto Protocol are invited to provide funding, which will be additional to the share of proceeds on clean development mechanism project activities.

4. The adaptation fund shall be operated and managed by an entity which operates the financial mechanism of the Convention, under the guidance of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol, with guidance to be provided by the Conference of the Parties in the period prior to entry into force of the Kyoto Protocol.

The evolution towards addressing adaptation is reflected in the IPCC's *Third Assessment Report (TAR)* and the forthcoming UNDP/GEF *Adaptation Policy Framework (APF)*. The TAR does so through a comprehensive literature review; the APF by creating the research and assessment framework around which the next (or, perhaps more accurately, first) generation of adaptation strategies can take shape.

The TAR goes beyond previous discussions of adaptation, consolidating the literature on selecting adaptation options and arguing that building adaptive or "coping" capacity of most vulnerable groups and systems to *today's* climate variability and extremes is a critical, "no-regrets" first step in adapting to climate change and reducing climate impacts.

The APF seeks to integrate short, medium and long-term climate change threats into national planning and development strategies. The result is intended to be a policy assessment framework that assists non-Annex I (developing) countries in identifying those "win-win" adaptation options that can enable them to lower exposure to present climate variability, while increasing adaptive capacity to long-term climate change threats.

Whereas the TAR may guide future research and policy toward a more robust mix of adaptation measures – including natural resource management – the APF is a policy assessment tool that calls directly for consideration (and integration) of natural resource and environmental management options. Moreover, it calls for taking environment and natural resource issues (local, regional and global) into account in adaptation planning, and for integrating adaptation strategies with natural hazard reduction and disaster prevention.

From the climate change perspective, this rationale is based on the premise that increased adaptive capacity is a first and most logical response to the complex threat of climate change, and that such capacity can only be attained through commitment to sustainable development. Specifically, IPCC WG II lists a number of requirements for enhancing adaptive capacity, including the following:[19]

→ Improved access to resources

→ Reduction in poverty

→ Lowering of inequities in resources and wealth among groups

→ Improved education and information

→ Diminished intergenerational inequities

→ Respect for accumulated local experience

→ Moderate long-standing structural inequities

→ Assurance that responses are comprehensive and integrative, not just technical

→ Active participation by concerned parties, especially to ensure that actions match local needs and resources

Through these mechanisms, the IPCC's *Third Assessment Report* concludes that "enhancement of adaptive capacity represents a practical means of coping with changes and uncertainties in climate, including variability and extremes. In this way, enhancement of adaptive capacity reduces vulnerabilities and promotes sustainable development."[20]

Today, a convergence of sorts can be seen in available intellectual and institutional resources around the question of adaptation, and indeed, a framework for meaningful inquiry appears to be taking shape.

2.4 Future Directions in Climate Change Adaptation: Integrating Natural Resources Management

Environmental management and mismanagement are moving towards the centre of the adaptation debate. The Policymaker's Summary of the TAR states, "Policies that lessen pressures on resources, improve management of environmental risks, and increase the welfare of the poorest members of society can simultaneously advance sustainable development and equity, enhance adaptive capacity, and reduce vulnerability to climate and other stresses".[21]

Long-term efforts to enhance local level adaptive capacity – though increasingly recognised as critical – are broadly lacking. Responses of governments to climate change vulnerability have tended to be reactive in nature, and the types of adaptation options considered have tended to be gradual autonomous adjustments, or costly structural ones.[22] Structural responses to climate change vulnerability, while an entirely necessary component of many anticipatory adaptation strategies, have dominated discussion. This type of response is not the only one and can be inappropriate in certain contexts.

Non-structural adaptation measures – such as environmental management activities – have until recently been peripheral to the discussion of adaptation. Yet there is evidence this is changing. The TAR noted in 2001 that, "Many of these adaptations – especially in agriculture, water resources, and coastal zone applications – essentially represent improved resource management".[23]

For each country, therefore, it is highly likely that planned adaptation measures will include actions that target particular aspects of natural resource management, in pursuit of sustainable development.

3. DISASTER RISK MANAGEMENT AND VULNERABILITY REDUCTION

Perhaps the sharpest direct impact of the changing climate on human and natural systems will be the increased incidence and severity of natural hazards and disasters, a point made convincingly in Abramovitz (2001). Her study demonstrates that the impact of disasters on regional economies and local livelihoods undermines development, deepening the divide between those who can afford to protect themselves and those who cannot. She notes that while large disasters pose a tremendous and growing threat, that small to medium-sized disasters represent an equal challenge. Yet the experience of the disaster risk management community suggests that disaster risk can be reduced in a cost-effective manner, and that natural resource management can play an important role in such efforts.

