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Adaptation to Climate Change in the Context of Sustainable Development

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By

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Introduction

Climate change is one of the all-encompassing global environmental changes likely to have deleterious effects on natural and human systems, economies and infrastructure. The risks associated with it call for a broad spectrum of policy responses and strategies at the local, regional, national and global level. The UNFCCC (United Nations Framework Convention on Climate Change) highlights two fundamental response strategies: mitigation and adaptation. While mitigation seeks to limit climate change by reducing the emissions of GHG (greenhouse gases) and by enhancing 'sink' opportunities, adaptation aims to alleviate the adverse impacts through a wide-range of system-specific actions (Fussel and Klein, 2002).

Albeit both mitigation and adaptation measures must be pursued to tackle the climate change problem and to create an effective and inclusive international climate change regime, more attention has been devoted to mitigation in the past, both in scientific research and policy debate. Sensitivity to the issue of adaptation has grown over the last couple of years, particularly after the IPCC (Intergovernmental Panel on Climate Change) TAR (Third Assessment Report). Adaptation has now emerged as an urgent policy priority, prompting action both within and outside the climate change negotiations (Parry *et al*. 2005).

Background

Conventional approaches to understanding climate change were limited to identifying and quantifying the potential long-term climate impacts on different ecosystems and economic sectors. While useful in depicting general trends and dynamic interactions between the atmosphere, biosphere, land, oceans and ice, this top–down, science-driven approach failed to address the regional and local impacts of climate change and the local abilities to adapt to climate-induced changes.

Transition from impacts to vulnerability and adaptation

This impact-driven approach[1] gave way to a new generation of scholarship, which utilised bottom-up or vulnerability-driven approaches that assessed past and present current vulnerability, existing adaptation strategies, and how these might be modified with climate change. Vulnerability in this context is defined as, "*the degree to which a system is susceptible to, or unable to cope with, the adverse effects of climate change, including climate variability and extremes*" and adaptation as, "*adjustments in ecological, social or economic systems in response to actual or expected stimuli and their effects or impacts. This term refers to changes in processes, practices and structures to moderate potential damages or to benefit from opportunities associated with climate change*" (IPCC 2001).

Recognition of the need to integrate adaptation into development policies

The international community is continuing to grapple with the likely socio-economic and environmental impacts that shall result from climate change. Adaptation to climate change is a new process for both developed and developing nations, and concrete experience in applying an integrated approach to adaptation is limited (Parry *et al.* 2005). The adaptation line of inquiry reflects the international community's escalating need to prepare for and adapt to climate change and to ensure that any future climate change regime will bestow on the issue its legitimate recognition. It also recognises growing international awareness of the need to integrate adaptation issues into core policy and decision-making processes. The question that needs to be address is how adaptation to climate variability and change can be more fully integrated into development policies and what are the funding instruments for adaptation?

The rationale for integrating adaptation into development strategies and practices is underlined by the fact that interventions required to increase resilience to climate variability and change generally further development objectives. Adaptation calls for natural resource management, buttressing food security, development of social and human capital and strengthening of institutional systems (Adger *et al.* 2003). Such processes, besides building the resilience of communities, regions and countries to all shocks and stresses, including climate variability and change, are good development practice in themselves. Hence the inclusion of climatic risks in the design and implementation of development initiatives is vital to reduce vulnerability and enhance sustainability.

This paper seeks to explore the nexus between adaptation to climate change and sustainable development and discusses ways of mainstreaming adaptation considerations into sustainable development efforts. The paper is actuated by the belief that key to an

[1] See Parry and Carter (1998), Burton *et al.* (2002).

Investigating the nexus between adaptation and sustainable development

effective climate change response strategy is a better understanding of relevant policy linkages: what specific climate change impacts and measures will affect development efforts and how? For e.g., an increase in fuel prices as a method of decreasing GHG emissions, could impose inequitable burdens on the poor; while carbon sequestration measures could aid social policy by enhancing sustainability of livelihoods. Hence integration between the two realms of adaptation and development is a prerequisite for a productive understanding and may provide new opportunities for integrated policy development.

The outline of the paper is as follows:

- Discussions on Vulnerability and Adaptation
- Vulnerability and Adaptation Assessments
- Integration of Adaptation Concerns into the Sustainable Development Process
- Funding Adaptation
- Conclusion

Discussions on Vulnerability and Adaptation

Concept of vulnerability

Widely varying definition of vulnerability

Since, vulnerability and its causes play essential roles in determining impacts, comprehending the dynamics of vulnerability is as important as understanding climate itself (Handmer *et al.* 1999). Definitions of vulnerability vary widely among different scholars. Researchers in social geography and political ecology regard vulnerability as an *a priori* condition of a household or community that is determined by socio-economic and political factors (Blaikie *et al.* 1994, Bohle *et al.* 1994). Contiguously, Kelly and Adger (2000:328) declare that vulnerability is the "*ability or inability of individuals or social groupings to respond to, in the sense of cope with, recover from, or adapt to, any external stress placed on their livelihoods and well-being*". A political economy approach is argued for- using the 'entitlements approach' (Sen 1981) in the analyses of vulnerability. This approach introduces a household perspective on vulnerability, and replaces the ecocentric approach to environmental change.

Vulnerability may also be conceptualised as the dose-response relationship between an exogenous hazard to a system and its effects. From a natural hazard perspective then, vulnerability may be defined as the characteristics of a person, or group in terms of their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard (Blaikie *et al.* 1994).

Another perspective is provided by the Africa Environment Outlook, which concentrates on the vulnerability-security continuum, with the state of vulnerability being characterised by low adaptive capacity,

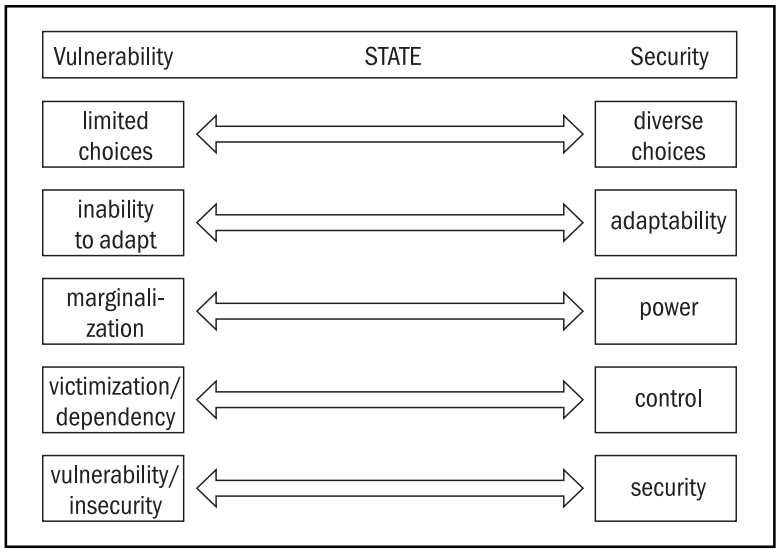

Figure 1 Vulnerability-Security Continuum
Source UNEP 2002. Africa Environment Outlook: past, present, and future perspectives <http://www.grida.no/aeo/>

limited choices and marginalisation; and that of security with high adaptive capacity, diversity in choices, power and control.

