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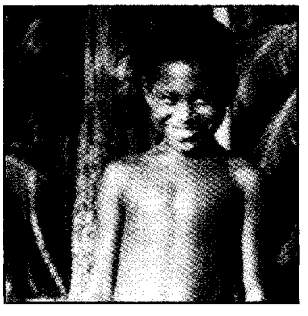

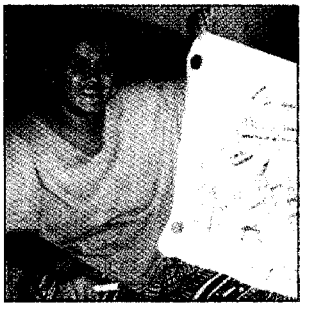

VOICES FROM THE VILLAGE

A COMPARATIVE STUDY OF COASTAL RESOURCE MANAGEMENT IN THE PACIFIC ISLANDS

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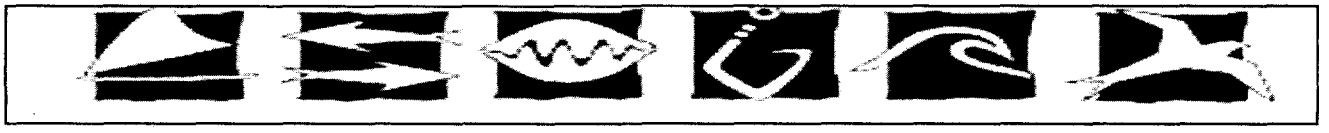

VOICES FROM THE VILLAGE: A COMPARATIVE STUDY OF COASTAL RESOURCE MANAGEMENT IN THE PACIFIC ISLANDS

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World Bank (2000b). *Voices from the Field: A Comparative Study of Coastal Resource Management in the Pacific Islands – Site Visits and National Summaries Annex.* East Asia and Pacific Region, Papua New Guinea and Pacific Islands Country Management Unit. The World Bank, Washington, D.C.

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Acronyms and Abbreviations

AIG	Alternative income generation
AUSAid	Australian Agency for International Department
BCN	Biodiversity Conservation Network
BDM	Beche-de-mer
CPUE	Catch per unit of effort
CRM	Coastal resource management
EASRD	Rural Development and Natural Resources Unit, East Asia and Pacific Region, the World Bank
FADs	Fish aggregation devices
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environmental Facility
ICLARM	International Center for Living Aquatic Resources Management
ICZM	Integrated coastal zone management
Km	Kilometer
NCDS	National Center for Development Studies, Australian National University
NGOs	Non-governmental organizations
OLS	Ordinary least squares
PNG	Papua New Guinea
PRA	Participatory rural appraisal
SPC	The Secretariat of the Pacific Community
SPREP	South Pacific Regional Environmental Programme
URI/CRC	University of Rhode Island's Coastal Resource Center
US$	United States Dollar
WB	World Bank

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Executive Summary

INTRODUCTION TO THE STUDY

The lives of the people who live on the 2,700 islands of the Pacific are closely intertwined with the ocean. In this vast ocean area of 30.6 million square kilometers, Pacific Islanders continue to depend heavily on the marine life in the coastal waters for food and income. Much of the culture of the islands — its way of life, traditional beliefs and recreation — is linked to the coastal areas.

Coastal areas, however, are facing many challenges. Population growth and the need for cash income have led to overexploitation of fish and shellfish resources. The lagoons, coral reefs, and shores are being threatened by pollution, siltation, and the construction of coastal infrastructure facilities. Moreover, the government agencies of most of the islands are not structured in a way that would enable them to carry out the integrated efforts that may be needed to deal effectively with the threats to coastal resources.

In 1998-99, the World Bank sponsored a survey of coastal communities in five Pacific Island countries – Fiji, Palau, Samoa, Solomon Islands and Tonga. The purpose of the study was to strengthen the understanding, among the region's coastal managers, of the factors that contribute to the successful management of coastal resources. The study was based on a six-months survey of 31 coastal communities and was carried out by a regional team composed of a study coordinator based in Fiji and a national consultant in each of the five countries. A World Bank team assisted in the study design, final analysis, and reporting.

The study relied primarily on community perceptions of trends in the condition of coastal resources and factors affecting resource management at the village level. There were two reasons for this approach. First, there had never been a comprehensive ecological survey of the condition of coastal resources in the Pacific Islands, and the time and costs that would have been required were beyond the scope of this study. Second, most of the decisions that have an effect on coastal resources are made by local communities based on their own perceptions of resource conditions. A better understanding of these perceptions was therefore believed to be essential to help Pacific Island countries and donor agencies formulate appropriate coastal resource management policies and programs.

The study sought to address the following questions: What are the factors external to the communities that are most likely to affect coastal resource management? What are the site-specific characteristics that influence management success? Which management processes are most conducive to successful coastal resource management? Also surveyed were the perceptions of community groups regarding coastal resource trends, the need for external assistance, the relevance of national legislation to the communities, the effectiveness of partnerships between communities and external organizations, and lessons learned from marine sanctuaries and income-substitution policies. Given the uncertainties that still surround these complex issues, the study's conclusions are presented as key lessons learned, and the recommendations are kept as specific as possible.

