



INTER-AMERICAN DEVELOPMENT BANK

Adaptation to Climate Change and Managing Disaster Risk in the Caribbean and South-East Asia

**Report of a Seminar
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Prepared by CDERA

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FOREWORD

Small island and coastal nations of the world have long been recognized as being among the most likely to be affected by the potential impacts of global climate change. Such nations may be found in both the Caribbean and Asian regions. These regions share other commonalities as well, such as tropical climates and, to some extent, the hazards to which these countries are vulnerable.

The inextricable linkage between climate change and disaster management emerges from the potential of the former to result in an increased frequency and severity of hydro-meteorological hazards and the associated increase in risk faced by countries as a whole and by vulnerable communities in particular. Within the Caribbean, the most visible of these impacts has been the increasing vulnerability to severe storms and the increased frequency and intensity of flood events. In Asia, the severity of weather extremes associated with the El Niño phenomenon has been apparent. Recent events have resulted in significant social, economic and environmental losses. But, the more gradual—yet nevertheless potentially as catastrophic—impacts expected from climate change include enhanced coastal and beach erosion; loss of land and property; dislocation of people; reduced resilience of coastal ecosystems and hence reduced viability for fisheries; and the bleaching and destruction of coral reefs. For the island states of both the Caribbean and Southeast Asia, which depend heavily on tourism, agriculture and fisheries for their livelihood, these impacts could be ruinous. For many countries, increased vulnerability to water shortages due to climate change is also a very significant concern.

The need for a comprehensive integrated approach to natural hazard risk management that would combine the broader climate change and risk management agendas, as well as the urgency to advance the mainstreaming of disaster management and climate change, resulted in the convening of the *Seminar on Climate Change and Severe Weather Events in the Caribbean and Asia*, held in Barbados in July, 2003. Specialists from both the Caribbean and Southeast Asia were brought together to discuss current adaptation strategies to severe weather events and to explore possible strategies for addressing climate change in the critical sectors of water resources, tourism, agriculture and fisheries. These sectors were examined in each region with a view toward sharing a range of experiences and facilitating inter-regional information exchange.

This publication brings together good practices identified through presentations and case studies prepared for the seminar, with a focus on practices that are both relevant and transferable between the regions. It is our hope that through this seminar, sustainable networks have been formed to carry on this mission long after the seminar's completion and that this paper will provide a useful departure point for future cooperation between the regions.

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ACRONYMS AND ABBREVIATIONS

ACCC	Adapting to Climate Change in the Caribbean (Project)
ADPC	Asian Disaster Preparedness Center
AIACC	Assessment of Impacts and Adaptation to Climate Change
BEST	Bahamas Environment, Science and Technology Commission
BPOA	Barbados Plan of Action
CDB	Caribbean Development Bank
CDERA	Caribbean Disaster Emergency Response Agency
CDM	Comprehensive Disaster Management
CDRM	Comprehensive Disaster Risk Management
CECI	Canadian Centre for International Studies and Cooperation
CEHI	Caribbean Environmental Health Institute
CHARM	Comprehensive Hazard and Risk Management
CIDA	Canadian International Development Agency
CIMH	Caribbean Institute of Meteorology and Hydrology
CPACC	Caribbean Planning for Adaptation to Global Climate Change
EIA	Environmental Impact Assessment
ENSO	El Niño Southern Oscillation
GEF	Global Environment Facility
GHG	Greenhouse Gases
IDB	Inter-American Development Bank
IUCN	International Union for the Conservation of Nature
IFRC	International Federation of Red Cross
IPCC	Inter-governmental Panel for Climate Change
MACC	Mainstreaming Adaptation to Climate Change
NAPAs	National Adaptation Plans of Action
NEPA	National Environment and Planning Agency
NGOs	Non-governmental Organisations
ODPEM	Office of Disaster Preparedness and Emergency Management
RCC	Regional Consultative Committee
SIDS	Small Island Developing States
SMEs	Small and Medium Size Enterprises
SOPAC	South Pacific Applied Geoscience Commission
SLR	Sea Level Rise
TAR	Third Assessment Report
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UWI	University of the West Indies
WRA	Water Resources Authority (Jamaica)
WMO	World Meteorological Organization

EXECUTIVE SUMMARY

The International Panel on Climate Change has projected that globally averaged surface temperatures will increase between 1.4 and 5.8 degrees Celsius by 2100 relative to 1990, and climate models have predicted reduced precipitation trends for the Caribbean region. Climate change has the potential to affect flooding, droughts, and the frequency and severity of tropical cyclonic systems (including hurricanes and tropical storms) both within the Caribbean region and in Southeast Asia. In addition, both regions are expected to be affected by sea-level rise.

Hazard impacts resulting from climate variability in the 1990s in the Caribbean and Southeast Asia have exposed the vulnerability of key economic sectors: tourism, agriculture, fisheries, and water resources. These identified vulnerabilities are further exacerbated by human activities such as settlement patterns, land use, economic activities and poor management. Given the identification of the hazard impacts associated with climate change, it is critical that the broader cross-sectoral framework of disaster loss mitigation be incorporated into adaptation strategies within the Caribbean and Asian regions.

This report is one of the outcomes of the *Seminar on Climate Change and Severe Weather Events in the Caribbean and Asia*, held in Barbados at the Grand Barbados Beach Resort on July 24-25, 2003. It was sponsored by the Inter-American Development Bank through its Japan Programme, co-sponsored by the Asian Disaster Preparedness Center and organized by the Caribbean Disaster Emergency Response Agency, in collaboration with the Adaptation to Climate Change in the Caribbean Project. Presentations made at the seminar were based on six case studies carried out in the Caribbean and Southeast Asia. In the tourism sector, studies were conducted in the Bahamas and Thailand; studies on agriculture and fisheries were carried out in East Timor and Belize, respectively; and the urban water case studies were undertaken in Jamaica and the Philippines.¹

The seminar was in response to the recognition by the International Panel on Climate Change that small-island and low-lying states are amongst those that will be most seriously impacted by climate change. It provided a forum in which experts from the Southeast Asian and Caribbean regions discussed the current impacts of climate variability and the potential impacts of climate change on four critical economic sectors. The specialists then compared adaptation strategies and made recommendations for future actions. This report seeks to present a summary of the vulnerabilities identified in each sector, share the best adaptation practices developed in the individual countries, and present the recommendations for each sector.

¹ The case study reports are available in the technical archives of CDERA, ADPC and the Environment Division of the IDB.

Tourism is particularly vulnerable to external shocks and any state highly dependent on this industry will potentially be severely affected by the impacts wrought by climate change. Several recommendations were given to lessen such impacts: mitigation measures can be taken to protect coral reefs and beaches; conserving energy and water must be promoted as an adaptation measure within the tourism sector; incentives should be provided to encourage stakeholders to locate facilities in less vulnerable areas; and a balance must be found between the demands of the visitor for ‘a beach view’ and the mitigation measures needed to protect against coastal hazards.

There is also a need for governments to shift their approach from preparedness and response towards systematic risk reduction. This would entail formulating structured, integrated programs that include building resilience through the adoption and enforcement of stringent building codes as a key component of the adaptation mix.

The suggested potential impacts on **agriculture** include increasing variability of rainfall patterns and more intense short-duration rainfall leading to flash floods in some areas. On the other hand, climate variability—notably through the El Niño phenomenon—will probably continue to result in periodic droughts in the Caribbean. However, existing local coping mechanisms in both the Caribbean and Southeast Asia already encompass some promising actions that address the negative potential impacts of droughts.

The impacts of temperature rise from climate change in coastal areas can be expected to lead to an increase in the frequency of storms affecting **fisheries**. The coastal ecosystems—coral reefs, sea grass beds, mangroves and littoral forest—can be severely damaged. The effects of sea-level rise and storms on these habitats will in turn impact the fisheries sector, which is critical to the long-term socio-economic development of several island states. Improved conservation of coastal ecosystems will mitigate these potential negative impacts.

Projections of the implications of climate change, combined with the anticipated future demand for **water resources**, suggest potential scenarios of demand exceeding supply. The suggested impacts on water systems include increasing variability of rainfall patterns; greater flooding from more intense hurricanes; increased contamination of water sources from flash flood wash; and lower minimum flows and groundwater levels due to diminished average rainfall. These impacts will also affect the El Niño Southern Oscillation (ENSO) phenomenon with potentially increasing floods and storms in certain areas and draught in others (climate variability).

The implications of potential impacts highlight the importance of climate variability and change as a development issue since all affected sectors make significant contributions to the economies of the Caribbean and Southeast Asia. The need for a comprehensive integrated approach to natural hazard risk management has been recognized, as well as the need to integrate the climate change and disaster management agendas. Approaches to addressing the potential impacts of climate change must be based upon the current capacity to address existing climate variability. As a first step a “no regrets approach” should be adopted in each of analyzed sectors. For example, for the urban water sector, this regards maintenance and the placing of facilities well away from danger areas

Programmes such as the Caribbean Planning for Adaptation to Climate Change (CPACC) and documents such as the National Communications on Climate Change to the United Nations Framework Convention on Climate Change have provided critical information and outlined adaptation options for various sectors. Actions should be based more on hazard mitigation as opposed to the current focus on disaster response. The involvement of central and local governments, and non-governmental organizations are critical in advancing these adaptation measures.

Since adaptation measures for climate variability and extremes already exist, it is recommended that adaptation to future climate change should seek to identify gaps in the current capacity for addressing these. It is pointed out that reducing vulnerability to near-term hazards is also an effective strategy for reducing long-term climate change risk

1. CLIMATE CHANGE AND DISASTER RISK MANAGEMENT

Introduction

Southeast Asia and the Caribbean are characterized by small island and coastal developing states, which, despite differences in scale, face similar challenges and threats with regard to climate variability and change. The risk management approach to climate change represents a paradigm shift in recent years in the nature of responses to the increased hazards that are expected to occur as a result of climate change: a shift from preparedness and response to risk assessment, vulnerability reduction and capacity enhancement. In adapting this model, communities need to consider their level of acceptable risk, which requires a dialogue about their values and goals for development and the setting of priorities based on the risks considered most urgent. In order to decrease redundant efforts, it is and will be necessary to synthesize the initiatives of the various stakeholders. Communication and consultation at all stages are therefore a crucial part of the process.