IPCC definition of vulnerability as a function of exposure, sensitivity and adaptive capacity

In climate change research, vulnerability is used as an integrative measure of the threats to a system (IPCC 2001, Kelly and Adger 2000). The IPCC (2001) definition of vulnerability, as mentioned earlier[2], is a function of the character, magnitude and rate of climate variation to which a system is exposed, its sensitivity and adaptive capacity. Exposure is defined as the, "*degree of climate stress upon a particular unit of analysis; it may be represented as either long-term changes in climate conditions, or by changes in climate variability, including the magnitude and frequency of extreme events*" (IPCC 2001). Smit *et al.* (2000), define sensitivity as, "*the degree to which a system will be affected by, or responsive to, climate stimuli*". Adaptive capacity is defined as "*the potential or capability of a system to adjust to climate change, including climate variability and extremes, to moderate potential damages, to take advantage of opportunities, or to cope with consequences*" (Smit and Pilifosova 2001).

It is important to mention here that broadly there are two interpretations of vulnerability – as an ***end point*** or as a ***starting point*** (O'Brien *et al.* 2004). As a starting point, vulnerability is a characteristic or state generated by multiple environmental and social processes, but exacerbated by climate change (Kelly and Adger 2000). Vulnerability provides a means of understanding how the impacts of climate change will be distributed, primarily to identify how vulnerability can be

[2] Background section, p. 2

reduced, i.e., the focus is on adaptive capacity and systemic properties and solutions can be found in sustainable development. As an end point, vulnerability is viewed as a residual of climate change impacts minus adaptation. It serves as a means of defining the extent of the climate problem and providing input into policy decisions regarding the cost of climate change versus costs related to GHG mitigation efforts (Kelly and Adger 2000).

Factors determining vulnerability

Considerable attention has been paid to identifying characteristics that influence a system's ability to adapt (as part of impact and vulnerability assessment) and/or their priority for adaptation measures (as a basis for policy development) (Smit and Pilifosova 2001).

A common theme in the climate change impacts and vulnerability literature is the idea that communities, social groups, sectors, regions and nations differ in the degree of vulnerability to climate change, i.e., there exists ***differential vulnerabilities*** (Bohle *et al.* 1994).

Notion of differential vulnerabilities

Developing countries, SIDS (Small Island Developing States), people living in arid-semi arid lands, water-limited or flood-prone areas, as well as countries and sectors heavily dependent on climate sensitive sectors – agriculture, water resources, forestry, fisheries etc are particularly at risk. This is partly due to the fact that climate-induced changes in temperature and precipitation will occur unevenly and hence climate change impacts will be unevenly distributed across the globe. It is also due to the fact that resources and wealth are distributed unevenly. IPCC (2001:15) recognises that, "*even within regions, impacts, adaptive capacity and vulnerability will vary*". Discussions of vulnerability often highlight the importance of poverty and inequality – or differential resource access (Adger and Kelly 1999).

The significance of climate variation depends on the degree of change and the characteristics of the society exposed to it. These characteristics determine the level of vulnerability of a system. Climate-induced changes can have vastly different ramifications on communities, regions and nations because of differential vulnerabilities and coping strategies. Poor developing countries are more vulnerable to and have lesser adaptive capacities to than developed nations, due to:

- Overpopulation (relative to current productivity, income and natural resources)
- Debilitated ecological base (land degradation and fragmentation)
- Over-dependence on climate-sensitive sectors: agriculture, forestry, fisheries

Factors exacerbating vulnerability

- Level of economic wealth
- Inequities in access to resources and wealth among groups
- Weak socio- cultural (rigidity in land-use practices, social conflicts) infrastructural, financial/market (uncertain pricing, availability of credit, lack of credit), legal and governance structures
- Technological, skills and human resource bottlenecks
- Poor pre-existing health conditions.

Reducing vulnerability involves reducing exposure through specific measures, or increasing adaptive capacity through activities that are closely aligned with development priorities.

Why focus on adaptation?

Traditionally, mitigation has received greater attention than adaptation, both from a scientific and policy perspective. One plausible reason for this could be that climate change emerged as a problem related to the long-term disturbance of the global geo-biochemical cycles and associated effects on the climate system (Cohen *et al.* 1998). The current discourse owes its legacy to two scientific programmes: oceanography and atmospheric science and their coalition, the GCMs (General Circulation Models). Hence the approach used was that of natural science (reductionism), which constructed the problem in a manner amenable to scientific analysis.

The focus on mitigation was later reflected in the work of the IPCC, an organisation jointly established by the UNEP (United Nations Environment Programme) and the WMO (World Meteorological Organisation) in 1988 to, "*assess the scientific, technical and socio-economic information relevant for the understanding of the risk of human-induced climate change*" (Najam *et al.* 2003). The KP also is largely concerned with quantitative limits for GHG emissions.

Reasons for considering adaptation as a response measure

However, there are convincing arguments for consideration of adaptation as a response measure. First, no matter how robust mitigation measures are, a certain degree of climate change is inevitable due to historical emissions and the inertia of the climate system (IPCC 2001). Second, while the effects of mitigation may take several decades to manifest, most adaptation activities take effect almost immediately. Third, such measures can be applied on a regional or local scale, and their effectiveness is less dependent on actions of others. Fourth, adaptation besides addressing the risks associated with changes in the climate in future typically reduces risks associated with current climate variability.

Defining the terms

Many definitions of adaptation can be found in the literature (Box 1). Some of the straightforward definitions describe adaptation as involving "*changes in a system in response to some force or perturbation, in our case related to climate*" (Smithers and Smit 1997) or as an "*…adjustment in individual, group and institutional behaviour in order to reduce society's vulnerabilities to climate*" (Pielke 1998).

Box 1 Definitions of adaptation reviewed by Smit *et al.* (2000)

- Adaptation to climate is the process through which people reduce the adverse effects of climate on their health and well-being, and take advantage of the opportunities that their climatic environment provides.
- Adaptation involves adjustments to enhance the viability of social and economic activities and to reduce their vulnerability to climate, including its current variability and extreme events as well as longer-term climate change.
- The term adaptation means any adjustment, whether passive, reactive or anticipatory, that is proposed as a means for ameliorating the anticipated adverse consequences associated with climate change.

The definition used here is taken from IPCC 2001, wherein adaptation refers to, "*adjustments in ecological, social or economic systems in response to actual or expected stimuli and their effects or impacts. This term refers to changes in processes, practices and structures to moderate potential damages or to benefit from opportunities associated with climate change*" (IPCC 2001)[3]. Adaptation hence involves adjustments to decrease the vulnerability of communities, regions, and nations to climate variability and change and in promoting sustainable development (IPCC 2001).

