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**REPORT OF THE STAP EXPERT GROUP WORKSHOP ON
ADAPTATION AND VULNERABILITY**

(Prepared by the Scientific and Technical Advisory Panel)

Report of the STAP Expert Group Workshop on Adaptation and Vulnerability

**February 18-20, 2002
UNEP Headquarters, Nairobi, Kenya**

*Prepared by
The Scientific and Technical Advisory Panel (STAP)
of the Global Environment Facility (GEF)*

**STAP Secretariat
United Nations Environment Programme**

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Preface

It is a pleasure to present the final report of the STAP Expert Group Workshop on Adaptation and Vulnerability convened at UNEP Headquarters, Nairobi, Kenya from February 18-20, 2002. STAP, on behalf of the GEF, would like to acknowledge all the experts who participated in the workshop and contributed their knowledge and experience freely. ~~STAP is very appreciative on the “China Efficient Industrial Boiler Project”. The Selective Review was undertaken as an integral part of the Programme Studies co-ordinated by the Monitoring and Evaluation Unit of the GEF Secretariat.~~

This report was prepared by Prof. Shuzo Nishioka and the STAP Secretariat.

Madhav Gadgil
STAP Chairman

Executive Summary

Scientifically and politically, adaptation to the impacts of climate change has emerged as one of the most urgent critically and contemporary societal issues. Adaptation is now recognised as an integral part of the response to the impact of climate change, because current agreements to limit emissions, even if implemented, will not stabilise atmospheric concentrations of greenhouse gas emissions and climate change. It is a process that needs to be incorporated in overall development planning, including the design and implementation of projects and programmes across all sectors. Furthermore, vulnerability reduction and by extension adaptation is neither a one-off intervention or stand-alone activity.

Notwithstanding the importance of adaptation, numerous scientific and technical gaps still remain. An overview is provided of indicative gaps in selected sectors. Lessons are also drawn from case studies addressing adaptation concerns. These give insights into the range of issues, particularly, at different scales, which must be taken into consideration is the design of adaptation measures.

A number of barriers are also highlighted which are mitigating agent to the incorporation of adaptation measures into broad base development. These include, but are not limited to, uncertainties with climate change and the artificial distinction between climate variability and change; inadequate awareness and knowledge on adaptation at the policy and decision-making levels, weaknesses in institutional capacity development; data and lack of scenarios development at the national and regional levels.

Key elements which could form the basis of the GEF Adaptation Strategy are presented. The issue of a new direction for adaptation assessment is highlighted, a shift from the “Scenario-Based” Approach to one of “Risk Assessment”. A number of principles are outlined which should guide the evaluation of the Adaptation Strategy as well as the challenges which must be addressed in designing an effective Adaptation Strategy.

A number of implementation consideration are outlined including the need for:

- A cross-cutting operational policy instead of the convention-wise sectoral approach;
- Revision of the incremental cost concept which applied to adaptation. Unlike mitigation activities which aim at reducing atmospheric greenhouse gas concentrations, the global benefits related to adaptation activities are likely to be intangible or more difficult to measure. As a consequence, particular attention should be paid for lowering the baseline for adaptation activities. Related to this is the need to establish national/regional adaptation baseline, in the absence of an internationally agreed one;
- Recent work on vulnerability and adaptation to climate change has shown that investment in adaptation is unlikely to be efficient and effective if not linked to efforts to promote sustainable development. Investment in adaptation will be unproductive in the absence of an enabling social, economic and institutional environment – the adaptive capacity of countries and communities.

As a first priority, funding needs to be directed at better understanding and enhancing adaptive capacity. Resources need to be directed at enhancing adaptive capacity, including identification of priorities for adaptation, strengthening institutions and networks, increasing skills, knowledge and awareness and developing information and communication technology.

Opportunities to create synergies with other environmental issues, such as combating land degradation and conserving biodiversity etc. should be pursued.

The first priority for specific responses is to reduce vulnerability to climatic hazards and maladaptation that increases risks. Early warning systems, preparedness, disaster recovery and insurance are existing strategies that need to be more widely applied.

- The activation of regional/local based work of implementation and executing agencies, and introduction of more local based agencies in implementing of adaptation measures. As a consequence, country priorities will require further elaboration of priorities at the national level. The National Action Plans for Adaptation could be used as initial means for achieving this, at least in Least Developed Countries. The country-driven framework will need to include local priorities and regional actions since adaptation is a multi-level endeavour.
- The Marrakech Accords explicitly recommend building capacity to adapt to climatic variability and consideration of other multi-lateral environmental agreements. Adaptation projects will need to be linked to other multi-lateral environmental agreements and to other multi and bilateral funding, for example on monitoring and early warning, disaster preparedness, and sectoral development, since sufficient resources are not available through the GEF to effectively mitigate present and future climatic risks.

SECTION 1: INTRODUCTION AND BACKGROUND

1.1. Background

Scientifically and politically, adaptation to the impacts of climate change has emerged as one of the most urgent, critical and contemporary societal issues. Adaptation is recognised as a critical response to the impact of climate change, because current agreements to limit emissions, even if implemented, will not stabilise atmospheric concentrations of greenhouse gas emissions and climate change. Hence adaptation ought to be considered as an integral part of response to climate variability and change.

Recognising the increasing importance of adaptation in the climate change debate and negotiations, the Global Environment Facility (GEF), has sought to respond in a timely and effective manner. In this regard, the Scientific and Technical Advisory Panel (STAP) of the GEF was requested to provide strategic scientific and technical advice on these issues, to inform the GEF policy response. STAP, in response, organised a Brainstorming Session in March 2001 to explore, in a preliminary manner, the various elements which could form the basis of a GEF programme for adaptation. It was however highlighted that, in addition to the guidance (Box 1.1) already provided by the COP/UNFCCC, due consideration should be given to the additional guidance which was likely to be provided by COP7/UNFCCC.

The COP7/UNFCCC did in fact provide a much clearer and comprehensive guidance on adaptation which will form the basis of the GEF responses. The COP7/UNFCCC guidance on adaptation was provided under four main categories, namely: Funding under the Convention (Decision 7/CP.7); Funding under the Kyoto Protocol (Decision 10/CP.7); Additional guidance to the operating entity of the financial mechanism (Decision 6/CP.6) and Implementation of Articles 4.8 and 4.9 (Decision 5/CP.5). These are summarised in Box 1.2. In addition, further guidance was also provided on a range of issues relevant to adaptation, namely: technology transfer and capacity, assessments and methodologies and methods and tools for new generation of V&A assessments (Box 1.3).

The additional guidance provided by COP7/UNFCCC, formed the context for the STAP Expert Group Workshop to further considered the issue of adaptation to climate change. The central question which the Expert Group Workshop considered was how to address adaptation, especially efforts to build adaptive capacity (including scientific, technical and institutional capacity) within the context of sustainable development. Efforts were made to answer the critical operational issue which this question raises, namely: How can adaptation concerns be successfully incorporated into development projects in sectors that are vulnerable to climate change impacts?

Box 1.1: Initial COP Guidance on Vulnerability Assessments and Adaptation

(a) Initial COP Guidance (Decision 11/CP.1):

- Stage I: Identify impacts, particularly vulnerable countries/regions and policy options;
- Stage II: For particularly vulnerable countries/regions, identify measures, including capacity-building, to prepare for adaptation;
- Stage III: Identify measures to facilitate adaptation, including insurance schemes.
- Decision 11/CP.1 requested GEF to initially fund Stage I in the context of national communications. Stages II and III would be funded later if Stage I studies, IPCC and other sources suggested such actions were necessary;
- Decision 2/CP.4 asked GEF to fund Stage II in the context of national communications. Decision 8/CP.5 reaffirmed this request;
- Kyoto Protocol strengthened all provisions of UNFCCC on implementation and financing of adaptation. It established Clean Development Mechanism as a source of funding and envisaged an adaptation fund.

(b) Enabling Activities

Launched as a response to COP 1 guidance requesting GEF to support Non-Annex-1 Parties in meeting their commitments under UNFCCC. (Decision 11/CP.1)

In accordance with Article 4.3 of UNFCCC, funding for enabling activities covers the agreed “full costs” incurred by developing country parties in complying with their obligations under Article 12.1 of UNFCCC, which requires each Party to prepare national communications.

Box 1.2: COP7/UNFCCC Guidance on Adaptation

1. Funding under the Convention and the Kyoto Protocol

Two new funds under the convention:

- **Special climate change fund** to finance:
 - ❖ Adaptation, in accordance with paragraph 8 of decision 5/CP.7,
 - ❖ Transfer of technologies, emissions reductions, and assistance to developing country Parties in diversifying their economies.
- **Least Developed Countries (LDCs) fund** to support LDCs in implementing the Convention and, in particular, to address their adaptation needs in accordance with Section II of decision 5/CP.7: Especially on National Action Plans for Adaptation (NAPAs).

2. One new fund under the Protocol:

- Adaptation fund to finance adaptation projects and programmes in accordance with paragraph 8 of decision 5/CP.7

3. Additional guidance to GEF

Provide financial resources activities including those identified in paragraph 7 of decision 5/CP.7, such as

- Strengthening the implementation of country-driven stage II adaptation activities;
- Establishing pilot or demonstration projects to show how adaptation planning and assessment can be practically translated into projects that will provide real benefits, and may be integrated into national policy and sustainable development planning;
- Enhancing the capacity of subregional and/or regional information networks on V&A assessment;
- Building the capacity for preventive measures, planning, preparedness for disasters related to climate change, including early warning systems.

4. Implementation of Articles 4.8 & 9

18 Specific Areas of Assistance (para 7 and 8)

- Activities in relation to information collection and analysis, and assessments of vulnerability and adaptation;
- The implementation of adaptation activities, including pilot projects, where sufficient information is available in specific sectors;
- Capacity-building for preventative measures, planning, preparedness and management of disasters relating to climate change;
- Monitoring, forecasting and early warning systems, national and regional centres and information networks for rapid response to extreme weather events;
- Education training and public awareness.

NB: The three new funds are to be operated by the GEF.

Box 1.3: Other Relevant SBI/SBSTA Activities

1. Nine agenda items, including COP7 decisions on Technology Transfer and Capacity building, address two key aspects of adaptation
 - Implementation: COP7 decisions;
 - Assessments and methodologies, including
 - ❖ Issues related to NAI National Communications (SBI)
 - ❖ V&A Methods and tools (SBSTA)
2. **Issues related to NAI NC**
 - Parties identified a number of financial, institutional and methodological problems to the area of assessment of V&A.
 - New UNFCCC Guidelines by COP8: clearer guidance for work on in V&A area is needed, including:
 - ❖ Specific technical guidelines and methods to address vulnerability and adaptation, including climate variability, adaptive capacity, policy options, address SD;
 - ❖ Other (than IPCC, 1994) approaches are needed for V&A assessment.
3. **Methods and Tools for “New Generation” of V&A Assessment**
 - To focus on policy options and address consistency with SD plans and goals;
 - To better address risks associated with variability and extreme events;
 - To involve stakeholders in the assessment at all stages;
 - To ensure that methods are practical and appropriate:
 - ❖ Exchange and dissemination of information is essential

1.2 Aims and Objectives

The specific aims and objectives of the STAP Expert Group Workshop on Adaptation and Vulnerability were:

- (i) Provide the GEF with scientific and technical advice on how to operationalise the guidance provided by the Conference of the Parties, taking into consideration:
 - The current level of scientific and technical knowledge in adaptation;
 - The difficulties in distinguishing between impacts resulting from climate variability and climate change;
 - The regional differences in terms of vulnerability and adaptive capacity;
 - The social, economic and environmental impacts of adaptation as well as the need to address this issue within the overall context of sustainable development.
- (ii) Identify gaps in current scientific knowledge in terms of integrating adaptation concerns into mainstream development in specific sectors;
- (iii) Provide advice on how to integrate adaptation concerns into mainstream development projects in specific sectors in a scientifically sound manner;

- (iv) Develop guidelines for the formulation of a framework and/or an approach for the GEF to fund adaptation interventions;
- (v) Outline the main elements of a targeted research agenda for adaptation, based on the gaps identified in (ii).