1.1 Climate Change Issues and Programmes: Asia and the Caribbean

1.1.1 The Caribbean Perspective

Dr. Neville Trotz of the Adaptation to Climate Change in the Caribbean (ACCC) Project provided an overview of climate change issues in the Caribbean. According to him, the current levels of carbon dioxide and other greenhouse gases in the atmosphere will inevitably lead to climate change, even if all new greenhouse gas emissions are stopped today. Therefore, it is important to address climate-related disasters now, as this will strengthen the capacity to deal with climate change impacts in the future.

Information from the International Panel on Climate Change (IPCC) Third Assessment Report (TAR) detailing climate change scenarios was elucidated. This included a prediction that significant changes in precipitation and temperature could occur in the region by 2050. Small Island Developing States (SIDS) are likely to suffer disproportionately from the enhanced effects of climate change and sea level rise. Evidence, however, reveals that these changes are already in effect. They include an increase of about 1° C in mean temperature in the region, a decrease in average rainfall by some 7%, and a Sea Level Rise (SLR) of approximately 2cm/decade recorded in the Northern Caribbean. Selected climate change effects on the water sector projected for 2050 are presented in Box 1.

The growing number of weather-related disasters will threaten governments' poverty alleviation and sustainable development targets. Such events may also lead to an escalation in financial and human losses, threaten the Millennium Development Goals for hunger and poverty, and impact natural systems. The poorest of the poor in developing countries are, and will be, the most vulnerable.

The regional response comprises a number of projects and initiatives that recognize that adaptability must be the major response of developing states. Climate change was accorded the highest priority in the Barbados Programme of Action (BPOA) arising from the 1994 SIDS conference. The region undertook the following initiatives: a Global Environment Facility (GEF)-funded project to assist countries in developing First National Communications; the GEF-funded Caribbean Planning for Adaptation to Global Climate Change (CPACC) project (1997-2001); the Canadian International Development Agency (CIDA)-funded ACCC project (2001-2004) and the GEF-funded Mainstreaming Adaptation to Climate Change (MACC) project (2003-2007), due to commence shortly.

BOX 1: Projected Climate Change Effects in the Caribbean for 2050 (IPCC)

- ✓ A 1.5-2 °C increase in temperature;
 - ✓ Subsequent increase in evaporation losses;
 - ✓ Decreased precipitation – continuation of a trend of rainfall decline observed in some parts of the region;
 - ✓ Projections by 2050 for the length of the rainy season – down by 7-8%;
 - ✓ Projections by 2050 for the length of the dry season – up by 6-8%;
 - ✓ Increased frequency of intense rains – up an average of 3% and projected to increase to 20% by 2050;
 - ✓ Increased erosion and contamination of coastal areas;
 - ✓ Sea Level Rise – median projection 40 cm by 2080 – causing increased salt water intrusion, augmented by storm surges;
 - ✓ Strongest hurricanes more intense, increasing disaster losses;
 - ✓ General increase in extreme events – droughts, floods; and
- Increased intensity of heavy rain events – rapid run-off/flash floods, causing soil erosion, run-off of contaminants, and adverse effects on coastal waters.

As a result of these potential impacts, the following key regional vulnerability issues have been highlighted: water scarcity with impacts on agriculture, tourism and public health; damage to human settlements and infrastructure, resulting from exposure to storm surges, floods, landslides and coastal erosion; negative impacts on the economy, especially the key sectors of tourism and agriculture (including fisheries); disruption of the coastal zone ecosystems, caused by increased stress on mangroves, reefs, sea grass beds, and wetlands; and public health, which is threatened by such factors as contamination of water resources, the expansion of vector ranges, potential deaths, and heat stress.

The formulation of adaptation policies involves a number of stages: hazard identification, vulnerability assessment, identification of systems at risk and, finally, the determination of responses to reduce the impact of risks and determine the feasibility of interventions, referred to in the risk management approach as “adaptation options.”

Several challenges to applying existing methodology were identified:

- Absence of specific data sets for the region;
- Inadequacy of monitoring systems (climate and sea-level);

- Non-specificity of projections from climate models;
- Absence of region-specific climate change scenarios both on climate change scenarios and localized impacts information;
- Lack of adequate capacity (individual and institutional) in the region.

Given these limitations, the task of developing adaptation policy responses is particularly challenging. However, while there are gaps in the necessary data and capacity, one approach has been to develop national/regional adaptation policies based on available knowledge and capacity in the region to address the vulnerability to present-day climate variability. These policies will be revised and updated as more precise scientific information becomes available. Strengthening the resilience of natural ecosystems, man-made systems and socio-economic systems will decrease the vulnerability to present day climate variability. This in turn would put the region on the path towards decreasing vulnerability to long-term climate change. If adaptation responses also contribute to its sustainable agenda, the region would be in a win/win situation.

A number of adaptation actions were proposed. These included early warning systems and better forecasting; land-use planning and zoning; adjusted building codes; better disaster mitigation strategies (including floodplain and other hazard mapping); inventories of resources (such as water); the use of water-saving devices and watershed management; the inclusion of traditional knowledge, especially in agriculture; and the integration of climate change considerations into the day-to-day management of all sectors.

A number of ‘lessons learnt’ were also detailed. These give indications that would enhance the capacity for hazard risk management. Medium-term investment in actions that decrease present-day vulnerability to climate-related events sets countries on the path to adaptation to longer-term climate change phenomena. Within the Caribbean region, the time for action is now. The climate change signals are clear. Furthermore, opportunities exist where there is coincidence between adaptation and sustainable development agendas—this provides a strategic entrée for implementing adaptation.

1.1.2 The Southeast Asian Perspective

Mr. Glenn Dolcemascolo of the Asian Disaster Preparedness Center (ADPC) gave an overview of the climate change issues and programmes in Southeast Asia. According to IPCC future climate projections for the region, Southeast Asia will experience less change than the global average. The major risks of climate change in Asia are detailed in Box 2.

BOX 2: Major Risks Associated with Climate Change in Asia

- Sea level rise in large deltas and coastal low-lying areas;
- Exacerbated vulnerabilities to extreme climate events such as droughts and floods;
- Increased precipitation intensity, particularly during the summer monsoon, that could increase flood-prone areas;
- Local freshwater availability is expected to be vulnerable to anticipated climate change due to increased precipitation patterns in some areas and lack of rain in others;
- Tropical cyclones could become more intense;
- Crop production and aquaculture would be threatened by a combination of thermal and water stresses, sea-level rise, increased flooding and strong winds associated with intense tropical cyclones;
- Warmer and wetter conditions would promote higher incidence of heat-related and infectious diseases; and
- Land-use changes partly affected by climate variability, may lead to threats to bio-diversity.

According to IPCC projections, as global temperature increases, the Pacific climate will tend to resemble a more permanent El Niño-like state. There will be an increased frequency of El Niño Southern Oscillation (ENSO) events and a shift in their seasonal cycle in a warmer atmosphere. Future seasonal precipitation extremes associated with ENSO events are likely to be more intense in the tropical Indian Ocean region. Areas that are anomalously wet under current climate conditions will be wetter during future events; areas that are anomalously dry now will be even drier in the future. ENSO is already recognized as a major factor affecting local climate, as it affects the spatial/temporal distribution of drought, flood, cyclone, typhoon and fires. With climate change it is anticipated that these effects will be exacerbated.

General adaptation strategies have been devised on both a macro and micro level. Those on the macro scale are focused on sustainable and equitable development, whereas micro scale strategies are focused on modifying the management of the most sensitive sectors.

A number of potential adaptation options for tropical Asia were identified. In the agricultural sector, they involve adjusting the cropping calendar and crop rotations, and developing and promoting the use of high-yield varieties and sustainable technological applications. In the water resources sector, adaptation options include developing flood and drought control management systems; reducing future developments in flood plains; using appropriate measures for protection against soil erosion; conserving the groundwater supply; water impoundments; and efficient water resource systems.

In dealing with the climate change issue throughout Southeast Asia, a number of government activities and initiatives have been introduced. These include National Communications,

National Adaptation Plans of Action (NAPAs) and notable initiatives in the Philippines, Bangladesh and Vietnam.

A number of non-governmental projects are also in effect, including the Assessment of Impacts and Adaptation to Climate Change (AIACC), a joint effort between the International Panel on Climate Change (IPCC), World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), which has the following mandate:

- Integrated Assessment of Climate Change Impacts, Adaptation and Vulnerability in Watershed Areas and Communities in Southeast Asia (Philippines, Indonesia, Laos, Cambodia and Vietnam), and
- Assessment of Southeast Asia Regional Vulnerability to Changing Water Resources, Extreme Hydrological Events due to Climate Change (Cambodia, Vietnam, Laos and Thailand).

Other non-governmental organizations (NGOs) with climate-related national projects are the International Federation of the Red Cross and Red Crescent Societies (IFRC), the International Union for the Conservation of Nature (IUCN) and the Canadian Centre for International Studies and Cooperation (CECI).

1.1.3 Discussion and Recommendations

There is a need to approach climate change adaptation in both regions by initially examining the capacity to address existing climate variability. Although communities are less interested in the issue of climate change—the results of which might not be experienced for another 30-50 years—than in the more immediate issue of dealing with the effects of severe weather events, the tangible issue at hand is climate extremes. Advances in the discussion may be made by comparing community experiences, both intra-regionally and inter-regionally. The following recommendations can be drawn from the discussion:

1. Focus interventions in both regions on applying practical solutions and target decision makers, with science supporting user needs;
2. Develop climate models at the micro-level particularly for the Caribbean region;
3. Integrate climate change with disaster management and national development as an effective strategy for advancing a common agenda. Climate change considerations should be incorporated into general development planning;
4. Provide for training in modelling techniques relevant to climate change impact in key sectors;
5. Promote the establishment and use of systematic monitoring and observation processes to enhance data collection for climate change and disaster management;
6. Recognize and integrate public awareness as a key activity within all interventions that needs to be explicitly designed and funded;
7. Support the development of a minimum institutional capacity to address climate change effects at the national level;
8. Develop a ‘mobile’ pool of regional skills to complement the national skills base; and
9. Programmes must be ‘country-driven’ with implementation occurring via regional delivery.