Adaptation needs vary across geographical scales (local, national, regional, global), temporal scales (coping with current impacts versus preparing for long-term change), and must be addressed within complex and uncertain conditions. Responding to this process hence calls for interdisciplinary and multiple expertise – a coalescing of researchers and practitioners in climatology, ecology, economics, management of natural resources, public health, disaster risk reduction, and community development.

[3] Often the terms resilience and adaptation are used interchangeably. The term resilience is drawn from the adaptive cycle seen in natural systems (for an exposition see Holling 1986). Walker, Carpenter, Anderies *et al.* (2002) state that resilience is the potential of a system to remain in a particular configuration and to maintain its feedbacks and function, and involves the ability of the system to re-organise, following disturbance-driven change.

Types of adaptation

Depending on its timing, goal and motive of its implementation, adaptation can either be reactive or anticipatory, private or public, planned or autonomous. Adaptations can also be short/long term, localised or widespread (IPCC 2001). In unmanaged natural systems, adaptation is autonomous and reactive and is the means by which species respond to changed conditions. In these situations, adaptation assessment is essentially equivalent to natural system impact assessment. Adaptations undertaken by individuals/communities is the focus here and can be classifies as:

- ***Reactive or Anticipatory*** Reactive adaptation takes place after the initial impacts of climate change have occurred. Anticipatory adaptation takes place before impacts become apparent. In natural systems, there are is no anticipatory adaptation.
- ***Private or Public*** The distinction is based on whether adaptation is motivated by private (individual households and companies) or public interest (government).
- ***Planned and Autonomous*** Planned adaptation is consequence of deliberate policy decision, based on the awareness that conditions have changed or are expected to change and that some form of action is required to maintain a desired state. Autonomous adaptation involves changes that systems will undergo in response to changing climate irrespective of any policy, plan or decision.

Figure 2 shows examples of the types of adaptation differentiated according to timing, natural/human systems and public or private decision makers.

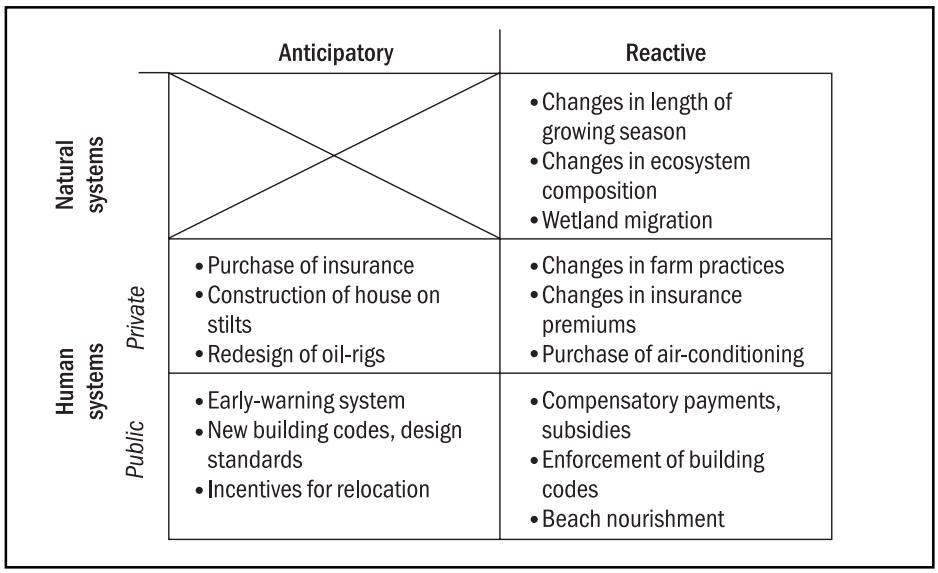

Figure 2 Classification of adaptation options
Source IPCC 2001. <http://www.grida.no/climate/ipcc_tar/wg2/645.htm#1825>

Adaptation at the multilateral level

Initially adaptation was viewed as a response mechanism, something to be undertaken specifically for expected or anticipated impacts of climate change, such as sea-level rise (IPCC 1996). Increasingly, it is being seen as a way of addressing risks associated with extreme events such as droughts and floods and climate variability (seasonality).

Although during the 1990s, most of the scientific research and negotiations concentrated on mitigation, a number of Articles in the UNFCCC refer to the need for adaptation to climate change. Article 3.3, does not mention the term adaptation explicitly, but states that, "*The Parties should take precautionary measures to anticipate, prevent or minimise the causes of climate change and mitigate its adverse effects*". With regard to the implementation of adaptation measures as part of a response strategy, Article 4.1 (b) commits parties to, "*formulate, implement, publish and regularly update national and where appropriate, regional programmes containing measures to mitigate climate change…and measures to facilitate adequate adaptation to climate change*". Article 4.1 (e) further goes on to state that all parties should, "*Cooperate in preparing for adaptation to the impacts of climate change*" (UN 1992).

Adaptation concerns within and outside the negotiation process

Within the negotiation process, the profile of adaptation has palpably increased, with the establishment of the Marrakesh Funds[4] at the CoP7 (Conference of Parties), the Delhi Declaration at CoP8, which reaffirmed economic and social development, poverty eradication, and the Buenos Aires Programme of Work on Adaptation and Response Measures at CoP10[5]. A five-year Work Programme on Adaptation was agreed upon at the CoP 11 in Montreal, 2005.

Outside the purview of the negotiations, there has been also been a cascade of research and policy activity on the issue of vulnerability and the need to adapt (Burton 1997, Cohen *et al.* 1998, Goklany 1995). At the multilateral level, the CBD (Convention on Biological Diversity) is examining the potential impacts of climate change on biodiversity and ecosystems. Several environmental, conservation[6], development and humanitarian organisations have also established work programmes on adaptation. Apart from ongoing academic scholarship into the

[4] The LDC Fund (Least Developed Country) and SCCF (Special Climate Change Fund) to be managed by the GEF and Adaptation Fund under the Kyoto Protocol.

[5] The decision in CoP10 adds to earlier work on adaptation undertaken by the SBI (Subsidiary Body for Implementation) and SBSTA (Subsidiary Body for Scientific and Technical Advice). It initiates a process for the development of a new 5-year work programme within the SBSTA.

[6] The World Conservation Union and the World Wildlife Fund are highlighting the role played by ecosystems in building adaptive capacity of communities.

characteristics, indicators and measurability of adaptation, several programmes such as the UK's Climate Impacts Programme, Canada's Climate Change Impacts and Adaptation Programme and the Caribbean Community Climate Change Centre have been established.