1.3 Structure of the Workshop

The Expert Group Workshop was structured in such a manner so as to facilitate a “bottom-up” approach focusing on case studies and ongoing experiences of adaptation activities. The Workshop was structured around three major elements, namely: a background paper commissioned by STAP; a number of case studies presented by operational experts involved in project design and implementation in the various sectors (i.e. agriculture, water resources management, urban planning, health, ecosystem/biodiversity conservation etc.) and working group sessions (Annex 1). In order to focus on promotion of adaptation measures at the operational level and their integration into mainstream development, the Working Groups focused on a series of issues namely:

- Gaps in current scientific knowledge including tools, methodologies, technologies: vulnerability assessment cost/benefit analysis;
- Barriers mitigating against practical incorporation/integration of adaptation into sector policies, plans and development projects;
- Cross-focal and social issues;
- How to bring S&T to bear on process of incorporating adaptation measures into sectoral policies and development projects taking into consideration cross-focal and social issues;
- Priority areas for intervention and potential types of interventions; and
- Criteria for prioritization and selection that are consistent with COP guidance.

1.4 Participation

The meeting was attended by experts from a wide cross-section of disciplines given the multi-disciplinary nature of adaptation and vulnerability, bilateral agencies; six STAP members, representatives from the Secretariat of the UNFCCC; the GEF Secretariat and the GEF Implementing Agencies (UNEP, UNDP and the World Bank) (Annex 2).

1.5 Official Opening

Prof. Madhav Gadgil, STAP Chairman, welcomed the participants to the meeting. He also emphasised the importance of the meeting in providing strategic advice to the GEF and encouraged those attending the meeting to fully participate in discussions and share their experience on adaptation. The meeting was also addressed by Janos Pasztor, Co-ordinator, Sustainable Development Programme, UNFCCC Secretariat. In his statement he challenged the meeting to consider adaptation in the context of development. He raised a number of issues including the meaning of the incremental cost principle in the adaptation context and what does adaptation mean in development funding as critical issues which the meeting could consider.

Dr. Yasemin Biro, Programme Manager, Climate Change and Ozone Depletion, GEF Secretariat, in her statement, expressed the hope that the workshop could provide advice on how to integrate and design the implementation of adaptation concerns into mainstream development projects in vulnerable sectors.

The meeting was officially opened, on behalf of the Executive Director, by Mr. A. Djoghla, Director, Division of GEF. He gave an overview of UNEP activities in GEF, particularly as it relates to the issues of adaptation and vulnerability. He also emphasised that UNEP will play a leading role in adaptation and vulnerability building on the platform which it has already established.

SECTION 2: THE NEED FOR ADAPTATION, ADAPTATION EXPERIENCES AND LESSONS LEARNT

2.1 Introduction

This section outlines the need for adaptation to the impacts of climate change as well as the main conclusions and lessons learnt from the case studies which were designed to address the issue of adaptation. It also provides an overview of adaptation options for a number of sectors.

2.2 Potential Impacts of Climate Change

The Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) provides a comprehensive overview of the current understanding of potential impact of climate change for sectors and regions.¹ An important conclusion is that recent regional climate changes, particularly temperature increases, have already affected many physical and biological systems. In addition, there are preliminary indications that some human systems have been affected in part by 20th century regional climate changes (e.g., increased damages from flood and wind storms in some locations).

Natural and human systems are expected to be exposed to changes in the mean and variability of temperature and precipitation, as well as in the frequency and severity of extreme climatic events, e.g., floods, heatwaves, etc.). Systems would also be exposed to indirect effects of climate change, e.g. due to changes in the frequency and intensity of wild fires and pest infestations and changes in the distribution of infectious disease vectors and hosts. The sensitivity of a system to these exposures depends on system characteristics and includes the potential for adverse and beneficial impacts.

In its Summary for Policymakers the IPCC² gives the following list of projected adverse impacts of climate change due to projected changes in means and extreme climatic events:

- A general reduction of potential crop yields in most tropical and subtropical regions for almost any projected increases in temperature.
- A general reduction, with some variation, in potential crop yields in most regions in mid-latitudes for increases in annual-average temperature of more than a few °C.
- Decreased water availability for populations in many water-scarce regions, particularly in the subtropics.
- An increase in the number of people exposed to vector-borne (e.g. malaria) and water-borne diseases (e.g. cholera) and an increase in heat stress mortality.
- A widespread increase in the risk of flooding for many human settlements, especially those in small islands and low-lying deltas (e.g. tens of millions of inhabitants in settlements studied in Bangladesh) from both increased heavy precipitation events and sea level rise.
- Increased energy demand for space cooling due to higher summer temperatures.

Projected beneficial impacts of climate change, as listed by the IPCC, include:

- Increased potential crop yields in some regions in temperature areas for increases in temperature of less than a few °C.
- A potential increase in global timber supply from appropriately managed forests.

¹ McCarthy *et al* 2001

² *op cit*

- Increased water availability for populations in some water-scarce regions (e.g., in parts of Southeast Asia).
- Reduced winter mortality in mid and high-latitudes.
- Reduced energy demand for space heating due to higher winter temperatures.

2.3 Why Adaptation?

Given that the natural and human systems have already been impacted by climate change in the 20th century and in the absence of effective mitigation of climate change through a reduction of greenhouse gas emissions, human and biophysical systems will have to adapt to the effects of climate change. Despite verifying degrees uncertainties associated with the quantification and the detail of future projections of uncertainty about the possible scenarios of climate change and the range of possible impacts, adverse impacts will be more severe with greater the rate and magnitude of climate change enough to constitute unacceptable harm, resulting in monetary losses, loss of species and habitats. If it is taken that there is a risk that an impact threshold could be exceeded, not only should the values attached to the threshold be reviewed, but the question should be asked whether the probability that a threshold may be exceeded warrants risk management, e.g. increasing adaptive capacity. It is generally agreed that the short-term policy response to climate change impact risk is to enhance the adaptive capacity so that the current coping range expands, reducing present vulnerability, and to develop this capacity in such a way that the longer-term risks to climate change are also reduced.

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In the consideration of climate change impact, a distinction could be made between first-order impacts (e.g., heat stress, floods and permafrost melting) and second-order impacts. Second-order impacts usually result from primary impacts in combination with cross-sectoral or social issues (Figure 2.1) shows the relationship between first and second order impacts:

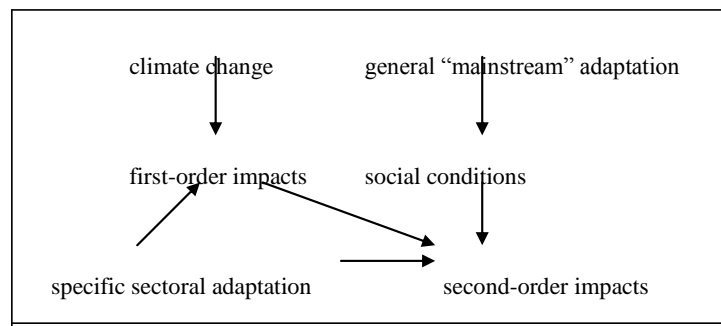


Figure 2.1: Relationship between Primary and Second Order Impacts

Specific, sectoral adaptation measures, such as early-warning systems, evacuation plans, implementation of building codes would be usually directed at the impacts, whilst more general, or mainstream, adaptation measures (such as improved planning) would be directed at the social conditions that interact with the impacts.

A human-system's vulnerability to climate change is determined by its exposure, sensitivity and adaptability to climate change and will vary with geographic location, time, and social, economic and environmental conditions function of its sensitivity to potential adverse impacts and its capacity to adapt to these impacts. The is adaptive capacity is determined by access to resources, information and technology, the skill and knowledge to use them and the stability and

effectiveness of cultural, economic, social and governance institutions that facilitate or constrain how human systems respond. ~~Following this line of argument, it can be argued that developing countries would be particularly exposed to adverse impacts, whilst impacts in industrialised countries would be less severe. Developed countries due to their socio-economic conditions or human and financial capital and infrastructure have greater adaptive capacity and generally are located in geographic locations that are less sensitive to climate change and thus would be less adversely affected by climate change. In contrast, developing countries are projects to be impacted adversely as they are already more flood and drought prone and a large share of the economy is in climate sensitive sectors most vulnerable as they have lower capacity to adapt because of a lack of financial, institutional and technological capacity and access to knowledge. In addition, developing countries usually have lower adaptive capacity than industrialised countries. These two factors together suggest that developing countries are more vulnerable to climate change than industrialised countries.~~ Notwithstanding the vulnerability of developing countries, it should be recognised that there are great variations in vulnerability amongst and within these countries. ~~In addition, impacts and adaptive capacity in these countries usually vary between sectors and geographic location, time and social, economic and environmental considerations.~~

An understanding of the direct and indirect costs of disasters is a critical factor in determining how much to invest in minimising losses. Unless something can be done to mitigate or reduce the impacts of a hazard, reducing vulnerability through adaptation is usually the main means of preventing losses. This underscores the point that vulnerability reduction and by extension adaptation is neither a one-off intervention nor a stand-alone activity. It is a process that needs to be incorporated in overall development planning, including the design and implementation of projects and programmes across all sectors. The process involves building coping capacity and increasing resilience over the longer term to strengthen the ability to withstand and recover from environmental changes and variations.

2.4 Case Studies Analysis

A number of case studies prepared and presented by operational experts involved in project design and implementation in the various sectors (i.e. agriculture, water resources management, urban planning, health, ecosystem/biodiversity conservation etc.) form the basis of the conclusions presented in this section. This approach has been adopted so as to facilitate a “bottom-up” approach using case studies and ongoing experiences of adaptation activities as a basis. In addition to the case studies, a number of presentations focused on methodological issues (Table 2.1).

To facilitate a “bottom-up” approach, the case studies addressed the following issues:

- How specific project(s) incorporated concerns about climate vulnerability and climate change impacts;
- The specific adaptation measures that were undertaken and/or contemplated in the project(s);
- The barriers (i.e. lack of information, policy constraints etc.) to addressing climate change impacts which were encountered during project design and implementation;
- Lessons learnt from project implementation and their implications for the design of future project addressing adaptation concerns.

Generally the case studies gave an insight into the dynamics which are likely to impact on adaptation activities across the sectors and at different scales. (Table 2.1 for case studies

presented). They also allowed for the identification of areas and/or sectors which require more emphasis in the evolving adaptation to climate change debate.