1.2 Risk Management Approaches to Climate Change

1.2.1 The Caribbean Perspective

The presentation on “Risk Management Approaches to Climate Change in the Caribbean” was made by Dr. Neville Trotz of ACCC.

Risk management is a tool that can be usefully applied in the design and selection of strategies for coping with areas of uncertainty, in this case, climate change. Some of the strengths of this approach include the capacity to integrate multiple factors, the possession of some level of predictive capacity and, if prudently applied, the capacity to reduce the level of vulnerability of a given exposure unit.

Risk management is preceded by risk assessment. This is an evaluation of the degree of exposure (vulnerability) to an event, and the proposal of a range of options for risk reduction. During the risk management stage, the selection and implementation of an option or options is carried out. The process is determined largely by human choice, and the chosen strategy depends on such factors as the society’s determination of what constitutes *acceptable risk*; how society values one set of resources versus another, and how much the society is able or if prepared to pay for coverage against a particular risk.

There are two international climate change risk management models that have influenced the Caribbean’s approach: i) The Canadian Standards Association’s *Risk Management Guidelines for Decision-Makers* and ii) Comprehensive Hazard and Risk Management (CHARM) for the South Pacific Region. The Guidelines of the Canadian Standards Association are being adapted to assess climate change risks in the Caribbean. It provides the basis of the ACCC Project 3, the aim of which is to integrate climate change into the physical planning process using a risk management approach. In the Caribbean region, workshops on risk management in climate change and risk management training seminars for the tourism, finance, water and agricultural sectors have been carried out as components of the ACCC project. The next stage involves the undertaking of a pilot project in a Caribbean territory to demonstrate ways in which institutions, procedures and legal requirements can be strengthened and/or modified to facilitate the integration of sectoral adaptation measures into national physical development planning.

CHARM is the other model that influences the Caribbean’s strategy. It effectively manages unacceptable risks associated with major hazards by moving the hazard and risk management approach away from response and relief toward a more holistic risk management containment strategy linked to the national development strategy. Another identified strength is that it seeks to involve all national and regional partners. The advantages of CHARM, referred to as the ‘charms of CHARM’ were identified as follows:

- Involves monitoring and review at all stages of the process;
- Clearly defines and relates to primary and secondary climate-related hazards; and
- Includes linkages to national development planning (social, economic and infrastructural), national and regional institutional mechanisms and programmes.

The risk management process for adapting to climate change impacts in the Caribbean will draw on the strengths of both models. The basic structure will follow the Canadian Standards Association guidelines to ensure it meets accredited standards and is thus recognized regionally as a viable concept. It will also use unique features of CHARM that are applicable to the Caribbean region with the benefits described above applicable to small island and low-lying coastal developing states.

1.2.2 The Southeast Asian Perspective

Mr. Glenn Dolcemascolo of the ADPC provided the Southeast Asian perspective.

Within the Asian region, a paradigm shift has taken place in recent years from disaster management to risk management and from emergency response to risk assessment, vulnerability reduction and capacity enhancement.

As in the Caribbean and the Pacific regions, the disaster risk management perspective has also been gaining momentum in Asia. The term Comprehensive Disaster Risk Management (CDRM) was endorsed at recent meetings of the Regional Consultative Committee on Disaster Management (RCC). The RCC is comprised of members of the ADPC's Board of Trustees/Advisory Council who work in key government positions in the National Disaster Management systems of 23 countries and territories in the Asian region.

This approach has been developed over the past three years through several regional meetings (held in cities such as Katmandu, Nepal; Bangkok, Thailand and Kobe, Japan) that have brought together a diverse and vibrant community of national, regional and international organizations.

The emerging framework emphasizes the following characteristics:

- Comprehensive: covers all aspects of disaster management;
- Multiple-hazards: full range of probable disasters;
- Integrated: vertically and horizontally to include “government/private/public” partnerships, “local/national/international” coordination and inter-sectoral planning and implementation; and
- Community friendly: recognizes the roles and responsibilities of communities in establishing disaster management programmes and systems, ensuring self-reliance and self-sufficiency in times of disaster.

The CDRM approach examines and combines all phases of the disaster management cycle, from prevention to response, restoration and national development. Implementation strategies for the CDRM are outlined in Box 3.

The enabling mechanisms for effective disaster reduction through CDRM include policies, institutional structures and systems, capacity enhancement and resources. The ultimate objectives of CDRM are sustainable development and the building of resilient communities.

BOX 3: Key Implementation Strategies of Comprehensive Disaster Risk Management

- ✓ Achieve effective disaster reduction and response through multi-level, multi-dimensional and multi-disciplinary cooperation and collaboration;
- ✓ Make decisions based on reliable disaster risk information from hazard mapping and vulnerability assessment;
- ✓ Enhance coordination and integration of stakeholders' actions through good communication and an efficient exchange of relevant and reliable information;
- ✓ Ensure appropriate enabling mechanisms are in place, including policy, structure, capacity building and resources; and
- ✓ Implement the disaster risk management process from the national level to the community level.

1.2.3 Discussion and Recommendations

There is a growing awareness of the need for—and a growing movement within both regions to develop—sustainable linkages between disaster management and climate change. Within the Caribbean, new linkages between disaster management and climate change in institutional contexts have been evidenced through the development of a formal relationship between CDERA and the Caribbean Community Secretariat and with the Caribbean Development Bank (CDB). Within Asia, similar country-level approach towards the systematic incorporation of disasters and climate change is taking place in Bangladesh. Other, informal connections between disaster management and climate change communities, also exist. The potential hazard impact of climate affects the work of both groups.

Inter- and intra-regional institutional partnerships must be supported and promoted. Within the Pacific region, the South Pacific Applied Geoscience Commission (SOPAC) and the ADPC have had many opportunities to share information and to cooperate but until now each has concentrated on its own programmes and geographical areas.

The credibility or reliability of weather forecast *data* must be improved in both regions to ensure confidence among communities. To facilitate this, greater dialogue is required between meteorologists, climatologists and climate information users so that the limitations of forecasts are well known, and end users are thus able to make more informed decisions. In the Asian region, the role of local knowledge garnered from the experiences of persons within the community helps form the adaptation strategies of particular groups (such as farmers). Local knowledge should be recorded in order to complement the already published research data.

There is a need to improve both climate change *modelling* and data in the Caribbean region. Most models assume a minimum level of data that is simply not yet available. Although several projects involve the gathering of data by extra-regional consultants, the data needs to be repatriated for use within the region. Significant progress has been made in this area through the establishment of 18 monitoring stations over the last four years under the CPACC project. However, there have been some challenges, since the efficiency of the stations is largely dependent on the technical capacity of national meteorological services. Most of the data is currently processed at the regional University of the West Indies; however, it needs to be further translated for users.

The funding priorities with respect to acceptable risk from the perspective of development banks were also shared. From the IDB point of view, three options were identified: 1) to invest in options with a minimum risk; 2) to incorporate mitigation as an issue and finance mitigation measures as a component of a programme; or 3) to establish first prevention projects in key sectors which would facilitate a later development of larger investment programmes. Since deciding on an acceptable level of risk is a process, it is important to establish indicators and socio-economic and ecological thresholds for decision makers in the most affected cost/benefit analyses should be incorporated in each alternative sectors.

In the case of the Caribbean Development Bank (CDB), significant investments have been made in disaster relief, response, and rehabilitation activities, with little evidence of reducing the vulnerability or risk. The goals of the CDB were identified as 1) to strengthen its capacity to incorporate disaster management into project planning, and 2) to assist countries in the implementation of disaster management. Whereas previously there was a focus on EIAs to consider the project's impact on the environment, there is now a movement towards national hazard impact assessments that assess the impact of natural hazards on planned projects.

Based on the above discussion, the following recommendations were put forth:

1. Support and promote the implementation of risk management approaches to climate variability and change, including utilization of tools such as the Caribbean Risk Management Guide, to determine adaptation options to climate change;
2. Integrate local knowledge into risk management approaches;
3. Promote and support inter- and intra-regional partnerships to advance the risk management agenda; and
4. Encourage and support the further collection of data and its processing into appropriate formats for risk management applications.

1.3 Mainstreaming Climate Variability and Change and Disaster Management

Ms. Liz Riley of the Caribbean Disaster Emergency Response Agency (CDERA) spoke on the issue of mainstreaming climate variability and change and disaster management. This presentation focused on hydro-geological events and considered the following areas: potential hazard implications of climate change; the current reality, which involved severe weather events; and recommendations for the way forward.

A number of potential hazard implications were identified. These were: i) tropical storms and hurricanes, which will potentially increase in frequency and severity; ii) flooding—the frequency and intensity of inland flooding events are likely to increase, as will coastal inundation due to sea level rise; and iii) drought—this hazard event, associated with El Niño, will potentially increase in frequency and intensity. These and other potential impacts of climate change are characterized by their long-term nature and uncertainty. However, as severe weather events are presently occurring, these should also be a focus of attention. Recent examples of severe weather events were detailed and illustrated including the effects of Hurricane Lenny on Grenada in 1999 and major flood events in Jamaica, including the 2002 floods.

Since adaptation measures for climate variability and extremes already exist, it is recommended that adaptation to future climate change should seek to identify gaps in the current capacity for addressing these. It was pointed out that reducing vulnerability to near-term hazards is an effective strategy for reducing long-term climate change risk.

Comprehensive Disaster Management (CDM) was recommended as the framework in which the necessary future changes and adaptations be implemented, and a number of its advantages were identified: its goal is sustainable development; all phases of the disaster management cycle are considered (not just preparedness and response but mitigation as well); management of hazards and hazard information are integrated into development planning and the planning process; it is multi-sectoral approach built on partnerships with stakeholders; and finally, it builds a culture of safety.