In summary, adaptation is important in the climate change debate in two ways – relating to the assessments of impacts and vulnerabilities, the other to the development and evaluation of response options (Smit and Pilifosova 2001: 881). It is generally agreed that effective adaptation:

- Must reduce vulnerability of the system and build in the potential to anticipate and act to future climatic changes
- Must be congruent with local environmental conditions and the needs of the local populace
- Responses and measures to be 'mainstreamed' into development and poverty eradication processes.

For vulnerable groups, adaptation strategies are vital, as failure to adapt could lead to "significant deprivation, social disruption and population displacement, and even morbidity and mortality" (Downing *et al.* 1997). The problem is in identifying those adaptations that favour the most vulnerable groups. For e.g., strategies such as large-scale agriculture, irrigation and hydroelectric development, may benefit large groups, or national interests, but may harm local, poor, indigenous populations. Hence what must be remembered is that adaptation does not yield the same benefits everywhere and win-win situations are unlikely in climate change, and there will also be winners and losers. The costs of adaptations need to include the secondary effects of the adaptations themselves, and the losses suffered by groups bypassed or marginalised (Kates 2000).

Evolution of Vulnerability Assessments

When trying to comprehend the notion of 'ability to adapt', two central questions need to be addressed: (a) how dangerous is climate change and (b) how to adapt to climate change. The first question can be analysed using scenarios or a top–down approach. Conventional approaches are used here, which usually focus on future climate scenarios using GCMs, which help in the identification and quantification of potential the impacts on ecosystems and sectors.

The second question is best explored using the systems/ bottom–up approach/ or vulnerability approach. The vulnerability approach is one way to facilitate mainstreaming (Kelly and Adger 2000). The analysis hence can start at a community level, and is better suited to identify local and future risks to climate change.

Vulnerability Based Assessments

Translating conceptual frameworks into operational vulnerability assessments: some suggestions

Transmuting conceptual frameworks into implementable vulnerability assessments demands developing a consensual definition, assessment and measurement of vulnerability.

The following steps may be undertaken[7]:

1. **Vulnerability Frameworks and Definitions**
   Regional and national assessments related to vulnerability and stakeholder led conceptual mapping can result in formal definitions of the term and a framework for analysis.
2. **Constructing a development baseline and identification of vulnerable regions and groups**
   - Construction of development baseline utilising national development status (e.g., poverty maps) and development indicators (e.g., economy, resources, health)
   - National identification of vulnerable groups and regions and descriptive of representative conditions of vulnerability

   This information can be mapped (spatial and temporal scale) to obtain a Development status (DS) and Vulnerable Groups/Regions listing (VG/R).
3. **Linking development baseline with climate change impacts**
   Current assessments of climatic risks and hazards, data on climatic resources and climate indices, can feed into ascertaining Current Variability (CV), which in turn is dependent on DS.
4. **Determining Future Climate Vulnerability**
   - Scenarios and probability distributions of future climates and impacts determine Future Climate Vulnerability (FCV)
   - Development scenarios and targets, sectoral scenarios, in coherence with the climate change scenario also flow into FCV.
5. **Testing of model outputs, and if relevant, to incorporate in stakeholders targets for development planning. Adaptation options to be discussed.**

Vulnerability and Adaptation Assessments: some examples

Impact assessments evaluate the potential effects of several climate change scenarios including a (hypothetical) constant climate scenario, on one or more impact domains. IPCC (2001) defines (Climate) Impact Assessment

[7] Adapted from <www.unep%20VA%20Indices.pdf>

Table 1 Characteristic properties of different stages of vulnerability assessments

	Impact assessment	First generation vulnerability assessment	Second generation vulnerability assessments	Adaptation policy assessment
Analytical approach	Positive	Positive	Positive	Normative
Main Result	Potential impacts	Pre-adaptation vulnerability	Post-adaptation vulnerability	Recommended adaptation
Consideration of adaptation	Little	Partial	Full	Full
Integration of natural and social science	Low	Low-medium	Medium–high	High

Source Fussel and Klein (2002:6)

as the "*practice of identifying and evaluating detrimental and beneficial consequences of climate change on natural and human systems*".

The evolution of vulnerability assessments has been stimulated by changing stakeholder needs, and has been aided by increasing scientific knowledge in a range of relevant disciplines. Impact assessments conducted in the early half of the 1990s, did not explicitly incorporate the issue of adaptation, and were limited to analysing the potential scale and long-term impacts of climate change. Fussel and Klein (2002) provide a table of different assessment stages.[8]

The evolution of vulnerability assessments reflects an increasing vertical and horizontal integration (involving interactions across sectors and disciplines), a shift from science-driven to policy-driven assessments and a shift in focus from the multiple effects of a particular stress (such as climate change) to multiple stressors that imperil a system.

At the outset, it must be mentioned that there is little guidance for full-blown adaptation policy assessments. The following are some of the vulnerability and adaptation assessment frameworks found in the literature.

Analytical framework for vulnerability assessment

This assessment starts with engaging the community to assess current vulnerabilities, which includes identifying conditions or exposures that are pertinent to the community and assessing the adaptive capacity of

[8] See Fussel and Klein for a reading of impact, first generation, and second-generation vulnerability assessments. See also Smith (1997), Smith *et al.* (1999).

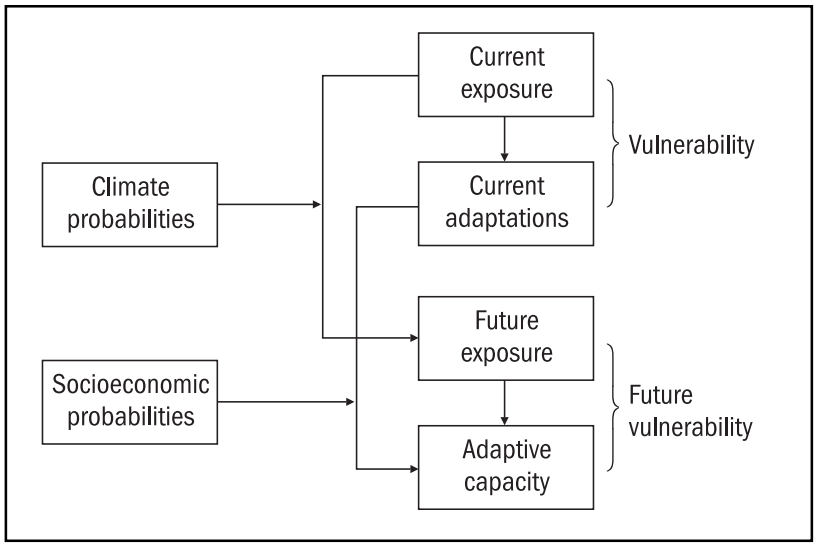

Figure 3 Analytical framework for vulnerability assessment
Source uoguelph.ca

the community to deal with these exposures. This appraisal of the capacity to adapt includes explicit consideration of the institutions, networks, policies and management processes that exist to deal with climatic risks. This outlines policies and practices within which climate change adaptation can be incorporated.