This section explores these assertions, highlighting the tools and vocabulary of disaster risk management. It concludes by evaluating these tools and distilling a set of principles to guide vulnerability reduction efforts, noting some of the hypotheses linking vulnerability and mismanagement of natural systems.

3.1 Disasters and Vulnerability

Natural hazards and disasters are defined as major disruptions of livelihoods and economic processes as a result of extreme weather-related or geological hazards combined with vulnerable human systems. Disasters can be caused by teluric hazards, such as earthquakes or volcanic eruptions, or by meteorological events (severe storms, tidal surges, windstorms, hail, snowstorms, hurricanes and drought) and their hydrological and geomorphological responses - floods, mudflows, landslides and coastal erosion. Much of disaster related research has centred on the study of hazards, geared essentially to a better understanding of these recurrent natural cycles.

The classical view of cause and effect in disaster is that an extreme weather event – or hazard – interacts with human vulnerability and risk-taking to produce casualties and damage[24]. It has become accepted however, that natural hazards are necessary but not exclusive ingredients in a disaster. What really defines a disaster is the combination of physical, biological or technological hazards with such factors as economic wealth, population growth and migration as well as the resulting the configuration of human settlement. Together these create patterns of vulnerability.

Vulnerability is "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"[25]. It is both the physical exposure to the hazardous event and the ability to cope with its impacts[26]. As Kenneth Hewitt suggests, "the problem of vulnerability is rooted in impaired adaptive capabilities in addition to defencelessness and structural disadvantage"[27].

Disasters are therefore not created by a threat external to society, but are socially constructed. "*Vulnerability is maintained by economic and other conditions. It is reproduced by the activities that sustain unsafe living conditions for some, or disempower them, and changes only if these conditions are transformed*".[28]

Box 3.1, below, illustrates how conditions of exclusion and structural social and economic disadvantage for the majority of populations in both urban and rural setting create the human conditions of weakness and lack of protection in the instance of a hazard, and the lack of resilience in recovering.

Box 3.1: Vulnerability: Some of the basic forms in which it arises[29]

1. Exposure to dangerous agents and environments.

2. Weaknesses: predisposition of persons, buildings, communities or activities to greater harm.

3. Lack of Protection against dangerous agents and for weaker persons and items.

4. Disadvantage: lack of the resources and attributes to affect risks or respond to danger.

5. Lack of resilience: limited or no capability to avoid, withstand or offset and recover from disaster.

6. Powerlessness: inability to influence safety conditions, or acquire means of protection and relief.

Vulnerability is the product of many processes, including:[30]

→ Poverty and marginalization

→ Social instability and conflict

→ **Population growth,**

→ **Coastal and floodplain settlement,**

→ **Rapid and unplanned urbanisation,**

→ **Overloaded infrastructure,**

→ **Growing economic value of the built environment, and**

→ **Environmental degradation.**

The combination of hazards and conditions of vulnerability are thus the major building blocks of disaster risk.

Because not all communities are equally endowed with social and environmental assets, disaster vulnerability differs between regions, nations, and socio-economic groups. While the human losses stemming from disasters have been declining in recent years, over 96 % of all disaster-related deaths took place in developing countries[31]. Moreover, for these countries, the economic losses from disasters can consume a significant proportion of their GDP and set economic development back by decades. El Nino, for example, is believed to have cost Ecuador US$2 billion in economic losses, more than 12 % of its GNP in 1997-98[32] (see Abramovitz, 2001).

The indirect economic impacts of disasters are substantial in terms of poverty alleviation and sustainable development. Disasters spark unemployment and lead to a loss of investor confidence, increased foreign indebtedness and depletion of capital reserves. They also cause a diversion of funds away from social programs and infrastructure investments, towards less-productive relief and reconstruction efforts. They destabilise natural resource management institutions and overturn efforts at conservation. Critical survival needs take precedence over long-term priorities[33].

Many of the most-vulnerable countries are also located in particularly hazard prone areas, such as Central America, South Asia, and the Pacific Islands Region. Already under stress from the forces of poverty, population growth, urbanization, and environmental degradation, developing countries – in particular the Least-Developed Countries – stand to suffer and lose the most as a result of disasters.

Within these regions and countries, certain sectors of the population are particularly vulnerable to natural hazards. Defined both by their condition of structural and non-structural disadvantage, these sectors typically lack the income and social or political capital to live in safer areas and secure lifestyles and employment less exposed to risk.[34] Thus, coastal communities and squatter settlements are particularly vulnerable to disasters as they often lack the capacity to protect themselves and recover from the impacts of hazards.

