



## MEDIUM-SIZED PROJECT PROPOSAL FOR GEF FUNDING

**AGENCY'S PROJECT ID:** 2033

**GEFSEC PROJECT ID:** 2092

**COUNTRIES:**

*AFRICA: Cameroon, Tanzania.*

*ASIA/PACIFIC: Fiji, India.*

**PROJECT TITLE:** *Coastal Resilience to Climate Change: Developing a Generalizable Method for Assessing Vulnerability and Adaptation of Mangroves and Associated Ecosystems*

**GEF AGENCY:** *UNEP.*

**OTHER EXECUTING AGENCY(IES):** *World Wildlife Fund-US, WWF Tanzania Programme Office (TPO), WWF-East Africa Regional Program Office (EARPO), EAME National Committee for Tanzania, WWF Cameroon, WWF Fiji, WWF South Pacific, WWF India*

**DURATION:** *3 years.*

**GEF FOCAL AREA:** *Biodiversity.*

**GEF OPERATIONAL PROGRAM:** *OP 2, Coastal, Marine, and Freshwater Ecosystems.*

**GEF STRATEGIC PRIORITY:** *SP4 with relevance to SP1 and SP2*

**IMPLEMENTING AGENCY FEE:** *\$90,000*

**ESTIMATED STARTING DATE:** *May 1, 2005*

<b>FINANCING PLAN (US\$)</b>	
<b>GEF PROJECT/COMPONENT</b>	
Project	\$975,000
PDF A*	\$25,000
<b>SUB-TOTAL GEF</b>	<b>\$1,000,000</b>
<b>CO-FINANCING</b>	
GEF Agency	
National Contribution	
<b>WWF</b>	<b>\$775,000</b>
<b>Wildlife Conservation Society</b>	<b>\$225,000</b>
<b>Sub-Total Co-financing:</b>	<b>\$1,000,000</b>
<b>Total Project Financing:</b>	<b>\$2,000,000</b>
*PDF-A Approved October 16, 2003	

**CONTRIBUTION TO KEY INDICATORS OF THE BUSINESS PLAN:** The project belongs to the Biodiversity Focal Area and within the four strategic priorities of this focal area it is relevant to: SP4 Generation and Dissemination of Best Practices; SP1 Catalyzing sustainability of Protected Areas; and SP2 Mainstreaming Biodiversity in Production Landscapes and Sectors. The project will directly contribute to the following key indicators:

- By the end of the first year, vulnerability assessments will have been completed for all project sites (470,000 hectares);
- Initial tests of generalizability of guidelines will take place throughout the WWF network at least 2 additional sites totaling 50,000 hectares;
- At least 4 demonstration sites (1 for each country) will have demonstrated adaptation plans and pilots which sites incorporate biodiversity concerns;
- Resulting adaptation guidelines will be presented at 3 national and international meetings;
- Project methodology uptake by WWF network and others, including UN; and
- 100 people show improved livelihoods based on more sustainable harvesting.

**RECORD OF ENDORSEMENT ON BEHALF OF THE GOVERNMENT:**

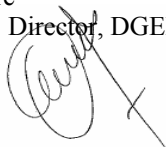
*Epeli Nasome, Director, Department of Environment, Fiji*  
*Justin Nantchou Ngoko, Ministry of Environment and Forestry, Cameroon*  
*R.O.S. Mollel, Permanent Secretary, Vice President's Office, Tanzania*  
*Sudhir Mital, Joint Secretary, Ministry of Environment and Forests, India*

May 7, 2003  
September 26, 2003  
April 8, 2003

**This proposal has been prepared in accordance with GEF policies and procedures and meets the standards of the GEF Project Review Criteria for a Medium-sized Project.**

Name & Signature

Ahmed Djoghlaif, Director, DGEF, UNEP GEF  
IA Coordinator



Project Contact Person:

IA: Kristin McLaughlin, UNEP/DGEF  
202-974-1312, km@rona.unep.org;

EA: Jennifer Biringer, WWF-US  
202-778-9634,  
jennifer.biringer@wwfus.org

Date: August 8, 2005

# COASTAL RESILIENCE TO CLIMATE CHANGE: DEVELOPING A GENERALIZABLE METHOD FOR ASSESSING VULNERABILITY AND ADAPTATION OF MANGROVES AND ASSOCIATED ECOSYSTEMS

## TABLE OF CONTENTS

PART I – PROJECT DESCRIPTION .....	2
A – SUMMARY .....	2
B – COUNTRY OWNERSHIP .....	6
1. COUNTRY ELIGIBILITY .....	6
2. COUNTRY DRIVENNESS .....	6
C – PROGRAM AND POLICY CONFORMITY .....	8
1. PROGRAM DESIGNATION AND CONFORMITY .....	8
2. PROJECT DESIGN .....	9
STRATEGY .....	14
RATIONALE AND OBJECTIVES .....	16
RATIONALE .....	16
Vulnerability Assessment .....	16
Adaptation Framework, Strategy Development and Pilot Actions .....	17
Site selection .....	18
OBJECTIVES .....	21
OUTCOMES AND INDICATIVE ACTIVITIES .....	22
3. SUSTAINABILITY (INCLUDING FINANCIAL SUSTAINABILITY) .....	29
4. REPLICABILITY .....	32
5. STAKEHOLDER INVOLVEMENT .....	32
6. MONITORING AND EVALUATION .....	33
D – FINANCIAL MODALITY AND COST EFFECTIVENESS .....	36
1. FINANCING PLAN .....	36
2. COST EFFECTIVENESS .....	38
E – INSTITUTIONAL COORDINATION AND SUPPORT .....	38
1. CORE COMMITMENTS AND LINKAGES .....	38
2. CONSULTATION, COORDINATION, AND COLLABORATION BETWEEN AND AMONG IAS, EXAS, AND GEFSEC .....	39
ANNEX A – LOGFRAME .....	41

## LIST OF ABBREVIATIONS

AusAID	Australian Agency for International Development
CBD	Convention on Biological Diversity
COP	Conference of Parties
CORDIO	Coral Reef Degradation in the Indian Ocean
COREMAP	Coral Reef Rehabilitation and Management Project
CPACC	Caribbean: Planning for Adaptation to Global Climate Change)
EAME	East Africa Marine Ecoregion
ExA	Executing Agency
FLMMA	Fiji Locally-Managed Marine Area
FAO	Food and Agriculture Organization of the United Nations
GCRMN	Global Coral Reef Monitoring Network
GEF	Global Environment Facility
GEFSEC	GEF Secretariat
IA	Implementing Agency
ICRI	International Coral Reef Initiative
IPCC	Intergovernmental Panel on Climate Change
IPCC TAR	Intergovernmental Panel on Climate Change Third Assessment Report
IOC	Intergovernmental Oceanographic Commission of UNEXCO
NBSAP	National Biodiversity Strategies and Action Plan
NGO	Nongovernmental Organization
OP 2	GEF Operational Program #2, Coastal, Marine, and Freshwater Ecosystems
PDF A	Project Development Facility Block A
STAP	Scientific and Technical Advisory Panel
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
USP	University of the South Pacific
US	United States
WB	World Bank
WWF	World Wildlife Fund
WWF-US	WWF Headquarters in Washington, DC

# **COASTAL RESILIENCE TO CLIMATE CHANGE: DEVELOPING A GENERALIZABLE METHOD FOR ASSESSING VULNERABILITY AND ADAPTATION OF MANGROVES AND ASSOCIATED ECOSYSTEMS**

## **PART I – PROJECT DESCRIPTION**

### **A – SUMMARY**

#### **OVERVIEW**

The primary objective of this proposal is to build and strengthen the capacity of conservation practitioners to promote effective vulnerability assessment and climate change adaptation projects and policies. The project will leverage focused activities within four target countries to develop a generalizable methodology for vulnerability assessment and climate change adaptation in mangrove and associated coral reef, seagrass and upland ecosystems. The involvement of multiple stakeholder groups in each of four countries throughout the planning and execution stages of the project will ensure national and local capacity-building in target countries, as well as on-the-ground projects demonstrating practical approaches to vulnerability assessment and adaptation. The ecological effectiveness of adaptation measures will be addressed by targeted research addressing factors influencing the resistance and resilience of the ecosystems in question.

The project is consistent with several GEF Biodiversity strategic priorities, including priority IV (“Generation and Dissemination of Best Practices for Addressing Current and Emerging Biodiversity Issues”), Priority I (“Catalyzing Sustainability of Protected Areas”), and Priority II (“Mainstreaming Biodiversity in Production Landscapes and Sectors”). This project will also serve as a model for GEF’s new goal of incorporating climate change adaptation into all OPs.

#### **RATIONALE**

##### ***1. Need for a Generalizable Method***

Low-lying coastal areas, particularly those in tropical Africa, Southeast Asia and the South Pacific, are predicted to experience among the most dire consequences of global climate change (IPCC WGII TAR 2001). Despite the serious consequences of climate change impacts to these ecosystems, it is obvious that there is no mechanism by which the direct atmospheric effects (altered temperature regimes, precipitation patterns, extreme weather events, etc.) of climate change can be ameliorated in the short term. The current state of the science indicates that these changes are already occurring, are impacting ecosystems, will have profoundly more adverse impacts on ecosystems, and will continue to occur even after atmospheric CO<sub>2</sub> emissions are decreased during the long period of time to stabilization. Conservation of ecosystems and biological resources requires that we develop adaptive resource management strategies or accept that many natural systems may be lost to climate change.

There has been little development of methodologies for vulnerability assessments and strategies that are specifically useful across ecosystem type, or even between sites with common habitat type. Rather, most vulnerability assessments have focused on particular sectors or individual ecosystem types. In order for methodologies to be employable by resource managers and economically feasible, such a methodology needs to be advanced. By examining similar systems

in multiple locations, the project aims to assist in the development of a generalizable method and replicable results between sites in mangrove, seagrass, and coral reef ecosystems.

This will also allow for development of regional scale planning, as well as to potentially promote ideas such as protected area networks and linkages between threatened systems (mangroves to seagrasses, coral reefs and upland areas). As a result, this project will show policies and plans that are required for countries to adapt to climate change.

In terms of linkages to ongoing GEF projects, the purpose of the coral bleaching module of the World Bank/GEF CRTRP is to develop targeted research on knowledge gaps related to mass coral bleaching processes and building local capacity. While the proposed project also aims to build local capacity, the main goal is quite different. This project focuses on increasing the health of mangroves as a potential adaptation strategy to increase coastal resilience to climate change, including seagrasses and near-shore coral reefs. These projects are complimentary, not duplicative; one on assessment, the other a test of possible response strategies.

## ***2. The Importance of Mangroves and the Concomitant Benefits for Coral Reefs***

Mangrove ecosystems are some of the most damaged and degraded of all natural systems, yet they are crucial for not only their own inherent composition, but for the support they provide for the biodiversity of other ecosystems as well. For example, they act as nurseries for many fish and invertebrate species that later live on coral reefs and in the pelagic zone, and they control aspects of water chemistry in estuaries and coastal zones. Mangroves live in estuaries at the interface of marine, terrestrial, and freshwater ecosystems, acting as a buffer between systems. Because of their unique habitat, they act as indicators of the health of each system and of their interconnections.

While the condition of mangal biodiversity is already dire, climate change is anticipated to make conditions worse still, adding a level of urgency to the need to take action to better protect these ecosystems. Mangrove communities are spread across the world's tropical coastline, generally in areas with limited funds for conservation or research and little technical capacity for assessing biodiversity threats and developing conservation strategies. These conditions make it very unlikely that mangrove systems globally will get the attention that is required to protect them. In an effort to meet the urgent conservation needs of mangal biodiversity under the added threat of climate change, given the dramatic lack of time, funds and capacity, the project proposes a generalizable approach to allow for the transfer of lessons learned from four tactically selected sites of high biodiversity importance to aid in the development of other studies and conservation efforts beyond these initial sites.

The interplay of ecological services between mangroves and coral reefs makes the pairing of adaptation strategies for both ecosystems concurrently a wise approach. Coral reefs are threatened by increasing sea surface temperature due to global climate change. Mangroves are believed to be a source of dissolved organic matter that acts to protect coral reefs from ultraviolet radiation by absorbing it in the water column (Mazda et al. 1990). Mangroves may provide protection to coral reefs from the bleaching, which results from exposure to increased water temperature and increased ultraviolet radiation penetration.

## ***3. Project Sites***

To achieve the goal of developing generalizable methods for adaptation of mangrove-coral reef systems around the world, the project proponents have selected four globally significant regions for development and testing of these ideas: Central Africa, East Africa, South Asia, and the South Pacific.

Four countries from Africa and the Asia/Pacific region will participate: Cameroon, Fiji, India, and Tanzania. In each country the proponents will work with diverse groups of government, academic, non-profit, and community representatives. Workshops have been held in three of the four countries, and have involved stakeholder groups in the design of this project.

Countries within each region were selected based on the presence of mangrove forests with globally significant biodiversity as reflected in WWF's Global 200 ecoregions list, by their level of vulnerability to climate change, the degree of national interest, and by the presence of WWF offices to coordinate the initiative. Criteria for site selection within each country were developed during a consultative process during the PDF A phase with all stakeholders involved, and included criteria such as: the condition of the mangroves, proximity to near-shore coral reefs, predicted resilience (level of vulnerability) and resistance (degree of adaptability) to climate change, similar areas nearby for control purposes, and ability to build upon ongoing work of WWF and other organizations within the landscape. In all project sites, coastal communities still rely heavily on mangroves for fuel, food, timber, and other services.

### **Rio del Rey Estuary, Cameroon**

The Gulf of Guinea contains Africa's most extensive mangroves, which help to stabilize a large part of the West African shoreline. The area is currently under high stress from urbanization, industrialization, and agriculture, as well as experiencing impacts from timber and petroleum exploitation around the Gulf coast. The project will focus the bulk of activities within the vicinity of the proposed Ndongore National Park in the Rio del Rey estuary, where the heart of Cameroon's mangroves are found.

### **Mafia Island and Kilwa District, Tanzania**

The East African Mangroves are considered among the most threatened habitats in the world, with charcoal and timber industries, urban growth pressures, and mounting pollution problems confounding climate change impacts (WWF 2001). Intensive shrimp farming and abundant coral reefs in the area present an opportunity to integrate marine and terrestrial assessments and resource management adaptation strategies. Project activities will take place on Mafia Island, and in Kilwa District along the coast.

### **Sundarbans Delta, India**

The Sundarbans Biosphere Reserve is the world's largest mangrove ecosystem. Sea level in the Sundarbans has risen at an average rate of 3.14 cm a year over the past two decades, much higher than the global average of 2 mm a year. In the past two decades, four islands have sunk into the sea and 6,000 families have been made homeless. In addition, giant tidal waves from the earthquake-induced tsunami in the Indian Ocean in December 2004, took the lives of at least 15,000 people in India and have affected the livelihoods of at least 300,000 families in coastal areas. The damage is greatest in the Andaman & Nicobar Islands and Tamilnadu, however Kerala, Pondicherry and Andhra Pradesh have also been affected. The effects of the tsunami in from resettlement as well as added pressure on the natural resources will mean an even greater reliance on natural resources in the Sundarbans region. Currently more than 4 million people inhabit the Indian Sundarbans and the community is fully dependent on natural resources. Due to the expansion of agriculture and the construction of irrigation canals, the mangrove forests in the area have been felled indiscriminately and they are degrading fast. Mangroves in the region are the most damaged and degraded of all natural systems, yet they are crucial for the ecological integrity and services of the region. Indeed, past studies have shown that mangroves provide a critical buffer against tidal waves and sea-level rise, and this has been confirmed by WWF staff in

India who note that coastal areas affected by the recent tsunami were less affected when they had intact mangroves along their shores. For this project, two island villages, Bali and Choto Mollakhali, have been identified for conservation action in the proposed project.