To assess the impact of coastal management, small focus groups were asked about their perceptions of trends in four major indicators:

- catch per unit of effort;
- habitat condition;
- threats to coastal resources, and
- compliance with resource management rules.

The perceptions about changes in these indicators during the past ten years were obtained through interviews with 133 focus groups, composed of either elders, women, or men resource users. In addition, the study team collected information from various community sources on factors that may affect management success: external factors, such as natural disasters and national policies; site characteristics, such as the quality of local leadership; and management processes, such as interaction with external partners (e.g., fisheries agencies) and the involvement of village stakeholders in decisions regarding resource use. The answers from the community were complemented by study team observations of site conditions and interviews with representatives of government agencies and external partners.

The findings of the study are described in Chapters V to VIII. Chapter V summarizes the site characteristics. Chapter VI reports on community perceptions of resource trends. Chapter VII describes the quantitative analysis of the factors that influence management success, and Chapter VIII presents findings on the key issues addressed by the study. The results chapters are organized independently, allowing readers to select sections that best meet their interests. Lessons learned

and specific recommendations are summarized in Chapter IX.

KEY RESULTS

Coastal resources are perceived to be declining... Community groups were generally pessimistic about resource trends. Only 10 percent of the responses stated that catch per unit of effort had improved over the last decade, and only 3 percent associated such an improvement with management interventions. Perceptions about habitat conditions and threats to coastal resources were more optimistic, with about half of the responses seeing negative trends. Several of the communities where resource were perceived to be declining were villages with low population densities, suggesting that even in remote areas, the impact of a few efficient commercial fishers on the exploitation of fragile coastal resources should not be overlooked. Overall, the study results indicate the need for much greater attention to coastal resource management throughout the region.

...and the nature of the threats to coastal resources appears to be changing. Communities perceived pollution as the fastest rising threat to coastal resources, while destructive fishing was perceived to have declined the most. Threats caused by overfishing, siltation, and mining fell between these two extremes. Overfishing and destructive practices, however, were commonly identified as among the most important threats to coastal resources at the study sites.

The outlook for coastal resources is perceived to be bleak... Respondents at 21 of the 31 sites believed coastal resources would continue to decline in the future. In village after village, people whose livelihood depended on the health of coastal resources argued for stricter enforcement of existing regulations and additional restrictions on commercial harvesting. There were, however, some notes of optimism: in Samoa, respondents at five of the six sites believed that resources would improve in the future because of recent community management efforts. And in Luaniua (Ontong Java, Solomon Islands), the community adopted an extended ban on their own fishing for trochus and beche-de-mer despite depending on coastal resources for 70 percent of their income. This suggests that communities are willing to make sacrifices to gain long-term benefits if they are aware of the potential benefits and are guided by strong local leadership.

Simple management rules work best... In general, the following types of rules were perceived as achieving the most compliance:

- national regulations which were seen to be relevant to the community and which were subsequently adopted by village leaders as local rules;
- national rules enforced by buyers or exporters, such as the national ban on trade in crocodiles in the Solomon Islands; and
- marine sanctuaries, closed seasons for specific fisheries, and rules restricting destructive fishing practices (e.g., a ban on night diving).

The results of the study also indicate that the simpler the national rules, the better they are understood and followed by coastal communities.

... while open access constrains community action. Eight of the 31 villages lacked any mechanisms to exclude outsiders from using their coastal site. With one possible exception, none of these open access sites had developed local rules for managing coastal resources. By contrast, all of the restricted access sites had adopted local management rules, indicating that the authority to restrict access by outsiders is a powerful incentive for community-based management. Compared with restricted access sites, open-access communities perceived threats to coastal resources to be increasing faster and felt less capable of dealing with local threats. Open access communities also tended to have less awareness of the benefits of coastal resource management.

Most alternative income generation programs do not appear to have been successful in reducing pressure on coastal resources... Many external programs in the Pacific have introduced alternative ways to earn income —such as aquaculture, offshore tuna fishing and deep slope fishing — to decrease pressure on coastal fisheries. Community perceptions at the study sites indicate that these programs have generally not been successful in reducing pressure on coastal resources. Commercial aquaculture operations were seen to be facing marketing difficulties. Tuna fishing did, in some cases, provide by-catch at the village level, but there was a perception that crew members were often not coastal fishers. At several sites, villagers stated that the ice plants introduced to support offshore fishing had actually helped opened up new markets for fresh coastal products and therefore

increased their exploitation. This suggests a need to explore income generation opportunities outside the fisheries sector, should they exist.

... and some of the most valued partners play primarily an advisory role to the communities. Fifteen study sites (48 percent) were being assisted by external partners in managing their coastal resources. In general, communities perceived the benefits of partnerships to outweigh their shortfalls, but communities and external partners tended to have different perceptions about the benefits of the partnership. Local communities focused on short-term, tangible benefits, while external partners were more interested in process-oriented results (e.g., strengthening local management institutions). Communities perceived unkept promises, inadequate consultation, and slowness in achieving results as the main flaws of the partnerships, while the external partner focused on the failure of villagers to fulfill their commitments. The study also found that while external partners felt that they had made strong efforts to provide information to the communities, there was often little evidence that villagers had absorbed the information provided.