Likewise, women and children are disproportionately affected by the impacts of disasters. For women, biological factors such as pregnancy and lactation can increase vulnerability, due to an increased need for food and water, as well as limited physical mobility.[35] Social factors that create vulnerabilities for women include inferior social positioning, which can translate into limited access to income, transportation, communication, and education. These conditions can prevent women from learning about appropriate protective and responsive measures (i.e evacuations, emergency shelters, etc.).

As the primary caregivers to children, the elderly and the disabled, women are often times limited in their mobility and expected to cater to a large number of needs during times of crisis. During the course and in the aftermath of disasters, women and children are exposed to increased levels of physical violence and aggression, as stress levels peak. Moreover, pre-existing conditions of malnutrition among women and children are worsened as a result of disasters.[36]

In summary, the classical view that a disaster is the product of an extreme weather event has shifted towards an understanding that vulnerability to natural hazards is socially constructed. Tackling the sources of vulnerability – ecologically destructive practices, poverty and marginalisation – requires integrating the concept of vulnerability into development planning.

3.2 Tools for Reducing Vulnerability[37]

The disasters community has developed a broad range of tools to reduce the economic and human loss stemming from natural hazards. The elements of the disaster cycle are often utilized in categorizing these tools or activities.[38] These elements include:

Mitigation: Activities to prevent or reduce impacts of a catastrophic event prior to its occurrence, such as land use planning, retrofitting, building codes and public education.

Preparedness: Activities to improve the effectiveness of response and recovery, such as establishing warning systems, developing hazard plans and storing emergency supplies.

Response: Activities during the acute phase of the disaster designed to minimise loss of life and restore basic services, such as rescue efforts, and provision of food, shelter and medical aid.

Recovery: Restoration and reconstruction of the community through emergency repairs, gradual restoration of structures and infrastructure, and replacement of capital stock.

In practice, these activities overlap in time and space. Mitigation and preparedness activities can, for example, be implemented during the response or recovery phase.

Disaster risk mitigation measures (in climate change terminology, 'adaptation strategies') are frequently described under the general headings of: structural, non-structural, and risk spreading.[39] **Structural approaches** seek to use engineering services to make buildings and lifelines (those systems and infrastructure essential for the social and economic well-being of a society, such as transportation, communications and public facilities) more capable of withstanding extreme events. By contrast, **non-structural approaches** employ land-use controls, information dissemination, and economic incentives to reduce or prevent disaster vulnerability. They require more careful management of the underlying human systems. The distinction between structural and non-structural measures can be best understood as the difference between physical interventions or construction measures on the one hand, and the design and application of policies and procedures on the other[40]. Finally, **risk spreading measures** increase economic and technological system resilience through damage and revenue loss insurance, and through the addition of redundancy to lifelines.

3.3 Assessing the Tools and their Implementation

There is a growing awareness that disaster response and recovery have proven to be an inadequate means for responding to the rising toll sparked by natural hazards, and that on-going investment in mitigation actions is needed to address, at their source, the forces that create

vulnerability[41]. The Organisation of American States concluded as early as 1991 that "[disaster risk] mitigation measures should be seen as a basic investment, fundamental to all development projects in high-risk areas, and not a luxury that may or may not be affordable"[42]. As noted by Abramovitz (2001), mitigation activities can cost far less than the funds needed for disaster relief and recovery.

Yet donors are more apt to give funds for response than for long-term recovery and development[43]. In 1999, for example, less than one percent of the European Commission Humanitarian Aid Office's US$1 Billion budget for Humanitarian Assistance was allocated to prevention and preparedness[44]. Moreover, as reported by Abramovitz (2001), international funds for Official Development Assistance are far below the Rio target of 0.7 % of GDP, and are unlikely to rise substantially.

Disaster mitigation efforts have mainly been directed to large-scale structural projects, such as flood-control dams and coastal protection. Efforts directed toward addressing natural hazards through structural mitigation are often costly and centralized. Resources are insufficient to tackle the large portion of urban populations housed in squatter communities and marginal lands. Building designs may be dictated by tradition or religion, and therefore difficult to revise.[45] In addition, structural efforts are of limited effectiveness during high magnitude events.[46] Moreover, they can exacerbate risk by creating a false sense of security. Thus, the construction of flood protection structures can encourage settlement in floodplains, increasing exposure to extreme natural events that overwhelm those structures. For these reasons, Smil argues for a decentralized, small-scale approach. "*Widespread, diffuse incremental adaptations are preferable to relatively sudden, centrally ordered interventions whose frequent irrationality born of the crisis attitude is demonstrated by their rather rapid self-destruction, or by their notorious inefficiency*" [47].