## **Fiji**

Fiji has the third largest mangrove area in the Pacific Island region. Climatic variation across the larger islands in Fiji influences mangrove distribution and ecology, and different locations are expected to experience distinct effects of climate change. There will also be differences in the rate of sea level rise within Fiji, as certain areas are experiencing tectonic uplift or subsidence, while others are tectonically stable. Project activities will take place across sites in five areas, including Verata, Votua, Viti Levu, Vanua Levu, and Yaqara.

## **OBJECTIVES**

The project goal is to ensure the long-term integrity of globally significant ecosystems by increasing resistance and resilience to climate change. Within this goal, the objective is to build and strengthen the capacity of conservation practitioners to promote effective vulnerability assessment and climate change adaptation projects and policies. A key activity to achieve this objective is the creation of a generalizable method and process to develop an effective adaptation strategy that could be applied in different sites within common ecosystems. The project will focus its activities on a single ecosystem type: mangroves and their associated systems, including near shore coral reefs in two project countries. The effectiveness of this approach and adaptation strategies for the ecosystems and communities involved will be tested via pilot initiatives in each of four project countries.

The project proponents hope to assist in overcoming the barriers to biodiversity adaptation as defined at the STAP Expert Workshop on Adaptation and Vulnerability held in February of 2002. These included separation of biodiversity and sustainable development issues, and little political commitment to implement policies or plans that benefit biodiversity.

The project will address three hypotheses:

- 1) Mangrove areas that are protected or restored will show greater resistance/resilience to global climate change relative to sites that are degraded;
- 2) Inshore reefs and seagrasses associated with protected/restored/intact mangroves in Fiji and Tanzania will show greater resistance/resilience to global climate change relative to reefs associated with degraded mangroves;
- 3) There are sufficient commonalities in assessing climate change vulnerability and the design of adaptation strategies in mangrove and coral reef ecosystems around world to enable the creation of a generalizable methodology for increasing system resistance and resilience.

Addressing these hypotheses will facilitate the development of accurate vulnerability assessments and effective adaptation strategies not just within this project, but globally as well.



## OUTCOMES

### The project has four expected outcomes:

- 1) Enhanced capacity in participating countries to perform effective climate change vulnerability assessments.
- 2) Improved policy and adaptation measures developed and implemented in the targeted ecosystem in the participating countries (reflecting the interests and needs of a wide range of stakeholders at the national, regional, and international levels).
- 3) Effective vulnerability assessment and adaptation planning method and process are replicated and used in other countries and in differing ecosystems.
- 4) Strengthened opportunities for knowledge sharing and activities related to climate change adaptation at the national, regional, and international levels.

Although the project will focus on climate change adaptation geared towards protecting biodiversity and functional ecosystems, the proponents anticipate that these adaptation strategies may be applied to other focal areas as well, such as international waters and forest ecosystems.

## B – COUNTRY OWNERSHIP

### 1. COUNTRY ELIGIBILITY

Four countries will participate in this project, two from Africa and two from the Asia/South Pacific region. Participating countries from Africa are Cameroon and Tanzania; participating countries from the Asia/Pacific region are Fiji and India.

Table 1. *Participating countries and dates of ratification of relevant conventions.*

Country	Convention	
	CBD	UNFCCC
Cameroon	1994	1994
Fiji	1993	1993
India	1994	1993
Tanzania	1996	1996

As indicated in Table 1, all participating countries are parties to two relevant conventions: the Convention on Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC).

### 2. COUNTRY DRIVENNESS

The project concept and brief were developed in coordination with the participating countries. Additionally, each participating country has provided a letter of endorsement for the project; a copy for India is attached, and letters of endorsement from Cameroon, Fiji, and Tanzania were attached to the PDF-A. At stakeholder workshops held recently in three of the four countries, the countries expressed ongoing excitement about this project.

Countries participating in this project are particularly vulnerable to the effects of climate change not only due to physical and geographic characteristics, but also due to lack of institutional capacity. Yet these countries also typically possess rich biological diversity and other ecological resources of national, regional, and global value.

**Fiji**, through its partnership with the South Pacific Regional Environmental Program's Pacific Island Climate Change Assistance Programme (PICCAP), is still in the process of creating its first national communication to the UNFCCC. However, the group has noted a clear priority in the area of marine and coastal resources, as indicated by the most recent national report to the UNCBD. Fiji's commitment to ensuring environmental sustainability is also reflected in the Fiji

National Assessment Report to the World Summit on Sustainable Development (2002), and in the most recent Fiji Strategic Development Plan 2003-2005.

WWF is already addressing the myriad threats in Fiji through participation in the Locally Managed Marine Areas Network and the South Pacific Regional Environmental Programme. This includes addressing issues of coastal development, overfishing and pollution. It is the aim of this project to develop new tools for even better environmental projects in the region well into the future as the changing climate becomes a growing challenge.

**Tanzania** prioritizes within its NBSAP catchment forests, wetlands, coral reefs and protected areas as among the five most ecologically sensitive areas that are in need of proper management and protection. The conservation of mangroves are noted for their close relationship with human communities, and also "the interdependence of the mangrove ecosystem on both inland and marine environments, and the value of clearly defined mangrove management zones with different uses and management strategies" (United Republic of Tanzania National Report to CBD 2001, p. 24). Tanzania, as a LDC will be formulating its generalized adaptation priorities and programmes under its National Adaptation Plan of Action funded through the LDC fund and implemented by UNEP. As specific to mangrove and coral ecosystems, this project will build on that ongoing process.

**Cameroon** notes in its NBSAP to the CBD the large-scale degradation and consequent vulnerability of its mangroves due to the majority of the population and petroleum industries resident along its coasts. The promotion of activities and policies to reduce the vulnerability of marine and coastal biodiversity is stated as a "very high priority".

**India** listed Natural Aquatic Ecosystems as one of 13 national thematic plans in preparing its draft NBSAP, and emphasizes the importance of "short- and long-term measures needed for conservation and sustainable use... including integration of people's livelihoods and conservation...and integrated management with surrounding land-uses." The draft NBSAP recognizes climate change as a proximate cause of biodiversity loss, and includes proactive work on climate change in its action plans. India's first report to the UNFCCC lists vulnerability assessment and adaptation strategies as one of four key project components.

Furthermore, the project contributes to the national priorities of the government and civil society groups of the identified countries, and will help to implement their responsibility under the United Nations Framework Convention on Climate Change (UNFCCC) and Convention on Biological Diversity (CBD). The vulnerability assessment and the adaptation strategy that will be initiated under the proposed project will build upon ongoing initiatives and provide a useful model for the development of the National Adaptation Plan of Action to effectively cope with climate related stresses on ecosystem functions.

**Fiji and Tanzania** are participants in the Assessments of Impacts and Adaptations to Climate Change in Multiple Regions and Sectors (AIACC) currently being implemented by UNEP. The results of these regional projects – including to build and enhance scientific and technical capacity and generate and communicate information regarding the impacts of climate change and possible adaptation options – will greatly benefit the proposed objective and the proponents will seek to synergize the workplan with these ongoing projects. In particular, the results, methodologies, and tools developed in this project can be integrated directly into the outputs of the AIACC project, including into curriculum of courses on vulnerability and adaptation, and also into the national communications and national assessments.

Responding to the needs of the countries, this project will identify a generalizable method and replicable model to develop specific adaptation strategies to effectively protect biological resources in different ecosystems and regions.

## **C – PROGRAM AND POLICY CONFORMITY**

### **1. PROGRAM DESIGNATION AND CONFORMITY**

GEF OP2's objective is "the conservation and sustainable use of the biological resources in coastal, marine, and freshwater ecosystems." Because climate change is having and will continue to have significant effects on these ecosystems, incorporating adaptation strategies into conservation planning is essential for long-term success. Similarly, sustainable use of biological resources requires understanding how those resources will be affected by climate change, and developing adaptation strategies for continued resource availability in a changing world. As noted in OP2 program objectives, sustainability also necessitates a combined focus on biodiversity conservation, production, and socio-economic goals. The project recognized this by specifically addressing the livelihood security of human communities in the project objectives.

OP2 also raises explicit concerns about the needs of tropical island ecosystems. The inclusion of Fiji as one of the four countries participating in this project will ensure that project results will be specifically transferable to tropical island states.

This project responds to the various decisions of the COP of the CBD that specifically call for support to developing countries in their efforts to build capacity to address global biodiversity issues and challenges. Because multiple stakeholders will be (and have already been) involved in all stages of planning and implementation of this project, it will also speak to GEF's strengthened focus on capacity building.

The project is consistent with recent Council Paper GEF/C.21/Inf.11 Strategic Business Planning: Direction and Targets, which states "support demonstration projects that generate synergies between biodiversity, climate change...Two issues will be of particular interest (i) vulnerability and adaptation of global change, and (ii) demonstration of ecosystem approaches." Project design specifically includes biodiversity, climate change, adaptation, and ecosystem approaches.

The project also responds directly to GEF-3 Biodiversity Strategic Priority IV, "Generation and Dissemination of Best Practices for Addressing Current and Emerging Biodiversity Issues". The proposal is intended to generate best practice and to develop generalizable methods and processes to increase the resilience of mangrove/coral reef ecosystems to the impacts of climate change. The project includes activities to effectively disseminate the practice to concerned groups in order to promote its adoption and replication in other relevant countries and sites.

Developing effective adaptation strategies for mangrove ecosystems with near shore coral reefs is also responsive to emerging issues under Priority I, "Catalyzing Sustainability of Protected Areas" and Priority I, "Mainstreaming Biodiversity in Production Landscapes and Sectors". Implementation of pilot initiatives for sustainable resource use of the mangrove/coral reef ecosystems, which include adaptation considerations, will make an important contribution to the productive sectors of tourism, fisheries, and agroforestry. Advancing implementation of adaptation strategies will increase sustainability of mangrove/coral reef ecosystems under both protected and non protected status.

As previously noted, this project seeks to integrate adaptation concerns primarily in the focal areas Coastal and Forest Ecosystems (OP2 and 3 respectively). During the development phase of this project, the GEF Paper “GEF Assistance to Address Adaptation” was issued (May 2004). Taking note of the emerging guidance in May 2004, the project was specifically designed to develop a methodology for vulnerability assessment and adaptation planning that will allow regional and national groups to create practical adaptation strategies specific to their region. As noted in the May 2004 paper, lack of information and education are among the main barriers to adaptation in developing countries; by developing a user’s manual and generalizable methodology, this project will help to overcome that barrier. For the countries involved in the project, it will also help to overcome another major barrier, the lack of sufficient and reliable data. Although the methodology will be generalizable, it will address the importance of contextualizing adaptation strategies, identified as a key to success.

At the recent November 2004 GEF Council Meeting, GEF presented for Council consideration the paper “ Programming to implement the guidance for the Special Climate Change Fund adopted by the Conference of Parties to the UNFCCC at its Ninth Session.”. This paper clarifies that the Special Climate Change Fund “may be called upon to support climate change adaptation activities activities that generate benefits by alleviating barriers to development caused by the effects of climate change and which may be primarily local benefits *whereas the GEF Trust Fund may be called upon to support adaptation activities primarily linked to producing global environmental benefits through its various focal areas.* Accordingly this project is being submitted under the Biodiversity Strategy 4 with relevance primarily to OP2 and OP3.

## 2. PROJECT DESIGN

### CURRENT CONTEXT: GLOBAL BASELINE

Mangroves play an integral role in coastal ecosystems, and are of invaluable local and global ecological, economic and social importance. They live in estuarine settings, at the interface between terrestrial, freshwater and marine systems, and are extensively developed on sedimentary shorelines such as deltas, where sediment supply determines their ability to keep up with sea-level rise. They afford protection to both terrestrial and estuarine systems from dynamic marine processes, preventing erosion and chaotic mixing and providing coastal communities substantial protection from tropical cyclonic storms. They also act locally to filter water. Mangrove forests protect seagrass beds and coral reefs from deposition of suspended matter that is transported seaward by rivers, and are critical nursery grounds for many commercially or environmentally important marine species. For centuries, mangal have provided a wide range of products that people use, including (but not limited to) timber and fuelwood, finfish and edible crustaceans, and bioactive compounds for tanning and medicinal purposes (Ellison, 2000). Mangal managed for multiple uses (e.g. ecosystem services) can yield a significantly greater economic return, often an order of magnitude or more, than a similar-sized area of mangrove forestry plantation (monoculture; Ellison, 2000, and refs therein).

Globally, however, mangrove systems have been degraded and destroyed (Farnsworth and Ellison 1997); as a result, coastal communities are losing resources on which they depend. Key threats to mangroves include overharvest for timber, clearing of mangroves for agriculture and aquaculture, coastal development, and pollution, which are leading to habitat degradation and deteriorating water quality. Climate change will magnify the effects of many of these threats, and mangrove forests are predicted to be some of the first ecosystems to be strongly affected by the rise in sea level caused by climate change (Ellison and Farnsworth 1997). Loss of these buffering

systems due to climate change and other causes precludes any protection they might afford, and may have significant environmental, social, and economic consequences for coastal communities.

Many coastal areas and the people that inhabit them that are most threatened by climate change are, ironically, the ones most in need of the coastal protection and ecosystem services offered by mangroves. Low-lying coastal areas, particularly those in tropical Africa, South Asia and the South Pacific, are predicted to experience among the most dire consequences of global climate change (IPCC WGII TAR 2001). Sea level rise may rapidly inundate large areas of coastline, and coastal water supplies may become too saline for drinking. Increased storm surges and flooding may increase rates of erosion, compounding the effects of sea level rise. Higher temperatures will likely increase the stress level of sensitive coastal ecosystems. Despite the serious consequences of climate change impacts to these ecosystems, there is no mechanism by which the direct atmospheric effects (altered temperature regimes, precipitation patterns, and extreme weather events. of climate change can be ameliorated in the short term. The current state of the science indicates that these changes are already occurring, are affecting ecosystems, will have profoundly more adverse impacts on ecosystems and will continue to occur even after atmospheric CO<sub>2</sub> emissions are decreased during the long period of time to stabilization. Conservation of ecosystems and biological resources requires that we develop adaptive resource management strategies or accept that many natural systems may be lost to climate change.

Unfortunately, many countries in vulnerable areas lack capacity in the form of sufficient funds and training to effectively address climate change adaptation. While governments and communities have expressed concern for mangrove conservation and climate change adaptation, on-the-ground progress has often been stymied for want of resources and information. Also, many coastal communities depend strongly on mangrove areas for their culture and livelihood, and restoration or conservation measures that fail to incorporate human needs will not meet with long-term success.