In general, partnerships fell into two categories: those which were largely initiated by the external partner (Category A), and those where the community itself requested the assistance (Category B). Category A partnerships tended to be found at sites of internationally recognized biodiversity importance, and often involved the introduction of new processes at the village level. Although the time needed for these processes to be absorbed was much longer than for Category B partnerships, the donors supporting Category A partnerships tended to have a shorter funding horizon than the national agencies and local NGOs which were typically involved in Category B partnerships. Mechanisms to ensure longer-term funding for Category A partners should therefore be considered. Community satisfaction with Category B partnerships seemed to be pronounced. These external partners were perceived as fulfilling the role of an 'honest broker', providing quick and sound management advice to the communities. Often, these partnerships relied on little more than technical support and awareness raising, and were effective at relatively low levels of funding.

Sanctuaries seem to act as catalysts for community awareness of the benefits of coastal resource management... Marine sanctuaries were found at 14 of the study sites. In general, communities had favorable impressions of the sanctuaries' impact. Compliance was perceived to be good, and key species were thought to be increasing in abundance. The communities also felt, in general, that the sanctuaries would be sustained into the future. Perhaps as relevant as their management role, sanctuaries seemed to act as catalysts in increasing community awareness of the benefits of coastal resource management. The study team found, however, that greater attention needs to be paid to ensuring that the results of ecological monitoring are available to villagers, that no-take rules inside sanctuaries are strictly enforced, that sanctuaries are properly located and sized, and that villagers clearly understand the sanctuaries' objectives and benefits. Moreover, while the benefits of sanctuaries were generally perceived to be positive, they did not eliminate the need for other management interventions.

Communities need help... Community-based management was found to be deficient in five major areas: first, the villagers felt that some form of outside assistance was needed to handle coastal pollution, mining operations, commercial overfishing, and other threats such as dredging, construction of causeways and drilling for oil. Second, nearly 40 percent of the villages lacked mechanisms to control their own fishing effort. Where such mechanisms existed, external partners had acted as catalysts for community action, or the village benefited from strong local leadership and from a high dependence on coastal resources. Third, communities had difficulty in enforcing local rules when it was unclear whether the rules conflicted with national laws (this was particularly true in Fiji and the Solomon Islands). Fourth, communities might need access to expert advice on technical aspects of resource management. And finally, many communities seemed to lack ways to prevent their leaders from engaging in private business interests which may conflict with their management responsibilities towards the community.

... yet coastal resource management seems to be receiving low priority. In general, the study found a need for greater government attention to coastal resource management. Only one fourth of the staff time of national fisheries agencies was estimated to be spent on coastal management matters. Given the low priority accorded to coastal management, it is not surprising that only about 40 percent of the villages had been visited by a gov-

ernment official to discuss coastal resource management issues during the last decade. Half of the sites visited were also receiving funding support from donors, suggesting that donor assistance is being used in some cases as a replacement for much needed government support.

Further collaborative efforts are needed, but perhaps of a different kind than presently provided. Overfishing was the most frequently perceived cause of catch declines and one of the most important threats found at the study sites, yet in many cases it could not be addressed adequately by current regulations. Programs may be needed to strengthen the communities' awareness of the need to restrict their own fishing effort, and to restrict the issuance of commercial licenses. In addition, many of the threats that, in the view of respondents, require some form of external assistance — for example, coastal pollution, mining, coastal infrastructure construction — cannot be controlled only by the institutions that traditionally have a mandate for coastal resource management (the fisheries and environmental agencies). Mechanisms are needed to coordinate government assistance across multiple sectors, a major institutional difficulty in Pacific Islands where inter-departmental cooperation remains weak. The study also indicated that the type of research that coastal communities most need may not require complex stock assessment, but instead a better understanding of the socio-economic incentives that affect resource use, and the development of simple technical solutions to assist communities in managing their coastal resources.

Which factors affect perceived success at the site level? The relatively small number of sites, along with data constraints, made it difficult to distinguish the effects of multiple factors on perceived indicators of successful resource management. However, some general conclusions can be drawn. Among factors external to the site, natural disasters (e.g., cyclones) were significantly associated with the perception that fish catches were recovering and habitats had improved following a major event. The study also provided indications of the national policies that may be needed to support community-based management of coastal resources: simple and clear national regulations, an enabling framework facilitating the adoption and enforcement of local rules, awareness programs aimed at local leaders, assistance on technical aspects of resource management, and inter-sectoral collaboration to address land-based threats to coastal habitats.

Among site-specific factors, sites with good local leadership and complex ecosystems had significantly lower perceptions of threats to coastal resources. Communities which shared the benefits or losses of management equally among their members perceived more positive catch trends and lower threats than other communities surveyed. The presence of pollution at a site caused perceived habitat trends to be worsening. Population growth rates and density did not appear to have a negative impact on the perceptions of successful management of coastal resources. However, the presence of nearby settlements resulted in perceptions of worsening habitats and increasing threats. The presence of modern fishing technology led generally to perceptions of increased catches, reflecting improved access to distant fishing grounds. More educated villages tended to perceive worsening habitat trends, presumably due to higher awareness of human impact on coastal habitats. High local awareness and effective local enforcement were also seen as important factors in management success.