Aspects of the political, economic and social context of vulnerable communities are vital to take into consideration in efforts to reduce vulnerability. One challenge is that traditional approaches to risk mitigation have often been criticized as 'top-down', driven by technical experts, and thus lacking the support of the community being protected. Risk mitigation plans must compete for political and economic capital with industrial development and social programs presenting more immediate and tangible benefits. Even when there is clear evidence that a community is at risk from disaster, poverty, unemployment and crime are likely to appear more urgent to local decision makers.[48]

Furthermore, it may be that the public treats natural hazards fatalistically. Just getting decisionmakers to recognise the seriousness of the threat, and see that there are means available for reducing the risks from that hazard, can require substantial effort.[49] Finally, there may be aspects of the culture itself, which preclude certain types of risk reduction efforts or increase the likelihood of secondary impacts.

Another set of challenges are typical of development efforts in general, and include issues such as bureaucratic turf battles, problems of institutional coordination between branches of government, nepotism and corruption, and in some countries, mistrust based on a history of antagonism and conflict.

Addressing this complex web of issues requires a set of principles for the design of interventions. Towards that end, the international community of practitioners involved in the IDNDR proposed the following set of guiding principles, in Box 3.2, below.

Box 3.2 Guidelines for Natural Disaster Prevention, Preparedness and Mitigation[50]
(Summarized from the Yokohama Strategy and Plan of Action for a Safer World, 1994)

Prevention is better than response: "Disaster response alone is not sufficient, as it yields only temporary results at a very high cost" (III.3).

The poor are at greatest risk, and should therefore be given priority attention: "Those usually most affected by disasters are the poor and socially disadvantaged groups in developing countries as they are least equipped to cope with them" (III.1) "Priority attention [will be given] to the developing countries, in particular the least developed, landlocked countries and small island developing states" (III.7b).

Disaster prevention should be integrated into development planning: "Prevention and preparedness should be considered integral aspects of development policy"(I.3).

Capacity building, community ownership and participation are essential: "Community involvement and their active participation…is of utmost importance to determine those things which favour or hinder prevention and mitigation" (III.6). "Vulnerability can be reduced…by appropriate education and training of the whole community" (I.4).

Conservation is "imperative": "Environmental protection as a component of sustainable development consistent with poverty alleviation is imperative to the prevention and mitigation of natural disasters" (I.9).

3.4 Moving Forward: The Role of Natural Resource Mismanagement in Disaster Vulnerability

One of the chief conclusions of the IDNDR was that conservation of natural systems is critical for disaster risk mitigation: "Environmental protection, as a component of sustainable development and consistent with poverty alleviation, is imperative in the prevention and mitigation of natural disasters"[51].

In spite of the intuitive fit between natural resource mismanagement and vulnerability of human systems to natural hazards, there have been few attempts to broadly document and rigorously assess the linkages[52]. In addition to increased vulnerability stemming from settlement in 'risky' zones - floodplains, river deltas, coastal zones and steep hillsides - hypothesized links include:

- **Deforestation and landslides:** The loss of vegetative cover on steep hillsides contributes to runoff and slope failure due to the loss of stabilizing root structures[53]. Trees in a mixed forest also catch snow and hold it, preventing avalanche[54]

- **Draining of wetlands and floods:** The draining of swamps and clearing of mangrove wetlands may disrupt natural runoff patterns and magnify flood hazards[55].

- **Loss of vegetation and droughts:** Local clearing of cover vegetation can prolong dry periods, changing the reflectivity of the land surface and accelerating soil loss[56].

- **Urbanization and flooding:** Paving of surfaces decreases infiltration and increases runoff, exacerbating the impacts of high rainfall events on river flow regimes[57].

- **Risk Mitigation efforts and increased risk:** River levees that are built to provide flood protection can destroy riparian habitat and heighten downstream floods[58]. Forest fire suppression may increase the magnitude of fires, when they escape control[59].

- **Monocropping and reduced resilience:** The replacement of traditional forms of multi-crop agriculture by monocrop practices may increase farmers' vulnerability to climate-related extremes[60].

In summary, as Abramovitz (2001) argues, destruction of coastal wetlands, dunes, and mangroves may eliminate vital natural 'shock absorbers' for storms, while deforestation, urbanization and river flow modifications can increase the likelihood of flooding. Yet such examples of environmental mismanagement are often symptomatic of underlying social forces.