TABLE 2.1: Case Studies Presented Showing Sectors and Scales

| A. SECTOR | SCALE | | | |
|--|----------------------------------|--------------------|---|-----------------------------|
| | FARM/LOCAL | NATIONAL | SUB-REGIONAL | REGIONAL |
| FORESTRY | | China ¹ | | |
| AGRICULTURE/AGRO-ECOSYSTEMS | Peninsular ² India | China ¹ | | |
| WATER RESOURCES | | China ¹ | West Africa ⁵ | |
| LAND USE/LAND USE CHANGE AND IMPACT | | | Miombo Eco-region ³ Southern Africa | |
| BIODIVERSITY | | | Southern Africa ⁴ | |
| COASTAL/MARINE/COASTAL INFRASTRUCTURE | | | | Caribbean SIDS ⁶ |
| B. METHODOLOGICAL: Moving From Scenario Based “Forecasts” to Risk Assessment ⁷ Methodologies for Analysing Existing Infrastructure Projects in Vulnerable Sectors ⁸ Cost and Benefits of Adaptation ⁹ | | | | |
| ¹ An adaptation Framework Suggested – Case Study for China’s Agriculture, Water and Forestry – Lin Erda ² Adaptation to Climate Change: Semi-arid agro-ecosystems on Peninsular India – M. Gadgil ³ Adaptation and Vulnerability to Climate Change in Southern Africa with Special Reference to the Miombo Ecoregion – Paul Desanker ⁴ Adaptation of Biodiversity to Climate Change in Southern Africa –Mike Rutherford ⁵ Impact of Climate Change on Drylands – Jan Verhagen, Tom Dietz, Ruud Ruben ⁶ Caribbean: Planning for Adaptation to Climate Change CPACC – Ulric Trotz | | | | |
| ⁷ Roger Jones ⁸ Anand Patwardhan ⁹ Ferenc Toth | | | | |

A critical issue which emerged from the analysis of the case studies which has important implications for the designing of adaptation interventions is the scale at which interventions are made. Some of the major conclusions drawn from the case studies for different spatial scales are presented below:

(a) Farm/Local Level

Bottom-up Approaches: Bottom-up approaches to adaptation which is evident at the farm and/or local levels are useful, can yield tangible results and entails relatively low costs. Such approaches also lend themselves to the more effective utilization of local and indigenous knowledge on adaptation to climate change and climate vulnerability. A bottom-up approach involving a collaboration of people in the field with scientists can make a significant positive contribution in relation to moving on to a path of sustainable development by itself, and in relation to climate change.

Linking of Formal and Ethno-Science: An experiment at working with farmers through an alliance of scientists and farmers led to the development of a crop model incorporating pest disease impacts that can simulate the behaviour of the crops on farmers' field far better than the earlier scientists working alone. The combination of formal and ethno-science provided can provide far better inputs for making farm level decisions under highly variable climatic conditions.

Importance of Recent Records in Climate Variability and Extremes: Adaptation to the current prevalent climate variability is an important ingredient of future preparedness of vulnerability in face of climate change. This is an important consideration to be taken on board in the formulation of a framework for assessing adaptation.

Coping Strategies in Agro-Ecosystems: The translation of climate change to agricultural production systems of the developing world has not received sufficient attention. Efforts to reduce rural and peri-urban poverty and increase food security have to consider the threats and options of climate change. Climate change will affect small-scale farmers, linking directly to issues of productivity, poverty, food security and sustainability of current use of the natural resource base. A new concept, complementary to the persistent questions of sustainability, is that of *sustainagility* – maintaining the coping strategies and options for farmers of the future to develop rural livelihood systems that will meet their needs. The resources for “*sustainagility*” depend on both human and natural resource capital, and analysis of these resources may reveal trade-offs between productivity increase in the short run and maintaining options for the future.

Agroecosystems are in a continuous process of change and adaptation to many factors and climate change may be a small additional ‘noise’ as long as we stay within the limits of physiological and genetic adaptation of the crops, trees and livestock currently used. But the adaptive response required of farmers may involve higher levels of ‘agility’ in switching to crops and commodities new to the current system and in finding new ways of managing soil and water resources. Exploring the thresholds and limits involved in this process will help us identify where climate change will become more than just background noise and become a dominant factor in the success or failure of local or regional agriculture.

Farmers all over the world use an array of strategies to cope with change in their environment in response to a variety of stresses (biotic, social, market, policy, etc.) and they will be able to adapt

to parts of the local impacts of global climate change on their production system. However, there are limits to adaptation and thresholds beyond which adaptation will have substantial costs.

(b) Sub-regional/Regional Approaches

The sub-regional approach, particularly in Africa and the regional approach, particularly in the case of the Small Island Developing States (SIDS), proved to be useful in addressing adaptation to climate change. Some of the major conclusions drawn from the regional and sub-regional studies are:

(i) Africa

Early Warning Systems: Early warning systems should be improved. The improvements should target both the technical indicators as well as the communication to stakeholders. The experiences in Mali (since 1983) could be used as a guide.

Knowledge Improvement: There is a need to improve the knowledge base of climate change and climate variability and the associated adaptation strategies. In addition, adaptive technologies should be developed and tested; facilitating exchange between regions and people. There is also a need to increase the understanding about the functioning of social security networks and mechanism during and after catastrophic events (e.g. droughts, floods, locust invasions). Furthermore, agricultural policy should be better aware of the role of geographical mobility, not only in pastoral systems but in arable systems as well. This would result in the redefinition of the importance of migration for both rural and urban economies

Biotechnology as an Adaptation Option: Biotechnology could offer an opportunity for adapting in dryland ecosystems. From the case study in West Africa, it is evident that climate change will lead to changes in crop productivity. This is likely to have both positive and negative implications on crop productivity felt in the dryland ecosystems of sub-saharan Africa. Adaptation strategies in these areas should include the selection of plants that are adapted to the new environment.

Stresses in crop production systems are interrelated and difficult to untangle. This so-called genotype-by-environment interaction hampers many breeding efforts. Using new techniques in biotechnology in association with conventional physiological research may better equip these communities to identify and understand crop responses to this complex interaction. ~~Furthermore, the delicate interaction between the genome and the environment can be mapped and explained using these techniques, enabling a more effective selection of suitable germplasm, both parents and final varieties with the desired characteristics for the new environmental conditions.~~

Food Security: In the discussion on the climate/water/land agricultural system, particularly in Sub-saharan Africa, food security was identified as a major issue. In this regard, specific reference was made to a number of constraints to food security such as:

- The development of more reliable drought forecast and mitigation strategies;
- Adaptive strategies for integrated pest, disease and weed control;
- Adaptive strategies for more efficient and effective land maintenance.

(ii) Regional (SIDS)

Regional Approach: In the basis of the Caribbean experience, the regional approach to addressing the issue of adaptation to climate change proved to be successful. This approach allowed the SIDS of the Caribbean to overcome some of their inherent limitations (i.e. limited skills in adaptation) by adopting a co-operative, participatory multi-country approaches. This resulted in the strengthening of regional co-operation institutions, provided a cost effective means for adaptation planning, data collection and sharing of information, skills and project benefits.

In the course of the implementation of CPACC, there was a further realisation that Caribbean countries are now vulnerable to climate variability and that most disasters in the region are climate related. There is, in the region, a store of expert knowledge which can be utilised to frame adequate responses to strengthen the region's resilience and hence reduce its vulnerability to climate variability. Any development in this direction will contribute to the longer-term adaptation to climate change

Data Collection and Analysis: The project underscored the need for strengthening countries capacities in data collection and analysis as a pre-requisite for planning effectively for adaptation to climate change.

Linkage between Science of Adaptation and Policy Makers: The successful integration of adaptation measures in overall development planning requires a conscious link between the science of adaptation, its application and the policy making process, particularly at the political level. In the case of the Caribbean, such a link was provided through the regional political structure (i.e. CARICOM). In general, the conclusion from IPCC report (IPCC 2002) is that climate change policy are most effective when they are embedded in general development strategies. This means that many of the other pressures, e.g. land degradation, are simultaneously considered along with climate change.

Role of the Private Sector: Based on the Caribbean experience, the private sector, particularly the insurance and banking industry can play leading roles in facilitating the integration of adaptation measure into critical sectors such as the tourism industry.

2.5 General Conclusions

In addition to the specific lessons highlighted in the foregoing section, a number of general conclusions and Overarching themes emerged from the case study experiences:

Baseline data and capacities: Significant gaps exist in the availability of baseline data, credible site specific regional climate and socio-economic scenarios skills to utilise available tools for carrying out the necessary impact assessments and the institutional capacity to develop comprehensive responses to climate change.

Though there was general agreement that gaps exist, it was agreed that this should not be used as an excuse to do nothing about adaptation. In this regard, the special situation of LDCs and SIDS were highlighted. For example, LDCs have the least data, technical capacity to do comprehensive assessment, yet there is graving evidence of their being adversely impacted already. There is a great need to start the implementation of activities for which the benefits are clear and that contribute to reducing further vulnerability.

The process of adaptation: The implementation of adaptation options can only be implemented successfully in an appropriate economic, institutional, legal and socio-cultural context. Adaptation strategies are therefore most effective when implemented as part of a broader,

integrated management framework that recognises both immediate and longer-term sectoral needs. Therefore, planned adaptation measures must be considered as part of a broader process that entails more than simply the implementation of a policy or technology. Adapting to the new challenges posed by climate change therefore calls for involvement of all sectors of society in the process of development and taking advantage of the knowledge available in all segments of the society.

Health and climate change: There was general agreement of the relatively little attention being devoted to the issues of health in adaptation studies. Issues identified which could be impacted on by climate change included, but not limited to:

- Vector-borne Diseases (VBDs) such as malaria, dengue etc., which in the case of malaria account for some 2 million deaths annually – especially in Sub-Saharan Africa. In more recent times with climate change, dengue has been responsible for significant amounts of illness and time lost from work.
- Food and Water-borne Diseases (FWBDs) such as cholera coinciding with changes in climate have caused massive loss of life in some vulnerable areas of developing world.
- Rodent-borne diseases e.g. hanta virus and leptospirosis have coincided with climate change.

It was therefore agreed that human health should be given a higher priority in considering vulnerability and adaptation to climate change.

Biodiversity: Even though treated as a sector, biodiversity was considered as unique and unlike any other sector in terms of climate adaptation and vulnerability, as climate variability and extremes would have significant impacts on biodiversity. The reasons for this were highlighted as follows:

- Biodiversity is recognised at three levels: Genetic, Species and Ecosystems (and Landscapes);
- Genetic conservation is a long-term goal and process, and hence biodiversity needs a long-term planning horizon;
- Biodiversity occurs within and outside of protected areas;
- Biodiversity is being lost at a rapid rate due to human activities (past, present and future);
- **Biodiversity and** Ecosystems provide environmental goods and services that are essential for human survival and well-being;
- Valuation (market and non-market) of biodiversity is fraught with many uncertainties;
- Although biodiversity has enormous global value, it is managed nationally and locally;
- There are many gaps in our scientific understanding of biodiversity which lead to uncertainties in projecting the impacts of climate change;
- While in the past users of ecosystem goods and services could respond and adapt rapidly to the mismanagement of the “commons” (biodiversity) due to their local proximity and direct perception of impacts, users of ecosystem goods and services today are poorly equipped to respond to impacts on the global commons (biodiversity) due to their geographic separation and disconnectedness by urbanization and global markets, in spite of their transnational dependence on it for food, health and environmental security.

While the scientific knowledge base was considered as being sufficient enough at present to suggest adaptation options, there was general agreement that the implementation of biodiversity adaptation options is not limited to science and technology. In this regard, a number of

biodiversity (marine, coastal and terrestrial including freshwater) adaptation options and mechanisms for climate change were highlighted.

Table 2.2: Biodiversity Adaptation Options and Mechanisms

| Adaptation Options | Mechanisms |
|--|--|
| 1. Network of Reserves with Corridors | Ex-Situ conservation, integrated land and water management (including rehabilitation and restoration) (ILWM) |
| 2. Enhanced Resilience of Nature Reserves (NRs)/Protected Areas (Pas) | In-Situ Conservation, ILWM |
| 3. Captive Breeding (Animals)/Culture/Cultivation (Zoos/Gardens/Culture Collections/Gene Banks) | Ex-situ |
| 4. Natural Pest, Disease, Vector Control; Replacement of Seed Dispersal and Pollination; Controlling Potentially New Areas of Water-borne Diseases | In-situ, Ex-situ |
| 5. Moving Species | Ex-situ, Corridors (Invasive species) |
| 6. Accepting Some Losses | Options/Bequest/Existence Value |
| 7. Institutional Capacity | In-situ, Ex-situ, ILWM |

Agriculture: In the case of agriculture, adaptation to climatic risks has a long tradition of disciplinary analysis and practical experience. This experience provides a good starting point for climate change adaptation. However, the consideration of adaptation measures, in this sector, would need to take account of a number of factors including:

- Local agroecological conditions (e.g., wet/dry, high altitude/low altitude, soil conditions, etc.)
- Cropping system (e.g., major crops, rotation, pests, etc.)
- Household structure (e.g., labour constraints, land tenure, technology)
- Economic structure (e.g., distance to markets, import/exports, inputs, etc.)
- Political economy (e.g., food aid, access to national markets, land conflicts, etc.)

