Initial Project Information Document (PID)

Report No: AB71

Project Name	EAST ASIA AND PACIFIC-Investigations of Impacts of Localized Stress and Compounding Effects of Climate Change on Sustainability of Coral Reef Ecosystems
Region	East Asia and Pacific Region
Sector	General agriculture, fishing and forestry sector (100%)
Theme	Other environment and natural resources management (P)
Project	P078034
Borrower(s)	MEXICO, TANZANIA, PHILIPPINES, PNG
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Environment Category	B (Partial Assessment)
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Bank Approval Date	May 14, 2004

1. Country and Sector Background

Coral reefs provide billions of dollars per year in goods and services to the world, yet these values are not fully internalized in decision-making, nor do they take into account the significant cultural and biodiversity value of reefs, which are less easily quantified and even more difficult to monetize. These "market failures", in combination with the short-term planning horizons of decision-makers and inadequate resource governance at the local level, have resulted in increasing pressure on coral reefs. Such pressures include: (i) overfishing and destructive fishing techniques which destroy the physical and ecological integrity of coral reef communities; (ii) land based sources of pollution (e.g., sedimentation, eutrophication and POPs) which suffocate reefs and degrade food chains; (iii) habitat loss from physical alteration and expanding development of the coastline. In the last decade, climate change related impacts (e.g., bleaching, disease, changes in recruitment potential, sea level rise and increased storm frequency and intensity) pose a major new threat to the sustainability of coral reefs, whose resilience may be undermined by cumulative stress from anthropogenic impacts.

To date, government strategies to deal with the degradation and loss of coral reefs (resulting in 35% of the worlds' reefs under severe threat) have been reactive at best, uninformed and fragmented. Management has suffered from a lack of rigorous empirical data which can provide information on stress/response, status and trends, and probability of recovery from major shocks, such as those associated with hurricanes, pest outbreaks, and other climate change related impacts. While the precautionary approach should be adopted in the absence of such data, this option is costly and has proved to be politically unfeasible. Establishing the scientific basis for sound management of coral reefs and linking this information to strategic policies and decision-making would significantly improve the cost-effectiveness of interventions and the likelihood of sustained political will, required to meet the challenges of conserving coral reef ecosystems.

2. Objectives

The Development Objective of this project is to conduct research within a robust framework for systematic investigations into the impacts of climate change and localized human stress on the sustainability of coral reef ecosystems, with direct application to management. A related objective is to build capacity in developing countries to carry out such long-term, targeted research through collaborative investigations and cross-regional learning, involving networks of developed and developing country scientists.

The Global Environmental objective is to fill critical gaps in our understanding of what determines coral reef ecosystem vulnerability and resilience in response to major stressors--from climate change to localized human stress-- and to link this knowledge directly to improving management and conservation of these globally threatened marine systems.

3. Rationale for Bank's Involvement

The **Coral Reef Targeted Research and Capacity Building** project is part of a long-term program to conduct targeted research to fill critically important information gaps in our fundamental understanding of factors which determine coral reef ecosystem sustainability so that management and policy interventions can be strengthened globally. This program is designed to test specific hypotheses about the impacts of major human and natural factors (including disease and climate change) threatening coral reef health and resilience. Through such targeted, systematic research, the program aims to alleviate the chronic lack of well-coordinated, quality-controlled data on stress-response processes and recovery in the wake of major disturbance events, so that science can more effectively support management and policy interventions. This program will also work to *enhance the capacity of researchers and managers within developing countries*, and to strengthen the development and revision of policies for sustainable use and conservation of the world's most biologically diverse marine communities. Findings from this Coral Reef Targeted Research will feed into ongoing GEF operations, and help guide the development of future strategic priorities for GEF interventions in the area of land/water interactions, climate change and biodiversity conservation.