There has been little development of methodologies for vulnerability assessments that are useful across ecosystem type, or even between sites with common habitat type. Rather, most vulnerability assessments have focused on particular sectors or individual ecosystem types. The science of climate change adaptation planning is even further behind. Without a generalizable approach, most of the world's mangroves will get no conservation attention in the timeframe necessary to respond to the threat of climate change. The best hope these systems have is the transfer of knowledge from strategically selected study sites to their resource managers so that better educated decisions can be made before these ecosystems are lost entirely. By examining similar systems in multiple locations and creating and disseminating a generalizable methodology, this project will fill a critical gap in climate change response.

Although there are no climate change vulnerability assessments and adaptation projects with a joint focus on sustaining biodiversity of mangroves, coral reefs, and associated systems, there are a handful of projects that focus on conservation and sustainable management of mangrove and coral reefs ecosystems. For instance, the World Bank and the Centre for Tropical Ecosystems Research have completed a draft code of conduct for the sustainable management of mangrove ecosystems and a companion document reviewing mangrove biodiversity conservation and management (Macintosh and Ashton, 2002; World Bank et al, 2003). However, in its table summarizing the major threats to mangroves around the world, however, the draft code of conduct neglects to mention climate change. Several studies have underlined the importance of addressing climate change threats to mangroves (e.g. Field, 1995;Pernetta, 1993), and some local projects have addressed mangrove restoration and climate change (e.g. the Vietnam Red Cross Society's Mangrove Reforestation Project). As noted by Farnsworth and Ellision (1997),

however, “this information must be disseminated more widely in a form that local nonscientists can use.” By focusing on methods development, capacity building, and transfer of knowledge globally, this project will address exactly that need. West and Salm (2003) laid out a framework for assessing resistance and resilience of coral reefs to climate change, but the adaptation and management implications of their work need to be tested.

While four notable vulnerability assessment and adaptation manuals have been created over the years, none has provided the practical guidelines in a widely available format geared towards the concerns of less wealthy or technologically advantaged countries. The most recent (Feenstra et al., 1998) was explicitly not designed as a “how to” manual, but rather to help individuals interested in doing relevant research. IPCC’s Technical Guidelines for Vulnerability Assessment and Adaptation (Carter et al., 1994), in addition to being out of print, takes a very general approach to the problem. The US Country Studies Program applied the IPCC approach to create a step-by-step guide to model-based methods (Benioff et al., 1996), which has had limited application. An early guidance document, “Climate Impact Assessment. Studies of the Interaction of Climate and Society,” provides a good overview of the issues, particularly socioeconomic ones, but is insufficiently detailed to use as a template for action.

Under the PDF-A, literature reviews were produced profiling the state of knowledge of both climate- and non-climate-related stressors on mangroves and associated systems in Cameroon, Fiji, and Tanzania (available upon request). This information will serve as a major input to be combined with best practice on vulnerability assessment in the creation of a methodology for analyzing vulnerability of mangroves, coral reefs and associated systems to climate change; and to the detailed vulnerability assessments that will be produced for each of the four project areas in the first stage of the project.

## **CURRENT CONTEXT: REGIONAL AND NATIONAL BASELINES**

### **Africa**

More than one-quarter of Africa’s population lives within 100 km of the coast. Recent projections of a mean global rise in sea level of 2 cm per year mean that the average annual number of people impacted by sea level rise in Africa could increase from 1 million in 1990 to 70 million in 2080. Flooding will drown natural and man-made buffers such as seawalls, and increase the number of people at risk from storm surges. Encroaching ocean waters will also mean that groundwater aquifers and agricultural lands are at risk, both of which have serious consequences for food and drinking water availability. (IPCC WGII TAR 2001)

The African mangrove sites have been identified by WWF as among the most vulnerable forest ecoregions globally due to combinations of loss of original cover and human stress. These, in combination with projected impacts from climate change, including changes in hydrological balance in the estuarine systems, increase in storm frequency and severity, and decrease in extent as the coastal zone is compressed between sea and inland agriculture and infrastructure, translate into highly vulnerable human and ecological systems. African mangroves also function as breeding, spawning, hatching and nursing grounds for juvenile stages of many fin and shell fish species, both commercial and non-commercial; and are also a critical resource for wood and wood products (e.g. Dahdouh-Guebas et al. 2000; Kairo 2001).

### *Central Africa/Gulf of Guinea Mangroves (Cameroon)*

The Gulf of Guinea contains Africa's most extensive mangroves, which help to stabilize a large part of the West African shoreline. These mangroves are a vital habitat for a number of

endangered species, including the African manatee, pygmy hippopotamus, and clawless otter, and provide important stopover points for large numbers of migrating birds. Forming a dense barrier between sea and land, the mangrove forest is a crucial food reservoir for coastal people who rely on its supply of shrimp and crabs. Coastal people also depend on mangroves for fuelwood; demand for fuelwood is predicted to increase 5-fold within the next 50 years (MINEF, 1998). The area is currently under high stress from urbanization, industrialization, and agriculture, as well as experiencing impacts from timber and petroleum exploitation around the Gulf coast. The 1998 IPCC Working Group II Report, entitled "The Regional Impacts of Climate Change: An Assessment of Vulnerability," noted that the West and Central African "low-lying lagoonal coasts are susceptible to erosion and hence are threatened by sea-level rise, particularly because most of the countries in this area have major and rapidly expanding cities on the coast" (IPCC 1996, in IPCC 1998).

Despite the socioeconomic importance of mangroves in Cameroon and the presence of more than thirty Wildlife National Parks and Forest Reserves, only two mangrove forests have legal protection: the Bois des Singes in the Cameroon estuary and the Douala-Edea Faunal Reserve. While there have been several initiatives focusing on mangrove health in the past decade, such as The Gulf of Guinea's Large Marine Ecosystem Project (GOGLME), there is not yet a coherent strategy for climate change adaptation activities aimed at mangroves in Cameroon.

#### *East African Coral reefs and Mangroves (Tanzania)*

The East African mangroves are considered among the most threatened habitats in the world, with charcoal and timber industries, urban growth pressures, and mounting pollution problems confounding climate change impacts (WWF 2001). They are a crucial habitat for diverse marine and terrestrial flora and fauna and in many areas are key to a healthy marine ecology. Intensive shrimp farming and abundant coral reefs in the area present an opportunity to integrate marine and terrestrial assessments and resource management adaptation strategies.

The Rufiji-Mafia Complex in Tanzania has the largest single block of mangrove forest in East Africa (53 km<sup>2</sup>), but there are also extensive fringing reefs and patch reefs, and extensive inter- and subtidal seagrass beds as well as algae beds between reef patches. Consequently, there is high habitat and species diversity, supporting an abundance of top predators, including crocodiles. The coral reef habitat is extensive and very diverse with over 350 species of fish, 45 hard coral genera, 140 species of algae, and 12 species of seagrass recorded from the area. The site is important for crustaceans (especially mangrove crabs and penaeid prawns) and fish as well as for sea turtles of which five species have been recorded. Several endemic plants, amphibians and insects exist on Mafia Island, as do hippopotami. The area is also a nesting and feeding site for shorebirds, including goliath herons. The high biodiversity of the complex is believed to be representative of many habitats found in the Eastern African Marine Ecoregion.

There is a major concern that sea-level rise will damage coral reefs, mangroves and wetlands within the Eastern Africa Marine Ecoregion (EAME), which are a major breeding ground for aquatic species and natural land-sea buffer zones (Alusa & Ogallo 1992; Salm 1995). Loss of reef zones will alter wave patterns to increase erosion from the land. The IPCC TAR highlights the vulnerability of the East African coastal region to climate change-induced flooding, citing the East Africa floods of 1998 and the Mozambique floods in February 2000 as evidence. The former resulted in major infrastructure damage -- to both transport and communication networks -- which led to large-scale mortalities. For example, the floods in Mozambique seriously affected approximately 2 million people through displacement, and caused the death of around 600

people. The estimated cost was over US \$167 million in emergency aid funds, notwithstanding the impact to the national economy.

Coastal management problems are widespread in the EAME and require urgent attention, particularly in the coral coast (WWF 2000) and the urban coastal areas of Kenya, Tanzania and Mozambique. Much of the degradation of mangroves and consequent loss of resources could be avoided, reduced or mitigated through intensified mangrove restoration and management. Restoration of mangroves is a cheaper, long-term, and more realistic option to mass migration or the construction of costly barriers to minimize the risk of sea level rise. A functioning ecosystem will also yield considerable socio-economic and biodiversity benefits.

## **Asia and Pacific**

### *South Asian mangroves (Sunderbans Delta, India)*

The Sundarbans is a vast complex of intertidal and estuarine areas situated on the border of India and Bangladesh where the Ganges, Brahmaputra, and Meghna rivers converge in the Bengal Basin. It is home to the world's largest mangrove ecosystem, and supports 32 mangrove and 10 seagrass species. It is extremely rich in floral and faunal diversity, including the Royal Bengal tiger, Indian otter, spotted deer, wild boar, estuarine crocodiles, fiddler crabs, mud crabs, and marine lizards and turtles. The area provides nursery grounds for many species of fish and invertebrates, including exploited species such as tiger prawns. The productivity of the Sundarbans plays a major role in supporting fisheries along the east coast of India. That role will be especially important given the recent devastating effects of the December 2004 tsunami in which at least 15,000 lives were lost and 300,000 families affected through loss of family members and livelihoods in Andaman & Nicobar Islands, Tamilnadu, and Kerala, Pondicherry and Andhra Pradesh. The Sundarbans were not substantially affected. It was noted, however, that coastal communities that were affected by the tsunami suffered less damage where intact mangrove systems were in place, thus creating great impetus for the objectives of mangrove restoration.

Although only 48 of the Sundarbans' 102 low-lying islands are populated, more than 4 million people live in the Indian Sundarbans. Due to the expansion of agriculture and the construction of irrigation canals the mangrove forests in the area have been felled indiscriminately and are degrading fast. The islands' ecosystems and human communities are severely stressed by the decreasing availability of natural resources, and are especially vulnerable to changes in climate. Communities have noticed the recent drastic changes in weather condition and monsoon pattern, along with frequent extreme climatic events like cyclones. Sea level rise is a major threat and already some of the low-lying islands are partially submerged resulting in massive environmental migration. Local communities suspect climate change is behind observed rise in sea level, delayed monsoon seasons, lengthier summers, and a dramatic increase in rainfall over the past 15 years.

The implications for a region where 65% of people depend upon agriculture are profound. Crop vulnerability to changing weather patterns, increased exposure to pests and salination of freshwater supplies are key threats. Communities are already responding by adjusting the timing of cropping, changing crop types, and increasing rainwater harvesting and building island mud barrages. Various NGOs, local governments, academic and state developmental agencies have also initiated various activities at different stakeholder levels.



### *South Pacific Mangroves(Fiji)*

The Republic of Fiji is an archipelago of more than 300 islands, providing ample coastline for mangrove forests and inshore reefs; Fiji's Exclusive Economic Zone covers an estimated ocean area of 1.29 million km<sup>2</sup>, over 98% of its territory. Fiji has the third largest mangrove area in the Pacific Island region, with eight true mangrove species and one hybrid (Ellision, 2004, and refs therein). The largest areas are on the SE and NW Viti Levu shorelines, and the northern shore of Vanua Levu, however, on many coastlines smaller mangrove areas exist that are significant to coastal stability and community usage. Climatic variation across the larger islands in Fiji influences mangrove distribution and ecology; this variation may serve as an indicator for how future changes in climate may affect Fiji's mangroves. The climatic variation also creates areas with opposing predicted changes in precipitation: dry areas are predicted to become even drier, and wet areas even wetter. Increasing temperatures will adversely affect mangroves; even more important may be the devastating effects of sea-level rise and increases in severe storms.

The Fijian government has begun work on management of their mangrove systems. Although no longer listed as "reserves," mangroves are considered an important portion of the foreshore structure, and are increasingly recognized by local communities as providing critical coastline stability (Scott 1993). In 2003, the Fiji Marine Ecoregion biodiversity vision workshop brought together 65 local and international experts to produce a baseline map of outstanding and distinctive biodiversity areas for Fiji's marine ecosystem; this map can help to guide future marine conservation efforts such as those included in this proposal.

Because of the large anticipated effects of climate change on Pacific Island nations, there have been several attempts to address this threat. The World Bank, in its "Cities, Seas, and Storms: Managing Change in Pacific Island Economies" series, underlined the importance of taking measures to adapt to climate change, but provided only general guidelines. The South Pacific Applied Geoscience Commission (SOPAC) has developed an environmental vulnerability index designed for use at the scale of countries, but it is too broad to serve as a basis for local vulnerability assessment and adaptation planning. The South Pacific Regional Environment Programme is working to build capacity of Pacific Island countries to adapt to climate change, but is focusing on socioeconomic effects rather than ecosystems. The proposed project, while building on existing projects, would address the critical need for practical, functional guidelines that local communities can use to create adaptation plans that protect both people and ecosystems.

### **STRATEGY AND OVERALL GOAL**

While coastal management projects exist, the baseline scenario is characterized by lack of climate change vulnerability assessment and adaptation projects with a focus on conserving biodiversity. This is due primarily to weak individual and institutional capacity for such activities. In working towards its overall goal of ensuring the long-term integrity of ecosystems by increasing resistance and resilience to climate change, the proposed project will address this major gap in the baseline scenario. Under the alternative (GEF) scenario, capacity in four target countries will be increased by engaging key stakeholders in the development of assessment and adaptation projects; additionally, the project explicitly incorporates a dissemination component that will enhance capacity beyond the borders of project countries.

### **STRATEGY**

Climate change is an immediate, global threat; even the best-case scenarios indicate that it will continue to be a major threat for centuries to come. It is therefore essential that we develop ways to increase the resistance and resilience of ecosystems to climate change, since we will not be able to completely prevent such change from occurring. Because there is neither the time nor the

money for a site-by-site approach to methods development, this project will develop a generalizable methodology for vulnerability assessment and creation of adaptation strategies that can be applied in multiple ecological and sociopolitical contexts. The project will do this by focusing on regions and ecosystems that are highly vulnerable to climate change.

The project will leverage focused activities within four target countries to develop this generalizable methodology. The involvement of multiple stakeholder groups in each of four countries throughout the planning and execution stages of the project will ensure national and local capacity-building in target countries, as well as on-the-ground projects demonstrating practical approaches to vulnerability assessment and adaptation. The ecological effectiveness of adaptation measures will be addressed by targeted research addressing factors influencing the resistance and resilience of the ecosystems in question.