The matching of adaptation options to these local conditions is best achieved during the project development processes. Table 2.3 provides examples of adaptation options relevant to the agricultural sector.

Table 2.3 Examples of Agricultural Adaptation Options

| |
|---|
| Practice conservation management |
| Use drought management |
| Encourage farmers to avoid monoculture |
| Tailor land use planning to consider potential climate change |
| More R&D on heat and drought resistant varieties |
| Increase irrigation efficiency |

| |
|---|
| Upgrade food storage and distribution system |
| Reduce runoff, improve water uptake and reduce wind erosion |
| Conserve soil moisture and nutrients |
| Reduce productions subsidies |

SECTION 3: GAPS IN CURRENT SCIENTIFIC KNOWLEDGE, METHODOLOGICAL CONSIDERATIONS AND BARRIERS MITIGATING AGAINST THE INCORPORATION OF ADAPTATION MEASURES IN DEVELOPMENT

3.1 Introduction

Climate adaptation is intricately linked to the issues addressed in the other GEF focal areas. As a consequence, in promoting adaptation measures at the operational level and their integration into mainstream development, cognizance must be taken of the various linkages because maladaptation in one sector may affect options in another (i.e. irrigation subsidies reducing water availability and increasing costs in the water sector).

3.2 Gaps in Scientific Knowledge on Adaptation Options

In analysing the current gaps in scientific knowledge on adaptation options, recognition was given to the evolving nature of “adaptation science”. Notwithstanding the fact that the UNFCCC refers to both mitigation and adaptation, the focus on adaptation in the international climate change debate thus far has been minimal in comparison to mitigation. As a consequence, national and international climate policies to-date, have focused mainly on mitigation. ~~This reflects, in part, the uncertainty about climate change being caused by human activity and the lack of theoretical and practical knowledge about adaptation to climate change.~~

~~A review of the IPCC Second Assessment Report, suggested that t~~The reason for the limited attention being paid to adaptation lies in the existence of two distinct schools of thought about climate change; the “preventionist” and the ‘adaptationists’ schools.³ The former argues that the ongoing increase of atmospheric greenhouse-gas concentrations could be catastrophic and that drastic action is required to reduce emissions. They also fear that the increased emphasis on adaptation will weaken society’s willingness to reduce emissions and thus delay or diminish mitigation efforts. The “adaptationist” school, on the other hand, sees no need to focus on either adaptation or mitigation. Adaptationists argue that natural and human systems have a long history of adapting naturally to changing circumstances and that active adaptation would constitute interference with these systems, bringing with it high social costs.

In more recent time, a third school of thought, the “realist” school⁴ has emerged. The realist school positions itself in between the two extreme views of the preventionists and adaptationists. Realists regard climate change as a fact, but acknowledge that impacts are still uncertain. Furthermore, realists appreciate that the planning and implementation of effective adaptation options takes time. Therefore, they understand that a process must be set in motion to consider adaptation as a crucial and realistic response option along with mitigation.⁵

Given the evolving state of adaptation science an effort was made to identify key gaps in the current knowledge about adaptation in selected sectors as a basis for a more targeted approach for addressing adaptation options. Table 3.1 gives an indicative list of gaps for selected sectors. A major conclusion which can be drawn from Table 3.1 is the lack and/or inadequacy of baseline data to meet the demands of assessment of vulnerability and adaptation and the need for a better

³ Klein R. and T. Downing, 2002 et al: Towards an International Funding Strategy for Climate Adaptation: The Role of Adaptation Science, A Background Paper to the Scientific and Technical Advisory Panel of the GEF

⁴ Klein and MacIver, 1999

⁵ Also see Parry *et al*, 1998 Pielke 1998

understanding and enhancement of adaptive capacity. What emerges is the need for mechanisms, particularly at the national and regional/sub-regional levels to systematically collect, analyse and maintain appropriate data and databases which would facilitate the assessment of vulnerability and the social and economic costs associated with the implementation of adaptation measures. Particularly important are institutions with responsibility across different sectors, since the sectors face multiple stresses which force societies to deal with those knowledge gaps too rather than climate change above.

Table 3.1: Gaps in Current Scientific Knowledge about Adaptation in Selected Sectors

| Areas | Knowledge Gaps |
|--|---|
| 1. Biodiversity Loss | <p>General:</p> <ul style="list-style-type: none"> • Incomplete inventory of biodiversity (Globally, 2-20% of species have been identified); • Regional and local variations in pressures and drivers (e.g. land use changes) affecting biodiversity loss? What biodiversity is being lost? • Threshold limits of biodiversity for maintaining ecosystem structure and function; • Factors affecting species survival and extinction; • Linkages between biodiversity and ecosystem structure and functions, and ecosystems resilience; • Progress being made at the eco-regional-global <u>global to local</u> level to understand pressures affecting biodiversity (e.g. in Millennium Ecosystem Assessments (MEAs)). <p>Ecosystem Goods and Services:</p> <ul style="list-style-type: none"> • Details of linkages between biodiversity and ecosystem goods and services; • Option, bequest and existence values of biodiversity being lost or changed; • Discrepancies between the direct local value of biodiversity and its direct market value; • Details about the importance of ecosystem processes in providing ecosystem good and services. <p>Protected Areas:</p> <ul style="list-style-type: none"> • The biodiversity content of protected areas, and their <u>long-term</u> protection <u>and maintenance level</u>. <p>Corridors:</p> <ul style="list-style-type: none"> • The importance of linear and non-linear stepping stones or corridors for biodiversity connectivity on landscapes; • The risks of corridors, and of introducing invasive species, pests and diseases; • Knowledge about landscape design and climate in terms of protected and non-protected areas. |
| 2. Human Settlements / Infrastructure / Health | <ul style="list-style-type: none"> • Insufficient knowledge on cause-effect relationships (particularly for secondary impacts); • Insufficient information to quantify impacts; • Following from the above: inability to identify critical thresholds (also a political decision); • Specific decision criteria for adaptation options; • Limited understanding of livelihood vulnerability and resilience, particularly in marginal parts of cities; • No tools to measure the effectiveness of planning and policy; • Limited <u>knowledge-understanding</u> on how to involve the private sector in adaptation; • No methods <u>Limited knowledge or experience</u> for social impact assessment in relation to climate change; • Need to <u>develop and then</u> make more systematic use of indicators, based on case studies and anecdotal evidence; • Need for long-term data collection and evaluation; • Need for better understanding on how to influence <u>human</u> behaviour; |

| | |
|--|--|
| | <ul style="list-style-type: none"> • Need for knowledge on how to address barriers. |
| 3. Coastal and Marine Resources | <ul style="list-style-type: none"> • Baseline information (water resources inventories, coastal morphology, fish stocks, etc.); • Existing adjustments communities have made to climate related impacts (fishing communities to reduction of revenue base during EL NINO); • Development and operationalization of a RISKS approach to adaptation to Climate Change; • Lack of site specific information needed to mainstream adaptation; • More effective development and use of socio-economic scenarios/plans/director at local/regional levels; • Adaptation Baseline Information; • Integrated models and Toolkits to link Systems Components; • Impacts of Economic valuations of water Resources. |
| 4. Agriculture: | <ul style="list-style-type: none"> • Inadequate data and availability restricted, including government and farmers (and researchers); • Meteorological, crop, yield, water requirements, growing season calendar; • Monitoring of climate trends and outlooks relevant to agricultural planning. |
| | Prospective agricultural technologies: <ul style="list-style-type: none"> • New crop varieties; • New cultivation practices; • Identification of how existing technologies might be of benefit to different uses and conditions; • Local and regional climate forecasts. |
| | Multiple Stresses: <ul style="list-style-type: none"> • Multiple stresses and relative importance of climate and climate change in agricultural systems and food security |
| | Methodologies, Methods and Tools: <ul style="list-style-type: none"> • Existing V&A studies are inconsistent; • Limited range applied and not accessible to all countries; • Very limited in some sectors – e.g. livestock systems; • Technology transfer between institutes. |
| | Scales: <ul style="list-style-type: none"> • Focus on plot/farm scale incomplete, need ecosystem services, catchment resources; • Regional scale for markets, planning, resources, extension services. |

3.3 Methodological Considerations

As a complement to the case study analysis, an overview was provided of a number of methodologies which could be employed in the assessment of adaptation measures and their integration into mainstream development.

3.3.1 From Scenario-based Approaches to Risk Assessment:

A critical analysis of the standard approach for assessing climate impacts (Figure 3.1) was undertaken. A number of reasons were highlighted why the model-scenario based approaches as highlighted in Figure 3.1 did not always produce the most useful results for the purpose of adaptation. These included:

- The scenarios generated utilizing these approaches represent only plausible future without any assigned probabilities, have wide confidence limits and are applicable to long time frames (greater than 50 years). As a consequence, their use for policy formulation is limited;
- Global Circulation Models (GCM) scenarios cover large spatial scales which are not sufficiently precise for local impact assessment. On the other hand adaptation measures are usually site specific;
- Impact assessments are usually not designed to consider a wide range of adaptation measures.

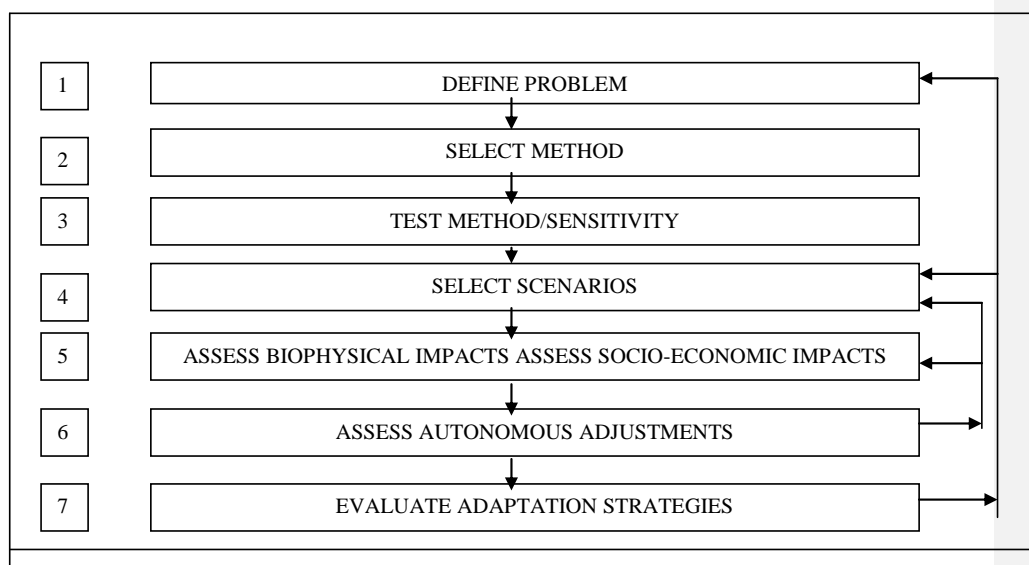


Figure 3.1: Scenario-Based Approach: Major Steps: After IPCC 1994

As a consequence of the inherent constraints in GCM the call was made for “new directions” for assessing adaptation, moving from a Scenario-Based “Forecasts” to Risk Assessment. The basic principles of this approach is outlined in Table 3.2. This approach varies from the scenario-based approach in that it begins with the recent climate experiences (i.e. variability and extremes) and

then assesses experiences in vulnerability and adaptation. In addition, adaptation is treated as an ongoing process and therefore allows adoption of a “learning-by-doing approach”. It was however recognised that techniques for risk analysis, adaptation assessment and stakeholder responses to risk are in their early stages of development.