This type of global knowledge creation and capacity building is consistent with the GEF's new strategic emphasis on targeted learning to build indigenous capacity within its clients for strategic and effective environmental decision-making. The Targeted Research is innovative in its approach to build this capacity by creating networks of the best coral reef scientists in the developing and developed world to collaborate on key questions of global concern. The project will, include young professionals in the fieldwork and formal degree level training associated with the research and, through such north-south and south/south partnerships, establish centers of excellence for coral reef research and management in strategic locations coinciding with the distribution of major coral reef ecosystems. The nature of this cross regional/global approach necessarily involves incremental costs which must be borne by facilities such as the GEF and other stakeholders in the marine conservation community. Alternatives to this approach include the no-project alternative, which would perpetuate the problems of uninformed/reactive management rather than science based/pro-active management. A second alternative of country- specific research, while valuable, would not have the spin-off and global learning impact of the networked research and integrated problem solving that is the hallmark of this Targeted Research and Capacity Building Program.

4. Description

The project will provide support for the following four components:

1. Addressing Knowledge and Technology Gaps

Over the past ten years, an increasing awareness of the importance of coral reefs has been evident, especially in light of their rapid decline in many regions, and their significance to developing countries. However, what remains fundamentally unknown about these ecosystems is alarming, especially when management interventions are becoming increasingly important. Significant gaps in understanding some of the basic forcing functions affecting coral reefs remain. This targeted research framework will systematically define those information gaps, and prioritize them in an order of strategic importance to management, so that the resulting information and tools developed can lead to credible outcomes. Furthermore, policies developed at regional and national levels can also be strengthened to help bring about better legislation to sustain the products and services provided to SIDS and coastal communities by coral reefs.

Based on several years of scoping meetings with coral reef scientists and managers around the world, a number of recurrent key themes emerged related to gaps in scientific understanding. These include:

a. the physiological mechanisms and ecological consequences of large area (or massive) coral reef bleaching, particularly in response to sea surface temperature anomalies, like the El Niño/Southern Oscillation episodes, and the potential consequences of their changes in frequency;

b. the nature, severity and spread of coral reef diseases, some of which may be responsible for major shifts in the structure, function and health and sustainability of coral reefs;

c. the importance of physical and biological connections (or "connectivity") between coral reefs, whether within or between different regions of International Waters. This also has direct bearing on the environmental conditions and key design factors needed to establish and sustain effective Marine Protected Areas (MPAs);

d. the tools, technologies and efficacy of restoring coral reefs that have been severely degraded or destroyed, and the key organisms to consider when rehabilitating a given coral reef environment;

e. the application of advanced technology, such as remote sensing, modeling and genetics to refine information and enhance the rate and scale at which knowledge can be generated and applied. This includes the need to modify technology so that it can be practically deployed and sustained within developing countries;

f. the need to develop indicators that can help to anticipate or predict impacts to coral reefs, especially those being actively managed (i.e. MPAs).

Based on these and other unknowns, six scientific working groups have been established as a part of this targeted research framework, and are represented internationally across a broad geographic range. The working groups include members from both developing and developed countries in "twinning" arrangements with both key experts and institutions. The working groups have identified and prioritized critical information gaps, and plans of action have been developed to target the necessary investigations to address them. Research plans, standard methods and development of capacity are being coordinated to maximize the level of effort between as many of the study locations and working groups as possible.

2. Linking Scientific Knowledge to Management

As a result of the investigative priorities, the resulting information (including cost-effective techniques and tools) will be produced, during the appropriate phases within the framework's timeline, to enhance the management of coral reefs. The resulting links between the scientific results and management applications range from in-situ diagnostics (for example, disease assessment and bio-indicators of specific forms of stress and metabolic response), to markers for larval recruitment indicating source and

sink reefs, and remote sensing products and applications to assess the state of coral reef health

3. Promoting Learning and Capacity Building

Within the program framework, targeted research sites and "Centers of Excellence" are being established within four major regions (Caribbean, Eastern Africa, Southeast Asia, and the Pacific) in which to initially focus the work. Site locations include (i) the Mesoamerican Barrier Reef System (UNAM facility at Puerto Morelos, Mexico and Glover's Reef Marine Station, Belize), (ii) Bolinao, northwest Philippines and the University of the Philippines Marine Science Institute, (iii) University of Zanzibar, Tanzania and WIOMSA - the Western Indian Ocean Marine Science Association, (iv) Papua New Guinea, (v) Palau, and (vi) Heron Island, Great Barrier Reef (the University of Queensland, Australia). Other potential locations are also under consideration.