To create a truly generalizable methodology, the project will work with a common ecosystem (mangroves) in different ecological contexts (intact vs. degraded; with and without associated reefs) and in four different countries. Mangrove protection and restoration can do much to limit or delay the negative effects of climate change on associated human and natural communities. Promoting healthy mangrove systems has significant benefits beyond their own resilience; mangroves are often associated with and enhance the health of nearshore coral reef systems. Coral reefs are among the most biologically productive systems in the world and harbor some of the richest biodiversity. They are found mostly in developing tropical countries, and it has been estimated that tens of millions of people are dependent upon coral reefs for at least part of their livelihood (Salvat 1992). Coral reefs are expected to be affected by many aspects of global climate change, including: increasing sea surface temperature, sea level rise, altered carbonate mineral saturation, increased ultraviolet radiation penetration due to increased water clarity, altered currents, and storm intensity (Smith and Buddemeier 1992). With sea surface temperature increases of only 1-2°C over average high temperature believed to be responsible for massive coral bleaching events, it is easy to see how climate change will have a dramatic, detrimental impact on the world's coral reef communities. Additionally, other pressures on corals, such as deteriorating water quality and coastal degradation, are anticipated to be magnified by climate change. Since the long-term effectiveness of adaptation strategies and restoration/conservation projects will not be discernable within the time-scale of this grant, a key measure of success will be the success of implementing a vulnerability assessment/adaptation strategy methodology in multiple countries.

Success depends on the involvement and commitment of communities affected by an adaptation strategy. Thus any plan must strengthen rather than weaken the livelihood security of these communities. Community stakeholders will be involved in the planning, implementation, and evaluation stages of this project to ensure that their needs are met.

In the end, the long-term success of any project will hinge upon local capacity, on the existence of sufficient information and expertise to allow local stakeholders to continually adjust existing strategies and to develop new ones. This project addresses capacity building by engaging individuals and organizations that play key roles in disseminating information, including research and academic institutions and local opinion leaders.

## **RATIONALE AND OBJECTIVES**

### **RATIONALE**

#### ***Vulnerability Assessment***

As a process to design an effective adaptive management strategy, the proposed project will first demonstrate a vulnerability assessment methodology to understand what aspects of the system are already experiencing climate change impacts or what aspects are most vulnerable to future impacts given existing, non-climate stresses which could exacerbate problems caused by climate change or limit a system's ability to respond to environmental changes. The project will utilize and modify methods that have been developed by the IPCC and others to assess impacts on various ecosystems. Project proponents will build on the following general approach to assessing ecosystem vulnerability (Biringer et al. 2004):

1. Assess stresses to the system by modelling climate;
2. Analyze species distribution and conservation coverage;
3. Gather data on the extent of harvesting and/or resource use;
4. Understand the socioeconomic baseline; and
5. Analyze the adaptive capacity of the system in question by rating against the following factors: redundancy, complementarity, spatial heterogeneity, and memory.

The approach used to obtain the information necessary for the assessment is fairly standard, generally including three approaches: on-site experimental research, gathering information from the literature on studies already conducted, and scenarios based upon climate change model projections.

The best method is to have on-site experimental research to determine changes. Additionally and alternatively, information on impacts will be gleaned by reviewing the existing literature. This has already been done for Cameroon, Fiji, and Tanzania during the PDF-A phase, and will serve as an input to the revised vulnerability assessments, in addition to integrating climate change model predictions. It is critical to consult multiple sources (several models, studies in several similar systems) in order to be inclusive of the potential variability of responses between different systems. The proposed project will involve a single ecosystem type (mangroves, and in two instances these will have associated near-shore coral reefs). This will allow for testing adaptation methods on geographically diverse locations of a common habitat type with the hope of increasing the effectiveness and replicability, i.e. develop generalizable methods and strategies.

During the process, the project will also attempt to assess what systems or aspects of the systems have greater resilience and resistance to climate change impacts. Coral reefs will serve as one variable to compare and contrast different mangrove systems by specifically analyzing whether their presence contributes to increased resilience and resistance. Many other system components that lead to increased resilience and resistance will also be studied. This type of information will assist in identifying sites that have greater long-term potential as ecosystem "refugia" from climate change impacts.

The project will also look into both proximal and confounding factors causing climate change impacts. For example, the proximal cause of coral bleaching is increased sea surface temperature, however there are many confounding variables that are suspected to exacerbate the rate of

bleaching or hinder recovery from bleaching. These confounding factors include ultraviolet radiation, nutrients from terrestrial systems and resource extraction. By combining mangrove restoration with coral reef protection, the mutual benefits for surviving climate change can be assessed.

### ***Adaptation Framework, Strategy Development and Pilot Actions***

In the first year, the project will produce a generalizable Framework for Adaptation that will serve as the backbone upon which each country develops a specific Adaptation Strategy. Each Adaptation Strategy will organize and prioritize the suite of adaptation response measures, and will require extensive stakeholder input and participation. The development of a comprehensive regional Adaptation Strategy is dependent upon the results of the vulnerability assessment. As a means to expedite the testing of the effectiveness of different management techniques, field trials based on existing state of knowledge on suitable response measures will be employed at an early stage of the project. The results from field trials or “pilot actions” will serve as an added input to the Adaptation Strategies, which will in turn be updated through an iterative process beyond the life of this three-year project. A major goal of this project is to examine and compare among countries the effectiveness and feasibility of the Adaptation Framework.

Response measures will be unique for each selected site, not generalized, considering their ecological, economic, political, and cultural conditions. Management strategies responding to climate change are not dissimilar from traditional conservation methods; however more emphasis is placed upon increasing spatial and temporal scales, protection of key communities known to be resilient, managing specifically for increased disturbances, and maintaining flexibility given uncertainties and surprises surrounding what climate change will bring (Hansen et al., 2003).

A basic premise to increasing resilience to rapid environmental change is enhancing or protecting the system's natural ability to respond to stress and change. This requires "healthy" and intact systems as a starting point. Such systems are thought to have the most innate ability to draw on their own internal diversity to have natural adaptation or acclimation potential, and therefore greater resilience. Activities that enhance the ecological health of a system can be seen as a potential buffer against negative impacts of climate change. Classic conservation strategies such as protection of key vulnerable and resilient spaces, restoration, and the reduction of present non-climate threats are suitable adaptation options. This project will begin to test the efficacy of these conservation strategies in relation to climate-specific impacts on mangroves such as changes in sediment dynamics, erosion and changes in salinity that accompany rises in sea-level; and coral reef bleaching that accompanies a rise in sea temperature.

In the case of mangroves, a central strategy is restoration of degraded systems, along with protection of intact systems. Restoration is applied in a strategic way, where the re-establishment of degraded sites in order to restore water quality and soil stabilization may be the only option to assist species' survival as tides move in at rates that may be higher than natural rates of migration for key mangrove species. Given projections of climate-related impacts, mangrove species will be selected which will be equipped to tolerate harsher conditions, such as higher salinity rates. A variety of species appropriate to each region will be selected and compared with regard to expected conditions.

It is important to note that restoration and protection of mangrove systems will likely be one of the most effective strategies for building resilience of associated systems such as coral reefs. An initial vulnerability assessment in Fiji has shown that high siltation rates are negatively affecting coral reef health. Replanting along riverbanks combined with possible use of silt traps is seen as a vital land-based management strategy that will build coral resilience. Viewed in this way,

restoration of mangrove systems can be seen as a low-cost preventative, and also ‘no regrets’ strategy for ensuring the health of the wider coastal and marine system on which many species (including coral reefs) and communities depend.

Improved land/marine use planning is also a key response measure to build resilience and resistance to climate change. For example, protected areas can be designed to better allow for species, population and ecosystem preservation in light of mounting climate change related pressures. This can include altering reserve design to include habitat refugia, adding robust corridors, linking reserves of different habitat types (such as marine and mangrove), or changing use allowances during periods of added stress. Other response measures will focus on improving water quality, for instance by building compost toilets and/or sewage tanks in areas with high levels of coliform bacteria.

The project also aims to work with local communities that utilize resources in the project sites in order to design a suite of response measures that will both enhance human livelihoods and reduce pressure to the coastal ecosystem. For instance, in India, establishment of fodder and fuelwood plantations in the two villages is proposed in order to directly decrease the pressure on mangroves. At the same time, agroforestry methods, including establishment of a small inland plantation is proposed along freshwater canals and ponds in order to both reduce the threat of sea-level rise and provide valuable livelihood benefits to the villages. Byproducts such as fruits and honey can be collected from these areas to provide alternative livelihoods to the harvesting of mangrove wood. Yet another proposed response measure includes enhancing the efficiency of use of mangrove wood with better cookstove technologies. Mangrove wood is used widely by local communities in some of the project areas for drying fish. Initial feedback from a stakeholder workshop in Cameroon suggests that relatively low-cost cookstoves exist that use up to 75% less wood, substantially reduce cooking time and fumes that cause health problems in humans.

### ***Site selection***

To achieve the goal of developing generalizable methods for adaptation of mangrove-coral reef systems around the world, the project proponents have selected four regions for development and testing of these ideas: Central Africa, East Africa, South Asia, and the South Pacific.

The initial filter for site selection was identification of areas with globally significant biodiversity. The four regions are found within key WWF ecoregions, several including areas designated for both outstanding marine and terrestrial composition. WWF’s Global 200 Ecoregions are determined by a science-based global ranking of the Earth’s most biologically outstanding habitats, in order to provide a blueprint for biodiversity conservation at a global scale.

A second filter for site selection was the ongoing presence of WWF and other key stakeholders in the conservation of mangroves and coral reefs within each project area. See below under each country site selection for more detail on this criterion.

Because this project focuses on climate change effects on biodiversity, a third filter was identification of ecoregions that have been highlighted as being particularly vulnerable to climate change impacts.

Country selection was also based on support for the project from national governments and local NGOs. This support has been expressed from the outset through input into the project concept and grant, participation in regional workshops, and through formal letters of endorsement. WWF local presence was also a basis for selection.

Selection of specific sites within each focal region began during a consultative process initiated during the PDF A phase. At regional workshops, multiple stakeholders discussed important site selection criteria such as: the condition of the mangroves, proximity to near-shore coral reefs, predicted resilience (level of vulnerability) and resistance (degree of adaptability) to climate change, similar areas nearby for control purposes, and ability to build upon ongoing work of WWF and other organizations within the landscape.

### ***Site Selection in Cameroon***

WWF has been active in mangrove conservation within the Gulf of Guinea, specifically as a focal point for Cameroon through the GEF/UNDP/UNIDO Gulf of Guinea Large Marine Ecosystem Project in the late 1990s, in which the second phase of the project was to support mangrove site rehabilitation. The project outcomes were compiled by WWF for the Cameroon Ministry of the Environment and Forestry to guide implementation of mangrove conservation. Critical components included creating awareness about the lack of legislation and recognition of mangroves by various governmental ministries, and providing technical assistance regarding the restoration of degraded mangrove areas (Nganje, 1999).

During a two-day stakeholder meeting financed by the PDF-A, several potential sites within two major areas of importance for mangrove conservation were identified: Rio del Rey, and Cameroon Estuary. Activities in Rio del Rey will be grounded by the ongoing process to define the Ndongore National Park. In Cameroon Estuary, restoration activities will be implemented through the Bimbia community.

### ***Site Selection in Fiji***

WWF-Fiji has been an active participant in an informal wetlands working group composed of representatives of a number of local academic, government, and NGO organizations. This group facilitates coordination of mangrove conservation efforts. Additionally, WWF has been actively building a network of Locally Managed Marine Areas at several sites around Fiji. LMMAs directly engage community members in designing conservation goals and activities that reflect their needs, and train community members to do on-going monitoring. The success of this program is such that WWF currently has many more requests for LMMAs than they can handle. The Fiji LMMA program won the 2002 Equator Initiative Award at the World Summit on Sustainable Development in Johannesburg, South Africa.

During Fiji's two-day stakeholder meeting, several candidate project sites identified and prioritized against the following specific selection criteria agreed upon by workshop participants:

- 1) Sites used for this study should be chosen in the context of existing programs; they should be either planned or existing conservation study sites, such as any of the Fiji Locally Managed Marine Area (FLMMA) sites.
- 2) Each site should contain both degraded and intact mangrove habitat, to allow for comparison of reef health in relationship to mangrove health.
- 3) Ideally, the sites should be areas identified as priority areas by NGOs or academics for mangroves, corals, or biodiversity in general.
- 4) Sites should include those in both wet and dry areas.
- 5) Sites should include both subsiding and tectonically stable areas.

Participants agreed that including as many sites as the budget will allow would be ideal, and suggested including surveys of corals along the coral coast offshore from some of the long-term mangrove restoration, and from unrestored areas. Based on these criteria, participants identified the following 5 sites:

**Verata** : The University of Fiji's Institute for Applied Sciences (IAS) is currently carrying out coastal resource management research and monitoring.

**Votua** : The University of Fiji's Institute for Applied Sciences (IAS) is currently carrying out coastal resource management research and monitoring.

**Tikina Wai on Viti Levu** : One of five project sites in WWF's Fiji office, where WWF has conducted a survey of biological and socio-economic baseline data to aid villagers in developing marine protected areas within their fishing grounds.

**Kubulau on Vanua Levu** : The Wildlife Conservation Society is working with local researchers and students through the Lomaiviti/Vatu-i-ra Conservation Seascape project to carry out scientific research on mangroves, coral reefs, and ecosystem function and connectivity within the Seascape area, focusing on Kubulau as well as Verata.

**Yaqara**: Proposed for assessment purposes only (not adaptation activities) to monitor changes before and after the clearance of a large swath of mangroves in the area once a large movie complex is developed.

#### ***Site Selection in India***

WWF India has become central in activities to preserve the region's unique coastal habitat, supporting the establishment of marine protected areas and promoting conservation awareness among local fishing communities in the Sundarbans. Through the Climate Witness Project, WWF-India is working to coordinate a shift from a reactionary governmental response to climate change to a proactive one.

Through an ongoing prioritization of WWF adaptation activities in the Sundarbans region in India, the following two island villages were selected to monitor the relationship between restored and degraded mangroves and human and ecological resilience to sea-level rise in conjunction with other NGO, research, and government partners:

**Bali** : The total area of the Bali islands including Bali I and Bali II villages is nearly 1,500 ha, with a total population of 27,800. Men outnumber women 2:1 in this area, and children constitute one third of the total population. The majority of people on the islands are fully dependent on the ecological integrity of the mangroves, though the mangroves are being degraded rapidly with an expansion of agriculture and construction of irrigation canals.

**Choto Mollakhali** : The village has a geographical area of 22.05 ha with a population of nearly 17,000. The literacy rate is lower than national standards though there are 15 schools in the village. Communities on the island are primarily involved in farming and tiger prawn collection, though a higher level of engagement in business industries will make for an interesting comparison with the Bali islands.

These areas have been prioritized for conservation activities by local NGO partners Govindapur Pally Unyan Samily and the Bali Nature & Wildlife Conservation Society.

#### ***Site Selection in Tanzania***

WWF-Tanzania has worked with the Tanzanian government and local fishermen to develop a plan for protecting the marine ecosystem and fishery at Mafia Island, and is currently working to scale this project up to the entire Rufiji-Mafia-Kilwa Seascape. The Mafia Island project was included as one of four MPAs in a series on effective MPAs (Rubens and Kazimoto, 2003).

WWF-Tanzania has also been an active participant in the East Africa Marine Ecoregion Project, and is collaborating with the Coral Reef Degradation in the Indian Ocean (CORDIO) project, an international organization focused on coral reef conservation.