1.3.1 Discussion and Recommendations

There is a need to continue promoting adaptation to the potential impacts of climate change in both regions. The basis for action should be existing mechanisms and approaches used to address present day climate variability. Since both the Caribbean and South-East Asian countries will feel the impacts of climate change, there is a need to focus on adapting to these impacts. Adaptation should therefore be a priority. The Kyoto Protocol's Clean Development Mechanism could be used to link the adaptation and mitigation approaches.

Local knowledge must be effectively incorporated into disaster management and climate change adaptation measures. Several examples of successful reliance on local knowledge exist. In Guyana, for example, where there are 30 varieties of cassava and 20 of maize, indigenous women know which variety should be planted in particular climatic conditions. CDM could be utilized as the framework in which such local knowledge is applied. It is thus important to establish a dialogue with peoples within the region and involve them and their knowledge in planning strategies. The following recommendations were drawn from the discussion:

1. Utilize Comprehensive Disaster Management as the framework within which adaptation actions are planned;
2. Incorporate risk assessment into the development planning process;
3. Increase risk awareness and strive towards risk reduction;
4. Enhance preparedness, response and hazard mitigation capability;

5. Promote the quantitative assessment of potential impacts through scientific data; such information should be incorporated into adaptation strategies;
6. Build national and regional capacity for drought management;
7. Enhance capacity especially in flood contingency planning;
8. Incorporate local knowledge into climate variability and climate change adaptation measures;
9. Adopt a multi-sector approach to managing climate variability (including severe weather events) and climate change impacts (including those for disaster management).

2. CLIMATE CHANGE IMPACTS AND ADAPTATION FOR THE TOURISM SECTOR: CASE STUDIES IN THE BAHAMAS AND THAILAND

Introduction

The case studies on the Bahamas and Thailand were presented by Mr. Ivor Jackson and Ms. Vivian Raksakulthai, respectively. The two countries showed marked similarities in the tourism sector: both are renowned island holiday destinations and their economies are heavily dependent on tourism. Like the Bahamas, the focus of the Thai presentation, Phuket Island, relies on its beaches as a major attraction for visitors. Both states experience seasonal weather that affects tourism demand and defines high and low seasons to a greater or lesser extent. In Phuket Island it is the monsoon season; in the Bahamas, it's the hurricane season. Past experience has illustrated the vulnerabilities of the sector and of the states which depend on it. The potential implications of climate change over the next several decades may lead to significant impacts both within and outside the normal tourism season.

Vulnerabilities of the Tourism Sector

Tourism is particularly vulnerable to external shocks and any state highly dependent on this industry will potentially be severely affected by the impacts wrought by climate change. Impacts from climate variability and severe weather events in Phuket are the result of four primary phenomena: 1) the southwest monsoon, 2) storms and floods, 3) droughts, and 4) El Niño. The seasonality that characterizes the weather pattern in Phuket already is the defining factor in the distribution of tourist arrivals throughout the year. Dimensions of future vulnerability include further shortages in water supply; increased flooding exacerbated by increasing degradation of natural resources and the environment, already stressed waste management systems and projected sea-level rise; damage to coral reefs through coral bleaching; and shifts in seasonality. These combined factors could result in greater uncertainty for planning activities and tourism demand. Areas of vulnerability for the Bahamas include water supply and distribution; and coral reefs, which are major factors in tourism development.

2.1 Current Adaptation Practices

Assessment and Forecast Information.

In the Bahamas, assessment and forecast information is available through an existing network of 14 meteorological stations, established in 1982. This network is considered insufficient for monitoring the climate. National authorities estimate that a network of a total of 60 observation stations would be needed. An additional source of forecasting information is obtained through the National Hurricane Center in Miami. In contrast, two major meteorological stations exist in Phuket. Daily and weekly forecasts are sent to users who include operators in the tourism sector.

Existing Policies, Programmes and Initiatives for Climate Change

A draft National Disaster Plan was prepared for the Bahamas in 2003. The document includes loss reduction plans to protect economic sectors including tourism. A Crisis Communications manual also exists for the tourism industry. A National Communications on Climate Change document was developed for Thailand in 2000. This document describes vulnerabilities to climate change for five sectors and proposes adaptation options. While tourism is not one of the sectors identified, many of the recommended adaptation options would be effective in reducing vulnerability for the sector. In addition, the Royal Irrigation Department is implementing a plan for the security of water supply.

Institutional Arrangements, Capacity Building and Legislative Initiatives

In Phuket, the research community has taken the main initiative to link climate and tourism. In the Bahamas, the mandate of the Bahamas Environment, Science and Technology (BEST) Commission includes coordinating climate change management activities. In addition, a National Climate Change Committee exists and is active. With respect to legislative initiatives, in the Bahamas, a draft bill, the Disaster Preparedness and Response Act, is under consideration. In addition, the Conservation and Protection of the Physical Landscape of the Bahamas Act of 1997 is an important piece of legislation affecting tourism industry and disaster reduction.

Economic Diversification and Insurance

In both countries, options for diversification from tourism are being explored. In the Bahamas, manufacturing is being developed in free trade zones in Freeport and Nassau. In addition, a repair facility for cruise ships and large vessels has been established. For Phuket, non-tourism sectors have been developing services for tourists. These include the health and agricultural sectors. In the Bahamas, the Office of the Registrar of Insurance Companies ensures the solvency of insurers and re-insurers, while in Phuket, most types of insurance to cover climate risks already exist.

2.2 Recommended Adaptation Strategies for the Tourism Sector

2.2.1 The Bahamas

Policy Initiatives

Specific recommendations on policy-based adaptation strategies were made in the National Communication on Climate Change report to the UNFCCC, namely:

- Economic evaluations of the impact of various climate change scenarios on tourism;
- Greater public awareness on the vulnerability of the Bahamas to climate change;
- Water quality monitoring for fresh, saline and hyper-saline waters to track the vulnerability to sea level rise;
- Expanding the network of hydro-meteorological, oceanographic and marine instruments to monitor climate change;

- Improved data management; and
- Capacity building to manage climate change impacts through tertiary training in critical disciplines such as hydrology, meteorology, oceanography, marine ecology and natural resource economics.

In addition, the following may be considered:

- Mapping of flood, storm surge, erosion and other weather-related hazards for all populated islands, prioritised by areas of highest risk and vulnerability;
- Reducing weather impacts on new projects using effective EIA studies; and
- Reducing the vulnerability of existing tourism operations by using weather hazard audit procedures.

Sectoral Plans

Strategic action was recommended, among others, in the following areas:

- Flood hazard mapping in priority zones for future tourism development;
- Updating of topographical and hydrographical maps for major tourism zones to ensure better accuracy and accessibility to users;
- Upgrading and effective maintenance of navigational markers in areas considered high risk to yacht cruising;
- Designation of official hurricane shelters for boats on islands with significant levels of pleasure boating activity, along with management procedures to be followed in the event of storms and hurricanes;
- Development and encouragement of the use of procedures for assessing the vulnerability of existing hotels, marinas and other tourism facilities to extreme weather events;
- Improvement in the application of EIA procedures—clarification of the legal authority and procedure for the use of EIA; monitoring of compliance with the agreed mitigation; the use of private professionals could be considered to monitor compliance of large developments with the cost borne by developers where government resources are lacking;
- Implementing an Integrated Coastal Management plan for the Bahamas—an appropriate and realistic institutional model that suits a multi-island territory must be found. Creative ways must also be found to build a reliable database and find the necessary technical skills to manage responses to coastal threats. One approach is the creation of a Department or Institute of Coastal Zone Management within the College of the Bahamas; and
- Enforcing building codes—for example, the Bahamas has stringent building codes, however, there is need for building inspectors to monitor their compliance.

2.2.2 Thailand

Recommendations for adaptation of the tourism sector in Thailand include:

- Implement integrated coastal zone management: one of the major problems facing the industry today, and the communities that depend on it, is the haphazard management of land use, water, and ecological resources in Phuket. There are several coastal zone management plans for the island, but they have not been effectively implemented.

- This is due to a combination of lack of political will, lack of coordination between relevant agencies, corruption, and the law;
- Increase the understanding of vulnerability and impacts; however, the pivotal area of research needed to bring climate risks to the fore is the economic analyses of climate impacts;
 - Build capacity and public awareness: one of the most important strategies is to build the capacity within the tourism sector to anticipate, and prepare for, risks from climate variability and change;
 - Focus on Small and Medium Size Enterprises (SMEs) and low-impact tourism: particular attention should be paid to tourism activities that minimize impact on the environment;
 - Enhance public/private partnerships: many training and marketing activities can be undertaken jointly among the government, universities, trade associations, and tourism businesses;
 - Increase electricity and water efficiency;
 - Water supply: to limit the risk of water shortages from drought and excessive demand, the Tourism Authority of Thailand plan recommends several measures to improve the stability of supply including increasing the quality of the water supply and water recycling systems; create land-use zones around the island; implement a more efficient fee structure for water consumption; establish new water supplies, e.g., producing fresh water from a mine; or transmitting water from nearby Phang Nga province and build a number of dams according to the capacity of each area. If implemented, these measures could increase the efficient use of water and, therefore, the resilience to climate change-induced reductions in water supply for the tourism sector in Phuket.

2.2.3 Discussion and Recommendations

Subsequent to the sector case study presentations the two speakers, Mr. Ivor Jackson and Ms. Vivian Raksakulthai, were joined by two other panellists, Mr. Earlston McPhee, General Manager, Sustainable Tourism of the Ministry of Tourism, Bahamas, and Mr. Paitoon Kengkarnchang, irrigation engineer of the Phuket Irrigation Project, Thailand. Mrs. Eleanor Jones moderated the panel discussion.