Table 3.2: Basic Principles of Risk Assessment

- Pay greater attention to recent climate experience. Link climate, impacts and outcomes to the coping range;
- Address adaptation to climate variability and extremes as part of reducing vulnerability to longer-term climate change;
- Assess risk according to how far climate change, in conjunction with other drivers of change, may drive activities beyond their coping range;
- Focus on present and future vulnerability to ground future adaptation policy development in present-day experience;
- Consider current development policies and proposed future activities and investments, especially those that may increase vulnerability.

FORENC TOTHTO INCLUDE A SECTION ON THE 3.3.2 Cost and Benefits of Adaptation

In the consideration of costs and benefits of adaptation it can be concluded that counting the cost and benefit of adaptation is indispensable. The concepts and techniques of counting depend on the characteristics of adaptation activity: whether it is public or private, involves a single actor or an internationally or globally linked economic sector, and whether the nature of the problem is static or dynamic. In addressing the economic analysis of the costs and benefits of adaptation, key distinction is to be made in measures and activities between the private sector (individuals, firms, farms) and public (communities, governments). In private decision-making weather is just one among many factors to consider in allocating resources and in determining the scales of operation. This is valid for both day-to-day decisions and strategic development decisions. Similarly, public response to climate change impacts also takes place in the context of broader policy objectives or social mandates of the particular public institution. It is important to note that there is no firewall between private and public adaptation activities: current and future public policies (unrelated to climate) will influence boundary conditions under which private actors operate and thus determine the nature and magnitude of private adaptation. This can foster or hinder economically efficient, environmentally effective, and socially equitable adaptation. Conversely: private actors tend to lobby for favoring public policies and climate change is promising to pose being victimized and for attempts to secure preferential treatment. This might be a potential source of distortions and can lead to mal-adaptation.

The basic principle for single private adaptation is that the adapting agent would devote additional units of resources to counterbalance effects of climate change as long as the marginal (private) benefits exceed the marginal (private) costs. This means that private actors disregard the external effects (externalities) of their adaptation activities.

The sum of all private adaptation can be taken as the social adaptation without any public intervention. The tasks for public adaptation in this context are as follows:

1. Assess private adaptation to design policies to:

- guide private adaptation in socially preferred / prevent non-preferred direction
- stimulate private adaptation to go to the socially desirable extent
- correct possible externalities of private adaptation
- correct inequitable implications of private adaptation

2. Provide public-good/service adaptation:

Private adaptation appears to be easy because only private costs (expenditures) and benefits (revenues) need to be counted. For operating decisions this means changing inputs at the margin to maximize profits. The response to changing climatic conditions does not differ from responses to any other changes in the external conditions of the firm (markets, technologies). The proper estimation of the climate-related costs needs to separate the gross impact (without adaptation), the costs of action devoted to counterbalance that impact, and the averted damage as a result of the adaptive action. The total damage from climate change is the sum of the resources diverted from other uses to adaptation and the residual (unaverted) damage from climate change.

The accounting principles are similar for private investments, but the task is somewhat more complicated because the costs of a one-shot investment has to be combined with operating costs and benefits over many years. In private entities, climate-adaptation-related investments compete with many other investment opportunities for scarce investment funds. It is important to control for (by using scenarios) or account for (in sensitivity analysis) changes in other sectors or markets in the same country. If adaptation interferes with other markets (demand, supply, prices of input and output) significantly, one must account for the indirect effects in affected sectors and for the induced effects in other sectors. The total effect can be estimated by using general equilibrium analysis. The same is true for changes in the same sector in other countries. If rearrangements are likely in international markets then international or global sectoral models (such as world food and agriculture, or global forestry models) are needed to estimate the international spill-over effects.

Public adaptation

In public adaptation investment projects, the pass-criteria are similar to those in private, but all costs and benefits are measured as utilities. Well-established concepts from welfare economics like willingness to pay, the compensating variation or equivalent variation play a central role. In practice, too many projects would pass this criterion, therefore decision-makers face the problem of having to select among them.

This ordering is an important indicator in comparing climate change adaptation projects to other public development projects.

The economic evaluation of public adaptation projects based on welfare economics, and using cost-benefit analysis and the concept of net present value, has been proposed by several authors.

S. Fankhauser⁶ provided an initial framework to separate the climate-impact-related additional

⁶ Fankhauser, S. (1998) The Costs of Adapting to Climate Change. Working Paper 16. Global Environmental Facility, Washington, D.C.

Fankhauser, S., J.B. Smith, R.S.J. Tol (1999) Weathering climate change: some simple rules to guide adaptation decisions. Ecological Economics 30:67-78.

component from a public investment project. N. Leary⁷ developed a generalized benefit-cost framework. The objective is to separate welfare changes resulting from climate change and private adaptation on the one hand and welfare changes from changes in climate-related public policies in the absence of and triggered by climate change, on the other.

Temporal dimensions of adaptation

Counting the static (equilibrium) costs/benefits of adaptation involves tallying the annual/short-term adjustments in input that induce shifts in the current operating costs. These are rather routine production planning decisions. The need for establishing the dynamic (intertemporal) costs/benefits of adaptation arises in two main cases:

- when climate change affects assets (stock) with slow turnover, and
- in investment planning (capital/fixed costs).

A largely ignored issue has been so far the interactions between the static (current) and dynamic (long-term) decisions. In many cases, a series of incremental short-term adjustments can be conceived as climatic conditions gradually change. But at one point, these are depleted and a major investment or restructuring is needed. This, in turn, will open new opportunities and preset the conditions for a new array of incremental short-term adjustments.

Two main cases need to be distinguished in the dynamic adaptation decisions. The first one is a single project with long life-time. Fankhauser et al. propose a simple decision rule: postpone the implementation of the project until the benefits of delay exceed the damages averted by the project. An alternative formulation is to postpone the investment until the time point for which the net present value of the project becomes positive.

The second case of dynamic adaptation decisions occur in sectors with slow turnover. Here the appropriate analytical framework is intertemporal optimization. The task is to maximize the net present value of the surplus across the full range of adaptation options (concerning both the input factors and the stock itself) and across the whole time horizon.

Getting economic trade-offs right is important because it helps getting other (social, environmental) trade-offs right. Public agencies need to assess the implications of existing policies for private adaptation. Public agencies also need to assess the direction and scope of private adaptation so that they can identify the need for public policies to guide private actors. Public adaptation consists of policies to guide private adaptation indirectly (probably the more difficult and more important area) and provide public-good directly. Finally, public adaptation must serve the 3E criteria (environmentally effective, socially equitable and economically efficient). This is a fundamental link to sustainable development.

| Welfare change | Climate and adaptation case |
|-------------------------------------|--|
| $W(e_{17},a_0) - W(e_{17},a_0)$ | Welfare change after climate change and private adaptation |
| $W(e_{17},a_4) - W(e_{17},a_0)$ | Net cost (+/-) of public adaptation to climate change |
| $W(e_{17},a_4) - W(e_{17},a_0)$ | Welfare change after climate change and private adaptation combined with public adaptation |
| $= W(e_{17},a_4) - W(e_{17},a_0)$ | = Welfare change after climate change and private adaptation |
| $= + W(e_{17},a_4) - W(e_{17},a_0)$ | = + Net cost (+/-) of public adaptation to climate change |

⁷ Leary, N. (1999) A framework for benefit-cost analysis of adaptation to climate change and climate variability. Mitigation and Adaptation Strategies for Global Change 4: 307-318.

| | |
|---------------------------------|---|
| $W(c_{10},a_1) - W(c_{10},a_0)$ | Net cost of public policy to adapt to present climate |
|---------------------------------|---|

Table: Measuring welfare changes under different combinations of climatic conditions (change versus no change) and climate related public policies (change versus no change). After Leary, N. (1999) A framework for benefit-cost analysis of adaptation to climate change and climate variability, *Mitigation and Adaptation Strategies for Global Change* 4 (3-4): 307-318.

Temporal dimensions of adaptation

As discussed above, counting the static (equilibrium) costs/benefits of adaptation involves tallying the annual/short term adjustments in input that induce shifts in the current operating costs. These are rather routine production planning decisions. The need for establishing the dynamic (intertemporal) costs/benefits of adaptation arises in two main cases:

- when climate change affects assets (stock) with slow turnover, and
- in investment planning (capital/fixed costs). A largely ignored issue has been so far the interactions between the static (current) and dynamic (long-term) decisions. In many cases, a series of incremental short term adjustments can be conceived as climatic conditions gradually change. But at one points, these are depleted and a major investment or restructuring is needed. This, in turn, will open new opportunities and preset the conditions for a new array of incremental short term adjustments.

Two main cases need to be distinguished in the dynamic adaptation decisions. The first one is a single project with long life time. Fankhauser et al. propose a simple decision rule: postpone the implementation of the project until the benefits of delay exceed the damages
Averted by the project. An alternative formulation is proposed here:

Postpone the investment until the time point τ for which the net present value of the project becomes positive, that is: $NPV_{\tau} > 0$, where

$$NPV_{\tau} = \sum_{t=\tau}^T \frac{R_t - C_t}{(1+r)^t}$$

and where: R_t = averted damage, C_t = costs in period t .

The second case of dynamic adaptation decisions occur in sectors with slow turnover. Here the appropriate analytical framework is intertemporal optimization. The task is to maximize the net present value of the surplus across the full range of adaptation options (concerning both the input factors and the stock itself) and across the whole time horizon,

In summary, we can conclude that counting the costs and benefits of adaptation is indispensable. The concepts and techniques of counting depend on the characteristics of adaptation activity: whether it is public or private, involves a single actor or an internationally or globally linked economic sector, and whether the nature of the problem is static or dynamic. Getting economic trade offs right is important because it helps getting other (social, environmental) trade offs right. Public agencies need to assess the implications of existing policies for private adaptation. Public agencies also need to assess the direction and scope of private adaptation so that they can identify the need for public policies to guide private actors. Public adaptation consists of policies to guide private adaptation indirectly (probably the more difficult and more important area) and provide public good directly. Finally, public adaptation must serve the 3E criteria (environmentally

effective, socially equitable and economically efficient). This is a fundamental link to sustainable development.

3.4 Barriers Mitigating Against the Incorporation of Adaptation Measures into Development Planning

The discussion on ‘barriers’ to the incorporation of adaptation was placed within an overall developmental context. In this regard, the issue of “adaption policy” became a central theme. It is considered as providing a ‘framework’ to facilitate the incorporation of adaption measures into all the relevant areas of government policy.

Table 3.2 gives a broad overview of some of the barriers identified as mitigating against the incorporation of adaption measures in the various sectors. An analysis is provided on some of the main barriers which seem to be common to all sectors and opportunities.

- **Uncertainties associated with climate change and the artificial distinction between climate variability and change:** For purposes of adaptation to climate change, investment in probabilistic climate outlooks, from the seasonal to 3-10 year time scale, have greater value than further scenarios of long-term climate change (e.g. 2050s to 2080s).

Despite recognition by the UNFCCC of the need to adaptation to climate change, one area of difficulty in its application scientifically, is the challenge in separating the costs of adaptation to climate change from the cost of adaption to climate variability.