Site selection in Tanzania likewise began through a two-day stakeholder meeting, where a range of possibilities were considered given the following guidelines:

1. Intact, functioning mangrove/coral reef that are facing threats to their intactness or ecological health.
2. Areas with potential to add to overall system resilience, due to either situational context or proximity to other healthy systems that could aid migration.
3. Determining factors for resilience of corals include things such as: identifying sites that have not bleached during previous bleaching events; sites that are associated with natural physical factors that may confer an advantage, such as high current or upwelling; or areas with low non-climate stresses.

With these guidelines in mind, a selection of 11 sites are to be chosen between Mafia Island, the Rufiji Delta, and Kilwa District.

## **OBJECTIVES**

The primary objective of this proposal is to build and strengthen the capacity of conservation practitioners to promote effective vulnerability assessment and climate change adaptation projects and policies. The aim is to develop a critical mass of knowledgeable and experienced professionals and community members who can improve climate change adaptation and thus the long-term conservation of biodiversity both within their countries and abroad.

The project will focus on the following four initiatives to be implemented jointly with government, NGO and other groups with a stake in resource management of mangroves and associated systems such as coral reefs:

- 1) Develop a vulnerability assessment method and process for developing adaptation strategies that is generalizable, by engaging in targeted scientific research (this will include local site assessments where adaptation projects will also be conducted).
- 2) Develop and implement adaptation strategies, including policy recommendations and adaptation measures, to increase resilience and resistance of vulnerable mangrove and associated systems.
- 3) Implement pilot initiatives to strengthen the livelihood security of human communities in project areas through sustainable resource uses (e.g. agroforestry, ecotourism) that balances economic and conservation needs.
- 4) Increase capacity of local stakeholders to respond and adapt to climate change impacts.

The project proponents aim to assist in overcoming the barriers to biodiversity adaptation as defined at the STAP Expert Workshop on Adaptation and Vulnerability held in February of 2002. These included separation of biodiversity and sustainable development issues, and little political commitment to implement policies or plans that benefit biodiversity.



## OUTCOMES AND INDICATIVE ACTIVITIES

### Outcome 1: Enhanced capacity in the four project countries to perform effective climate change vulnerability assessments

#### Key outputs

- **Computerized inventory of selected mangrove and coral ecosystems.** Collecting the necessary baseline information for a vulnerability assessment takes time and money, as does putting the information into a useable format. Creating a computerized inventory of relevant ecosystems within each country will help not only with this project, but with future projects as well. The database will also allow a more accurate assessment of the long-term changes in mangrove and coral reef ecosystems and thus the success of this project in years to come.
- **Statistical analysis by country of past coral bleaching events (severity and recovery time) in relation to mangrove proximity/health.** Assessing the influence of new mangrove restoration projects on the health of associated reefs will take years, even decades, yet information to plan adaptation strategies is needed now. Looking at the relationship between healthy mangrove and bleaching of nearshore reefs in the past will strengthen the project proponents' ability to address this central research hypothesis.
- **Increased skills and knowledge among local communities to identify climate change impacts.** There is increasing recognition that engaging local communities as partners in conservation enterprises is crucial. Such engagement is essential for the immediate success of any project, but it is also important for developing future projects and understanding on-the-ground effects of climate change. Because communities interact with and depend on their surrounding ecosystems daily, they may notice changes that conservation professionals who only visit the area may miss.
- **Creation of vulnerability assessments for each project site that stakeholders feel accurately reflects vulnerability to climate change effects.** There is no better way to learn than by doing. By working with key stakeholders in project countries to create actual vulnerability assessments for select sites within each country, the project will help develop a cadre of experience and knowledgeable individuals and organizations capable of sharing their knowledge and experience with others.

#### Activities

1. **Develop inventory of selected coastal mangrove, seagrass, and coral sites in order to assess their present biophysical status and vulnerability to climate change.** A local mangrove and/or coral reef expert in consultation with local communities will undertake the initiative.
2. **Collect and analyze data to examine the resilience and resistance of coral reefs to bleaching relative to their proximity to restored vs. degraded mangroves.** This will be accomplished by site monitoring as well as by gathering published and unpublished information from communities, government agencies, NGOs, and the literature on 1) the extent and severity of past bleaching events, as well as rate and extent of recovery, and 2) historic and current health, location, and extent of mangrove forests and associated systems. In some areas, partial collections of this information already exist (e.g. Fiji's wetlands database).
3. **Engage community and scientific stakeholders in a collaborative assessment process through awareness raising, training, and planning initiatives.** As mentioned above, a key aspect of building capacity is to fully engage key stakeholders who can then share what they've learned with others. In both Fiji and Tanzania, there are strong networks in which

communities, scientists, and NGOs work collaboratively to develop marine protected areas and monitoring plans that meet the needs of local communities. Site-level work in Cameroon and India will also be integrated within local networks that include communities, researchers, NGOs, and governments.

- 4. Develop, field test and implement vulnerability assessments in each region for mangrove and/or coral reefs and associated ecosystems.** WWF offices in the four target countries will take the lead in convening groups of relevant stakeholders in each country to develop, test, and implement vulnerability assessment techniques. A meeting of experts in charge of conducting the assessments will meet in the first and second years to discuss methodologies. A global coordinator will work closely with the team of experts in each country to compile existing vulnerability assessment methodology and lessons learned so that this effort will not be duplicated among countries. Additionally, the coordinator will facilitate communication among project countries to ensure the best possible outcome. In Cameroon, Fiji, and Tanzania, initial vulnerability reviews were carried out as part of the PDF-A which will serve as a baseline for the refined assessments. In all countries, coastal communities dependent on mangrove forests have already been engaged as participants in this process. In the case of Fiji, several vulnerability analyses relevant to this project have been conducted in the region (e.g. SOPAC's Environmental Vulnerability Index; the CBDAMPIC climate change adaptation program carried out by SPREP, Fiji's DoE, and CIDA), but all have focused on socioeconomic vulnerability rather than ecological vulnerability. Workshop participants suggested that the coral and mangrove vulnerability assessment activities of this grant could be incorporated into existing vulnerability assessment frameworks.

**Outcome 2: Development and implementation within target countries of climate change adaptation measures that increase resistance and resilience of target ecosystems and enhance the resource base for local communities.**

#### **Key outputs**

- **Generalized Framework for Adapting Biodiversity to the Impacts of Climate Change produced and applied to each of 4 project areas.** Currently the UNFCCC has produced drafts of adaptation frameworks for several sectors, yet there is a gap in the area of biodiversity/ecosystem management which this project will address. A Biodiversity Adaptation Framework will provide the backbone for the development of local to national-level adaptation strategies by listing the process and inputs necessary for success.
- **Completion of 4 adaptation strategies covering the project areas in Cameroon, Fiji, India, and Tanzania.** Through a multi-stakeholder process, the project will create Adaptation Strategies for the targeted project areas that lists opportunities and constraints and prioritizes and organizes specific policy and management activities to be undertaken in the short to long-term.
- **Implementation of site-appropriate pilot adaptation trials.** In all countries, restoration of degraded mangrove areas will take place. The results of the restoration efforts will be integrated within ongoing monitoring and comparison of healthy versus degraded mangroves, and the consequent effect of the degree of health on corresponding coral reefs. Restoration activities will be complemented by a host of additional adaptation field trials, including efforts to conserve mangrove stands, enhancing resource efficiency, agroforestry, community forestry activities, plantations for alternatives to the use of mangrove wood, MPA design, enforcement, and activities aimed at reducing pollutants.

- **Enhanced resource base and livelihood security for local communities.** Many communities dependent on mangroves have experienced a declining resource base, sometimes through local activities and sometimes through activities beyond their control, such as upstream pollution or climate change effects. By planning for the long-term resistance and resilience of ecosystems, the project will help to enhance the long-term availability of mangrove-related resources for local communities. This will involve working with communities to develop ways to reduce the strain they place on mangrove forests while simultaneously improving their quality of life.
- **Database of related projects/resources/gaps, compiled in part at gathering of global experts.** Although climate change adaptation projects like those proposed for this project are in their infancy, smaller-scale or related projects may still provide valuable lessons learned. The global coordinator, in collaboration with others, will collect as many details as possible (e.g. scope, timing, outcomes, methods) on relevant projects and disseminate the resultant database among project partners.

### Activities

1. **Identify past and ongoing related work on mangroves and coral reefs and identify the gaps for necessary actions.** By networking with others engaged in related work, project impact and efficiency can be increased. In some cases, existing projects may provide a perfect platform for climate change adaptation activities, and adaptation activities will add value to existing conservation projects. A list of such work was developed by workshop participants in each country as part of the PDF-A process, but in many cases participants were unsure of the extent or exact nature of the work done. Using the lists developed during the PDF-A process, project coordinators in each country can fill in details and make necessary contacts to finalize the identification of gaps.
2. **Produce Generalizable Framework for Adaptation of Biodiversity to Climate Change.** This document will be drafted to provide a generalized way of thinking about how to craft local to national or regional-level Adaptation Strategies. The guidance will focus on the process and necessary inputs to developing a Strategy that in turn help organize and prioritize the suite of policy and ecosystem management activities necessary to increase resilience.
3. **Convene and facilitate country and regional level stakeholder workshops to further raise awareness of vulnerability to climate change, and to gather input to the development of Adaptation Strategies.** Bringing together multiple stakeholders ensures that a greater number of considerations are brought to the planning table. Several such meetings will occur throughout the project period, and will include researchers, local communities, governments, and vested non-profit organizations. Initial meetings will focus on review of local to regional-level vulnerability to climate change, and on applying a framework for adaptation of biodiversity that will result in the development of an Adaptation Strategy. Later meetings will focus on periodic evaluation and adjustment of the strategy. The workshops convened as part of the PDF-A activities set the stage for future workshops by initiating discussions about the process with relevant stakeholders, and identifying any stakeholders that may have not participate in the PDF-A process. Workshop participants emphasized that there is often a lack of trust in outside agencies that arrive in a country with a pre-determined agenda; the PDF-A meetings began a process of trust-building and two-way dialogue essential for the ultimate success of this project.
4. **Formulate Adaptation Strategy for each of four focal project areas.** The project coordinator or identified expert in each country will draft an Adaptation Strategy that will be

the culmination of results of the vulnerability assessment, list of adaptation options, and input from stakeholders. The Adaptation Strategy will clearly identify the long-term objectives, scope of actions. Implementation of adaptation strategies will be an iterative process, and will require long-term dedication to monitoring, and revision of management strategies as the need arises. By entering the strategy development process with a clear understanding of the priority needs, desired outputs and larger policy and planning context, planners can help to ensure that a targeted and effective strategy is produced.

5. **Implement site-appropriate adaptation pilots.** Field trials will provide important information that will serve as technical inputs to longer-term Adaptation Strategies, as well as to the efficacy of particular management strategies in responding to climate change impacts. During the PDF-A phase, workshop participants discussed possible adaptation field trials which are listed below in more detail:

**Cameroon.** A combination of efforts aimed at the protection and restoration of mangroves in the Rio del Ray and Cameroon Estuary border region will increase the resilience of one of Cameroon's most vital mangrove resources. In addition, project proponents will work with local communities to explore the application of technologies that increase efficiency of the use of wood from mangroves.

- **Mangrove restoration with “climate smart species”** will enhance the resilience of the National Park by providing a buffer to areas under heavy resource use. A proposed community-based restoration field trial is also proposed for the Bimbia community within the Cameroon Estuary. This activity will compare and select a variety of species in relation to growth rates and adaptability to expected climatic conditions (e.g. higher salinity, warmer temperatures). The project will prioritize the use of indigenous species to maintain the resilience of the native ecosystem.
- **Definition of the boundaries of the proposed Ndongore National Park** is taking place through an ongoing participatory exercise. This project will incorporate knowledge from a refined climate vulnerability assessment to identify areas that are important for protection due to their resilience to factors that will likely make them more resilient to climate change. This project will offer baseline information that will allow for decisions to be made on zoning for a variety of uses given projections of climate change.
- **Improving efficiency of resource use** by substantially reducing the amount of mangrove wood used in traditional smoke houses. By employing relatively simple and inexpensive technologies, efficiency of wood used is increased by at least 50%, the time required for cooking is shortened from 2-3 days to a few hours, and respiratory health effects are diminished.

**Fiji.** WWF will work together with its partners through the existing Fiji Locally Managed Marine Areas (FLMMA) network, which encompasses each of the project sites designated for this project. Grants will be given, through the FLMMA network for each site, with the existing project coordinator responsible for carrying out community based field activities.

- **Mangrove restoration with “climate smart species”** is proposed as a key element of project activities in Kubulau on Vanua Levu. A specific focus on replanting along riverbanks will be used where early vulnerability assessments have shown high siltation rates to be negatively affecting the near-shore coral reefs. Species will be compared and selected with regard to their ability to withstand new climatic conditions.

- **Monitoring of restoration activities and comparison between and among intact versus degraded mangrove sites for a correlation with the health and resilience of coral reefs** will take place on Verata, Votua, Tikina Wai, and Kubulau. A before and after picture of the effects of clearance of large swaths of mangroves on Yaqara (the proposed site for a large film event) will also provide an invaluable opportunity for monitoring the relationship between mangrove and coral reef resilience more immediately.
- **The zoning and potential establishment of marine protected areas** is proposed in Tikina Wai on Viti Levu, where WWF has conducted a survey of biological and socioeconomic baseline data to aid villagers in developing MPAs within their fishing grounds.
- **The use of improved technology** is proposed for two different activities. The first proposes reducing inputs of coliform bacteria, which is a major stressor to local coral reefs, by building low-cost compost toilets and/or sewage tanks at appropriate facilities. The second form of improved technology that is being proposed is the use of siltation traps to reduce high siltation rates in the immediate to mid-term until mangroves have been successfully re-established.

**India.** The pilot work will focus on a combination of proposed restoration, agroforestry, alternative resource use, and ecotourism activities within the two villages of Bali and Chotomollakhali in the Sundarabans region:

- **Mangrove restoration with “climate smart species” to enhance embankments in order to resist the influx of sea water in agriculture lands.** Seeds will be collected from the wild to start a nursery in the inter-tidal zone where little maintenance will be required. After the seedlings reach a height of 2-3’ they will be transplanted into the target area. A variety of species will be compared and selected with regard to their ability to withstand harsher climate-related impacts.
- **Fodder and fuelwood plantation in the villages to promote stall feeding which directly decrease the pressure on forests.** The species that are normally planted for fodder are sonajhuri (*Cassia fistula*), akashmami (*Acacia auriculiforme*), eucalyptus and shiris (*Albizia lebbek*). These species are used by the villagers in their houses and also by West Bengal Renewable Energy Development Agency (WBREDA) for their gasifiers in Gosaba and Chhoto Mollakhali. *Avicennia (Baen)* is also recommended as good fuel-wood.
- **Inland plantation of easy growing flowering and fruiting trees along freshwater canals and ponds.** Species like Bakul ( *Mimusops elengi* ), Semul (*Bombax sp.* ) and Paltemader ( *Erythina indica* ) grow very fast and are normally planted along the canal. A few climbers with vegetative propagation are ideal soil binders. Fruit trees such as Mango, Guava, Lime will also be planted for the benefit of the villagers.
- **Marketing byproducts from trees.** Bable and Keora (*Sonneratia sp.*) fruits are extracted from the forests for human consumption. Honey is another byproduct which is under great demand by tourists which could be promoted to reduce reliance on cutting of mangroves.