The information on current vulnerability provides the foundation for the assessment of future exposure (climate science) and future adaptive capacity (via social science).

Framework for Vulnerability Assessment

It was developed by START (System for Analysis Research and Training), as part of the Assessments of Impacts and Adaptation to Climate Change in Multiple Regions and Sectors (AIACC) project. The project incorporates 24 regional case studies in 46 countries through Latin America, Africa, Asia and the Small Island States.

The framework looks at what systems, places and people are vulnerable and why, and in the process identifies what types of adaptation strategies will be most effective. Preliminary lessons learnt include:

- Stakeholder engagement is indispensable in the assessment of vulnerability.
- Strategies to cope with current climate variability can be a source of information to learn about system sensitivities, resilience, capacities, determinants of vulnerability and strategies to cope and adapt.
- Importance of undertaking a multi-scale analysis: different sub-units within a region or community and cross-scale interactions. Focusing on a single scale of analysis may lead to flawed diagnosis of

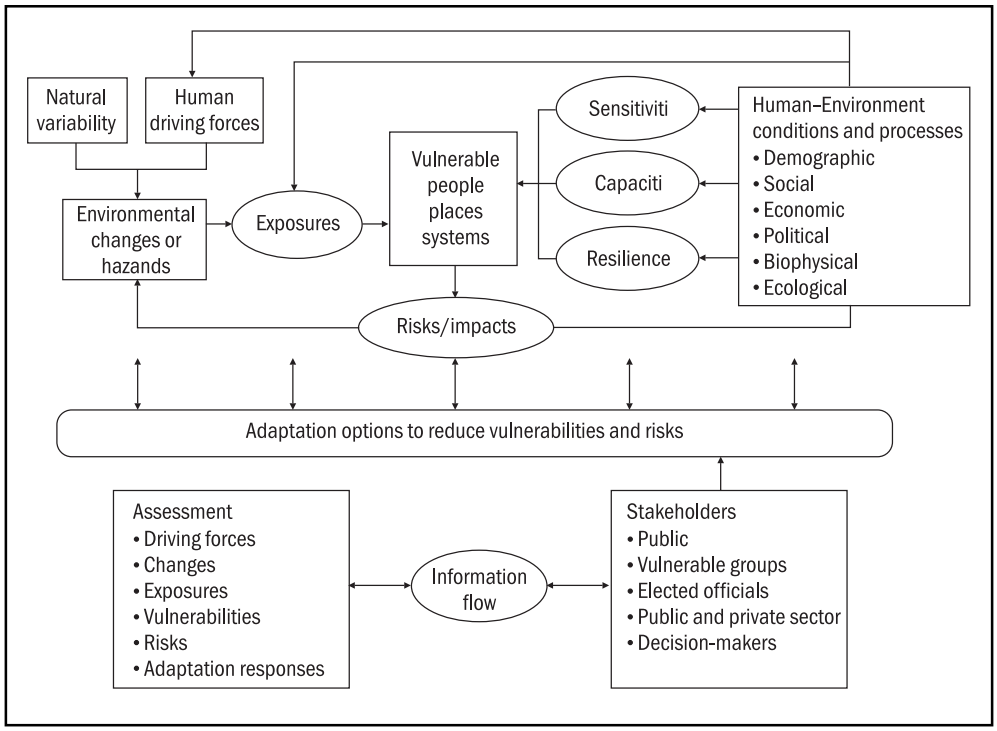

Figure 4 Framework for Vulnerability Assessment
Source <www.aiaccproject.org>

vulnerability, coping capacities, threshold limits and prescription of ineffective adaptation options.

- Multiple future scenarios (socio-economic, political and climatic).
- Regional climate models not always apposite for assessing vulnerability. Guided sensitivity analysis crucial as the first step.
- Livelihoods concept useful, insofar as climatic changes can restrict/expand livelihood opportunities.

Adaptation Policy Framework (APF) of the GEF

The APF may be viewed as a structured approach to developing adaptation strategies, policies and measures to ensure human development in the face of climate variability and change. It links adaptation to sustainable development and global environmental issues (UNDP, GEF, 2003). It outlines four basic principles from which actions to adapt to climate change and variability can be developed:

- Adaptation to short-term climate variability and extreme events for reducing vulnerability to long-term climate change
- Adaptation policy and measures assessed in a developmental context
- Adaptation occurs at different levels in society, including the local level
- Adaptation strategy and the process by which it is implemented are equally important.

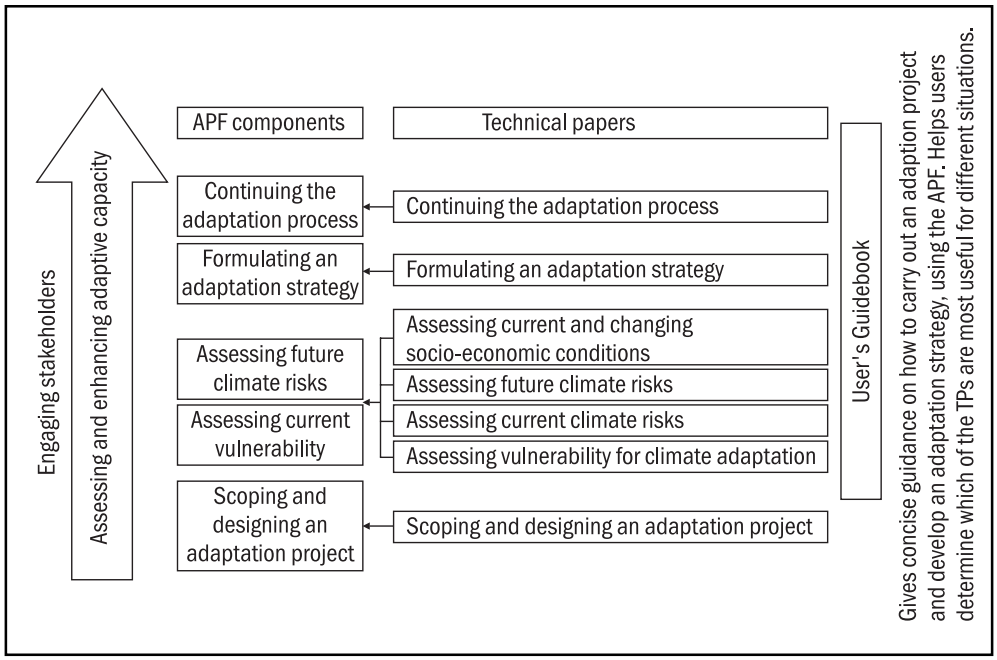

Figure 5 Adaptation Policy Framework (APF)
Source <http://www.undp.org/gef/undp-gef_publications/publications/apf%20sectionI_ugb.pdf>

The above figure illustrates the APF process. Five basic APF components are linked by two cross-cutting components; represented by the arrow Adaptive capacity, and the larger frame, the Stakeholder Context, within which all the components are played out. Details regarding the technical underpinnings of the AFP is provided by the nine Technical Papers (TPs).