Following the discussion, a number of recommendations were offered. There is a need for mitigation measures in the protection of beaches. Given the critical role played by beaches in the tourism sector of Southeast Asia and the Caribbean, natural rebuilding in the wake of severe erosion is not an appropriate action. The ‘Blue Flag’ programme currently in operation in the Bahamas—whose popularity reflects the fact that stakeholders were fully supportive of the protection of the marine and beach environments—was identified as a successful mitigation programme.

Several other recommendations emerged from the panel discussion: conserving energy and water must be promoted as an adaptation measure within the tourism sector; incentives should be provided to encourage stakeholders to locate facilities in less vulnerable areas; a balance must be found between the demands of the visitor for ‘a beach view’ and the mitigation measures that may be taken against coastal hazards; there is a need for

governments to shift their approach from preparedness and response towards risk reduction through the formulation of structured, integrated programmes for the systematic reduction of risk; and building resilience through the adoption and enforcement of stringent building codes must be a component of the adaptation mix.

Promotion of climate change mitigation in the tourism sector was discussed. The sector contributes a significant amount to greenhouse gas emissions through travel. For example, one 5,000-km flight consumes as much fuel as a family car would over the course of 17 years. Measures can be undertaken to reduce fuel consumption.

3. CLIMATE CHANGE IMPACTS AND ADAPTATION FOR AGRICULTURE AND FISHERIES: CASE STUDIES IN EAST TIMOR AND BELIZE

Introduction

The case studies on agriculture in East Timor and the fisheries sector in Belize were presented by Mr. Glen Dolcemascolo and Mr. Vincent Gillett, respectively. Agriculture is the primary human interface with the physical environment, and as such is highly dependent on favourable climatic conditions. A successful fishing industry also depends heavily on predictable climate scenarios. Both industries are fragile and easily impacted by local and global climate change. Even modest climatic ‘surprises’ have direct and almost immediate impacts on production, food security and economic growth. However, according to the IPCC, Southeast Asia is not yet equipped to deal with current climate variability, and Belize’s readiness to cope with the impacts of sea level rise has been described as ‘lukewarm.’

Vulnerability of the Agricultural Sector in East Timor

East Timor (or Timor Loro’ Sae) is highly vulnerable to climate risk. It is both the youngest and the poorest country in the world and an estimated 74% of its population is rural. Agriculture, and to a lesser extent, fisheries are, and for some time will continue to be, the anchor of food security for the people of Timor Loro’ Sae. Owing largely to its topography and climate, East Timor is generally vulnerable to both flash floods and slower onset floods. From a strictly hydro-meteorological perspective, East Timor is especially vulnerable to drought, with limited groundwater and unreliable rainfall, especially during El Niño years. Regional models developed for the Asian region, though not yet downscaled to reflect East Timorese climatic factors, indicate projected increases in annual average temperatures and reduced rainfall.

Vulnerability of the Fisheries Sector in Belize

Belize has been identified by the United Nations Framework Convention on Climate Change (UNFCCC) as one of those countries that is most vulnerable to the impacts of hurricanes and climate change. The impacts of temperature rise on climate change in coastal areas of Belize can be expected to lead to an increase in the frequency of storms throughout this century, which could have significant environmental impacts on the country’s coastal habitats. Aside from storms, changes in sea level, water temperature, and salinity, constitute risks to reefs and coastal wetlands. Coral reefs, sea grass beds, mangroves and littoral forest—are the basis of the Belize fishing industry. Activities in the fisheries sector may therefore be considerably diminished resulting in significant socio-economic hardship to fishermen, their dependents, and to coastal communities in general. The effects of sea level rise and storms on these habitats will in turn impact the fisheries sector, which is critical to the long-term socio-economic development of Belize.

The fishing industry makes important contributions to the economy, employment, food and nutrition, and import substitution. Foreign exchange earnings from the fisheries sector (which comprises both the capture fishery industry and aquaculture) ranked third in export earnings in 2001. Aquaculture is an important component of the Belizean fisheries sector, contributing 71% of fisheries earnings. Potential impacts of severe events on aquaculture can come from storm events, such as mechanical damage to production and ancillary infrastructure, loss of stocks from inundation and consequent overflow of pond walls or levies, and damage to the hatchery system. The potential impacts from sea level rise, such as increased coastal erosion and damage to dykes or embankments of some aquaculture ponds, must also be factored into the equation.

3.1 Current Adaptation Practices in the Agriculture and Fisheries Sectors

3.1.1 Agricultural Sector in East Timor

Relatively few government initiatives in East Timor explicitly consider their mission to be reducing risk to climate change or even climate-related disasters. Nevertheless, many programmes and policies play an indirect role in reducing vulnerabilities.

Local Coping Strategies

The people of East Timor have adapted to climatic variability through distinctive agricultural traditions aimed at minimizing the risk of food shortage rather than optimizing productivity. There is also some regional variation in coping strategies. The strategies identified include: preparations for the anticipated lean period of February-November; maintaining kitchen gardens; gathering forest foods (tubers, fruit) for sale and consumption; hunting wild game; fishing as a source of supplemental income; and reciprocal exchange mechanisms.

Existing Policies, Programmes and Initiatives for Managing Climate Risk

East Timor has no meteorology department, nonetheless its cyclone warnings. Weather forecasts and El Niño forecasts are provided on an ad hoc basis by the Bureau of Meteorology in Australia. Climate risk is addressed in part through the emphasis within the agricultural sector on irrigation systems and the recognition of the constraints placed on agricultural productivity by drought and untimely rain. The National Disaster Management Office is mandated to recommend disaster management policy, coordinate operational level monitoring of vulnerability and provide relief services. A number of initiatives have been undertaken by this department including:

- Undertaking a capacity-building programme;
- Initiating an awareness campaign for flood and landslide preparedness;
- Initiated a baseline data collection to increase knowledge of vulnerability to natural hazards in the country; and
- Carried out vulnerability-mapping projects.

Within the Department of the Environment, there is an awareness of the issues related to climate change. The work of this office is focused primarily on developing legal frameworks for environmental issues. Coastal zone management is a high priority.

One notable initiative has been the formation of an ENSO task force. Though an informal initiative, the task force has built relationships between individuals and has proven to be an effective network for communicating the risks related to the phenomenon. Predictions for the 2002-03 El Niño impact were carried out and used to inform decision-makers.

3.1.2 Fisheries Sector in Belize

Generally, fisheries management practices in Belize have focused on classical species protection measures. These include closed seasons to protect spawning stocks and to allow for natural replenishment, closed areas to protect spawning aggregations, and gear selectivity mainly in the form of mesh size regulation to protect young fish at first capture. Other responses have also focused on modern fishery management methods where attention is brought to bear on the wider environment supporting the fish stocks. Current activities in Belize that address the vulnerabilities of the fisheries sector to climate variability have focused mainly on safety measures and post-disaster assessments. This response has been led and coordinated by the National Emergency Management Organization (NEMO). These activities fall into the categories of policies, programmes and projects, legislative initiatives and institutional frameworks.

Policies, Programmes and Projects

Belize participated in selected pilot phases of the CPACC project. These included installing a regional network of tide gauges and automatic weather stations; establishing a database for all information gathered by the CPACC; compiling an Inventory of Coastal Resources; drafting a generic policy framework for integrated coastal zone management legislation; and creating a pilot scale initiative involving coral reef monitoring.

The first National Communication on Climate Change was published in 2002. This document assesses the socio-economic and environmental implications of climate variability and change for Belize, provides advice for a coordinated approach to issues related to climate change, and proposes adaptation and mitigation options for several sectors, including the coastal area. More recently, the government of Belize, through NEMO, has been in the process of developing a National Hazard Mitigation Policy. This policy outlines a national framework for reducing vulnerability to hazard risks including the potential hazard impacts of climate change.

Legislative Initiatives and Institutional Frameworks

The National Meteorological Service of Belize is central to the development of actions dealing with hurricanes and climate change. The agency advises the government on technical issues related to hurricanes and climate change and is the focal point for all climate change-related activities. In addition, the Meteorological Service has produced a number of papers on vulnerability and response mechanisms to climate change.

The National Emergency Management Organisation receives its legal basis through the Disaster Preparedness Response Act and other statutory instruments passed in 2000. NEMO has a mandate to direct and manage Belize's response to natural disasters (including hurricanes) and has adopted the Comprehensive Disaster Management strategy developed by

CDERA. CDM promotes a multi-sector approach to managing hazards including those potential hazards related to climate variability and change.

In addition, the Integrated Coastal Zone Management Process is being executed through the Coastal Zone Management Authority established in 1998 and the related Coastal Zone Management Strategy for Belize (2002) published by that Authority.

3.2 Recommended Adaptation Strategies for Agriculture and Fisheries

3.2.1 Agriculture Sector in East Timor

Recommendations made during the seminar presentation are presented in Table 1.

Table 1: Recommended Adaptation Strategies for Agriculture in East Timor

Adaptation Category	Actions
Vulnerability Assessment	Conduct community-based assessments of vulnerability and risk; Identify critical thresholds and goals to reduce vulnerability; Develop observation and monitoring systems.
Communicating Climate Risk	Establish early warning for floods and drought; Develop institutional infrastructure and mechanisms for communicating climate risk.
Planning	Internalise climate risk in the planning process at national and local levels; Contract targeted studies of irrigation feasibility based on climate projections; Carry out cost-benefit studies for prevention investments; Develop a demand and the capacity to provide tailored climate information for risk reduction; Identify climate information needs; Plan for access to relevant climate information in the interim.
Training and Knowledge Development	Begin training in graduate level university programmes; Begin training in interpreting climate information; Monitor and support advances in climatology and other relevant sciences for applications in Belize.
Policy Actions	Forward the proposal for establishing a National Meteorological Agency; Expedite the National Adaptation Plan of Action; Develop an integrated Coastal Zone Management Plan; Develop agricultural extension services.
Pursue Poverty Alleviation	Design government initiatives (to improve life and economic viability) with an awareness of how climate risk might affect the success of the endeavour.