**Tanzania.** Activities will include a mix of mangrove restoration, monitoring the relationship between intact and degraded mangroves and the consequent impact on coral reefs, and a host of community forestry and enforcement initiatives.

- **Mangrove restoration with “climate smart species”** in potentially resilient areas on Mafia Island, Kilwa District, and the Rufiji Delta. These areas will be sited in proximity to intact mangrove areas, where the potential for assisted migration is maximized. In both areas, the project will work with local villages through the recently established mangrove management groups to replant areas of high use with native species. The variety of species will be compared and selected for their adaptability to climate-related conditions.
- **Monitoring of restoration activities and comparison between and among sites for a determination of correlation with the health and resilience of coral reefs** will take place on Mafia Island, and in Kilwa District. A combination of 11 intact, degraded, and sites in the initial stages of restoration will be utilized to assess the potential correlation.
- **Patrolling and enforcement and community-based management.** WWF works with a variety of stakeholders in both Mafia Island and Kilwa District through the Seascope Program to involve local communities into the management of marine and mangrove resources. Sufficient laws exist to protect mangroves, and a marine protected area on the island of Mafia has set up a framework for the conservation of resources. Working with the Rufiji and Mafia District Councils, WWF will pair awareness raising seminars and training programs with initiatives to involve locals in enforcement activities to provide a deterrent to illegal resource use. Activities will include patrolling and the guarding the resources, and reporting of cases of violation in a systematic way.

**Outcome 3: Decreased barriers to vulnerability assessment and adaptation planning globally.**

**Key output**

- **An effective vulnerability assessment and adaptation planning method and process that is replicable in different project areas and ecosystems.** Although the concept of vulnerability assessment and adaptation planning is not new, there is not yet a broadly coherent approach to these activities. Conservation practitioners often think and act in ways that are limited by geography or ecotype. By explicitly working across boundaries, and replication of the methodology in at least 4 sites (potential countries include Indonesia, Philippines, Mozambique, and Kenya) beyond the 4 focal pilot areas, this project will contribute to the development of a widely applicable approach to confronting climate change effects.
- **Practical guidelines, references and training manuals for field practitioners/resource managers on how to carry out coastal vulnerability assessments and develop adaptation strategies at the site, ecoregional and national level.** By creating, publicizing, and distributing a “how-to” book to project stakeholders during a final workshop, this project will reduce the amount of information- and data-gathering needed before national, regional, or local groups can carry out their own vulnerability assessment and adaptation planning. WWF project coordinators will also work with ecoregion staff responsible for implementing ecoregional visions and landscape planning to successfully integrate the guidance within WWF field projects globally. The publications will be available in both hard copies as well as available electronically on the internet.

## Activities

1. **Develop and implement pilot initiatives on adaptive measures by local communities in each of the four project countries, which could be replicated in other locations.** These pilot projects will serve several purposes. They will provide some measure of adaptation for the communities involved in this project, but will also provide valuable practical examples of the application of vulnerability assessment and adaptation methodology. One key initiative that many workshop participants felt would increase capacity for wider use of mangrove restoration activities was the development of locally managed nurseries of key mangrove species/strains in each country. Such nurseries are essential for many restoration projects, but are unavailable in many regions.
2. **Present results at global, regional, and national meetings.** Even the best methodology is useless if no one is aware of it. By presenting project results in a variety of public forums, a larger audience will be made aware of the existence and availability of the new methodology. The generalized model on which this project is based has already been presented with good response at the Society for Conservation Biology 2004 annual meeting and the World Parks Congress, and will be presented at the Society of Ecological Restoration International's annual World Conference on Ecological Restoration, and at the UNFCCC COP. Discussions around these presentations make it clear that conservation practitioners are eager for information on actual ecological climate change adaptation projects.
3. **Analysis of commonalities and differences among trials that highlights generalizable aspects of the methodology.** To create a generalizable methodology, it will be important to understand which procedural steps worked in all pilot sites, and which were most likely to require adaptation to local circumstances. The methods manual could then include alternative approaches for the least generalizable steps. The PDF-A workshops underlined the sociocultural, political, and ecological differences among project countries, but also the commonalities. Workshop participants were eager to hear what had happened at other country workshops, and what activities other countries had undertaken as regards mangroves, corals, and climate change.
4. **In the third year of the project, there will be an initial testing throughout the WWF network to assess whether this tool is indeed generalizable.** As one of the largest global conservation organizations, WWF has offices around the world. This will facilitate initial testing of the project methodology in countries not participating in the pilot initiatives. As described for the previous activity, this will allow the creation of a more realistic manual.

**Outcome 4: Established and strengthened opportunities for knowledge sharing and activities related to climate change adaptation at the national, regional, and international levels.**

## Key output

- **Increased skills and knowledge among local, national and regional stakeholders to respond and adapt to climate change impacts and to disseminate project findings for replication at multiple scales.** Engaging stakeholders in actual vulnerability assessment and adaptation activities will increase their sense of having something to contribute to the local, national, and international discussion of such activities.
- **Formal and informal networks of conservation practitioners and others within and between countries, in particular with participating countries serving as regional nodes**

**through the Coordination Committee for dissemination of information related to coastal climate vulnerability and adaptation.** Climate change science is not static, and adaptation planning is still in the very early stages. Thus it is essential that conservation practitioners have networks of people with whom they can share successes, ideas, and difficulties.

### **Activities**

- 1. Creation of partnerships between leading climate science organizations and governments, agencies and NGOs.** There is increasing recognition that successfully addressing the challenge of climate change will require increased communication and collaboration among divergent segments of the conservation community. By actively involving a range of stakeholders in development and implementation of pilot initiatives, this project will foster formal and informal interactions between organizations and individuals that can translate into long-term information sharing partnerships.
- 2. Project results published in leading peer-reviewed journals and in different formats appropriate for the popular media and participating communities in each pilot country.** To disseminate project results as widely as possible, it is important to publicize them in a variety of ways. Publication in peer-reviewed journals will inform the broader scientific and policy community about project activities, and help to create a dialog about appropriate and effective approaches to adaptation. Publication in formats appropriate for the popular media will insert climate change adaptation into the public's mind, while publications aimed at participating communities will affirm their importance in the process and their ability to serve as role models.
- 3. National and regional meetings of stakeholders, with participating countries serving as regional nodes through the Coordination Committee.** The project proposes that an annual meeting of key stakeholders from each countries take place to facilitate the sharing of knowledge between participating regions. The intent is for the participating countries to further serve as regional nodes for dissemination of information on coastal vulnerability to climate change and adaptation.

### **Long-term Success Indicators:**

Adaptive resource management for climate change is a lengthy process with success indicated by the long-term survival of ecosystems. This makes identifying indicators for the overall success of adaptation measure within the timeframe of the project difficult. Coral reefs offer the unique opportunity to monitor adaptation success via resistance and resilience to coral bleaching events brought on by increased sea surface temperatures, but such events are not guaranteed within the three-year time-frame of this grant. However, ongoing monitoring of such events will continue within WWF's ongoing work within especially the East African Marine Ecoregion and in Fiji.

### **3. SUSTAINABILITY (INCLUDING FINANCIAL SUSTAINABILITY)**

The sustainability of both project benefits and financing are partially addressed by linkages of this project to existing or planned large-scale programs in place within the target countries. Increasing the capacity of regional and national stakeholders for effective vulnerability analysis and adaptation planning will allow these activities to be integrated into future conservation plans and policies within the target countries. By working with various ministries in charge of natural resources and land use, lessons learned from the field will be taken into account in the policy development processes as regards conservation and sustainable management of mangrove forests.



Project results will be published in peer-reviewed journals and other formats as appropriate for media in pilot countries, such as brochures or web sites. A user's manual outlining a generalizable methodology for vulnerability assessment and adaptation planning, including explicit guidelines, will be available for free both in hard copy, on CD, and on the web. The manual will include chapters discussing how the methodology was applied in each of the four pilot countries; this will provide local contexts for extension of project activities to other locations within pilot countries, as well as provide useful lessons learned for other countries seeking to adapt the methodologies. The generalizable vulnerability assessment/adaptation planning methodology developed by this project will be integrated into WWF conservation plans through ecoregional visioning and implementation processes. Testing of the methodology, widespread dissemination and uptake is envisioned as outlined under Outcome 3 and additional mechanisms outlined below.

### **Cameroon**

In Cameroon, the project area is located in the central part of the coastal zone and comprises the most degraded mangrove forests due to human pressure and industrial pollution. This area is the focus of a variety of activities, centered on climate change and pollution, initiated by university faculty and other researchers. Working with these academic and research institutions, and bringing community-based organizations into the mix, the proposed GEF project will increase the opportunities for future generations and the general public to learn about issues related to resistance and resilience of mangrove forest and associated coral reefs to climate change.

The goals of planned WWF conservation activities with regard to coastal and marine ecosystems in Cameroon are:

- The protection and effective management of marine and coastal sites;
- The gazettement of at least one extension to an existing protected area for the protection of migratory species;
- To catalyze and promote policies and legislation in favor of threatened coastal and ocean species, and of the reduction of pollution and its environmental impacts.

Coastal area landscapes, covering about 393,000 ha, have been included in the new protected area system under development in Cameroon; this project will add climate change adaptation as a new goal to WWF conservation efforts within coastal and marine ecosystems in Cameroon.

Additionally, Cameroon has just commenced the process for the development of multi-sectoral fisheries policy and legislation. Activities to be carried out by this project will provide information that feeds the legislative and policy development process for the long-term management of fisheries in Cameroon, bearing in mind that mangroves are an important breeding ground for fish.

In the Rio del Rey area, located in the northern part of Cameroon estuary, a two-year FAO project on participatory management and conservation of biological diversity of mangroves is planned. Its main objective is the sensitization of various interest groups with regard to this particular ecosystem. The proposed GEF project will provide the FAO project with information related to resistance and resilience of mangrove forest and associated coral reefs to climate change, so that this information can be included in their activities.

### **Tanzania**

Within the East Africa Marine Ecoregion, WWF is coordinating a multi-stakeholder, long-term program to ensure the sustainable use of the region's marine resources and the protection of its immense biodiversity. Within the context of this broader program, WWF-Tanzani is taking a lead

role in developing the Rufiji/Mafia/Kilwa seascape conservation project, a partnership program with local communities and organizations for sustainable utilization of marine and coastal resources in this area. By working within the framework of this larger program, this GEF project will be able to include adaptation to climate change as one of the explicit goals of the EAME plan.

The Marine and Coastal Environmental Management Project (MACEMP) for Tanzania, a multi-million dollar project supported by the World Bank, is scheduled to begin in 2005. Although focused primarily on the management of marine resources, the project aims to “identify and support scientific and technical research that contributes to improved regulation, management, development, and protection of marine and coastal resources;” climate change adaptation for mangrove and coral reef ecosystems will play an important role in ensuring the long-term sustainability of marine and coastal resources.

Coral Reefs Targeted Research, a major initiative launched by the World Bank, IOC/UNESCO and a range of partners, has identified the Institute of Marine Sciences in Zanzibar as one of the focal areas. Targeted research on coral reef responses to human disturbances and climate change will be conducted in selected reef areas around Zanzibar and Tanzania mainland. Continued monitoring of the proposed GEF project’s research sites in Tanzania will provide CRTR with valuable information on possible approaches to increasing reef resistance and resilience.

Coral Reef Degradation in the Indian Ocean (CORDIO), a program created following massive coral bleaching in 1998 to “respond to the degradation of coral reefs throughout the Indian Ocean,” has expressed strong interest in working with the proposed GEF project and incorporating the results into ongoing CORDIO activities.

### **Fiji**

The bulk of policy-makers and conservation workers in the South Pacific receive their education at Fiji's University of the South Pacific. By working closely with key faculty members at USP, this project ensures that future generations of individuals with influence over environmental issues will be exposed to vulnerability assessments and adaptation planning during their education. The professor in charge of a vulnerability assessment course at USP has expressed interest in working with project participants to include climate change vulnerability assessments in his course. Additionally, WWF-South Pacific has an active climate change program, and the program coordinator is eager to use knowledge gained from this project in her ongoing work in Fiji and other South Pacific countries. Several environmental NGOs with offices in Fiji have been actively involved in this project, and will likewise incorporate results of this project in their ongoing work.

### **India**

The Sundarbans have been named a focal area for WWF work on climate change impacts and adaptations. This project will play a key role in initiating this work, and WWF will carry on with it after project funding ends. There are a number of parks, reserves, and sanctuaries within the Sundarbans; the Sundarbans National Park was declared a world heritage site in 1985, and the entire Sundarbans area was declared a Biosphere Reserve in 1989. By engaging with key stakeholders involved in management planning for the parks and reserves within the Sundarbans, this project will demonstrate how climate change adaptation can be included in on-going park and reserve management planning. Additionally, the Marine Science Department at Calcutta University has been engaged in long-term monitoring since 1980; long-term monitoring of project success may be incorporated into existing monitoring programs.

Some project activities do not require financial support beyond the three-year project period. For example, once mangroves have been replanted and local communities trained in maintaining nurseries, community members will care for these areas on a volunteer basis. Any new and strengthened professional relationships established through the project's networking component will continue after the project has ended without the need for additional funding.

#### **4. REPLICABILITY**

Outcomes 3 and 4 (see pages 27-29) are specifically designed to increase the dissemination and replicability of project outcomes. Activities are designed to nurture exchange of experiences, knowledge sharing and even extending output benefits of specific activities beyond pilot sites (e.g. development of nurseries to serve entire regions).

A number of global, regional and national meetings will be vehicles for the presentation of project results and dissemination of methodology. Additional innovations include creation of partnerships amongst leading climate science organizations, governments and NGOs, and publication of project results in peer reviewed journals and press releases to more popular mass media publications

In the third year of the project, the project will commence initial testing throughout the WWF network to assess whether this tool is indeed generalizable. As one of the largest global conservation organizations, WWF has offices around the world. This will facilitate initial testing of the project methodology in countries not participating in the pilot initiatives, and help to fine-tune the methodology for use in countries that were not part of the initial method development. This will facilitate the creation of a more realistic, practical manual and its uptake.

In order to achieve effective coordination, the proponents propose forming a Coordinative Committee made up of conservation practitioners involved in the creation or implementation of vulnerability assessments and adaptation strategies from the governmental, non-profit, and private sectors. It is proposed that the Committee meet on an annual basis in order to ensure that lessons learned from this and other projects are incorporated both within existing projects and institutional and policy processes.

#### **5. STAKEHOLDER INVOLVEMENT**

Numerous consultations were made with the government and key stakeholders in each participating country to develop the PDF-A proposal and seek country endorsement. Since receiving PDF-A funds, the project proponents have held multi-stakeholder workshops in three of the four countries (Cameroon, Fiji, and Tanzania). Workshop participants expressed a willingness and desire to help not only with on-going project design, but with actual implementation and monitoring.