Poverty and policies that reinforce the marginalization of particular groups can force people to live in high-risk areas, or to clear upstream or uphill vegetation. Illegal exploitation of forests and other natural areas, due to corruption or to a failure of the institutions responsible for conservation, can force migration and decrease coping options.

This chapter began by showing that the degree of vulnerability of human communities to natural hazards is often a result of pre-existing social, health and economic conditions. It concluded by highlighting the importance of environmental protection – the sustainable and equitable management of natural resources. As Blaikie.*et al*. remind us: "*a 'safe environment' is the goal [...], but it is also the means. Reducing vulnerability to disasters will be shown to be tied up with increased resource access and empowerment of marginal groups*". [61]

4. TARGETED NATURAL RESOURCE MANAGEMENT AND VULNERABILITY REDUCTION

The growing social and economic costs of disasters have been recognized, as has the potential for climate change to increase climatic variability and extremes. While international negotiations aimed at mitigating the volume of greenhouse gas emissions have been moving forward since their inception in the 1990s, there is a growing need for the implementation of measures to adapt to an already-changing climate. As section 2 illustrated, adaptation is moving from a theoretical concern to becoming a central issue in negotiations and policy processes, with international legitimization in the form of a fund to assist developing countries, particularly the Least-Developed Countries, in their efforts to adapt to climatic hazards. Moreover, it has become acknowledged that effective adaptation measures in regions and communities with the greatest vulnerability will likely depend on enhanced natural resource management, consistent with broader sustainable development planning objectives.

Section 3 delved into the tools utilized in disaster management, noting that vulnerability is often the product of complex social processes, including poverty and marginalization. Yet natural resource mismanagement plays an important role in exacerbating risk. And it may offer a compelling tool for addressing many of the sources of vulnerability.

This section starts from the proposition shared by the disasters and climate change communities that enhanced natural resource management is a critical tool in reducing vulnerability to climatic hazards. It then introduces the practice of natural resource conservation, describing some particular examples of targeted management activities being used to reduce disaster risk. It concludes that the cost-effective integration of multiple sustainable development objectives – disaster risk reduction, conservation of biodiversity, mitigation of climate change and targeting of the poor - could make targeted natural resource management a compelling "win-win" adaptation option, attractive to policymakers and donors, even among cash-strapped developing countries.

4.1 Conservation: Towards Protecting Nature and People

"Whoever plants…a large forest near the border of his country, watered by a river and yielding material of a high value, is said to outmanoeuvre the others. A forest watered by a river is self-sustaining and provides shelter in times of calamities".

- The Arthashastra, 320 BC[62]

According to IUCN-The World Conservation Union, conservation is the protection of the integrity and diversity of nature while ensuring that any use of natural resources is equitable and ecologically sustainable.

The practice of conservation has changed tremendously in the hundred years since the establishment of the world's first National Park in Yosemite Valley, California, in 1864.[63] During the 20th century, some 30,000 protected areas were established around the world, arguably one of the greatest achievements of modern times. Together, these areas cover about 12.8 million sq. km, which amounts to 9.5% of the planet's land area, larger than the areas of China and India combined.[64]

Whereas conservation had at one time meant the preservation of pristine natural spaces free from human encroachment, increasingly this is seen as an unsustainable and in some cases unethical. Conservation must serve people as well. One of the central challenges for Conservation in the 21st Century is "to bring benefits to people, embedding protected areas more firmly in local economies so that communities, local, national and international, benefit from the full range of material and non-material values of protected areas".[65] According to the former Director-General of IUCN, Martin Holdgate, "conservation of biodiversity and biological resources [needs to be placed] in the wider context of action to combat poverty and support development and economic growth".[66] Conservation - to be successful, enduring, sustainable – needs compelling arguments. Ethics alone are not enough. Conservation must pay for itself in terms of the benefits it provides to people.

According to extensive research by the Biodiversity Support Program, "in the last few decades, conservationists and natural resource managers have moved away from trying to keep people out of protected areas and toward developing productive relationships with resource users […] Most new conservation plans call for local participation in natural resources management and many advocate shifting power to the local level as a way to promote conservation-oriented decision-making about natural resource management and benefits".[67]

It has been learned that conservation is most successful when there is strong locally based interest in environmental concerns that are demonstrably critical to rural livelihoods, urban well-being,

and the viability of industrial and commercial enterprises.[68] This is the integration of conservation with the attainment of sustainable development.