Are stated perceptions true perceptions? Perceptions of resource trends were found to be remarkably consistent at any particular site. With the exception of habitat trends, the study found no statistically significant differences between the perceptions of the focus groups of similar characteristics. Perceptions of compliance with management rules appeared to be the only indicator where there might be a clear incentive to underreport the incidence of violations, but the indicator remains useful to compare the perceived compliance with the various management rules.

The present study departed from conventional survey methods by relying heavily on the perceptions of coastal communities. This produced useful insights as well as some unexpected findings that are relevant to the management of coastal resources in the Pacific. This experience indicates that in future studies, careful attention should be given to the views of coastal communities. It is those villagers who are dependent on coastal resources, who play a major role in the success of any management system, and who have the greatest stake in whether the system succeeds or fails.

I. Introduction

IMPORTANCE OF COASTAL RESOURCES[1]

Pacific Islanders are closely linked to their coastal environment. For the 2.6 million people who inhabit the small islands of the Pacific, the coastal areas are vital to their nutrition, welfare, culture, and recreation.

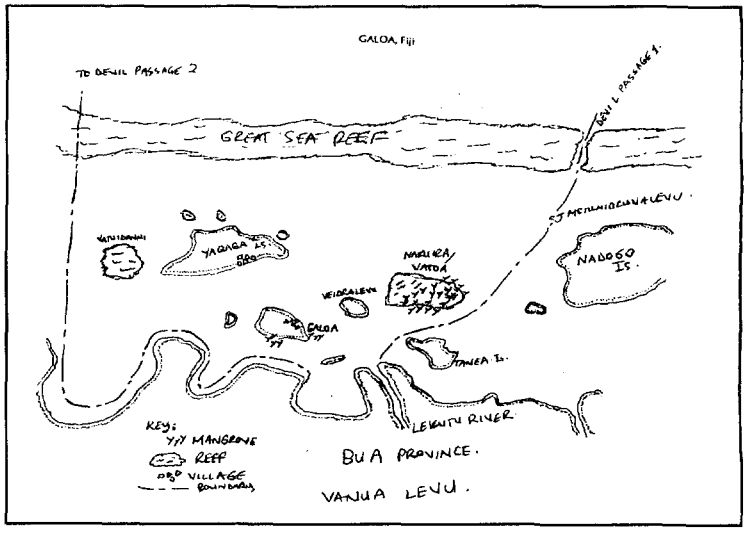
Fish and other marine resources provide Pacific Islanders with US$262 million in annual revenues and 39 percent of the total animal protein in their diet, compared to 16 percent for people worldwide. Without subsistence fisheries, individual countries would have to import an additional US$3-8 million a year in substitute foods. Tourism, which is also highly dependent on the quality of the coastal environment, provides the islands with an estimated US$1 billion in gross revenues annually (World Bank, 1995; Laureti, 1992; Dalzell and Adams, 1994; Pacific Business, 1998). And the coral reefs, mangrove systems, and rocky barriers of the coastal habitats play a key role in erosion control, reducing the islands' vulnerability to cyclones, tidal waves, and other natural disasters.

For centuries, ways of dealing with the ocean have shaped the culture of Pacific Islanders, and aquatic sports, marine totems and taboo areas continue to be essential aspects of the Pacific way of life.

EVOLVING PRIORITIES

The way Pacific Islanders interact with their coastal resources has been evolving throughout the region. Historically, many coastal communities did not distinguish between land and coastal waters in setting village boundaries. The village territory simply extended to the outer edge of the reef (see Figures 1 and 2). To allow for coastal resources to regenerate, communities adopted local management rules such as special areas where harvesting was prohibited. People from outside the community were often excluded from harvesting inside community waters.

These traditional systems have proven remarkably resilient to recent challenges, such as the introduction of laws entrusting national governments with the responsibility for managing



Figures 1 and 2. A typical coastal area in the Pacific (Aleipata, Samoa). Figure 2 shows a community demarcation of their coastal area in Galoa, Fiji. The community coastal boundaries extend from the land to the outer edge of the reef, delineated by the two reef passages.

coastal resources. In recent years there has been a growing awareness that centralized management has not been effective and that local communities must have greater involvement in coastal management efforts.

At the national level, fisheries agencies are generally responsible for coastal resource management. Estimates from this study indicate, however, that less than one fourth of the working time of fisheries agencies is spent on coastal management. The remaining is typically spent on routine administration and fish-

[1] For a definition of coastal resources, see Chapter II.

eries development. In some countries, the emphasis on coastal management may have actually declined in recent years.

Environmental agencies are relative newcomers to coastal management and often operate in partnership with nongovernmental organizations (NGOs) in promoting marine conservation programs. The separation between fisheries and environmental groups also extends to regional organizations. The Secretariat of the Pacific Community (SPC) provides management assistance on coastal fisheries to its 22 island member countries and territories, while the South Pacific Regional Environmental Programme (SPREP) is involved in marine conservation and integrated coastal zone management (ICZM).[2] The impact of conservation programs on coastal areas is unclear, but attempts at ICZM have met with limited success to date.

KEY ISSUES

The Pacific Islands face numerous challenges in managing their coastal environments:

- **Population and Economic Pressures:** Between 1970 and 1990, the Pacific Island population grew by 2.2 million people, an annual growth rate of 2.3 percent. Combined with a low annual economic growth of 3.1 percent in recent years and weak prices for agricultural commodities such as copra and taro, the commercial harvesting of coastal resources has intensified, leading to overexploitation (NCDS, 1994; World Bank, 1998).