Aside from GEF, UNEP, and WWF, the key stakeholders identified during the PDF-A phase are: (a) representatives of local, state, and national governments and resource management agencies who are responsible for the long-term health of each country's environment; (b) representatives of local and international NGOs which have an interest in climate change, mangroves, or coral reefs; (c) members of local and regional academic institutions and research groups who have interest, experience, and expertise with regard to climate change, mangroves, or corals in each country; and (d) community members who own, control, or depend on the mangrove and coral reefs ecosystems on which this project focuses. WWF-US will take a coordinating role for the project overall, and WWF offices at the national level will coordinate initiatives with the local partners.

Until project sites within each country have been selected, the key partner communities cannot be finalized. Nonetheless, all countries have actively engaged with communities at potential sites. Representatives of the Bimbia Bonadikombo community participated in stakeholder workshops conducted during the PDF-A phase in Cameroon, and members of the district councils for Kilwa, Rufiji, and Mafia districts participated in similar workshops in Tanzania. In Fiji, consultation with community members occurred during visits to individual villages. Additionally, WWF-Fiji has ongoing relationships with community members in several potential project sites through their involvement in the Locally Managed Marine Areas program, which gives communities a sense of ownership of marine resource conservation and management by working with them to create and carry out policies and monitoring plans that reflect community values.

## **6. MONITORING AND EVALUATION**

Using UNEP's standard monitoring and evaluation procedure, regular monitoring of project implementation will be carried out based on the indicators specified for the project activities, outcomes, and overall goals. This is essential to ensure that any needed adjustments or changes can be made in a timely fashion. Monitoring and evaluation will be qualitative and quantitative, and will take place at both output and project levels. WWF offices in each of the four project countries will be responsible for the on-going monitoring and evaluation of the country-specific activities, while WWF US, as the international coordinator, will be responsible for monitoring and evaluation of overall project goals and activities.

Key project outputs and timelines are described in the logframe table (Annex A). More specific, verifiable output-based milestones and indicators will be developed as stakeholders in each country finalize project activities for their region. Primary responsibility for implementing project activities and delivering expected products within the agreed budget and time frame will also be determined as part of this process. These milestones and indicators, along with indicators listed in the logframe table, will be used for project review and evaluation.

Field monitoring will take place on two levels. Coordinating agencies within each country will train and work with networks of community members in or near project sites to assist with ongoing quantitative monitoring of restoration/conservation sites. In addition, members of coordinating agencies will perform annual monitoring of all project sites. This will provide an opportunity for local communities to interact with coordinating agencies and to discuss their observations, as well as to ensure consistent evaluation across countries. Variables included in monitoring protocols will be determined based on stakeholder input and local ecology. Inshore reefs associated with mangrove restoration/conservation sites will be monitored annually and during any mass bleaching events that may occur during the project period to compare extent of bleaching and recovery in these reefs relative to reefs associated with degraded mangrove areas. A global coordinator will receive regular reports from coordinators in each country, and work with each country to solve problems or share successes that have occurred. All stakeholders will work together to create a list of lessons learned at the end of the project period.

Qualitative monitoring will be based on field visit reports, workshop reports, and feedback from workshop attendees, quarterly progress reports, and minutes of research team meetings. Feedback from workshop attendees will be obtained using a short questionnaire. Feedback related to relevance of the research for policy and impact on policy frameworks will be solicited from policy makers. Peer-reviewed journal articles and other research publications will provide a measure of the quality of the research.

Opinions of wetland users will be solicited to establish perceptions about this research, relevance of the research, expectations, the effectiveness and impact of alternative land and water management strategies and interventions.

External evaluation of the project will comprise a midterm review by a panel of independent reviewers, review of project implementation and completion reports, performance audit reports, and an evaluation at the end of the project to assess achievement of the project objectives and impacts. The midterm evaluation will be carried out at the end of the second year. Its aims will be to ensure that the project implementation is on target, and also to make recommendations for changes where necessary.

The different activities for monitoring and evaluation and the responsible group are shown in Table 1.

**Table 1. Monitoring and evaluation.**

<b>Monitoring and Evaluation Activity</b>	<b>Responsible Institution / Group</b>	<b>Performance Indicators</b>
Outcome 1, outputs 1-3: vulnerability assessment, increased skills and knowledge, inventory	WWF country offices	Work plan and agreed milestones
Outcome 1, output 4: Analysis of bleaching/mangroves	WWF-US/Climate Change	Work plan and agreed milestones
Outcome 2, all outputs	WWF country offices	Work plan and agreed milestones
Outcome 3, all outputs	WWF-US/Climate Change	Work plan and agreed milestones
Outcome 4, all outputs	WWF-US/Climate Change	Work plan and agreed milestones
Overall project Progress	WWF country offices (national level); WWF-US/Climate Change (international level)	Project milestones and budget
Midterm and end of project evaluation.	WWF-US/Climate Change	Project milestones; impacts
Feedback – perceptions and relevance of project.	Community members	1. Proportion of men and women responding favorably 2. Proportion of communities adopting adaptation strategies
Feedback - relevance of research for policy and food security.	Policy makers, researchers, and extension personnel	1. Proportion of policy makers responding favorably 2. Adoption of project findings 3. References to project research by other researchers.
Midterm review.	Independent review team	Project milestones and budget
End of project evaluation.	Independent review team	Project objectives and milestones

**Table 2: Monitoring and progress reports**

<b>Report</b>	<b>Format and Content</b>	<b>Timing</b>	<b>Responsibility</b>
<b>Progress Reports</b>			
Document the completion of planned activities, and describe progress in relation to the annual operating/work plan.  Review any implementation problems that impact on performance  Summary of problems and proposed action  Provide adequate substantive data outcomes for inclusion in consolidated project half-yearly/quarterly and annual progress reports  Highlights of achievements	Reports will use standard UNEP Progress Report format.  The project logframe will be attached to each report and progress reported against outcome and output indicators.	Half-yearly, within 30 days of end of each reporting period,	WWF-US
The Project Implementation Review (PIR) reports	Per GEFSEC format	Yearly (after project has been under implementation for one year)	UNEP Task Manager
<b>Financial reports</b>			
Report on cofinancing that has been provided to project as originally estimated in project proposal approved by GEF	Use Annex as found in project document with supporting documentation of realized cofinancing	Annual	WWF-US
<b>Financial reports</b> Details project expenses and disbursements	Standardized UNEP format as found in project document  Disbursements and expenses in categories and format as set out in standard UNEP format, together with supporting documents as necessary	Half Yearly	WWF-US
<b>Financial audits</b>			
Annual audit	Audit of accounts for project management and expenditures	Annual	WWF-US

## D – FINANCIAL MODALITY AND COST EFFECTIVENESS

### 1. FINANCING PLAN

Activities	GEF Cash	Matching Funds										Total
		WWF-US		Cameroon (WWF)		Fiji (WWF/WCS)		India (WWF)		Tanzania (WWF)		
		Cash	In kind	Cash	In kind	Cash	In kind	Cash	In kind	Cash	In kind	
PDF A	25,000	5,000	10,000									40,000
<b>Outcome 1: Enhancing capacity to assess vulnerability</b>												<b>734,700</b>
Activity 1.1 Vulnerability assessments	85,000				1,500				2,000		2,000	90,500
Activity 1.2 Inventory mangroves/corals	70,000				1,500	23,700				19,800	20,000	135,000
Activity 1.3 Assess mangrove-coral resilience relationship	65,000		5,500							7,600	4,800	82,900
Activity 1.4 Engaging stakeholders in assessment & planning	68,000		4,300	8,000	28,400	12,000	27,000	7,500	29,000	16,000	27,600	227,800
Activity 1.5 Enhancing capacity	65,000			22,000	12,000	28,000	12,000	8,000	12,000	21,000	18,500	198,500
<b>Outcome 2: Adaptation Measures</b>												<b>855,700</b>

Activity 2.1 Convene stakeholders	80,000		2,000		14,000		7,200		23,000		26,000	152,200
Activity 2.2 Identifying ongoing work	5,000	4,500	2,000		4,500		4,500		4,500		4,500	29,500
Activity 2.3 Resource efficiency measures	20,000											20,000
Activity 2.4 Implement adaptation plans	412,000		2,000	60,000		60,000		60,000		60,000		654,000
<b>Outcome 3 Decreasing barriers to VA and adaptation planning</b>												<b>275,800</b>
Activity 3.1 Implement community- based pilots	105,000			21,400	8,700	30,000	16,000	5,100	6,600	13,600	10,800	217,200
Activity 3.2 Present results at international meetings	-	5,000	2,500					2,400	2,000			11,900
Activity 3.3 Assess generalizeability	-	6,000	17,500									23,500
Activity 3.4 Test tool in WWF network	-	14,000	9,200									23,200
<b>Outcome 4 Sharing lessons learned</b>												<b>93,800</b>
Activity 4.1 Partnership creation	-	5,000			18,000		4,600	5,900	8,000	11,200	12,100	64,800
Activity 4.2 Publish project results	-	24,000	5,000									29,000
Activity 4.3 National and regional stakeholder meetings	-	-	-	-	-	-	-	-	-	-	-	-
<b>Subtotals</b>	1,000,000	63,500	60,000	111,400	88,600	153,700	71,300	88,900	87,100	149,200	126,300	<b>2,000,000</b>
<b>Match Totals</b>	<b>1,000,000</b>	<b>123,500</b>	<b>200,000</b>	<b>225,000</b>	<b>176,000</b>	<b>275,500</b>	<b>2,000,000</b>					



## **2. COST EFFECTIVENESS**

This project seeks to minimize costs and add value in the following ways:

- ◆ Since several countries will be working on a common problem simultaneously, certain costs (e.g. reviewing the status of current global knowledge and related projects) will be borne by the project overall rather than repeatedly by each country.
- ◆ By initiating vulnerability assessment/adaptation planning methodology development in four geographically, ecologically, and sociopolitically diverse countries and disseminating the results of the project widely, the project is reducing the likelihood that governmental or non-governmental groups in multiple countries will duplicate each other's efforts in developing similar methodologies. Creating a generalizable methodology reduces the need for countries to create methodologies on their own.
- ◆ The role of a global coordinator is essential to realize cost savings, as is providing an opportunity for regional experts to interact so that methodology is developed and lessons learned are shared in coordinated way
- ◆ preventative measures, such as protection and restoration of mangroves, are much cheaper than waiting until the system has been severely degraded by climate change and the effects are dire.
- ◆ engaging communities as key participants in project execution and monitoring leads to a more comprehensive strategy that ensures their input and strengthened livelihood; it also more cost effective than relying on scientists/formal technicians

## **3. Status of Co-financing**

Several organizations have committed to providing co-financing. For the period of 2004-2007, WWF-India will provide \$176,000, WWF-Cameroon \$200,000, WWF-Tanzania \$300,000, WCS \$225,000 toward project costs in Fiji, and WWF-US will provide \$123,500 toward implementation costs for each region, and also overall project coordination costs.

# **E – INSTITUTIONAL COORDINATION AND SUPPORT**

## **1. CORE COMMITMENTS AND LINKAGES**

This project will provide information crucial for the long-term biodiversity conservation of mangroves, with a concomitant benefit for coral reefs. To this end, this project will provide valuable information for enhancing several other GEF projects. Among them “Coral Reef Monitoring Network in Monitoring States of the Indian Ocean Commission (COI), within the Global Reef Monitoring Network (GCRMN)”, “Effects of Localized Anthropogenic Stress and Compounding Impacts of Climate Change on the Sustainability of Coral Reef Ecosystems and the Implications for Management” and a project still in development, “Knowledge Base for Best Practice and Lessons Learned in the Management of Coral Reefs.” It is the intent of this project to provide information and tools to benefit several other regional projects in different geographic areas. These include “Management of Coral Reef Ecosystems of Andaman and Nicobar Islands” and “Coral Reef Rehabilitation and Management” (COREMAP I and II), an AusAID-funded project in Indonesia. This project will reciprocally benefit from the findings of these other projects. The project proponents are also committed to maximizing the potential value of this project’s findings for enhancing mangrove and coral management effectiveness, and to sharing the project results through international programs such as GCRMN, ICRI and CORDIO.

An on-going GEF project with particularly close linkages to this project is “Caribbean: Planning for Adaptation to Global Climate Change (CPACC)”, whose goal is to “support Caribbean

countries in preparing to cope with the adverse effects of global climate change, particularly sea level rise, in coastal and marine areas through vulnerability assessment, adaptation planning, and capacity building linked to adaptation planning.” CPACC is working with three countries to develop vulnerability and risk assessment for their coastal areas. Project proponents will communicate with CPACC representatives to ensure that efforts are not duplicated, and also to share lessons learned. This will ensure maximum cost and effort efficiency for both projects.

In terms of linkages to the ongoing GEF projects, the purpose of the coral bleaching module of the World Bank/GEF CRTRP is to develop targeted research on knowledge gaps related to mass coral bleaching processes and building local capacity. While this project also aims to build local capacity, the main goal is quite different. This project focuses on mangrove restoration as a potential adaptation strategy to increase coastal resilience to climate change, including near-shore coral reefs. These projects are complimentary, not duplicative; one on assessment, the other a test of possible response strategies.

The United Nations Environment Programme Coral Reef Unit is helping to lead international effort to save the planet's threatened coral reefs. It works actively with international partners around the world in a concerted effort to reverse coral reef degradation and to increase international, national and local support for coral reef conservation and sustainable use. It is responsible for UNEP's participation in the International Coral Reef Action Network (ICRAN) and other international programmes, and provides the administrative base for the ICRAN Coordinating Unit. It includes staff at UNEP Headquarters in Nairobi, Kenya, for close collaboration with the Regional Seas Programmes in Division of International Conventions; UN agencies and Convention Secretariats; and in Cambridge, England, at the UNEP World Conservation Monitoring Centre.

## **2. CONSULTATION, COORDINATION, AND COLLABORATION BETWEEN AND AMONG IAS, EXAS, AND GEFSEC**

The project aims to assist in overcoming the barriers to biodiversity adaptation as defined at the STAP Expert Workshop on Adaptation and Vulnerability held in February of 2002. These included separation of biodiversity and sustainable development issues, and little political commitment to implement policies or plans that benefit biodiversity. The project will have close coordination with ongoing impacts and adaptation initiatives, such as the UNEP/GEF supported projects and UNEP/WWF Memorandum of Understanding under the Nairobi and Abidjan Conventions.

In order to achieve effective coordination, the proponents propose forming a Coordinative Committee made up of conservation practitioners involved in the creation or implementation of vulnerability assessments and adaptation strategies from the governmental, non-profit, and private sectors. It is proposed that the Committee meet on an annual basis in order to ensure that lessons learned from this and other projects are incorporated both within existing projects and institutional and policy processes.

## **3. IMPLEMENTATION/EXECUTION ARRANGEMENTS**

A project coordinator with WWF's Forest Program will coordinate and implement activities in collaboration with WWF's Climate Change Program, and also regional and national WWF offices and other WWF partners in project countries. Coordinators within each country will consult with representatives of national and local governments, NGOs, academic institutions, and

other relevant stakeholders to ensure that the project matches that country's national plans and programs and incorporates identified priority concerns. The Coordinative Committee proposed above will be the vehicle for achieving these synergies.