Arguably, the conservation of nature to reduce vulnerability to disasters may present one of the greatest and most-consistently under-valued natural services provided by biodiversity. The protective value of ecosystems may exceed income from the use of their resources. Ecosystems' protective services, such as the prevention of erosion, floods, landslides, avalanches, cyclones and other natural and unnatural disasters, deserve far more attention when it comes to assessing their value.

There are many shared characteristics of effective disaster risk mitigation efforts and climate change adaptation strategies. While both adaptation and disaster vulnerability reduction call for enhanced natural resource management, the tools for doing so have not been elaborated. Yet the methodology needed can be derived from the best practices of natural resource management.

These can be typified by the following guidelines for successful conservation, distilled from a wide-ranging research program by the Biodiversity Support Program:[69]

Clarity of conservation goals and objectives

Being clear about what you are trying to achieve is the starting point for any successful project. Goals and objectives should be discussed, negotiated and agreed upon by all of the partners and stakeholders involved or affected by the project. Feedback information is critical to assessing impact and managing your activities. Monitoring systems developed and implemented by community members and project managers provide this type of information.

Equitable and effective social processes and alliances for conservation

Alliances make it feasible to pool the resources and complementary skills necessary to take on complex tasks. When alliances are created honestly, effectively and with a common vision, they can greatly enhance conservation impact while at the same time being beneficial to the partner organisations themselves. The process undertaken to form the alliance, moreover, can be equally important in achieving conservation success.

Appropriate incentives for biodiversity valuation and conservation

In order to succeed, conservation initiatives must identify and support locally expressed incentives to protect biodiversity, whether spiritual, economic or to preserve health. Even though financial benefits play and important role, non-cash benefits – such as education, community pride and land tenure – are valued as high as, if not more than, cash.

International, national, and local policies supportive of conservation

Even with clear goals, healthy alliances and projects that promote appropriate incentives, it is difficult to achieve or maintain conservation without the support of an effective policy framework, integrated across multiple levels of government. Policies resulting from stakeholder involvement are often more likely to succeed than those handed down from the government.

Sufficient awareness, knowledge and capacity to conserve biodiversity

To convert ideas into action, people must have the necessary skills at the levels of: local community members, conservation project and program managers, and policy makers. Since much depends on the institutional framework as well, capacity building should also strengthen

institutions: NGOs, community-based organisations and government agencies. The ultimate goal is to help people to manage their own resources.

4.2 Conservation and Adapting to Climate Change: Lessons from Practice

Enhanced natural resource management is playing a growing role in helping communities at all decision-making levels address the sources of disaster. This section will concentrate on tools used at local community levels, and at some of the experiences at the broader, national and regional level.

4.2.1 Community adaptation to climatic extremes and variability

There is much to be learned from examining traditional means for living with natural hazards.

Traditional societies typically lack the means to dramatically modify their environment, and therefore have developed livelihood and coping strategies adapted to variability. Farmers practice intercropping; homes are built in locations known to be sheltered from storms and avalanches; housing is made to fail without killing its occupants[70].

While Hurricane Mitch devastated large areas in Honduras and Nicaragua in 1998, for example, the traditional Quezungal farming method practised by local people of the remote village Guarita (Honduras) has reduced their loss of crops to only 10 percent. The method consists in planting crops under trees whose roots anchor the soil and terracing to reduce soil erosion[71].

Among the natural resource management tools that could be useful in addressing vulnerability to climate change, there are many local-scale environmental management measures that have been applied as drought-proofing and/or anti-desertification techniques elsewhere around the world:

Soil Management - This approach for increasing the stability and productivity of soil is a general term that involves a range of specific techniques such as fallow cycling, forest buffering, selective planting, managed grazing, etc. Soil management is recognised as central to combating desertification.

Water harvesting - Around the world, this approach has many variants - from the construction of johads (earthen dams) in Northwest India, to rooftop collection in the Caribbean, to the forest zai in West Africa - and many champions. Water harvesting techniques have been used as a drought-proofing tool to increase water available for households, irrigation, as well as baseline water flow for watershed restoration. (In Western Sudan, for instance, the trunk of the Adansonia digtata tree is used for water harvesting, purification and storage.)

Windbreak Construction - As wind erosion contributes significantly to the process of desertification, a number of environmental management methods have been applied, both through formal desertification projects and autonomous activities of farmers, to reduce its effect. Replanting of indigenous trees and shrubs for windbreaks, as well as ridging, mulching and rock bunds, are but a few methods.

Intercropping - The technique of planting selected food crops within stands of trees (e.g., in the case of Sudan, gum arabic stands) can provide local communities with added food security and income through livelihood diversification, while at the same time reducing deforestation and desertification.