Adaptation Policy Assessment

Adaptation Assessment refers to the "practice of identifying options to adapt to climate change and evaluating them in terms of criteria such as availability, benefits, costs, effectiveness, efficiency and feasibility" (IPCC 2001).

The elements of the conceptual framework include several concepts: flow variables (e.g., emissions), state variables (e.g., concentrations) at different spatial and temporal scales, complex, probabilistic properties of a system (e.g., climatic variability), spatio-temporal events (e.g., exposure), dose-response relationship (e.g., sensitivity) and human actions (e.g., adaptation). Each of the main elements on the framework has backward and forward linkages.

The assessment begins with scenarios of emissions or atmospheric concentrations of GHGs. On the basis of this, scenarios for the level of anthropogenic climate change and its spatial and temporal variability are developed using climate models. The exposure of a system to climate

stimuli depends on its location and the level/degree of climate change. Burton (1997) proposes ranking weather and climate phenomena (type 1,2,3) to discern single climatic variables (e.g., local temperature), specific weather events (e.g., storm), and long-term processes (e.g., anthropogenic climate change). The sensitivity of a system denotes a dose-response relationship, and climate impacts[9] are a function of a change in exposure, and sensitivity. Non-climatic factors include ecological, economic, social, demographic, technological and political factors that affect vulnerability of a stem or society to climate change.

Two types of adaptation are distinguished in the framework: facilitation and implementation. The former encompasses activities that enhance adaptive capacity (e.g., awareness generation, capacity building, institutional and governance structure fortification etc), thereby improving conditions for the implementation of adaptation measures. Implementation refers to activities that actually assist in alleviating and/or avoiding adverse impacts of climate change. The same applies to mitigation: facilitation measures such as establishment of a carbon-trading regime can enhance mitigative capacity. The replacement of an obsolete power plant by a more carbon-efficient plant, which may now be economically viable with the carbon-trading regime in place, is an implementation measure.

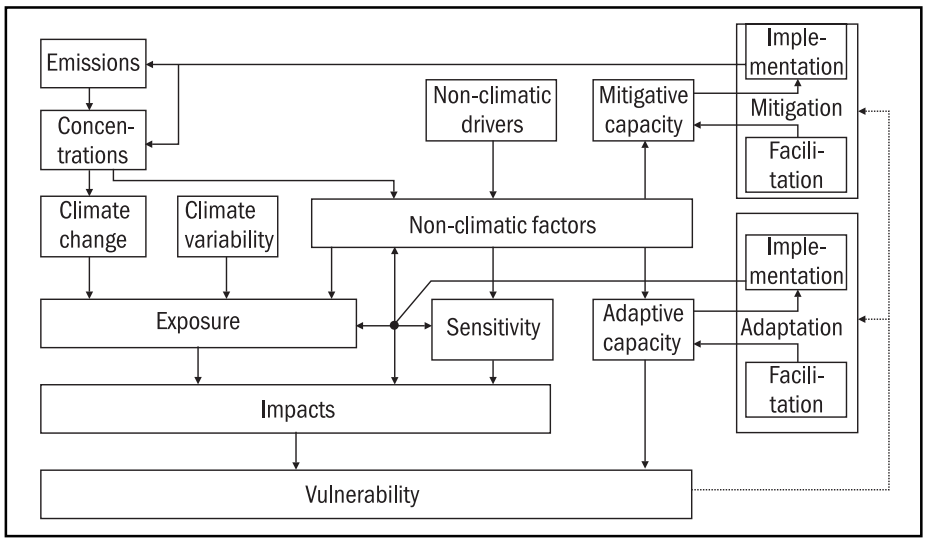

Figure 6 Adaptation Policy Assessment
Source Klein and Fussel 2002.

[9] Potential impacts are determined in assessments where the exposure of a system changes, but its sensitivity is assumed unaffected. Residual impacts requires assessments that explicitly consider adaptation measures.

Hence Adaptation Policy Assessment, by taking a look at both concepts of mitigation and adaptation, recommend specific anticipatory adaptation measures. This calls for:

- A more detailed look at the process of adaptation and enmeshing of adaptation strategies into a policy context
- Intensive involvement of stakeholders, strong emphasis on vulnerability to current climate variability
- Formulation of response strategies that reduce the vulnerability of a system to multiple stressors simultaneously rather than formulate independent adaptation strategies for each.

Use of Vulnerability Assessments

Figure 7 highlights the uses of vulnerability assessments in different scales and sectors.

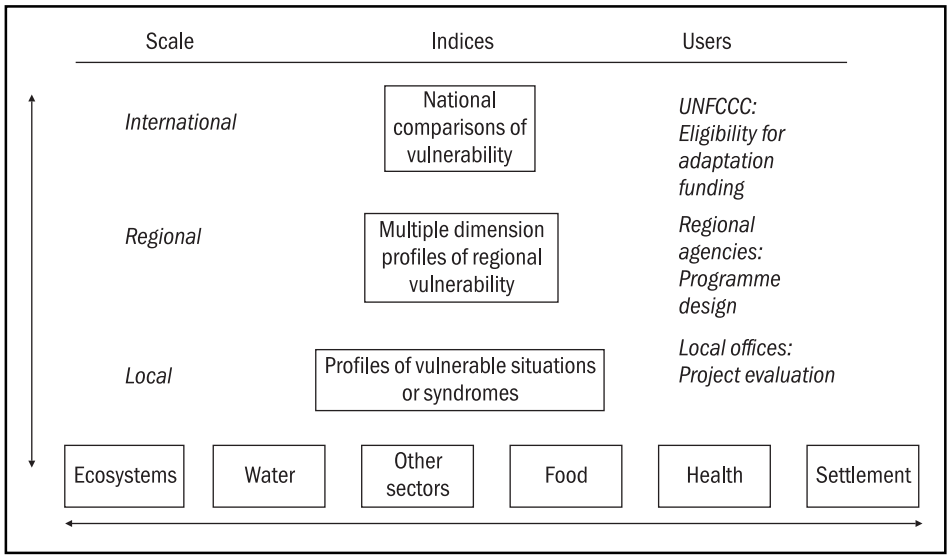

Figure 7 Uses of vulnerability assessments
Source <www.unitar.org/cep/samoa/UNEP%20VA%20Indices.pdf>

Integration of adaptation into policy processes

The international discourse on climate change and sustainable development represent different cultures; with significant differences in the way they have been played out, both as research questions and policy issues. While climate change has been primarily science-driven, sustainable development is more human-behaviour centred.