- **Ecological Degradation:** Pollution and sedimentation caused by poor logging practices, human waste and agricultural run-off have contributed to the degradation of coastal habitats. In Samoa, the costs of urban pollution in terms of lost reef fisheries revenue are estimated at about US$170 per hectare per year (World Bank, 1995; Zann, 1991).

- **Weak Institutional Coordination.** Government agencies in many Pacific Island countries are structured along sectoral lines (fisheries, tourism, public works) with weak central planning agencies. This kind of structure makes it difficult to carry out the integrated efforts that may be needed to manage the coastal environments of small island countries.

- **Low Awareness.** Among many high level policy makers, there is little awareness that coastal resources may be declining to critical levels and that management is necessary for their recovery.

- **Technical Challenges.** Since the early 1970s, conservation experts have favored the creation of closed areas (sanctuaries) as a better way to manage coastal ecosystems than other forms of management, such as outright bans on fishing for particular species or harvesting quotas. The relative effectiveness of sanctuaries as opposed to other forms of management is not well known, however. Similarly, the impact of alternative income-generation programs (such as aquaculture) in relieving overexploitation of coastal resources remains largely unknown.

Pacific Island communities play a vital role in coastal resource use. Community decisions to manage and use coastal resources are based on local perceptions and the socio-economic factors judged to be important at the local level. A better understanding of these perceptions is therefore essential to help Pacific Island governments and external donors formulate appropriate national policies and coastal programs. This study provides this perspective from the point of view of 31 communities in five countries (Fiji, Palau, Samoa, Solomon Islands and Tonga). The authors hope that the study findings will contribute to an improved knowledge of the factors that affect coastal resource management throughout the Pacific.

[2] ICZM seeks to use inter-sectoral approaches to deal with the multiple threats affecting coastal zones.

II. Previous Studies

The great majority of surveys of coastal resources on Pacific Island countries have focused on biological assessment. There have also been numerous anthropological and socioeconomic studies of coastal areas but, for the most part, these have been case studies of individual communities, countries, or regional reviews (see, for example, Adams and Ledua 1997; Adams 1997; Crocombe 1994; Eaton 1985; Holthus 1991; Hviding and Ruddle 1991; Johannes 1994, 1978; Munro and Fakahan 1993; Preston and Wright 1990; Ram 1981; UNDP 1991; Veitayaki 1990). Case studies are important to gain in-depth knowledge about a particular site's conditions, but the different methods used can make cross-site comparisons difficult.

This study used a baseline-independent method similar to the ICLARM-URI/CRC survey of villages in the Philippines (Pomeroy, Pollnac et al., 1996 and 1997)[3] which investigated community perceptions of changes in social and economic variables resulting from the implementation of the Central Visayas Regional Project. The project, funded by the World Bank, included community-based management interventions in coastal areas, such as the establishment of marine sanctuaries and artificial reefs. The survey relied on respondents' perceptions of changes in such indicators as local income, community conflict, and control over resources prior to and after the project. The results indicated that level of education, income from outside the household, and the ability of community members to cooperate with each other were the most relevant variables in explaining the project's perceived impact on human behavior. The impacts on natural resources and household well-being were explained primarily by the perceived level of degradation prior to the project implementation, the community ability to work together, and the degree of community participation in project planning. The survey is now being expanded to villages in both the Philippines and Indonesia.

The ICLARM/URI study benefited from the fact that all of the villages surveyed were subjected to common project interventions. On the other hand, the study was conducted in a relatively small number of villages, and hence the variables which explained success could not be compared at the site level.

The Biodiversity Conservation Network (BCN), a grant program administered through the World Wildlife Fund, The Nature Conservancy and the World Resources Institute, conducted an evaluation of 20 projects in the Asia and Pacific region in 1998 to determine whether or not micro-enterprises created to provide alternative sources of income to communities helped achieve conservation goals (Salafsky, N. et al., 1999). The study sample consisted of 48 micro-enterprises. Conservation impacts were measured based on perceptions of the reduction of threats to the site, a measure of future conservation success, and ecological monitoring data. The study results, released in September 1999, found that micro-enterprises could be an effective tool for conservation but only when used in conjunction with other management interventions and under particular conditions. The study found, however, that cash benefits were not necessary for conservation success. More important were non-cash benefits such as improved village facilities, an increased sense of empowerment, or better environmental conditions. The BCN survey benefited from a rigorous methodology built around a single hypothesis (BCN 1998, 1999). A modified version of the threat reduction index developed by BCN was used in this study.

In 1997, the World Bank conducted a review of Integrated Conservation and Development projects in Indonesia at 21 national parks. The study's findings were based on site visits, reviews of project documents, and interviews. The study found that there were weak links between conservation and development activities, and concluded that large development projects and weak regional planning were often a greater threat to the parks than the activities of nearby inhabitants (World Bank, 1997). White, Hale et al. (1994) also produced a comprehensive review of lessons of experience with collaborative and community-based management systems in coral reefs.

While much has been learned through the contribution of studies such as those and other socio-economic reviews, overall knowledge of the effectiveness of different types of coastal management remains fragmentary.

[3] Pomeroy, Pollnac et al. (1997) also review the available literature on factors which may be important in determining coastal management success.