Abramovitz (2001) also cites the examples of coastal mangrove preservation and the resulting protection from storm surges in Vietnam, and of agro ecological practices reducing the impacts of landslides and flooding in the wake of Hurricane Mitch in Honduras, Nicaragua and Guatemala[72].

4.2.2 National and Regional Policies to Address Vulnerability Through Conservation

Abramovitz and others have likewise described examples of regional natural resource management measures with the potential to reduce vulnerability. They include hillside reforestation to mitigate landslides, wetland conservation and restoration to provide storm surge buffers, mangrove protection to avoid coastal flooding, and removal of alien species of plant to restore hydrological conditions.

Switzerland learned the importance of conserving its high mountain forests over 100 years ago. Widespread flooding, avalanches and landslides in the late 19th Century demonstrated the link between deforestation and these catastrophic events and led to the passage in 1876 of an historic law aimed at conserving forested areas. The protective value of these forests to protecting villages, towns, infrastructure and tourism, and thus the economy as a whole, was estimated in the mid-1980s at US$2-3.5 billion per year[73]. The Swiss government provides US$25-35 million per year in subsidies for conservation of 'protective' forests[74].

Likewise, in **Bangladesh** it is recognised that the Sundarbans, one of the world's largest mangrove forests, protect several communities from otherwise-devastating tropical cyclones. An estimate by the Bangladeshi government suggests that the storm protection provided by the mangrove area has saved the public purse nearly half a billion dollars in avoided costs of structural mitigation and relocation.[75]

In **Central America**, the seven disaster-prone countries of the region are collaborating to protect a Mesoamerican Biological Corridor along the Atlantic coast of the isthmus, from Mexico to Panama. The corridor aims to preserve watersheds and forests, while attracting over US$100 million per year in international greenhouse gas offset funds[76].

In the wake of the Yangtze River basin floods of 1998 (see Abramovitz, 2001), which reportedly affected an area of nearly 26 million square kilometers and forced the relocation of nearly 14 million people, **China** is putting measures into place to tackle the environmental sources of vulnerability[77]. China is seeking $10 million in GEF funds to restore natural forests, wetlands and grasslands along the river.

Paying for the conservation of 'protective' natural systems could be achieved through several innovative finance mechanisms developed by conservationists. Environmental services payments are currently being used by municipal utilities companies in **Costa Rica** to support the conservation of upper watersheds that supply water and energy to urban communities. These institutional arrangements could enable those communities adjacent to protected areas to benefit from cross-scale linkages to mutual benefit. These regional institutional constructs would enable a linking of local natural resource management (community forestry, wetlands restoration) to the mitigation of natural hazards and the adaptation to climate change, through environmental service payments and other bioregional transfers of resources.

Likewise, debt-for-nature swaps have frequently been employed to conserve particular natural spaces, and could be targeted for the protection of natural services such as disaster prevention[78].

How then can we develop instruments and institutions of environmental governance that can supersede, complement and enhance national and regional agendas? Conversely, can we adequately extrapolate from local experiences in sustainable livelihoods and resilience-building initiatives, to the regional/landscape/ecosystem approach without losing sight of essential institutional linkages?

We need to focus on these cross scale issues that enable to link the macro with the micro, the highlands with the lowlands and the rural and urban communities in many societies. The emergence of regional initiatives geared around biological corridors, bioregional, landscape and ecosystem approaches to conservation, such as the Mesoamerican Biological Corridor, have contributed to creating tools and institutional arrangements at the meso-scale.

These could prove to be some of the most important steps in building institutional arrangements that enable urban populations and regional economies to compensate the custodians and stewards of protective environmental services from natural systems.

4.3 Natural Resource Management and Adaptation: Co-benefits

The application of targeted conservation of natural buffer systems as a strategy for adapting to climate change offers several potential co-benefits:

- Biodiversity conservation
- Poverty alleviation
- Enhanced sink capacity

4.3.1 Biodiversity Conservation

Biodiversity provides many direct benefits, including the natural resource base essential for many livelihoods, genetic material for breeding and new medicines, aesthetic beauty, and tourism revenues. Moreover, according to the World Resources Institute, "the diversity of species undergirds the ability of an ecosystem to provide most of its other goods and services. Reducing the biodiversity of an ecosystem may well diminish its resilience to disturbance, increase its susceptibility to disease outbreaks and decrease productivity".[79] In addition to directly providing livelihoods, therefore, biodiversity is important in ensuring the long-term viability of natural buffer systems in the face of disaster.