- **Inadequate awareness and knowledge on adaptation at the policy and decision making levels:** Generally, there is a recognition in scientific community that we are a far way from linking present decision-making with future risk for a wide range of economic, environmental and resource management regimes sensitive to climate change impacts.

Table 3.3: Barriers Mitigating Against the Incorporation of Adaptation Measures into Development Planning

| Areas | Mitigation Barriers |
|---|--|
| 1. Biodiversity | General: <ul style="list-style-type: none"> • Different land use and ownership patterns; • Inadequate information dissemination and public awareness; • Lack of climate impact scenarios at local and regional levels; • Irregular or uneven distribution or representation of biodiversity; • Small size of representative ecosystems/protected areas; • Poor understanding of potential replacement of pollinator/dispersal/pest/vector/disease species especially in terms of pollination and dispersal mechanisms, and pest and disease control; • Poor understanding of the balance of nature in terms of predator-prey, host-parasite, mutualistic and symbiotic relationships; • Importance of mitigation and long-term climate change compared to short-term events (resilience and extinction) from policy and funding perspectives. |
| | Ecosystem Goods and Services: <ul style="list-style-type: none"> • Shortcomings in current economic valuation techniques, especially in under-valuation of biodiversity. |
| | Protected Areas: <ul style="list-style-type: none"> • Inadequate understanding of the scale, size and connectivity of Protected Areas; • Political conflicts in transboundary situations; • Costliness and uncertain success of captive breeding; • Costliness and questionable selectivity of species translocated or moved to new habitats/areas. |
| 2. Human Settlements / Infrastructure / Health | <ul style="list-style-type: none"> • Absence of stable local institutions and institutional fragmentation; • Lack of and access to information; • Perceived lack of credibility of experts by stakeholders; • Limited finances and long-term institutional investment (leading to inability to seize opportunities); • Perceived long-term nature of climate change; • Lack of public awareness and participatory decision-making; • Lack of understanding of specifics of climate change in a way that is useful to planners and managers; • Lack of policy priority and attention for people living in slums; • Poorly defined responsibilities and sense of ownership (related to tenure security). |

| Areas | Mitigation Barriers |
|-----------------------------|--|
| 3. Aquatic / Coastal Marine | <ul style="list-style-type: none"> • Inadequate awareness and knowledge on adaptation at the policy and decision making level; • Low capacity in analysis (technical and economic) of adaptation options, activities and projects; • Artificial distinction between climate variability and change; • Uncertainties and misunderstanding related to climate change and variability; • Public awareness; • Lack of capacity to utilize available tools (e.g., hydrological, climate change models, etc.); • The definition of “Global Benefits” should be revised to include extra-national social and economic benefits; • The gaps between Top-Down Agencies (UN Bank National Governments) and on the ground local institutions and need for empowerment; • Limited knowledge of socio-economic drivers; • Community rights over land and water resources; • Lack of capacity (available tools, ability to use the tools, public perception, political understanding, etc.); • Fixed Water Laws and Rights. |
| 4. Agriculture | <ul style="list-style-type: none"> • If warming is faster than expected (on average), adaptation planning may not be <u>possible rapid enough</u>; • Land tenure; • Lack of data available to meeting the demands of methodologies that apply to vulnerability and adaptation assessments; • Connection between science (e.g., NC) and policy – mainstreaming into national planning policies; • Most adaptation is spontaneous, government does not drive process, structural constraints of information and co-ordination, motivation is lacking among people in marginal areas; • Translating state of the art to policy – GTZ review of 120 studies: nearly none referred to climate change adaptation, but they were all land, agriculture, water and forestry projects. Need for training of trainers, guidelines for operational consideration of issues, practical information; • Know the target group; • Using climate outlooks at a variety of scales, e.g., short term weather forecasting, seasonal forecasting to climate change depending on time scales; • Climate change studies (e.g. 2050) are a barrier to understanding adaptation processes and potentials. (Re)focus regional climate change science to 20 year outlooks related to the present (transient), at a useful scale (downscaling, RCMs) and in user-oriented systems. Uncertainty will always be there – need to learn what to do with them; • Inadequate technical skill; • Lack of finance; • NC: emphasis on mitigating international capacity building rather than V&A; • Lack of awareness, among specific stakeholders. |

Awareness of climate change, and more particularly on adaptation, varies enormously between countries and amongst resource managers, planners and the general population. Whilst a great quantity of information is available internationally, site specific information of relevance to local issues and target audiences is variable. Dissemination of information at the local, national and regional level are required, going beyond the usual media (print, radio, television) to participatory forums.⁸ Research and applications projects should include specific strategies and mechanisms for disseminating results to relevant audiences. This point was highlighted in the Caribbean case study as an important aspect of adaptation studies. In building capacity to promote awareness of climate change, particular attention needs to be given to promoting institutional memory – too often initiatives are short-lived and repeated rather than co-ordinated as part of a larger programme of public education.

An important tool is monitoring of climate change (key climate variable, impacts and responses). This will assist local and national planners to provide specific advice as to when climate change impacts are likely to occur and who might be affected.

- **Institutional Capacity Development:** Beyond awareness, those affected and responsible for planning adaptive responses need to understand the issues and have the skills to evaluate options. Though most adaptation is spontaneous, and not driven specifically by governments, from an institutional standpoint, structures and processes exist at the national levels in most countries which offer opportunities for the incorporation of adaptation measures:
 - **Disaster/plans/policies:** Adaptation measures could be developed to respond to specific climate related risk (i.e. floods, droughts, hurricanes etc.). Countries might already have some of these plans in place (i.e. flood management plan, coastal zone management plans). These could be re-evaluated and/or revised to include climate change.
 - **Physical Development and Sectoral Plans:** Adaptation measures could be designed and incorporated into specific sectoral plans for agriculture, tourism, health, water resources etc. Physical Development Plans on the other hand, could be used as an instrument in direct settlements in terms of location, design and construction of infrastructure. In most countries, these plans are already in place and could be revisited to take account of the climate change dimension. In addition, innovative mechanisms to facilitate such integration could be identified. Already, one mechanism that has been used to change behaviour with respect to hazard response is insurance.
- **Data and lack of scenarios development at the national and regional levels:** A major constraint in vulnerability and adaptation assessments in developing countries is the lack of data, available to meet the demands of the methodologies that apply to these assessments, and the inability of these countries to conduct the type of assessments that would generate reliable results which could be incorporated into national planning processes. Data required as input to impact models and assessments are either not present (uncollected), inaccessible or inappropriate. The lack of data arises because of inadequacies in data collection, monitoring and access to existing databases, and an incapacity to analyse, manipulate and improve quality assurance in some data sets. Another area of concern is the absence of regional scenario models at the national and regional levels.

Data required for developing regional climate change scenarios are unavailable in some cases; in others they are too coarsely resolved, both in time and in space, to be useful for vulnerability and

⁸ Gupta and Hisschemoller, 1997

adaptation assessments (for example, on small islands and in mountainous regions/countries). The number of variables is often limited (for example, daily precipitation is often not available for input to impact models), or derived variables relating to extreme events are unavailable. In cases where necessary variables are available, large uncertainties occur and therefore only broad sensitivity studies can be conducted within climate scenarios.

SECTION 4: TOWARDS THE FORMULATION OF A GEF ADAPTATION STRATEGY

4.1 Introduction

The section provides an overview of some of the key elements which could form the basis of a GEF Adaptation Strategy. Generally, it was agreed that the GEF Adaptation Strategy should be placed in the overall context of sustainable development. That is to maintain sound human life, to secure a stable production base and to ~~preserve~~conserve natural resources, while living with changing global environment such as caused by ~~global warming~~climate change. An integral part of the strategy should be implementing procedure to accomplish this objective through the effective allocation of available resources, such as private and official funds, scientific and managerial knowledge and individual and institutional human effort. The strategy should be based on and underpinned by sound science and technology.

4.2 Framework for Adaptation

In the design of adaptation measures, a number of frameworks can be employed to assist with its understanding. Consideration could be given to public/private sector frameworks; frameworks which addresses the geographical/temporal scale of the activity (e.g. plant genetic, landscape, catchment policy); anticipatory versus reactive and autonomous versus planned frameworks.

With respect to assessing adaptation, consideration should be given to moving from an essentially “Scenario-Based” Approach to include a “Risk Assessment” approach. The basic principles of this approach are as follows:

- Pay greater attention to recent climate experience. Link climate, impacts and outcomes to the coping range;
- Address adaptation to climate variability and extremes as part of reducing vulnerability to longer-term climate change;
- Assess risk according to how far climate change, in conjunction with other ~~drivers of change~~pressures (e.g. land and water degradation, resource over exploitation etc.), may drive activities beyond their coping range;
- Focus on ~~present~~past and ~~present~~future vulnerability to ground future adaptation policy development in present-day experience;
- Consider current development policies and proposed future activities and investments, especially those that may increase overall sector or system vulnerability.

This approach varies from the scenario-based approach in that it begins with the recent climate experiences (i.e. variability and extremes) and then assesses experiences in vulnerability and adaptation. In addition, adaptation is treated as an ongoing process and therefore allows adoption of a “learning-by-doing approach”.

4.3 General Principles to be Considered in Formulating An Adaptation Strategy

In general, any adaptation strategy should take its grounding on the following specific characteristics (especially in contrast with mitigation strategy) of adaptation to climate change. Following are a number of characteristics which should be considered in the formulation of the strategy.

- (i) ***The object is the local environment as a whole, where human and nature coexist and consist of the vernacular identity which needs to be sustained:*** A holistic view of this

local environment is essential. Since adaptation measures, in the main, are likely to be site specific, attention should be paid to the situation of local environment, such as the pressures from change, vulnerability and the resilient capacity of nature and society. The strategy should be flexible so as to respond to this diversity, as well as integrated in orientation. Generalization of adaptation policy is not always appropriate.

- (ii) ***Adaptation relates to ~~multiple global change or multiple pressure~~change issues:*** Climate change is only one of a number of global changes – the others include land-use and land-cover change; soil and water pollution and degradation (including desertification), and air pollution; diversion of water to intensively managed ecosystems and urban systems; habitat fragmentation; selective exploitation of species; the introduction of non-native species; and stratospheric ozone depletion, which ~~is~~ are taking place. The strategy should therefore be multi-purpose, simultaneously addressing other issues (i.e. local pollution, loss of biodiversity, soil degradation, inland water problem etc.) in an integrated way.
- (iii) ***Adaptation is response to local impacts caused by global scale phenomena:*** The Adaptation strategy will require fusion of a “top-down” approach that identify impacts from global scale climate change, and “bottom-up” approach rooted in local, national and regional experiences. The former coming in the main from scientific knowledge, and the latter mainly directed towards enhancement of resilience capacity.
- (iv) ***Decisions are made under scientific and societal uncertainty:*** Current science has not ~~matured-progressed~~ enough to forecast plausible patterns of local impacts, to identify existing vulnerability and to evaluate the effectiveness of responding measures to climate change. The adaptation strategy should not be deterministic but rather be flexible and based on the risk management concept.
- (v) ***Wide scope insight is needed in terms of exposure unit and associated stakeholders:*** Climate change gives sequential impacts, such as from water resources to agriculture, food industry and world trade of foods. Consideration should be given to adaptation measures in individual stages, as well as integrating policies throughout the stages. It should also be recognised that stakeholders’ options also differ stage by stage, such as personal efforts, farm level management, local and national governments’ regional development plan.
- (vi) ***Actors of adaptation are diversified:*** Unlike mitigation, adaptation issues address a wide cross-section of stakeholders at every level of society. In designing adaptation measures, it will be critical to have stakeholders’ involvement in early stage of planning, if establishing and implementing adaptation measures are to be successful.
- (vii) ***Impacts of Climate change ~~proceeds may be~~slowly but steadily non-linear, and ~~is~~ are often accompanied by thresholds (showing large changes) and delays (inertia)~~accompanied by various delays~~:*** Generally, climate impacts proceed slowly but steadily, although some abrupt changes ~~and extremes~~ are anticipated. Taking into consideration a large inertia which exists in climate systems responses and in social reaction and in the decision making process the first stage scoping work, at least, needs to be started as early as possible. The strategy should have long-term perspective and be anticipatory, stepwise and adaptive. The decision making process should be sequential and flexible, and renewed continuously by feeding back updated scientific information.