Sustainable development has been viewed as a panacea for traditional issues such as poverty, economic stagnation and for newer challenges such as environmental degradation and globalisation. While the term was coined in the 1980s, its intellectual pedigree goes back much further. During the 1980s, the separate strands of nature conservation, pollution concerns and economic development came

Three main dimensions of sustainable development: economic, social and environmental

together. Also the creation of the WCED (World Commission on Environment and Development) by the UN in 1985 represented a turning point in the debate, incorporating developing countries' concerns[10]. The oft-quoted definition of the term traces its genesis to the Brundtland Commission documents, *Our Common Future*[11] ; wherein the two concepts 'needs' (particularly of the poor) and 'limitations' (imposed by the environment's ability to meet present and future needs are embedded (Brundtland Commission 1987). The Commission coalesced two previously disparate literatures: environmental sustainability and social and economic development, arguing that issues of human development cannot be divorced from environmental issues. The three main dimensions of sustainable development have been identified as economic, social and environmental, and these should be advanced at the local, regional, national and global level. These concerns reached their zenith at the UNCED (United Nations Conference on Environment and Development) held at Rio de Janeiro in 1992.

Climate Change and Sustainable Development: the nexus

The links between climate change and sustainable development are several and varied (Cohen *et al.* 1998, Robinson and Herbert 2001, Banuri and Gupta 2000). Generally climate change and sustainable development interact in a circular fashion. Human-induced climate change poses a palpable threat to the achievement of MDGs (Millennium Development Goals), related national poverty alleviation and sustainable development (AfDB *et al.* 2002). It is expected to have deleterious effects on agricultural and hydrological systems, forests, fisheries, and human health; economies and infrastructure and result in increases in the frequency and magnitude of extreme events. Human health and well-being which are dependent on the sustained resilience and robustness of ecosystems, hence, get debilitated, worsening existing conditions of poverty, malnutrition and illness, and pressure on natural resources, thereby exacerbating the vicious cycle. This relates to sustainable development largely through impediments to and implications on the opportunities for socio-economic development and issues of equity and justice[12].

[10] For an exposition see Cohen *et al.* (1998: 349,350)

[11] "*…development that meets the needs of the present without compromising the ability of future generations to meet their own needs*"

[12] Both inter and intra generational equity are likely to be worsened since poorer communities, regions and countries are likely to be more vulnerable. Moreover the costs of damage as well as of the required mitigation and adaptation efforts will be unevenly distributed within and among nations.

Circular interaction between climate change and sustainable development

In turn, alternative development pathways will determine GHG emission levels that will affect future climate change, influence non-climatic stressors such as land-use changes, and future capacity to adopt mitigation and adaptation measures. Also, wider development goals such as improving of institutions to address current socio-economic and environmental problems, and to augment social capital; stimulating technological innovation of promotion of environmentally friendly technologies; development of drought-resistant varieties of crops can help in ameliorating the capacity to cope and adapt to climate variability and change.

Box 2 Climate Change and Sustainable Development: developing countries

Evidence reveals that developing countries are likely to face the most adverse effects of climate change and are less capable of coping to or adapting to such changes. Hence climate change is an impediment in achieving development goals. Recognition of how climate change is likely to impact development priorities is crucial in developing cost-effective strategies and integrated, institutional capacity in these countries. Beg *et al.* (2002), identify three sets of policy questions that emerge in relation to the inter-linkages:

(a) Threshold of allowable emissions
(b) Level, timing and allocation of emission reduction: sustainable development issues of equity., fairness, equity and cost considerations
(c) Type of action: mitigation vs. adaptation, choice of instruments etc

Mainstreaming vulnerability and adaptation to climate change into sustainable development planning

The global community has begun to develop and implement strategies and approaches for adapting to the on-going process of climate change, vulnerability-based assessments have been completed and priority areas for enhancing adaptive capacity have been identified[13]. However, more needs to be done in ensuring that the designs of policies/programmes/projects bear these findings. For e.g., in India, documents that guide development strategies such as PRSPs (Poverty Reduction Strategy Programme), pay little attention to climate change (Agarwala 2004).

Huq *et al.* (2003) maintain that in order to effectively support adaptation and to minimise risks associated with predicted impacts, there is an urgent need to integrate adaptation issues and considerations

[13] For e.g., the CBDAMPIC (Capacity Building for the Development of Adaptation Measures in Pacific Island Countries), Portland USA (impacts on water supply and demands and exploring alternatives), Tyndall Centre, UK (assist businesses in understanding their vulnerability and how to adapt) etc.

into the centre of decision-making and policy formation. Hence, the notion of mainstreaming. Mainstreaming refers to the incorporation of initiatives, measures and strategies to reduce vulnerability to climate into existing policies, processes and structures regarding environmental datasets, disaster management plans, food security, water resource management, health issues, sustainable livelihoods, institutional structures, project design and implementation etc. the primary objective being that "adaptation to climate" became part of programmes that further sustainable development planning (adapted from OECD 2003)[14]. Embedding climate change adaptation into sector policies, programmes and projects, expands the range of opportunities for reducing vulnerability and also enables impacts to be addressed in a more economically efficient manner (OECD 2005).

Tools, methods and avenues of integration

Integration of adaptation into policy processes requires a range of tools, methods and technologies at each step of the process. Integration of adaptation into policy processes involves:

- Identification of current risks and coping strategies
- Estimating future climatic risks and impacts
- Using this to review policies, programmes and projects to determine how they might be affected by climate change, how then will they contribute to adaptive capacity and whether modifications are desired
- Identification of reform measures
- Implementation
- Monitoring and evaluation.

The tools used at each stage of the integration process will vary depending on scale, sector and user; and can be drawn from a variety of disciplines: GIS (Geographical Information Systems), Vulnerability Assessments, Geography, Economics, Human Health, Sustainable Livelihoods Assessments etc (Parry *et al.* 2005). Some particular assessment or evaluation 'tools' include: BCA (Benefit Cost Analysis), SAM (Social Account Matrices), GEM (General Equilibrium Modelling), RARM (Risk Assessment and Risk Management), SLA (Sustainable Livelihoods Approach), and PVA (Participatory Vulnerability Assessment). The main short term challenge though is applying existing tools and technologies in effective ways,and making

[14] Another commonly used term is climate proofing: development of actions to protect infrastructure, systems and processes against climate impacts (Parry *et al.* 2005).

sure that they are transferred to areas that are most vulnerable to climate change.

Integration also takes place at different levels:

- ***Local level***: municipal planning processes and community level strategies, covering areas such as risk assessment practices, community services, emergency preparedness programmes, seed banks etc (see, AfDB 2002)
- ***Sectoral level***: impacts on agriculture, water resources, forestry, fisheries, coastal zones, urban planning, human health, and disaster risk reduction, need to built into the sectoral planning process (see Huq and Reid 2004)
- ***National Level***: government planning and budgetary processes (AfDB 2002)
- ***Global level***: integrated unequivocally into the MDGs, country assistance strategies of international financial institutions, aid initiatives etc.