4.3.2 Benefit the Poorest and Most Vulnerable

Adaptation measures focused on enhanced natural resource management can also more-effectively benefit the poor than large-scale structural measures. It is the poor who are most dependent on natural resources, both directly for their livelihoods, and for succour during times of crisis. It is also the poor who are most often living on marginal lands and in vulnerable locations, whom would benefit most directly from enhanced resource management.

The World Bank estimates that poverty increases in proportion to distance from cities and coasts, typified by the distribution of poverty in China, Vietnam and Latin America[80]. Agriculture, forestry and fishing are directly responsible for 50% of all jobs worldwide and 70% of jobs in sub-Saharan Africa, East Asia and the Pacific.[81] Because the poor have a narrow and

geographically concentrated set of livelihood sources, they are most vulnerable to losing their livelihoods during disasters.

Coping strategies typically employed in the wake of a disaster include changing the mix of livelihoods, creating new livelihoods, seeking new sources of resources (by force of arms or otherwise), and migrating. A group or individual will seek to deploy the different assets they possess to best effect within the range of choices they possess. The poor usually have the least choice among strategies, receive the least assistance from government authorities and are therefore most dependent on the state of the environment for providing alternative livelihoods. Thus, investing in the natural resource base that sustains their livelihoods may have a direct positive impact on their immediate lives and long-term resilience to climate variability.

4.3.3 Enhanced Sink Capacity

A number of environmental management-based adaptation activities can also serve as climate change *mitigation* measures. For example, sustainable rangelands management activities have in the past been employed in a number of countries to combat desertification – a local, national and regional sustainable development goal. Recently, these measures have been explored in terms of their simultaneous drought-proofing attributes – central to climate change adaptation - and carbon sequestration capabilities – a central endeavour of climate change mitigation.[82]

4.4 Natural Resource Management and Adaptation: Role of the Task Force

To the extent that targeted natural resource can act as both an adaptation activity and also realise climate change mitigation objectives – thereby garnering greenhouse gas reduction credits for Parties to the UNFCCC - such measures will appear increasingly attractive in comparison with other options.

But are such measures cost-effective? How do such measures perform in terms of the 'triple benefits' alleged above? What are the best institutional and financial means for sustaining them? Where have they been attempted, and how did they perform?

This paper began by asking whether targeted natural resource management make a substantial and cost-effective contribution to reducing the vulnerability of human systems to climate-related natural hazards. This paper only begins to outline the foundations for the definitive answer. There is a compelling need for further inquiry, for the compilation of policy-relevant research that can bridge the divide between disasters, climate change and conservation.

5. THE MISSION OF THE TASK FORCE *FOR DISCUSSION*

The foundation for this Task Force's work consists of the following assertions:

Climate Change Adaptation: In recent discussions on global change and the vulnerability of natural and human systems, options for adapting to climate change have become increasingly central, and frequently include calls for enhanced natural resource management.

The Rising Costs of Disasters: The human and economic costs of climate-related disasters are growing, as the vulnerability of the poor and the marginalised is increasing. Extreme events complicate the attainment of sustainable development since, in addition to their vast and inequitable human cost, recovery from such events divert resources from social investments, destabilise natural resource management regimes, and entrench poverty.

Reducing Vulnerability: The sources of vulnerability have a great deal to do with our patterns of development, and small investments in reducing risk can have disproportionately large positive impacts in protecting communities from harm. Moreover, greater emphasis should be given to enhancing natural resource management, consistent with poverty alleviation, in order to reduce vulnerability.

Adaptation through Conservation: The potential for targeted natural resource management to play a key role in the toolkit of disaster mitigation and adaptation strategies is based on the range of benefits hypothesized: reduction in vulnerability, biodiversity conservation, enhanced livelihood security among the poorest and most vulnerable, and greater carbon sink capacity. Conservation of natural resources in support of livelihoods can address the needs of the poorest and most vulnerable, in contrast to large-scale structural adaptation strategies.

Lessons learnt: Evidence for these assertions does exist, but is dispersed and poorly documented. There has been little effort to take these lessons and share them more broadly. In response to the rising demand for climate-related adaptation strategies, there is an urgent need to cast these experiences in compelling terms, in the form of general principles with practical examples that can inform policy makers and planners.

Bridging the Gap: If natural resource management offers a set of tools for reducing vulnerability to climate change and addressing disaster risk, then the methodology for applying successful natural resource management would be most rapidly integrated from the experiences of those who have learned how to do it the best. The time has come to bridge the gap dividing the climate change community from the disaster risk managers, and to bring these groups into dialogue with conservationists. With their combined knowledge, these different actors can offer decision makers an array of environmental management options that protect people and nature.

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