- (viii) ***Long-lived nature of impacts and adaptation:*** The impacts of ~~global climate~~ change will ~~last long be long-term (e.g. sea level rise for thousands of years) and continuously~~. The responding measures should not be a one-off intervention. Continuous follow-up efforts, stakeholders involvement, monitoring and evaluating effectiveness of adaptation policy are indispensable.
- (ix) ***Adaptation must be economically efficient, contribute to the advancement of social and environmental objectives:*** Adaptation activities should be designed to support national economic objectives including social objectives and should be compatible with long-term environmental objectives.

4.4 Challenges in Designing an Effective on Adaptation Strategy – Filling The Gaps

Taking into consideration foregoing specific characteristics of impacts of and adaptation to climate change, a number of scientific and socio-managerial gaps remain to be filled. The adaptation strategy should be formulated in such a way so as to enable these gaps to be addressed.

(a) Scientific and Methodological Challenges

- (i) ***Fusion of “top-down” and “bottom-up” approaches:*** The local climate change scenario is usually provided by regional climate models (RCMs) which are down-scaled from the global scale General Circulation Model (GCM). Adaptation, on the other hand, is ~~fully~~-site specific. Each local has its own vernacular environmental and societal values, tradition and institutions and the appropriateness of adaptation policy and measure differs from place to place. Discourse between these two approaches aimed at establishing a common information base is an urgent priority.
- (ii) ***Framework for Adaptation:*** The establishment of a framework for an evolutionary adaptation approach using the risk management concept is also critical considering the existing uncertainty and delay. As a consequence, the “risk management” approach should form the ~~base~~is of the strategy. In adopting this approach, a wide range of responding measures could be prepared, not in the context of rigid and temporal planning, but a stepwise continuing decision process which is flexible in selecting best path in response to updated scientific knowledge and social changes.
- (iii) ***Benefiting from Synergies:*** Structuring synergetic adaptation policy with other global and regional environmental issues, such as biodiversity, soil erosion, inland water and urban pollution. Should be an important component of the Adaptation Strategy.
- (iv) ***Value judgement and quantification:*** It is necessary to establish criteria how to evaluate and respect local values (indirect, existing, bequest, option values) and ensure their complementarity with wider common and global value as well as to characterize and quantify them into indicators usable for decision-making.
- (v) ***Establishing criteria for judging rationale of GEF climate investment, in place of incremental cost:*** How to quantify global benefits of local adaptation? How is the baseline set for quantifying benefits of adaptation measures?

- (vi) **Indicators:** Establishing methods of monitoring and assessing effectiveness of adaptation measures, including development of indicators is necessary.
- (vii) **Integration of socio-economic consideration into adaptation:** Consideration should be given, not only to the technical measures, but also socio-economic measures based on existing local tradition knowledge, customs and institutional frameworks.

(b) Social and managerial challenges

- (i) **Development of participatory procedures from the early stage of adaptation policy-making:** Stakeholders' participatory processes work effectively in finding local values and vulnerable points and autonomous reactions on the individual level. This effectively strengthens and ensures the role of stakeholders in the implementation stages and sustainability of adaptation, and fosters *in situ* resilient capacity as well. Active information dissemination among stakeholder is also critical.
- (ii) **Development and dissemination of user friendly guidance:** Practical guidance in designing a framework for adaptation and setting priorities among alternative measures, targeted both to local people and donors and collaborators, is strongly required. Many of the technologies applicable to adaptation are rather conventional and existing ones. The guidelines to select an appropriate combination of them which fits the local environmental and societal condition is helpful.
- (iii) **Integration into sustainable development efforts of local/regional/national government:** The final goal of any adaptation strategy is to sustain human, environmental and economic development. Any adaptation policy should therefore be harmonized with regional socio-economic development plans. Institutional structures and processes (i.e. disaster plans; drought mitigation plans, sectoral plans etc.) are already in place in most countries and these offer opportunities for the incorporation of adaptation measures into mainstream development.

The existence of gaps underscores the need for the use of the GEF targeted research policy as a vehicle for the improvement of scientific and technical information and knowledge on adaptation. In this regard, consideration should be given to the corporate identification of critical gaps which could be addressed by targeted research.

This approach could also benefit from consideration of some of the key research questions which resulted from the Potsdam Workshop, namely:

- How does vulnerability to climate change manifest itself and how should it be defined and assessed to identify adaptation requirements?
- How and in what forms does adaptation to climate change occur, what processes and actors are involved and how can it be modelled?
- What constitutes an enabling environment for implementing adaptation options, what is the role of social capital and how can it be enhanced?

- How can adaptation to climate change be integrated into sustainable development and how can synergies with other policy objectives be created?

It is important that, the scientific and technical community, particularly in developing countries actively are engaged in such a process aimed at improving existing knowledge about adaptation processes.

4.5 Implementation Considerations

To facilitate the effective implementation of the GEF Adaptation Strategy, consideration should be given to:

- (i) A cross-cutting operational policy instead of the convention-wise sectoral approach;
- (ii) Revision of the incremental cost concept when applied to adaptation. Unlike mitigation activities, which aim at reducing atmospheric greenhouse-gas concentrations, the global benefits related to adaptation activities are likely to be intangible or more difficult to measure. As a consequence, particular attention should be paid for lowering the baseline for adaptation activities. Related to this is the need to establish national/regional adaptation baseline, in the absence of an internationally agreed one.
- (iii) Recent work on vulnerability and adaptation to climate change has shown that investment in adaptation is unlikely to be efficient and effective if not linked to efforts to promote sustainable development. Investment in adaptation will be unproductive in the absence of an enabling social, economic and institutional environment – the adaptive capacity of countries and communities.

As a first priority, funding needs to be directed at better understanding and enhancing adaptive capacity. Resources need to be directed at enhancing adaptive capacity, including identification of priorities for adaptation, strengthening institutions and networks, increasing skills, knowledge and awareness and developing information and communication technology. Opportunities to create synergies with other environmental issues, such as combating land degradation and conserving biodiversity etc. should be pursued.

The first priority for specific responses is to reduce vulnerability to climatic hazards and maladaptation that increases risks. Early warning systems, preparedness, disaster recovery and insurance are existing strategies that need to be more widely applied.

- (iv) The activation of regional/local based work of implementing and executing agencies, and introduction of more local based agencies in implementing of adaptation measures. As a consequence, country priorities will require further elaboration of priorities at the national level. The National Action Plans for Adaptation could be used as initial means for achieving this, at least in Least Developed Countries. The country-driven framework will need to include local priorities and regional actions since adaptation is a multi-level endeavour.
- (v) The Marrakech Accords explicitly recommend building capacity to adapt to climatic variability and consideration of other multi-lateral environmental agreements. Adaptation projects will need to be linked to other multi-lateral and bilateral funding, for example on monitoring and early warning, disaster preparedness, and sectoral

development. Since sufficient resources are not available through the GEF to effectively mitigate present and future climatic risks;

Three categories appear to be important. In prioritizing adaptation projects, being quite different from the mitigation case, long-lived sustainability of the project based on the sound scientific knowledge is so important. For the sustainability of the projects, just as in many projects for biodiversity protection, local building is the key component of the adaptation. Consideration could be given to structuring GEF programming in the following manner:

- (i) **Science and Technology:** The gaps in scientific knowledge suggest there is a need to prioritize, plan, implement and evaluate adaptation options indicates as well as the strengthening and/or development of methodologies. In this regard, targeted research should be promoted. Lack of historical and rigid data in every sector hinders scientific assessment. Scientific guidelines for selecting and implementing adaptation measures newly edited in consideration to the place based methodology helps practitioners.
- (ii) **Capacity Building:** Enhancing local resilience capacity to cope with climate variability and change is suggested to be the core. It is also the most flexible way of responding to uncertain future climate. Not only should public participation be strengthened but also enhancement of local scientific knowledge and utilization of indigenous knowledge. It is important to ensure the participation of local experts and people in the planning of GEF project at an early stage.
- (iii) **Investment Interventions:** Hard type investment works efficiently when incorporated into mainstream development. Assessment and consideration to the local and national size urban planning, river basin management, integrated coastal zone management needs to be well preceded to concrete investment. Deliberative stepwise screening is necessary so as to avoid mal-adaptation caused by irreversible hard type investments.

Since the integration of adaptation measures into mainstream development will necessitate a multi-stakeholder approach, specific consideration should be given to the role of the private sector in adaptation planning and implementation. In most developing countries, private investment is far greater than official development assistance.

To enable the operationalisation of COP/7 decisions, Table 4.1 has been designed to give an indicative notion on how this should be approached.

Table 4.1: Indicative Activities Which Could Be Developed Consistent with COP/7 Guidance

| Elements | Issues/Possible Approaches | Additional Issues |
|--|--|--|
| LDC Fund | Draft operational guidelines | |
| Adaptation Fund under the GEF Trust Fund CP/7 | <ul style="list-style-type: none"> • GEF to report on specific steps taken COP/8 assumption: use of existing GEF Trust Fund | |
| Implementation of Stage II Adaptation Activities | <ul style="list-style-type: none"> • The assumption being that an enabling environment has been created through Stage I activities • Build on work done at national levels including NAPAs as well as in vulnerable countries and regions in Stage I activities <p>Possible activities that could be funded:</p> <ul style="list-style-type: none"> • Determining vulnerabilities of greatest concern; • Determining where adaptation will be most effective; • Getting the economics right; • Developing national strategies for adaptation; • Integrating adaptation strategies into national sustainable development planning; • Capacity building/Institutional strengthening; • Supporting public outreach and education programmes on adaptation; • Ensuring public participation; • Addressing regional or transboundary adaptation; • Facilitation of national/regional access to the information; • Development of portable national/regional models; • Methodologies related to adaptation to address policy needs; • Integration of adaptation measures with natural hazard reduction or disaster prevention programs; • Collection and reporting of adaptation related data; • Linkage with other mechanisms (i.e. early warning systems, disaster preparedness, etc.) <p>Assumption: full cost basis Decision 2/CP.4</p> | Analysis of which countries/regions are considered as particularly vulnerable? |
| Pilot/Demonstration Projects | <ul style="list-style-type: none"> • Initiatives to show how adaptation planning and assessment can be practically translated into projects (a) to provide 'real' benefits (b) integrated into national policy and sustainable development planning (c) based on information provided in national communications, national studies. • Initiatives aimed at addressing gaps. In this regard, the GEF Targeted Research Policy could be used as a modality to achieve this objective. • Methodologies on how to mainstream adaptation into development projects in vulnerable sector. | <p>Definition of what is meant by 'real' benefits?</p> <p>How to mainstream adaptation into development projects in vulnerable sectors.</p> <p>What is meant by 'real' benefits?</p> |
| Capacity Building | <ul style="list-style-type: none"> • Capacity building for prevention measures, planning preparedness for disasters related to climate change | |

| | | |
|--|---|------------------------|
| | <ul style="list-style-type: none"> • Enhance capacity to mainstream climate change considerations into land-use management at the community level • Enhancing capacity to integrate adaptation into the development planning process (i.e. sectoral plans, physical development plans, etc.) • Strengthening institutional response mechanisms for climate change and adaptation • Support the development of integrated assessment tools/models that link climate change with other issues • Training programmes on environmental assessments and adaptation. | |
| Capacity Building Related to Climate Information | <ul style="list-style-type: none"> • Improvement of data collection management, archiving, analysis, interpretation, dissemination; • Provide training relevant to adaptation; • Strengthen/establish national, regional, sub-regional databases; • Strengthen/establish national/regional systematic observation and monitoring networks; • Strengthen/establish sub-regional or regional information networks, centers of excellence, research programmes | |
| National Communications | <ul style="list-style-type: none"> • Support for enabling activities for vulnerability and adaptation assessment; • Preparation/completion of initial national communication; • Development/implementation of prioritized projects identified in national communication. | What kind of projects? |
| Public Awareness | <ul style="list-style-type: none"> • Public awareness and education activities; • Community involvement and participation. | |
| Technology Transfer | <ul style="list-style-type: none"> • Promote transfer of adaptation technologies • Kind and types of adaptation technologies | |

4.6 Criteria for the Selection of Adaptation Interventions and Priority Areas of Intervention by Sector

Setting priority adaptation measures is not an easy task because of a number of factors including (i) the broad spectrum of the adaptation measures ranging from large-scale investment of infrastructure such as dam and irrigation to species change in agricultural production, to coastal zone management and epidemic prevention, etc. (ii) methodological weaknesses in vulnerability assessment in spite of continuing efforts by the scientific community (iii) difficulties in designing effective adaptation measure and their economic evaluation. Notwithstanding these constraints, possible criteria for the prioritisation and selection of adaptation interventions that are consistent with COP guidance were identified. These are outlined in Table 4.2.