Examples of Mainstreaming

Mozambique: Integrating Adaptation to Climate Risks into Mozambique's Action Plan for Poverty Reduction

Mozambique is particularly vulnerable to shocks arising from natural disasters. The floods experienced in 2000 and 2001 had far-reaching social and economic consequences. The impact of natural disasters is recognised in the country's Action Plan for the Reduction of Absolute Poverty 2001–05, in which vulnerability to natural diasters is one of the key action areas. It states, "*Natural disasters are a risk factor, which affect the pace of economic growth, and destroys assets of the poorest segments of the population in affected areas…Therefore measures aimed at managing this risk are of utmost importance*" (Mozambique Action Plan 2001–05). The Action Plan goes on to recommend that action be taken to strengthen the national capacity to respond to natural disaster by raising the standard of national early warning systems. This limited means of enhancing the capacity to deal with climate-related disasters represents a type of adaptation to climate change that also contributes to reducing vulnerability to current risks, helps reduce threats to livelihoods and hence contributes to poverty eradication.

Vietnam: Mangrove Planting

The Vietnam Red Cross (VNRC) has supported local communities in the northern coastal provinces in planting 12000 hectares of mangrove trees to break the 1.5 metre eaves typically associated with tropical typhoons and to act as a buffer to 110 km of sea dyke. The programme has cost US$1.1 million; the benefits have already proved far greater.

- Costs of dyke maintenance have fallen by us$7.3 million a year.
- Typhoon Wukong in October 2000 claimed no lives on the island, no damage to the dyke and minimal damage to property and possessions.
- The mangrove planting has created livelihood opportunities for 7750 families involved in the replanting and protection effort and who are harvesting shellfish among the mangroves (Source: IFRC-RCS 2002).

Mexico: Funding for Natural Disaster Relief

In 1996, the government established the FONDEN (Fund for Natural Disasters) for post-disaster (droughts, frost or other weather-related perils) financing for reconstruction of infrastructure and compensation to low-income producers for crops and livestock losses. In addition, providing catastrophic insurance coverage has encouraged the formation of mutual insurance funds amongst farmer organisations, to provide mutual crop insurance to their members. Termed as fondos (fondos de aseguramiento), these organisations collect premiums, creating reserves to pay indemnities and covering operational costs (World Bank 2000).

Funding Adaptation

Handmer *et al.* (1999) posit that poorer regions and countries will have difficulty in adapting to climate change, since they lack to wherewithal - technical and financial. It has long been recognised that assistance will be provided to the most vulnerable countries to help meet the costs of adaptation.

Morrakech Funds: LDC, SCCF and the Adaptation Fund

In response to these circumstances, at the 7th CoP at Marrakech in 2001, three new funds known as the Marrakech Funds came into existence.

- **LDC Fund (Least Developed Country)** to support atleast 49 LDCs, to design NAPAs (National Adaptation Programme of Action) over the period 2003–05.

- **SCCF (Special Climate Change Fund)** to support a broad mandate of adaptation covering areas such as technology transfer, transport, industry, natural resource and waste management, health issues, to assist developing countries in diversifying their economies. This fund is to become operational from 2005 with voluntary contributions. LDC and SCCF will be operated by the GEF (Global Environmental Facility).
- **Adaptation Fund (under the Kyoto Protocol)** to support concrete adaptation projects and programmes and to be financed from a 2% levy on the CDM (Clean Development Mechanism) projects. Hence, this financing is contingent upon the CDM generating funds, which seems rather dubious.

Problem areas with GEF financing

Problematic notions of 'incremental costs' and 'global environmental benefits'

The GEF has a climate change operational programme, which has funded mitigation activities to the tune of nearly a billion dollars since its inception in 1992 (Huq and Burton, 2003). However, it has funded only a small number of activities directed towards adaptation. At CoP 1 at Berlin 1996, it was agreed that it would fund activities in three stages: Stage I – to support assessments, Stage II – to support planning and Stage III – to support actions. So far, most support has been for Stage I only. At CoP 4 in Buenos Aires it was decided that adaptation activities should move to Stage II. Nevertheless, only a few projects under this stage have been funded (e.g., in the Caribbean and Pacific Islands).

The GEF operational strategy for funding under Article 4.3 is difficult in the adaptation context for the following reasons:

- It requires baseline information for incremental calculation of costs, which is difficult to obtain.
- It requires demonstration of 'global environmental benefits'; when in reality benefits from adaptation projects yield local, at the most regional benefits.
- It calls for a separation of actions adaptation to future 'climate change', from those that enhance 'climate variability'.
- Adaptation activities intimately connected with other aspects of development, hence difficult to determine adaptation component of a project (IISD 2004). Most actions that seek to enhance adaptive capacity are also likely to result in building capacity to cope, vis-à-vis climate variability and change.

What does this imply? More pragmatic rules need to be introduced with respect to funding.

- Stand-alone funds that specifically target climate change impacts by themselves will not suffice. New and additional funding is required

'New' and 'additional' funding for adaptation

- Need to integrate adaptation considerations into day-to-day budgetary processes, and ensure that financial flows are new and additional.
- Adaptation should be treated as part of/factored into all development assistance activities that are climate sensitive/ sustainable development in all developing countries.
- Targets for funding:
  - highly vulnerable countries: LDCs and SIDS
  - climate sensitive sectors such as agriculture, forestry, fisheries,
  - disaster risk reduction.
- Financial flows outside the Convention
  - Bilateral Development Agencies
  - World Bank[15] and other IFIs (International Financial Institutions)
  - Private Sector
  - NGDOs (Non Governmental Development Organisations)
  - Role of insurance and risk transfer instruments such as weather derivatives, weather hedges, catastrophe bonds etc.[16]

Conclusion

Integrating climate change adaptation considerations into policy processes and decision-making across a range of sectors and scales is critical in managing the impacts of climate change. Efforts to achieve this objective, might be undertaken unde the direction of the UNFCCC, and/or independently through actions supported by the private sector, national finance ministries, international financial institutions, and NGDOs.

There is a need to develop, disseminate and implement the knowledge, tools and technologies required to effectively engage in an integrated approach. There are several assessment frameworks in place that can potentially help reduce vulnerability to climate change. At the same time, new tools are needed to address lacunae that have been identified, such as tools for screening projects for their exposure to climate risks (Agarwala 2004) and economic valuation of climate change impacts (OECD 2005). Financing adaptation actiivites and costs associated with the impacts of climate change is a key concern for developing countries. Long-term, firm and regular support is indispensable.

[15] Through VARG (Vulnerability and Adaptation Resource Group), BioCarbon Fund and Community Development Carbon Fund.

[16] See Vellanga and Mills (2004), Linnerooth-Bayer, *et al.* (2003) and Hamilton (2004) for insurance.

Finally, particular attention needs to be paid to the issues of adaptation in any future international climate regime, as a cross-cutting theme that is fully integrated into UNFCCC actions related to future research, commitments, capacity building, and also into decision-makign and management practices at various scales.

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