3.2.2 Fisheries Sector in Belize

The proposed adaptation options include:

- Mitigation: greater emphasis on hazard mitigation and less on response;
- Land-use policies: development of clear policies and plans regarding the use and development of coastal lands;
- Adjust land use practices to reduce negative impacts of climate change on coastal ecosystems;

- Fisheries sector:
 - Security: a need for insurance, which is not currently available for fishermen, or the price of which is prohibitive.
 - Creation of a Fishermen's Hurricane Relief Trust Fund.
 - Mitigation measures: the Belize Fishermen Cooperative Association has been promoting the establishment of a programme called the 'Surveillance, Enforcement and Assessment Support' project. This project seeks to equip fishermen with radios to inform them of impending emergencies (especially hurricanes); and to acquire land to develop a facility away from the coast to be used to store boats, engines and fishing gear for fishermen during severe weather events. Damage to and loss of equipment would therefore be reduced.

In addition, the adaptation options put forward in the First National Communication on Climate Change offer a number of mitigation activities for the coastal zone. These are elaborated on in Table 2.

Table 2: Adaptation and Mitigation Options for the Belizean Coastal Zone

Activity	Benefits
Establish setbacks for undeveloped coastal areas	Reduced incidence of property loss due to erosion and inundation; Autonomous adaptation of coastline; Ecosystems migrate; Aesthetic value of the coast maintained.
Construct and improve seawalls	Property damage and loss reduced; Shoreline of developed areas protected.
Beach nourishment	Economically important beaches protected; Intrinsic character of areas and their communities maintained.
Relocate vulnerable coastal communities	Vulnerability of residents reduced.
Prepare post-disaster reconstruction plans	Reconstruction on severely damaged coastal properties discouraged.
Monitor relative sea level rise and local wave climate	Improved availability of data for making informed decisions including for prediction of sediment transport and for the engineering of resistant coastal structures.
Monitor shoreline	Rates of shoreline erosion or accretion measured;
Develop education and public awareness campaign	Public understanding of the need for adaptation measures; Decision makers incorporating adaptation measures in sectoral development strategy.

Source: Adapted from Belize First National Communication to the Conference of the Parties of the UN Framework Convention on Climate Change, 2002.

3.2.3 Discussion and Recommendations

Subsequent to the sector case study presentations the two speakers, Mr. Glenn Dolcemascolo and Mr. Vincent Gillett, were joined by the following persons to constitute the panel: Dr. Lystra Fletcher-Paul of the FAO; Professor Charles McDavid of the Faculty of Agriculture of the University of the West Indies; Mr. Terrence Phillips of the Caribbean Regional Fisheries Mechanism (CFRM); Mr. James Azueta of the Fisheries Division, Belize; Ms. Marcia Creary of the ACCC Project; and Mr. Cesaltino dos Reis de Carvalho of the Ministry of Planning

and Finance, East Timor. The panel discussion was moderated by Ms. Vivian Raksakulthai of the ADPC. The following recommendations can be drawn from the discussion:

1. For both regions certain useful but unused climate change data has been collected. It should be analyzed and disseminated for decision making purposes.
2. It is recommended that the proposed Climate Change Centre be established as a coordinating body in the Caribbean region. The centre would link the national agencies and assist with capacity building in order to improve adaptation and mitigation measures in the region.
3. Strengthen the role of the meteorological services in decision making in both regions.
4. Promote and support a multi-sectoral approach to climate change issues including the utilization of public and private sector partnerships as a viable means of strengthening response.

4. CLIMATE CHANGE IMPACTS AND ADAPTATION FOR URBAN WATER SUPPLY: CASE STUDIES IN JAMAICA AND THE PHILIPPINES

Introduction

The case studies on the urban water sectors in Jamaica and Metro Manila, Philippines were presented by Mrs. Eleanor Jones and Dr. Aida José, respectively. Like many other parts of the world, Jamaica and the Philippines have experienced the significant pull of urban centres, and their growing urbanization has been characterized by urban sprawl and inadequate social infrastructure. Rapid industrialization and population growth in urban centres have out-paced the ability of authorities to plan for and provide the necessary amenities, particularly water. This situation will only be exacerbated by the expected changes in future rainfall and temperature patterns, as well as the potential of climate variability and change to affect the occurrence of flooding, droughts, and the frequency and severity of tropical cyclonic systems, including hurricanes and tropical storms.

Vulnerabilities in the Urban Water Supply in Jamaica

The urbanization of Jamaica is dominated by the greater Kingston Metropolitan Region with an estimated population of more than one million people. Montego Bay, with a population of approximately 100,000, is regarded as the “second city.” A review of drought conditions over a 100-year period (1887 – 1987) illustrates the weather patterns experienced by Jamaica where flood-producing conditions alternate with extended dry periods and water shortages in many parts of the island.

In light of the projected changes in rainfall regimes, increased evaporation due to higher temperatures and higher sea levels anticipated to accompany climate change, it has been suggested that water managers in the Caribbean should adopt a risk management approach in the design and operation of water facilities and in their policies. The potential impacts on water systems include increasing variability of rainfall patterns; more intense, short- duration rainfall leading to flash floods; greater flooding from more intense hurricanes; increased contamination of water sources from flash flood wash; and lower minimum flows and groundwater levels due to generally reduced rainfall in certain areas. These reduced levels will induce higher concentrations of contaminants, as dilution effects will be reduced.

Vulnerabilities of the Angat Multipurpose Reservoir to Climate Variability and Change in the Philippines

Metro Manila, located on the west coast of the main island of Luzon, is inhabited by more than 9.9 million people. Rapid industrialization and population growth in urban centers have put pressure on basic services, particularly the water supply. The observed increase in the recurrence of extreme weather events in the last few decades has added more strain to this climate-dependent sector. About 97% of the fresh water in the National Capital Region comes from the Angat Dam while the remaining 3% is derived from ground water sources.

With the growing population, available supply from the central distribution system is currently below the total demand of the service area.

The Angat dam is highly sensitive to climate variability as has been demonstrated in previous occurrences of severe weather events. A 1993 study evaluating the vulnerability of the Angat multipurpose reservoir to climate variability and change revealed generally increasing trends of annual temperatures. Rainfall trends in western Luzon are mainly increasing, while water inflows in some major multipurpose reservoirs in Luzon (including that of Angat) indicate decreasing trends. Decrease of water inflow is found to be prominent during El Niño Southern Oscillation (ENSO) events. Nearly all of the negative anomalies (lower than normal inflow) are associated with the El Niño events, while some years with positive anomalies (higher than normal inflow) occurred during La Niña conditions.

In the study of Angat's vulnerability to climate change, projections of water demand were made to assess the capacity of the reservoir to meet future demands. These projections were made up to the year 2050. Future requirements for commercial and domestic purposes show remarkable increases. Domestic requirements are expected to double in 2050 in anticipation of an increase in urban population and changes in lifestyle as the middle class grows. Commercial requirements are projected to increase more than six-fold and industrial demand almost double. Demand for irrigation is projected to remain the same.

Analysis shows that inflow is highly susceptible to changes overall and in the variability of rainfall and temperature. It was concluded that this would continue in the future, and that the reservoir (which is already exposed to extreme rainfall variability and its adverse consequences) will face more threats from increased climatic variability.

4.1 Current National Coping Mechanisms

Documentation of Jamaica's experience with extreme climatic events reveals a pattern of floods, droughts and hardship for road and water supply infrastructure, agriculture and food supply, and community resilience. Response and reaction are the principal coping modes as relatively little has traditionally been done to prevent losses. Existing coping mechanisms in Jamaica are outlined in Table 3.

In the Philippines, cognizant of the disastrous impacts of severe weather events associated with El Niño/La Niña to the operation and management of the Angat reservoir, short- and long-term coping strategies have been identified and are being carried out by the Metropolitan Waterworks and Sewerage System, the National Irrigation Administration, and the National Power Corporation to deal with both significant increases and decreases in the reservoir's monthly inflow. Table 4 outlines the current coping strategies of these Philippine agencies.

Table 3: Current Coping Mechanisms in Jamaica

Local coping strategies	
Rudimentary early warning systems	Established in some flood-prone areas where rising water levels are demarcated and the achievement of a predetermined level is used as a warning for evacuation of an area.
Water catchments	Built in rural communities where areas of slope are paved to induce runoff into a cistern, which serves as storage for a farm or even a community.
Collection drums	Used for rainwater storage and serve as limited supply sources; serve as back up when the public supply fails, or when storms or drought cause water lock-offs and loss of infrastructure.
Relocation	Not a preferred option, as most residents of hazard-prone areas prefer to return after floodwaters have receded and resume cropping when water returns after a drought.
Availability and use of forecast information	
Doplar Radar	Installed by the Meteorological Office of Jamaica in 1999, it enables a more targeted real-time forecast as imagery reveals the location and intensity of rainfall and assists in tracking showers. It has improved hurricane forecasting as tracking is enhanced when the hurricane system enters the radar range.
Satellite telecommunications	The link was upgraded in 1995 and the receiving equipment enables a faster communication link with the Global Area Forecast Centre.
Existing policies, programmes and initiatives for managing climate risk	
Office of Disaster Preparedness and Emergency Management	Vulnerability Reduction project in the Rio Grande Valley of Portland, Jamaica.
National Water Commission	Budgetary allocations for repairs, but transaction costs for mitigation measures currently exceed the financial capability of the Commission in some instances. Development of hazard information and incorporation into development planning and decision-making as another initiative for managing climate risk. Improved efficiency of water use in the public system. Water supply upgrading programmes are being implemented in the urban and rural sectors.
Ministry of Land and Environment	Watershed Management Council; Watershed Protection Act is administered by the National Environment and Planning Agency.
Economic diversification and sustainable development	
Planning Institute of Jamaica	A Sustainable Development Unit has been established in the Planning Institute of Jamaica. The National Disaster Mitigation plan is integral to planning and policy programmes.
Capacity building initiatives	
National and local institutions	The initiatives are for institutional systems, human resources and tertiary programmes. Enhancement of preparedness, response and mitigation capacity has been recognized as essential to minimizing human suffering, social and economic dislocation and repeated losses.