At each of the defined Centers of Excellence, this program is developing learning and capacity building between developed and developing country scientists. Specific learning exchanges are already underway in which a range of researchers have the opportunity to formally exchange ideas, and jointly implement research techniques and methods. Large-scale experimental designs also offer the opportunity to engage both researchers and managers in the design, testing and implementation of the priority, targeted experiments.

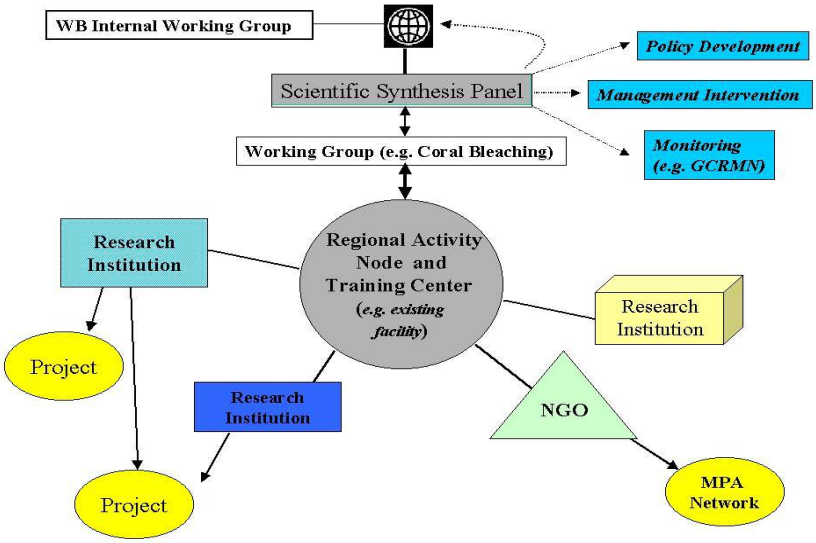

Figure 1. Illustration of the institutional linkages involved in designing, implementing and disseminating the results of investigations in the field. Capacity building will result from collaboration between Centers of Excellence and other research facilities in selected locations with coral reef ecosystems. Research results are channeled to management projects and activities to inform decision making, and to policymakers to introduce needed reforms. Similar clusters of node and satellite institutions are envisioned in each region and some of the working groups may overlap in their use of field sites and clusters to carry out investigations.

4. Modeling and Shaping the Future (Scenario Building for Policy/Decision-making)

A key outcome of this work will be to improve our predictive capability in assessing impacts to coral reef ecosystems in the face of uncertainty, the stresses of increasing coastal populations, and changes in climate. These targeted investigations are being designed to feed into models and decision support systems for managers and policymakers, and to make the information available to a variety of users -- from the scientific and NGO communities to the general public.

A guiding Synthesis Panel, comprised of the chairs from each of the working groups, plus four additional professionals and scientists, directs the targeted research framework. This Panel helps shape the future through adaptive management of the targeted research program. It synthesizes and interprets results, and

modifies the focus of investigations as needed to benefit management and policy. This Panel also serves as a formal interlocutor with other disciplines (such as economics, law, and development) so that progress can be made with the most effective application of research results, and so that a range of scenarios can be examined and evaluated to guide policy, and future decision-making.

5. Financing

Source (Total (US$m))

BORROWER/RECIPIENT ($0.00)
GLOBAL ENVIRONMENT FACILITY ($11.00)
FOREIGN UNIVERSITIES ($9.00)
Total Project Cost: $20.00

6. Implementation

A major study to identify the most appropriate institutional arrangements and flow of funds is currently underway. A group of executing entities in the field will carry out the research, under the technical direction of a Synthesis Panel composed of the chairs of the 6 working groups plus four internationally recognized experts, and under the management direction of a global implementing agency, responsible for overall administration of the project. A number of candidate implementing institutions and their commitment to the objectives of the targeted research are currently being assessed to determine the most appropriate arrangements.