**National Leading Agencies :**

**Tanzania:** WWF Tanzania Programme Office (TPO), WWF-East Africa Regional Program Office (EARPO), EAME National Committee for Tanzania

**Cameroon:** WWF Cameroon

**Fiji:** WWF Fiji, WWF South Pacific

**India:** WWF India

**Key Governmental Agencies**

**Tanzania:** Departments of Environment, Fisheries and Forestry (Ministry of Natural Resources and Tourism)

**Cameroon:** Ministry of Environment and Forestry, Ministry of Mines, Water and Energy, Ministry of Tourism, Ministry of Town Planning, Ministry of Territorial Administration and Decentralization, Ministry of Scientific and Technical Research, Ministry of Fisheries and Animal Industries, Ministry of Agriculture, Ministry of Transports.

**Fiji:** Departments of Land, Fisheries, Forests, and the Environment; Ministry of Tourism

**India:** Department of Forests, Government of West Bengal; Sundarban Tiger Reserve

**Partner NGOs:**

**Tanzania:** Wildlife Conservation Society of Tanzania (WCST), IUCN, CARE International, CORDIO

**Cameroon:** Association for the Protection of Marine and coastal Ecosystems and Wetlands (APMC, Cameroon Wildlife Conservation Society (CWCS), NGO Partnership, International Centre for Conservation of Natural Resources and Rural Development (CICRNDER)

**Fiji:** Wetlands International, Wildlife Conservation Society

**India:** Gobindapur Palli Unanyan Samitee; Bali Nature and Wildlife Conservation Society, Bali Unayan Parishad, Wildlife Protection Society of India (WPSI), Tagore Society for Rural Development

**Partner academic/research institutions:**

**Tanzania:** Institute of Marine Science, Faculty of Aquatic Sciences and Technology (University of Dar es Salaam), Rufiji Basin Development Agency (RUBADA)

**Cameroon:** IRAD Fisheries and Oceanography Research Station, University of Dschang, University of Douala

**Fiji:** University of the South Pacific Institute of Applied Sciences and Marine Studies Program

**India:** Department of Marine Science, University of Calcutta, Jadavpur University



## ANNEX A: LOGFRAME

PROJECT STRATEGY	OBJECTIVELY VERIFIABLE INDICATORS			SOURCES OF VERIFICATION	ASSUMPTIONS
	GOAL	INDICATOR	BASELINE		
To ensure the long-term integrity of ecosystems by increasing resistance and resilience to climate change					
<b>OBJECTIVE</b>					
To build and strengthen the capacity of conservation practitioners to promote effective vulnerability assessment and climate change adaptation projects and policies	By the end of the project period, vulnerability assessment and adaptation methodologies developed by the project have been adapted for use in several sites (Indonesia, Kenya, Mozambique, Philippines as well as additional sites within Cameroon, Fiji, India, and Tanzania) beyond the 4 areas serving as pilots for this project.	Vulnerability assessment and adaptation are only weakly incorporated into conservation planning because of weak individual and institutional capacity.	By the end of the 3rd year, key stakeholders in the four project countries and in 2 others will be experienced in developing and applying vulnerability assessment and adaptation.	Documentation of completed vulnerability assessments and adaptation pilot projects in four target countries.	<p><i>There are sufficient similarities among countries that a useful generalizable method can be created.</i></p> <p>Countries/communities beyond those included in this study express interest in the methodology.</p>

PROJECT STRATEGY	OBJECTIVELY VERIFIABLE INDICATORS			SOURCES OF VERIFICATION	ASSUMPTIONS
	OUTCOMES	INDICATOR	BASELINE		
<b>Outcome 1:</b> Enhanced capacity in the four project countries to perform effective climate change vulnerability assessments	<p>The completion of 4 vulnerability assessments, and evidence of at least 2 new vulnerability assessments underway for 2 new project areas.</p> <p>Enhanced understanding among communities is demonstrated by replication and uptake of methods at at least 3 new sites within the project focal areas.</p>	<p>There is limited individual and institutional capacity related to vulnerability assessment and climate change adaptation at the national level.</p>	<p>By the end of the project, a core group of national and local stakeholders is experienced in and knowledgeable about the current state of vulnerability assessment and adaptation.</p>	<p>Interviews with relevant communities and organizations to verify increased vulnerability assessment capacity</p> <p>Documentation of method replication in non-project communities.</p>	<p>Participants will remain active in conservation projects within their country.</p> <p>Participants will be sufficiently engaged with the vulnerability process that learning will occur.</p>
<b>Outcome 2:</b> Development and implementation of climate change adaptation measures within target countries that increase resistance and resilience of target ecosystems and enhance the resource base for local communities.	<p>Adaptation plans and policy recommendations devised jointly with national, regional, and local communities for 4 project areas targeted by this project.</p> <p>Increased understanding that biophysical and socioeconomic climate change adaptation go hand in hand is demonstrated by increased incorporation of adaptation methods in 4 pilot sites within the project areas.</p>	<p>Biophysical adaptation projects occur rarely if at all; socioeconomic adaptation and community resource use are seen as opposing biophysical adaptation.</p> <p>Ecosystems deteriorate as climate change progresses.</p>	<p>By the end of the project, four adaptation strategies – one in each country – implemented to demonstrate actions that decrease vulnerability to climate change while enhancing biodiversity and also increasing resource efficiency/improving livelihoods of those dependent on local fisheries and wood use.</p>	<p>Documentation of mangrove restoration in 4 countries; creation of National Park in Cameroon; conservation plans for marine protected areas.</p> <p>Stakeholder interviews.</p> <p>Records of participants' home institutions.</p> <p>Documentation of enforcement activities to show decrease in illegal fishing and wood use.</p>	<p>Inability to control upstream processes will not negate effectiveness of efforts on the coast.</p> <p>Natural disasters that would prevent implementation of adaptation measures will not occur.</p>

OUTCOMES	INDICATOR	BASELINE	TARGET	SOURCES OF VERIFICATION	ASSUMPTIONS
<p><b>Outcome 3:</b> Decreased barriers to vulnerability assessment and adaptation planning globally.</p>	<p>Project methodology is considered for integration with VA/adaptation planning methodologies for biodiversity at the UN and other leading scientific bodies.</p> <p>Adjustments for local socio-economic and environmental conditions are easily incorporated into the methodology as new countries use the manual/guidelines; evidenced by at least 2 new countries using the manual/guidelines.</p> <p>Conservation practitioners integrate climate adaptation plans into 3 ecoregional visions.</p>	<p>Vulnerability assessment and adaptation planning are intimidating to most conservation practitioners around the globe; those that are interested in such activities are often overwhelmed by lack of access to practical information</p>	<p>Stakeholders in project countries are able to apply lessons learned to implement similar projects in other parts of the country.</p> <p>Methods manual allows others to effectively carry out vulnerability assessment and adaptation planning.</p> <p>Links made between sustainable use of wild species and landscapes, livelihoods, food security, and resilience to the impacts of climate change.</p>	<p>Distribution of records for project methods manual.</p> <p>Interviews with communities using the methods manual.</p>	<p>Lack of information is a key barrier to vulnerability assessment and adaptation planning.</p>
<p><b>Outcome 4:</b> Established and strengthened opportunities for knowledge sharing and activities related to climate change adaptation at the national, regional, and international levels.</p>	<p>Stakeholders actively engage in formal and informal interactions at meetings throughout the project.</p> <p>Climate change adaptation planning methodology specifically for biodiversity is presented at relevant global, regional, and national meetings.</p>	<p>Stakeholders are unaware of many local, national, and global sources for adaptation information, and don't know with whom they could discuss these issues.</p>	<p>Improved compilation and dissemination of best practice on vulnerability assessment and biodiversity adaptation plans.</p> <p>Local, regional, and national stakeholders will regularly use new and strengthened networking opportunities for collaboration, knowledge sharing, and support.</p>	<p>Survey of participants and project evaluations.</p> <p>Records of networking activities (e.g. study visits, workshops, etc.).</p>	<p>Project participants are interested in networking, and will continue to interact after the project ends.</p>

PROJECT STRATEGY	OBJECTIVELY VERIFIABLE INDICATORS			SOURCES OF VERIFICATION	ASSUMPTIONS
	OUTPUTS	INDICATOR	BASELINE		
<p><b>For Outcome 1: Enhanced capacity</b></p> <p>Participatory development of vulnerability assessments for each project site.</p> <p>Inventory of selected mangrove and coral ecosystems</p> <p>Increased skills and knowledge among local communities to identify and adapt to climate change threats/impacts.</p> <p>Statistical analysis in Fiji and Tanzania of past coral bleaching events in relation to mangrove proximity/health.</p>	<p>By the end of the first year, vulnerability assessments will have been completed for all project sites (470,000 hectares), as well as computerized inventories of mangrove and coral resources at these sites.</p> <p>By the end of the project, a publishable report in an internationally recognized journal on the relationship between coral bleaching and mangrove health in relation to climate change impacts will have been prepared and published with credit provided to GEF and UNEP and other partners for their role in this project.</p>	<p>Vulnerability assessments do not happen at project sites.</p> <p>Most project sites will not have the computerized resource inventories necessary for adequate vulnerability assessment/adaptation planning and evaluation.</p>	<p>Four completed vulnerability assessments and computerized mangrove/reef inventory for the selected region in each country.</p> <p>Twenty stakeholders trained in vulnerability assessment and the development of adaptation strategies.</p> <p>At least two community members from each project site will be sufficiently involved in project activities to become a resource for their community and educator for adjacent communities.</p> <p>Two reports of statistical analysis of coral/mangrove relationship.</p>	<p>Vulnerability assessment reports.</p> <p>Computerized inventories, accuracy verified by consultation with local experts.</p> <p>Interviews with community members involved in project.</p> <p>Publication of bleaching/mangrove manuscript.</p>	<p>Sufficient information and stakeholder commitment exists to complete an accurate vulnerability assessment.</p> <p>Local communities will be interested in developing skills and knowledge relevant to climate change.</p> <p>Sufficient data exist to adequately address the relationship between coral bleaching and mangrove forests.</p>



PROJECT STRATEGY	OBJECTIVELY VERIFIABLE INDICATORS			SOURCES OF VERIFICATION	ASSUMPTIONS
	OUTPUTS	INDICATOR	BASELINE		
<p><b>For Outcome 2: Adaptation pilots</b></p> <p>Stakeholder workshops in each of four countries.</p> <p>Database of related projects/resources/gaps.</p> <p>Completion of site-appropriate field trials.</p> <p>Enhanced resource base and livelihood security for local communities.</p>	<p>By the end of the 2<sup>nd</sup> quarter of the first year, a database of relevant local and global projects will be compiled and distributed to project executants, partners and other relevant stakeholders (with existing project funding).</p> <p>Initial tests of generalizability of guidelines will take place throughout the WWF network at at least 2 additional sites totaling 50,000 hectares.</p>	<p>Adaptation field trials in project countries do not take place at this time.</p> <p>Resource base and livelihood security of local communities continues to be threatened by climate change and unsustainable resource use.</p>	<p>Twelve stakeholder workshops held – three in each country – to involve local, national, and regional stakeholders in the analysis of vulnerability, the development of adaptation strategies, and to share lessons learned.</p> <p>Database of related projects, resources, and gaps will be available on the internet, and will be distributed to project participants.</p> <p>Four adaptation pilot projects underway in each country.</p> <p>100 people show improved livelihoods based on more sustainable harvesting.</p>	<p>Electronic database.</p> <p>Pilot project reports.</p> <p>Documented use of resource efficient technologies (e.g. more efficient cookstoves).</p> <p>Interviews with local communities within project area.</p> <p>Documented changes in vulnerability level.</p>	<p>There are sufficient commonalities across countries that creating generalizable methods will be possible.</p>

PROJECT STRATEGY	OBJECTIVELY VERIFIABLE INDICATORS			SOURCES OF VERIFICATION	ASSUMPTIONS
OUTPUTS	INDICATOR	BASELINE	TARGET		
<p><b>For Outcome 3: Decreased barriers</b></p> <p>Formal and informal networks within and between countries of individuals and organizations concerned with and knowledgeable about assessment/adaptation.</p>	<p>Stakeholders at all levels will share knowledge, skills, and project results in 15 formal and informal information-sharing settings, aiding the adoption of project methodology in the 4 project areas.</p> <p>Initial tests of generalizability of guidelines will take place throughout the WWF network.</p>	<p>Vulnerability assessment and adaptation activities around the globe remain limited due in part to lack of access to practical, generalizable methods documents.</p>	<p>By the 1<sup>st</sup> quarter of the 3rd year, draft assessment/adaptation guidelines based on project experience will be available for testing in non-project locations; a final version will be complete by the end of the project.</p> <p>Project results presented at 3 national and international meetings by end of project.</p>	<p>Documentation of success of initial tests of guidelines in other regions served by the WWF network.</p> <p>National and international meeting proceedings/agenda.</p>	<p>There are sufficient commonalities across countries that creating generalizable methods will be possible.</p>

PROJECT STRATEGY	OBJECTIVELY VERIFIABLE INDICATORS			SOURCES OF VERIFICATION	ASSUMPTIONS
OUTPUTS	INDICATOR	BASELINE	TARGET		
<p><b>For Outcome 4, Knowledge sharing:</b></p> <p>Increased skills and knowledge among local, national and regional stakeholders to respond and adapt to climate change impacts, and to disseminate project findings for broader replication at multiple scales.</p> <p>Formal and informal networks within and between countries of individuals and organizations concerned with and knowledgeable about assessment/adaptation.</p>	<p>Stakeholders at all levels will share knowledge, skills, and project results in 15 formal and informal information-sharing settings, aiding the adoption of project methodology by new sites.</p> <p>Project participants, both within and among countries, will maintain on-going relationships for support and knowledge sharing about climate change responses through networks on climate adaptation.</p>	<p>Only a small number of stakeholders in any country have sufficient time and experience to effectively respond and adapt to climate change impacts.</p> <p>Stakeholders concerned with and knowledgeable about assessment/adaptation feel isolated and unsure of where to go for resources and support.</p>	<p>At least once a year throughout the study, all stakeholders within a country will meet to discuss plans, problems, and successes.</p> <p>Three meetings of Coordinative Committee to take place annually to coordinate methodologies for vulnerability assessment and adaptation strategies, and for the integration of lessons learned within this and other similar projects and policy processes.</p> <p>Twelve stakeholder workshops held – three in each country – to involve local, national, and regional stakeholders in the analysis of vulnerability, the development of adaptation strategies, and to share lessons learned. (cross-referenced under Outcome 2).</p>	<p>Interviews with stakeholders.</p> <p>Proceedings of stakeholder workshops and meetings of the Coordinative Committee/national/project-wide meetings.</p> <p>Documentation of presentation of project results at a variety of venues (village meetings, government workshops, conferences, etc.)</p>	<p>Networking and collaboration activities during the project will facilitate on-going relationships among stakeholders.</p> <p>Stakeholders have or will develop sufficient credibility that others will listen to what they have to say.</p>