Table 4: Current Coping Strategies of Agencies in the Philippines

Metropolitan Waterworks and Sewerage System	
Short-term Coping Strategies	<ul style="list-style-type: none"> • Intensive public information campaign on water conservation; • Water rationing through water tankers to areas that have been affected due to low water pressure and intermittent to no water supply; • Installation of static tanks in strategic locations for water storage; • Rotation basis of water supply distribution and effectiveness; • Increased supply of water; • Reduction of water waste and losses; • Establishment of water patrols to closely monitor any unauthorized manipulation of water facilities and distribution lines, such as drawing water from fire hydrants and illegal connections; • Water conservation through people's participation in reporting leaks, illegal connections and voluntary consumers' reduction of water consumption.
Long-term Coping Strategies	<ul style="list-style-type: none"> • Tapping of new water sources; • Expansion of water supply facilities; • Augmentation or expansion of distribution system; • Optimisation of existing water supply system; • Reduction of non-revenue water.
National Irrigation Administration	
Short-term Coping Strategies	<ul style="list-style-type: none"> • Reduction of programmed area of irrigation; • Adjusting cropping calendar and farming activities; • Farmers are encouraged to plant crops that need less irrigation than rice; • Rotational scheme of irrigation and water distribution; • Improvement of irrigation systems to minimize water losses; • Water conservation through reducing conveyance, delivery and on-farm water waste; • Training of farmers and staff in improved irrigation practices; • Optimum utilization of rainfall and interim flows; • Conjunctive use of shallow wells; • Construction of small farm reservoirs; • Installation of facilities for re-use of drainage water.
Long-term Coping Strategies	<ul style="list-style-type: none"> • Construction of water-impounding dams in drought-prone areas to store excess river flows during the rainy season; • Construction of the Bayabas dam to utilize the Bayabas creek; • Reforestation of open grasslands to improve vegetative cover of watersheds.
National Power Corporation	
Short-term Coping Strategies	<ul style="list-style-type: none"> • Promotion of energy conservation; • Increased power generation contributions from non-hydropower plants; • Curtailment of power supply to customers during electricity supply deficiency; • Deferment of hydropower plant maintenance work to compensate for the decrease in hydro-electric capacity; • For reservoirs with low water, planting of fast-growing grass along the sides of the watershed to prevent erosion during heavy downpours; • Modification of the reservoir rule curve to consider irrigation and water supply reductions.
Long-term Coping Strategies	<ul style="list-style-type: none"> • Construction of additional non-hydropower plants, e.g., geothermal; • Utilization of new and renewable energy sources like solar, biomass, wind and tidal; • Demand-side management programmes.

4.1.1 Availability and Use of Assessment and Forecast Information

An increased awareness of the impacts of El Niño/La Niña on water supply and demand (brought about by the recurrence of these phenomena during the last two decades) have resulted in a corresponding increase in the need for reliable climate outlook information not only by policy makers but by other stakeholders as well. The need for a more efficient early warning system has been identified as a relatively inexpensive coping mechanism to mitigate extreme climate event impacts when compared to other coping strategies. As such, the National ENSO Early Warning and Monitoring System has been developed as an institutional mechanism for long-range seasonal forecasts and for assessing the potential impacts of droughts and floods.

4.1.2 Existing Policies, Programmes and Initiatives for Managing Climate Risk

In recognition of the impact of natural phenomena on the country's water resources (including the Angat Reservoir) the government has created organizations and enacted legislation to mitigate the effects of possible droughts and flooding. These include an Interagency Committee on Water Crisis Management; the First National Water Summit, 1994; the National Water Crisis Act of 1995; the Cabinet Cluster G advisory committee to the President and the Cabinet on all matters relating to water resources; the Presidential Task Force on Water Resources Development and Management; the Presidential Task Force on El Niño, 1997; the Presidential Task Force La Niña, 1998; and the El Niño National Action Team. Other existing policies and initiatives for managing climate relief include capacity building programmes and sustainable development initiatives.

4.2 Recommended Adaptation Strategies for Urban Water Supplies

4.2.1 Jamaica

Adaptation strategies may be categorized into short-, medium- and long-term approaches. These three levels of approach include the following strategies: enhancing preparedness, response and mitigation capacity; developing hazard information and its incorporation into development planning and decision-making; improving forecasting capability, vulnerability assessment and risk mapping; creative and inclusive approaches to watershed management; improving efficiency and rationalization of water use; improving and expanding water storage capacity; reducing vulnerability in the distribution network; and implementing risk reduction measures. General adaptation strategies also include developing collaborative approaches, linkages and common actions among agencies, institutions and private enterprises. Particularly important is the need to utilize mitigation measures rather than to limit actions to only response. This is especially pertinent when the cost factor is taken into account. Mitigation costs for critical facilities could amount to less than 2% of project costs, whereas replacement costs are often 100% or greater than the project cost. Mitigation measures are therefore essential.

Recommended Policy Tools

- Adopt a “no regrets approach” to management of the urban water sector, especially as regards maintenance and the locating of facilities well away from danger areas;
- Integrate the water sector into the National Hazard Mitigation Policy;
- Institute a demand management programme in urban areas;

- Revise the national watershed policy to include consideration to water supply from rivers and their drainage areas;
- Pursue watershed protection incentives for private land owners;
- Apply vulnerability and risk assessment to loss reduction in water works;
- Revise building codes as appropriate to mandate rainwater capture by private individuals and enterprises; expand storage capacity for urban centres;
- Rationalise data collection, management and accessibility for application to water resource planning;
- Institute and enforce a drainage policy for major developments and road infrastructure; reduce ‘wash-out’ of water infrastructure;
- Develop a database for recording the impacts of extreme events (necessary for mitigation planning);
- Evaluate the reasons for the failure of water systems during extreme weather events and incorporate this information into the database;
- Include water management in public education, e.g., NEPA, ODPEM, forestry.

Recommended Sectoral Plans

Each sector has its particular water needs and responsibilities and therefore a sector approach to contingency planning and risk reduction would be more effective than a “blueprint approach.” Quantification of the monetary risk would also be helpful for planning strategies. Recommendations include:

- Quantify the potential monetary loss from extreme weather events for each urban area;
- Develop contingency plans for risk reduction, taking into account the particular circumstances of each urban system;
- Replicate successful water management initiatives where possible; and
- Promote demand management and pollution prevention in the industrial sector through the Bureau of Standards programmes and by implementing Environmental Management Systems.

4.2.2 Philippines

Adaptation strategies have been identified from both the supply and demand perspectives and are outlined in Table 5.

Table 5: Recommendations for Supply and Demand Side Adaptation Options in the Philippines

Supply Options	Demand Options
Comprehensive watershed management	Enhancement of irrigation efficiency
Review and revamp water allocation systems and procedures	Introduction of low water use crops and farming policies
Market-based instruments for pollution control	Use of water pricing policies and structures
Erosion and sediment control	Improvement in monitoring and forecasting systems for floods and droughts
	Promoting awareness of climate variability and change.

4.2.3 Discussion and Recommendations

Subsequent to the sector case study presentations, the two speakers, Mrs. Eleanor Jones and Dr. Aida M. José, were joined by three other panellists: Mr. Vincent Sweeney of the Caribbean Environmental Health Institute (CEHI); Mr. Kailas Narayan of the CIMH; and Mr. Herbert Thomas of the Water Resources Authority (WRA) of Jamaica. The panel discussion was moderated by Dr. Mark Griffith of UNEP. Each of the panellists spoke of the issues briefly.

Mr. Narayan spoke of the importance of quantifying the impacts and links between climate change and disasters. Data is still being collected and collated into databases for analysis. Furthermore, public awareness is needed on water resource issues as some members of the public have the misconception that water is an infinite resource. He briefly reviewed training programmes underway to address the needs of governments.

Mr. Herbert Thomas of the WRA of Jamaica discussed water resources as they relate to adapting to climate change. He identified the following issues: monitoring and appraisal of data; demand management (which should focus on public education and awareness); flood damage reduction (which would include training users in the use of maps, and rendering the maps more user-friendly); capacity building (restructuring the WRA and related agencies to deal with flood events); and, finally, the revision of the Water Master Plan to include environmental needs. The following recommendations can be drawn from the discussion:

- There is a need for improved availability of data in the Caribbean, including enhanced forecasting capability. This includes mapping national water resources and drainage systems since resources must be quantified before they can be managed. The marked difference in data available in the two regions was pointed out, with the Philippines being far in advance of the Caribbean.
- There is also a need for an integrated management approach governing how water is used, and when and where. This is particularly important as increasing population and demands will lead to increased water users' conflicts.
- Improving of early warning systems and monitoring to ensure better responses and adaptation to climate risks is also critical.
- It is necessary to prioritise mitigation activities. Funds are often available for replacement of frequently damaged infrastructure, yet they are not available for mitigation measures, which would total approximately 2% of replacement costs. A related mitigation issue is the pricing and wastage of water. The latter includes the often high percentage of unaccounted for water.
- A systematic approach to planning and land use was identified as a strategy to effectively mitigate natural hazards. Such an approach would include developing and implementing land-use policies that would encompass climate change, pollution, disasters and all other sustainable development-related issues. Such an integrated approach would promote and support the integration of climate change and variability considerations into policies, programmes and projects and is critical to ensuring sustainable development.
- There is a need for funding agencies to include the projected implications of climate change into future interventions.
- There is a need to promote partnerships between the media and climatologists and meteorologists to enhance public education. Educational initiatives could be supported

through applied research, with the outcomes being shared between climate information users and producers. Meteorologists and climatologists must also better understand the needs of users and the necessity of developing sustainable monitoring systems in smaller islands in order to quantify resources.

- The region needs to strengthen its institutional capability, which is critical to building the capacity for change.

CONCLUSION

The International Panel on Climate Change has projected that globally averaged surface temperatures will increase between 1.4 and 5.8 degrees Celsius by 2100 relative to 1990, and climate models have predicted reduced precipitation trends for the Caribbean region. Climate change has the potential to affect flooding, droughts, and the frequency and severity of tropical cyclonic systems (including hurricanes and tropical storms) both within the Caribbean region and in Southeast Asia. In addition, both regions are expected to be affected by sea-level rise.