7. Sustainability

This initiative for Targeted Research and Capacity Building must be viewed within a longer time frame than most Bank/GEF projects. This is necessary because coral reefs are influenced by processes over a wide range of time and space scales. Research in other marine environments have consistently identified the need to establish long-term studies (at least 10 to 15 years) to better understand the dynamics and drivers of ecosystems. This is especially true within coral reef ecosystems, and some existing research indicates that coral reefs may fluctuate at time scales on the order of decades. This effort, therefore, is envisioned as a 15 year program, to be implemented in three phases. Although the framework for the Targeted Research will be developed over several phases, information products will be staged for delivery at periodic intervals to provide interim benefits and tools for managers. This will help sustain the commitment that will be required to reap the benefits of targeted investigations over the longer term. This project document focuses on the specific activities to be implemented within the first phase of the 15 year program. As the program develops, the Centers of Excellence become established, and the working groups generate visible benefits to management and policy, it is anticipated that partnerships will expand and additional financing from research institutions, governments and private foundations will become the major source of funding in the subsequent phases of the program. These partnerships are already taking place with a number of the working groups and their members, as specific scientific proposals are already being leveraged and co-funded in concert with the Targeted Research program development.

8. Lessons learned from past operations in the country/sector

Lessons learned from past experience with research initiatives suggest the need to (i) target research on strategic priorities which will significantly enhance knowledge required for effective management, (ii) identify near-to-medium products and tools that can be applied in the interim to demonstrate the benefits of a committed, targeted research program; (iii) ensure transparency and full fledged participation in partnerships between developed and developing countries, and (iv) disseminate knowledge as widely as possible, taking care to tailor messages to different target audiences.

9. Environment Aspects (including any public consultation)

Issues : This project is to be implemented in four specific tropical regions around the world (see Section 3). During the GEF preparation grant (PDF) Block A phase of this project, a large number of consultations and meetings were held with managers and scientists concerning the most pressing issues in framing this targeted research. The consultations gave rise to the identification and formation of the six thematic Working Groups. These working groups engage additional networks of scientists and managers in the issues to be addressed and implementation of the research. Environmental impacts are all expected to be positive as a result of the research.

10. List of factual technical documents:

The list of documents below includes publications and papers in press that have been produces so far by four of the six thematic Working Groups organized under the Project:

Bleaching Working Group

- Nature, Vol 45, 28 Feb 2002: "Reef under threat from 'bleaching' outbreak"
- R.P. Cooney, O.Pantos, M.D. Le-Tissier and J.C. Bythell: 'Comparison of the molecular microbiology of black band disease in corals between the Great Barrier Reef and Caribbean' (*Marine and Freshwater Research*, accepted).
- T.C. LaJeunesse, W.K.W. Loh, R.V. Woesik, O. Hoegh-Guldberg, G.W. Schmidt and W.K. Fitt: 'Symbiotic dinoflagellate (zooxanthellae) diversity occurring in Cnidarians from the Southern Great Barrier Reef compared with the Caribbean' (submitted, 2002)

Remote Sensing Working Group

- P.J. Mumby and eight coauthors. A Review of Remote Sensing for Coral Reefs. Submitted *Marine Pollution Bulletin*

Disease Working Group

- C. D. Harvell and seven coauthors. In prep. New Perspectives on International Impacts of Coral Disease.
- Mullen, Harvell, Jordan, Ward, Alker, Smith, Petes. submitted. Host range and anti-fungal resistance of aspergillosis in three seafan species of the Yucatan. *Marine Biology*.
- Ward, Lafferty, Harvell. in prep (analysis and draft complete). Proxies Reveal Increasing Impacts of Disease in the Ocean. *Nature*.
- Ward, Harvell, Smith, Bruno, Rypien, Jordan. in prep. A Test of the Disease as a Driver of coral Biodiversity Hypothesis.
- Harvell, Pates and Peters. in prep. Mechanisms of Coral Resistance to Disease. (Chapter contributions for a book edited by Eugene Rosenberg, in prep. *Global Coral Health and Disease.*)
- Weil and Smith. in prep. Local and geographic variability in disease prevalence at the species level in the Wider Caribbean.
- Willis, Smith, Ritchie and Paige. Prevalence of Coral Disease in Australia.
- Raymunodo and Kacsmarsky. Prevalence of newly described Philippine Coral Diseases.

Restoration and Remediation Working Group

- L.M. Chou and ten co-authors. A preliminary guide to coral reef restoration and remediation options for managers. Planned for December, 2003.

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Note: This is information on an evolving project. Certain components may not be necessarily included in the final project.