Table 4.2: Criteria for Prioritisation and Selection of Adaptation Interventions

| |
|---|
| <ul style="list-style-type: none">• Win-win-win: meets present development goals (e.g., climatic variability), long-term climate change and GHG emissions reduction;• Support for development, the progression from poverty to sustainable livelihoods;• Protecting vulnerable regions and populations;• Apply evaluation criteria for sustainable development to ensure development meets both income and environmental benefits;• Consistent with mitigation goals;• Better farm management;• Preventing land degradation and maintaining soil fertility;• Replicability of interventions;• Community-led initiatives on resource management;• Provision of innovation technologies, lessons learnt, etc.;• Identified gaps which need to be addressed, thus facilitating quick response;• Mainstreaming into national plans and frameworks. |
|---|

In addition to the criteria for prioritization consideration was given to priority areas for intervention. These are highlighted in Table 4.3 for the Agricultural Sector and Biodiversity.

Table 4.3: Priority Areas For Intervention

| SECTOR | PRIORITY AREAS |
|-----------------------|--|
| Biodiversity | <ul style="list-style-type: none"> • Information collection and analysis, and assessment of vulnerability and adaptation; • Implementation of adaptation activities; • Capacity-building for preventative measures, planning, preparedness and management of climate disasters; • Monitoring, forecasting and early warning systems; • Education, training and public awareness. <p>Priority Areas in Terms of Human-Induced Pressures</p> <ul style="list-style-type: none"> • Species and Populations (under increased risk of extinction due to climate change) <ul style="list-style-type: none"> ♦ Species with limited climatic ranges (e.g. montane, insular, peninsular species) ♦ Species with sensitive physiological traits (e.g. amphibians) ♦ Species already at risk due to other pressures. • Ecosystems and Landscapes <ul style="list-style-type: none"> ♦ Geographically restricted ecosystems (e.g. high altitude, high latitude, hyper-arid and hyper-saline, coral atolls) ♦ Remnant ecosystems (e.g. grassland and pastures, wetlands) ♦ Ecotones (e.g. mangroves, coastal and freshwater wetlands, coral reefs) <p>A case-by-case approach is necessary for establishing interventions with respect to the above biodiversity adaptation options to climate change.</p> |
| Agriculture | <ul style="list-style-type: none"> • Agro-ecosystems that are most sensitive to risk. Emphasis should be placed on small farmers; protection of the most productive areas, and those subject to land degradation; • Technical assistance projects on future drought risk and limited to adaptive capacity. Builds upon the present understanding of drought vulnerability and coping strategies to see if there are limits to adaptive capacity given a range of future drought risks; • Grassland ecosystems and pastoral adaptation to climatic risk. Exploration of adaptation options for vulnerable drylands (i.e. destocking, transhumance etc.) • Reducing exposure to present climate variability (i.e. drought proofing, famine early warning, sustainable livelihoods. • Reduce vulnerability to extreme events by soft adaptation policy, regulations, incentives, penalties insurance; • Pilot test cases/experiments/trials to assess/create wider range of choice/local involvement; • Drinking water resources/accessibility • Coastal zones (hazard mapping, flood protection) • Water Conservation – demand side management • Big hardware projects need engagement of Software and Peopleware; • Policy analysis review and reform • Factor in Climate Change considerations into major development projects being funded • Documentation of traditional practices in fresh water resources management; • Pilot studies – targeted research to help set guidelines – (innovative, lessons learnt). |
| Methodological | <ul style="list-style-type: none"> • State of the art vulnerability assessment; • Sector wise analysis of gaps and barriers; • Sector wise adaptation options and technologies; • Evaluation methodologies |

Agenda

Day 1 – Monday, 18 February, 2002

Official Opening:

Chair: Dr. Eric Odada, STAP Member

- 9:00 a.m. Welcome by Prof. M. Gadgil, STAP Chairman
Statement: Representative from the GEF Secretariat
Statement: Representative from the UNFCC Secretariat
Statement by Deputy Executive Director of UNEP
Statement and Official Opening of the Meeting by the Hon. Minister of Environment
- 9:45 a.m. Coffee Break

Plenary Session 1: Background and Context of the Workshop

Chair: Dr. Stephen Karekezi

- 10:15 a.m. Aims and Objectives of the Workshop by Prof. Shuzo Nishioka, STAP Member and Workshop Co-ordinator
- 10:35 a.m. Presentation of the Outcomes of COP7 related to Adaptation, Chair of SBSTA/UNFCCC
- 10:55 a.m. Overview of GEF Activities on Adaptation and Vulnerability by the Representative of the GEF Secretariat:
- 11:25 a.m. Background Paper: Overview of Adaptation and Vulnerability: Gaps and Research Agenda, Drs. Richard Klein and Tom Downing

Discussion on Key Issues Emerging from the Paper

- 1:00 p.m. Lunch Presentation:
1. The Third Assessment Report, IPCC: Lunch Provided – Prof. Ian Burton, Professor, University of Toronto & Dr. Habiba Gitay, Senior Lecturer, Environmental Management and Development Program
 2. AIACC – Dr. Neil Leary, Science Director, Assessments of Impacts and Adaptations to Climate Change (AIACC)

Plenary Session 2: Case Studies on Adaptation and Vulnerability

Chair: Prof. Eric Odada, STAP Member

2.30 p.m. Panel Discussion: Barriers Mitigating Against the Incorporation of Adaptation Measures into Mainstream Development: GEF Implementing Agencies

Discussion

- 3:20 p.m. Case Study 1: Adaptation to Climate Change: The Indian Experience, Prof. M. Gadgil, STAP Chairman
- Discussion
- 4:00 p.m. Case Study 2: An Adaptation Framework Suggestion: Case study for Agriculture, Water and Forestry - Dr. Lin Erda, Director and Professor, Agrometeorology Institute.
- Discussion
- 4:45 p.m. Coffee Break
- 5:00 p.m. Case Study 3: Adaptation and Vulnerability to Climate Change in Southern Africa with special Reference to Biodiversity Ecosystems - Dr. Paul Desanker, LDC, Group of Experts focal point, Mike Rutherford.
- Discussion
- 5:45 p.m. **Panel Discussion:** Incorporation of Adaptation Measures into Mainstream Development: The Case of Small Island Developing States – Project Managers of GEF Adaptation Project in SIDS and/or experts from SIDS – Dr. Ulric O’D Trotz (Caribbean), Project Manager, Caribbean Planning for Adaptation to Global Climate Change/Regional Project Implementation Unit (CPACC/RPIU), Dr. Taito Nakalevu, Climate Change Adaptation Officer, South Pacific Regional Environmental Programme (SPREP).
- Discussion
- 6:45 p.m. Closure of Meeting
[A small Working Group will summarize the lessons learnt from the case studies. The Group will comprise Profs. Shuzo Nishioka, Eric Odada, Paola Rossi, Drs. Setijati Sastrapradja and Stephen Karekezi.]
- 7:00 p.m. Reception

Day 2 – Tuesday, 19 February 2002

Chair: Prof. Shuzo Nishioka

Plenary Session III: Case Studies, Methodologies and Lessons Learnt

- 9:00 a.m. Case Study IV: Response to the Impact of Climate Change in Drylands: With a Focus on West Africa – Dr. A. Verhagen, Plant Research International.

Discussion

- 9:40 a.m. Case Study V: Methodologies for Analyzing Existing Infrastructure Projects in Vulnerable Sectors: Implications for the Integration of Adaptation Measures into Project Design, Costing and Implementation – Prof. Anand Patwardhan, Associate Professor, S.J. Mehta School of Management.
- Discussion.
- 10:20 a.m. Coffee Break
- 10:40 a.m. Presentation on methodologies for impact and vulnerability assessment, regional climate models; the state of knowledge and gaps in information and science – Dr. Roger Jones, Climate Risk and Integrated Assessment Project.
- Discussion**
- 11:20 a.m. Presentation on the costs and benefits of Adaptation – Dr. Ferenc Toth, International Institute of Applied Systems Analysis (IIASA)
- Discussion
- 12:00 p.m. **Working Group Session I:**
- Formation of Working Groups: Four Working Groups will be convened, each addressing a particular sector as follows: **Working Group 1:** Agriculture and Forestry/Land Management for Productive Purposes; **Working Group 2:** Water Resources/Fresh Water Supply, Wetlands, Coastal Zones, Fisheries, Hydro-Electric Power; **Working Group 3:** Human Settlement/Urban and Rural Infrastructure, Health; **Working Group 4:** Biodiversity and Ecosystems/Protected Areas, Corridors. The focus in the Working Groups on specific sectors is intended to help focus the discussion to an operational level. The outputs from the Working Groups will feed into the preparation process of a GEF adaptation strategy which will provide initial guidance to the Implementing Agencies in scoping out project ideas.
- Each Working Group will address the following issues:
- (i) Gaps in current scientific knowledge including tools, methodologies, technologies; vulnerability assessment cost/benefit analysis;
 - (ii) Barriers mitigating against practical incorporation/integration of adaptation into sector policies, plans and development projects;
 - (iii) Cross-focal and social issues;
 - (iv) How to bring S&T to bear on process of incorporating adaptation measures into sectoral policies and development projects taking into consideration cross-focal and social issues;
 - (v) Priority areas for intervention and potential types of interventions;
 - (vi) Criteria for prioritization and selection that are consistent with COP guidance.
- 12:20 p.m. Lunch presentation – The Dutch Programme on Vulnerability and Adaptation to Climate Change - Dr. A. Verhagen and Mr. BertJan Heij, Head, Focal Point Climate Change, The Netherlands.

1:30 p.m. Working Groups Work commences

Day 3 – Wednesday 20 February 2002

Working Group Sessions II:

9:00 a.m. Brief reports on the status of the working groups

10:30 a.m. Working Group session continue

1:00 p.m. Lunch Presentation: “Agroforestry as Both an Adaptation and Mitigation Strategy for Small Holder Farmers” – Dr. Louis Verchot, Programme Leader, Ecosystem Processes and Management, ICRAF - Lunch Provided

3:00 p.m. Report of Working Groups and the development of elements and guidelines for a framework for GEF adaptation interventions

5:00 p.m. Closure of the meeting.

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