III. Methods

STUDY OBJECTIVE AND KEY AUDIENCES

The objective of this study was to strengthen the understanding of factors contributing to the successful management of coastal resources in the Pacific Island region, from the perspective of coastal communities. The study was targeted to coastal resource managers in the Pacific at the governmental, NGO, and regional organization levels. Secondary audiences included the communities surveyed, policymakers, and coastal management experts worldwide.

STRATEGIC CHOICES

The study originated from a request by the Fiji Fisheries Director in 1997 to assess the strengths and limitations of community-based management in coastal areas. Subsequent discussions with regional experts and NGOs indicated that a comparative study of this type would provide a useful contribution to emerging coastal management initiatives in the Pacific Islands. It was felt, however, that focussing the study in Fiji would limit its relevance to the region. On the other hand, applying it to a large number of countries might overlook socio-cultural traits unique to each country. A focus on five countries — Fiji, Palau, Samoa, Solomon Islands, and Tonga — was therefore chosen as the optimal scope for the study.

In selecting the number of sites to be surveyed, the study team considered the trade-offs between in-depth coverage of only a few sites or a less comprehensive analysis of a larger number of sites. The final choice of 31 sites was made based on the available funding and the need to have a sufficient sample to conduct a quantitative analysis.

The term "coastal resources" generally includes both living and non-living components of the zone of waters from the shoreline to the outer edge of the reef (or, where no reef exists, the open ocean). Only living resources and their habitats were included in the study. Successful coastal resource management was defined to include all interventions that contribute to improved overall benefits from resource use. It also included interventions that meet conservation goals in protected areas (such as turtle protection).

In order to understand the factors influencing the success of management of coastal resources, a survey team would ideally obtain data for different sites and different years. Such data with both a spatial and a time dimension is referred to as a panel data set (Hsiao 1986). Unfortunately, no comprehensive ecological survey of coastal conditions, let alone panel data, existed for the Pacific. There was also no common project intervention across many sites that would allow for an evaluation of coastal management impact. Conducting an ecological survey was ruled out for several reasons: first, it would have required surveys in more than one season, and this was beyond the timing and funding available for the study. Second, a survey of this type would produce only a baseline: it would have been difficult to distinguish any long-term trends.

Given the above challenges, the survey team used a baseline-independent methodology which relied on community perceptions of ecological trends over a period of a decade. The advantage of this approach is that a time dimension – the perception of changes – can be added to what is essentially a spatial data set, thus enriching the analysis.[1]

Aside from a rapid assessment of the sites' conditions carried out by the study team, little attempt was made to validate community perceptions. Whether or not they reflect the state of the resources, they influence local decision making and need to be understood as stated.

ANALYTICAL FRAMEWORK

For the purposes of the study, coastal management success at a site$_i$ was thought to depend on the following factors:

$$\textit{Perceived Success}_i = \textit{function of } (\textit{Ext}_i, \textit{Site}_i, \textit{Process}_i)$$

where

Perceived Success$_i$ is measured by community perceptions of various ecological indicators at a particular site$_i$ as determined by:

Ext$_i$ - factors external to the site which may affect success (e.g., major cyclones)

Site$_i$ - intrinsic site factors, such as socio-cultural characteristics (e.g., leadership), pressure on resources (e.g., population density), and ecosystem characteristics

Process$_i$ - processes relevant to management at the site level, such as how the community shares the benefits and losses from resource use.

[1] The study team is grateful to Richard Pollnac, Ruud Koning and Herman Cesar for their suggestions on this section.

KEY ISSUES ADDRESSED

Within the above framework, the study sought to assess the following issues:

- *Factors external to the community that are likely to affect site management;*
- *Key site-specific characteristics that influence management success; and*
- *Processes most conducive to site management.*

The study also sought to address a number of "burning issues" relevant to coastal management:

- *Community perceptions about key ecological trends;*
- *The optimal roles of communities and governments in coastal resource management (e.g., what are some of the limitations of community-based management and where is external assistance most needed?);*
- *The relevance of national coastal management regulations;*
- *Perceived constraints of open-access regimes;*
- *Perceived effectiveness of external partnerships;*
- *Lessons learned from marine sanctuaries; and*
- *Perceived impact of income-substitution programs.*

THE STUDY TEAM

The study was implemented through the collaboration of a regional team responsible for carrying out the survey, and a World Bank team responsible for the quantitative analysis (Fig. 3).

The regional team included a regional coordinator in Fiji who worked with a local consultant in each country. The five local consultants were selected on the basis of their expertise, knowledge of the country, ability to use participatory appraisal methods, commitment to the study, and ability to work independently. Two were seconded from government agencies, one was from a local NGO, and two were private consultants. During the initial design, the team was also assisted by two specialists in participatory rural appraisal (PRA).[5] A cultural advisor