Hazard impacts resulting from climate variability in the Caribbean and Southeast Asia in the 1990s have exposed the vulnerability of key economic sectors: tourism, agriculture, fisheries, and water resources. These identified vulnerabilities are further exacerbated by human activities such as settlement patterns, land use, economic activities and poor management. Given the identification of the hazard impacts associated with climate change, it is critical that the broader cross-sectoral framework of disaster loss mitigation be incorporated into adaptation strategies within the Caribbean and Asian regions.

There is a need for a comprehensive integrated approach to natural hazard risk management and its integration with the climate change and disaster management agendas. Actions should be based more on hazard mitigation as opposed to the current focus on disaster response. Involvement of central and local governments, and non-governmental organizations are critical in advancing adaptation measures.

The *Seminar on Climate Change and Severe Weather Events* proved to be an innovative, interdisciplinary forum that allowed a comparative sharing of experiences and recommendations amongst professionals from the Caribbean and Southeast Asia. Case study presentations and panel discussions on the tourism, agricultural, fisheries, and water resources sectors allowed for an exposure of the vulnerability of these four sectors, a comparison of current adaptation practices and the recommendation of strategies for adaptation and mitigation.

Challenges facing the tourism sector with respect to climate variability and change are similar in the two regions. The importance of building resilience within sectors and communities through incorporating hazard mitigation measures was highlighted. Such measures may encompass conservation of energy and water resources, and determining and enforcing appropriate setbacks from high water marks. Reinforcement of these approaches through strict policy and enforcing building codes is critical to the long-term survival of the industry. Such practices may also be encouraged through creative incentive schemes and supported by public education and awareness programmes.

For the agricultural and fisheries sectors, adaptation strategies should include an understanding of vulnerability to climate variability and change. Conservation measures are needed to facilitate sustainable production. The utilization of early warning systems to communicate climate risk to relevant actors within the sector must be promoted within the agricultural sector. Issues affecting the water resources sectors in both regions have significant similarities. Projected changes in

precipitation patterns and temperature regimes pose challenges for already stretched water resources. Adaptation solutions must rely on both supply and demand side options.

Projections of the implications of climate change, combined with the anticipated future demand for water resources, suggest potential scenarios of demand exceeding supply. The suggested impacts on water systems include increasing variability of rainfall patterns; greater flooding from more intense hurricanes; increased contamination of water sources from flash flood wash; and lower minimum flows and groundwater levels due to diminished average rainfall. These impacts (from the monsoon season, floods and storms, and drought) are also affected by the El Niño Southern Oscillation (ENSO) phenomenon. It is pointed out that reducing vulnerability to near-term hazards is an effective strategy for reducing long-term climate change risk

Although differences between the two regions in terms of institutional and cultural heritages affected how each region approached the issue of risk management, there was a common recognition of the critical importance of the hazard risk and climate variability issue. The way forward for both regions must therefore be rooted in an analysis of existing capacities and approaches to managing hazard risk and adapting to climate variability.

In addressing the gaps identified in the presentations, specific regional needs related to data availability and capacity at the national and regional levels should be addressed. There is a clear need to refine tools for understanding the existing vulnerabilities to climatic hazards. A critical first step is to map existing hazards, conduct vulnerability assessments, and integrate risk assessments into development planning. It is only through a clear understanding of the risks faced by these regions that decisions may be made with respect to the levels of acceptable risk. In the case of the Caribbean, the downscaling of climate models is required with some urgency. Any approaches, in order to be successful, must also be supported by integrated public information and education programmes.

The risk management approach to determining adaptation options is appropriate for both regions. The value of local knowledge in the adaptation mix is critical and all efforts should be made to ensure their integration with scientific knowledge. Climate change is a development issue and, as such, demands the involvement and input of stakeholders at all levels—national, sectoral and project—in developing coping strategies. There is also a role to be played by the private, public and financial sectors. However, at the same time, community-based approaches and solutions must not be ignored, nor the role of traditional knowledge and solutions. Such an approach is fully evident in the comprehensive disaster management measures adopted in both regions.

Whilst initiatives should be country-driven, strategies can and should be developed at a regional level. Common challenges to common problems are best approached within a collaborative framework and through the sharing of successful experiences. Within both geographic areas therefore, the development of regional mechanisms to address climate change in collaboration with other regional actors (such as disaster management agencies) should be promoted. In the Caribbean, the Comprehensive Disaster Management plan and, in Southeast Asia, the Comprehensive Disaster Risk Management plan, promote similar approaches and goals.

APPENDIX 1 – SEMINAR OVERVIEW

The *Seminar on Climate Change and Severe Weather Events in the Caribbean and Asia* was held at the Grand Barbados Beach Resort in Barbados on July 24 - 25, 2003. During the opening ceremony, representatives of the three sponsoring agencies, Jeremy Collymore of the CDERA, Kari Keipi of the IDB and Glenn Dolcemascolo of the ADPC, gave opening remarks. A note of thanks was given by Neville Trotz of ACCC.

The Seminar comprised five plenary sessions. The first four were structured to allow the presentation of Asian and Caribbean perspectives on the key issues. Session 1 was a context-setting session and involved presentations on Climate Change Issues and Programmes, Risk Management Approaches to Climate Change, and Mainstreaming Climate Variability and Change and Disaster Management. Presentations were made by Neville Trotz and Glenn Dolcemascolo, who gave the perspectives on the Caribbean and Southeast Asia, respectively. The final component was presented by Liz Riley of CDERA. Each of the segments was followed by a discussion session.

Session 2 dealt with the specific vulnerabilities of, and adaptation options for, the tourism sector. Case studies on the Bahamas and Thailand were presented by Ivor Jackson and Vivian Raksakulthai, respectively. The presentations were followed by a panel discussion on the tourism sector, moderated by Eleanor Jones. The following persons joined the presenters to form the panel: Earlston McPhee of the Ministry of Tourism, Bahamas, and Paitoon Kengkarnchang of the Phuket Irrigation Project, Thailand.

Session 3 addressed the Agriculture and Fisheries sectors. Glen Dolcemascolo presented the case study on the agricultural sector of East Timor and Vincent Gillett made the presentation on the fisheries sector of Belize. The presenters were then joined by the following persons and together formed the panel for the group discussion: Lystra Fletcher-Paul of the FAO; Charles McDavid of the Faculty of Agriculture, UWI; Terrence Phillips of CRFM; James Azueta of the Fisheries Division of Belize; Marcia Creary of the ACCC; and Cesaltino Nasario dos Reis de Carvalho of the Ministry of Planning and Finance, East Timor. This panel discussion was followed by a wrap-up of the day's proceedings.

Sessions 4 and 5 took place on Day 2. The fourth session dealt with water resources in urban areas. Eleanor Jones presented a case study of Jamaica while Aida M. Jose presented a case study from the Philippines. After the presentations the panel discussion took place. The panellists who joined the presenters were Vincent Sweeney of CEHI, Kailas Narayan of CIMH and Herbert Thomas of WRA. After the break the fifth and final plenary session was convened. It comprised the presentation of the rapporteur's reports on the case study sessions and the wrap-up and closing remarks by the three sponsoring agencies. Closing remarks were delivered by representatives of CDERA, ADPC and the IDB.

APPENDIX 2 – ABOUT THE PRESENTERS

Ivor Jackson

Ivor Jackson, a landscape architect/planner, is head of Ivor Jackson & Associates (IJA) a small firm providing environmental and tourism consulting services to governments, international and regional organizations and developers in the Caribbean. Environmental impact assessments (EIAs) and environmental audits for tourism projects are two of the services IJA provides. In addition, IJA does conceptual planning and land design schemes for new tourism projects. Ivor Jackson is also a sailor who conducts studies and provides advice to the yachting sector and is part owner of a marina. He is also owner of a mini-hotel, Country Inn Cottages, which is a member of Very Intimate Places (VIP) of Antigua/Barbuda.

Vincent Gillett

Vincent Gillett holds a Bachelor of Science and a Master of Philosophy degree in Marine Science and was a Ph.D. candidate at the University of British Columbia in the area of Marine Resource Management and Environmental Studies from 1995 to 1999. He has worked with the Belize Fisheries Department as Chief Fisheries Officer (Fisheries Administrator) and as the Chief Executive Officer of the Coastal Zone Management Authority and Institute. Mr. Gillett currently works with the Belize Fishermen Cooperative Association and also teaches part time at the University of Belize. Most of his professional life's work has been in the area of fisheries and environmental management.

Eleanor Jones

Eleanor Jones is an environmental management and project development specialist who has been intimately involved with disaster management for over twenty years as a researcher, adviser, teacher/trainer, community relations advocate/lobbyist, and consultant. A highly skilled communicator for whom environmental perception and strategy are key ingredients for effecting change, her approach to disaster management is based on a sound knowledge of the integrated nature of natural, social and economic systems. Ms. Jones is a founding partner and consulting principal of Environmental Solutions Ltd., an environmental management and engineering firm registered in Jamaica, West Indies.

Glenn Dolcemascolo

Glenn Dolcemascolo is a technical advisor to the Asian Disaster Preparedness Center in Bangkok with special focus on climate risk, institutional analysis and linking science and policy. In his spare time, he is finishing his PhD in Ecological Anthropology at the University of Hawaii. His dissertation is based on field research in Indonesia where he studied grassroots, national and international approaches to managing forest fires. Prior to joining the ADPC, he worked at the East West Center in Honolulu on issues of climate change, land use/land cover change and community-based resource management.

Vivian Raksakulthai

Vivian Raksakulthai is a technical advisor at the Asian Disaster Preparedness Center with the Climate Risk Management Division. She has worked in several countries in South and Southeast Asia, looking at climate change, disasters, and development. Before joining the ADPC, she worked with the UN Institute for Training and Research on capacity-building programmes for climate issues. She has degrees in economics and environmental management.

APPENDIX 3 – SEMINAR PARTICIPANTS

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Grand Barbados Beach Resort, Barbados
July 24 - 25, 2003

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