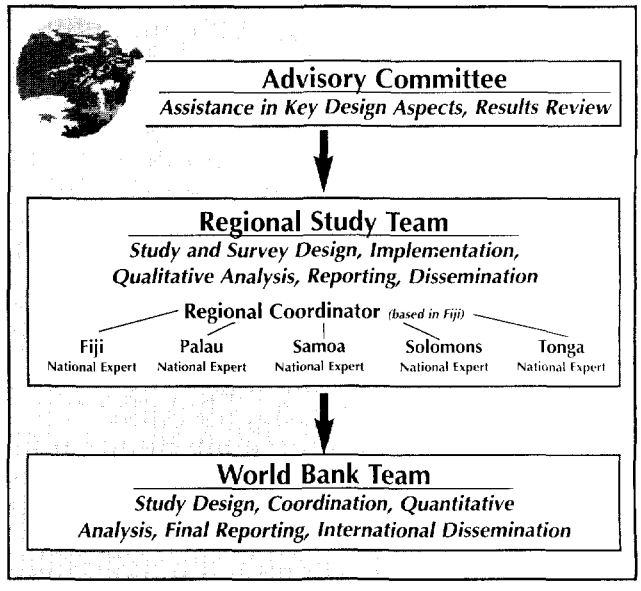


Figure 3. Study Team Composition and Responsibilities

in each country helped adjust the survey to local conditions.

An 11-member advisory committee assisted the study team in the final design of the survey methods. The advisory team included coastal management experts from SPC, SPREP, the University of South Pacific, the Food and Agriculture Organization of the United Nations (FAO), NGOs, and an anthropologist involved in the ICLARM-URI/CRC initiative (see Chapter II). The advisory panel and the study team held a workshop in Fiji in June 1998 to discuss site selection, identification and refinement of success factors, and the survey questionnaire. Following a training session on PRA, the regional team tested the questionnaire at the village of Mua-i-vuso near Suva. Based on this test, the questionnaire was extensively revised, and minor adjustments continued to be made during the first three site surveys.

The World Bank team initiated the study, collaborated with the regional team in the design, carried out the quantitative analysis of the study's results, and compiled the final report.

COUNTRY SELECTION

The five study countries were chosen from the three major island groupings in the Pacific (Melanesia, Polynesia, and Micronesia) to represent a range of coastal management conditions which the study team wanted to examine (Box 1):

[5] PRA techniques are simple visual tools that are used for participatory planning. They include, for example, simple resource maps (see Figure 9), or pairwise comparisons of resource importance, where respondents are asked simply to state whether a certain resource "x" is more important than resource "y".

Box 1: Country Selection

Fiji:	*A country with strong, but eroding traditions of traditional marine management, which is exposed to many threats found in other Pacific Island countries;*
Palau:	*A country with solid NGO involvement in coastal management that has made strong efforts to improve public awareness of coastal management problems, and where coastal resources are exposed to poaching from South-east Asian countries;*
Samoa:	*A country with a recent interest in community-based management of coastal resources and the establishment of marine sanctuaries;*
Solomon Islands:	*A country with complex ecosystems where coastal resources are suffering from degradation caused by overexploitation, over-population and land-based activities;*
Tonga:	*A country with no modern marine tenure systems, containing many low islands and centralized coastal management.*

SITE SELECTION

The 31 study sites were selected in consultation with the study's advisory team, national consultants, government agencies, NGOs and other groups at the national level. The sites were not selected at random, but were chosen to cover a range of conditions which were believed to influence management success (Fig. 4).

Range of Conditions Used for Site Selection

Successful Sites	Non-successful Sites
Non-Conservation Sites	Conservation Sites
Community Established	Externally Established
Functioning Customary Marine Tenure (CMT)	Absent (or inoperational) CMT
Low Islands	High Islands
Isolated Sites	Peri-Urban Sites

Figure 4 - Site Selection Criteria

The study team selected 2 or 3 "focus" sites in each country for in-depth analysis. Focus sites were those believed to result in the most significant lessons of experience. Site visits in focus sites averaged five days each. Three or four "supplementary" sites were also selected for less-detailed analysis. Site visits in supplementary sites averaged two days each.

For the purposes of the study, a site was defined as the coastal area perceived by the community to be within its ability to manage. This generally coincided with the coastal area adjacent to the community and excluded fishing grounds in distant waters. The location of the sites and their characteristics are discussed in Chapter IV.

IMPLEMENTING THE SITE SURVEY

The site surveys took place between July and December 1998. Country surveys were completed in Fiji (July-August 1998), Tonga (August-September), Samoa (September-October), Solomon Islands (October-November) and Palau (December). To ensure consistent interpretation of the questionnaire across all sites, the regional coordinator joined the national consultants in the first half of each country survey.

PRA tools, structured questionnaire interviews, study team observations, and open-ended questions were used to collect information for the survey. Prior to visiting each village, the study team collected census data, maps, and other information about each site. Each visit began with the customary formalities; an earlier contact was sometimes needed to work out the timing of the survey. Where deemed appropriate by the local consultants, the villagers were compensated for the time spent with the survey team in accordance with local practices.

The study team used a multi-level questionnaire for different informants (Fig. 5). The first meeting was held with village leaders and was used to collect general information on the village, key population groups and village history. The degree of village control over access to coastal waters, and past external shocks affecting coastal resources (e.g. cyclones) were also assessed during this meeting. At focus sites, the meeting with community leaders was followed by a large village meeting where PRA tools were used to create site maps and collect general information on resource use. This general meeting helped stimulate the interest of villagers in the study, and to discover the names used in the vernacular for coastal habitats and resources: villagers might understand a reef system as including many different habitats, such as reef passes, the wave impact zone, an outer reef flat, etc. (Figs. 6-8).

Information on specific factors, such as education, dependence on resources, and integration into markets was collected from appropriate groups — that is, teachers, women, shopkeepers. Information about

The Study Survey: A Multi-Level Questionnaire

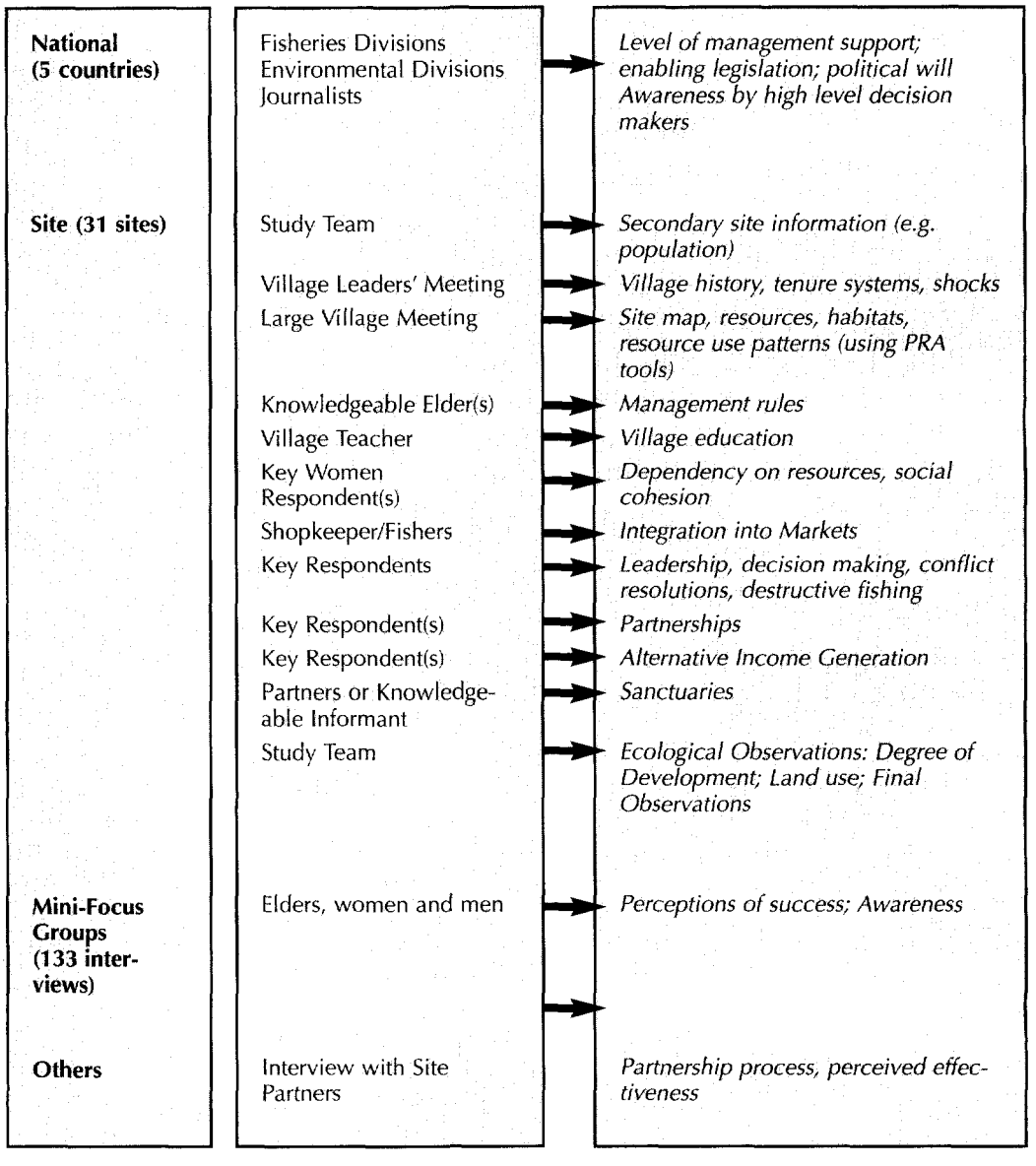
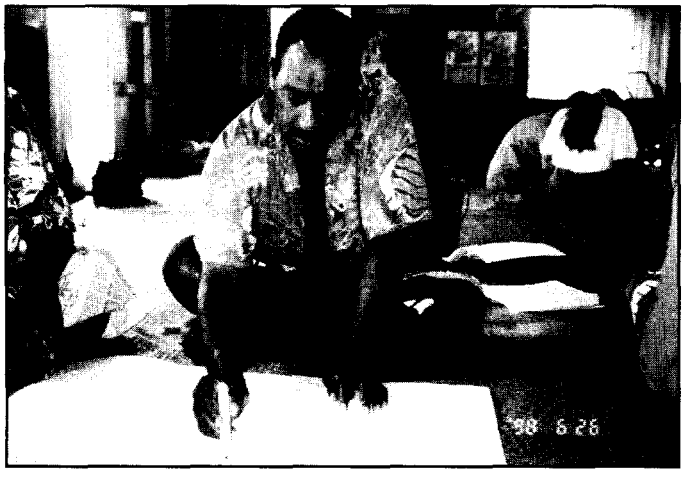
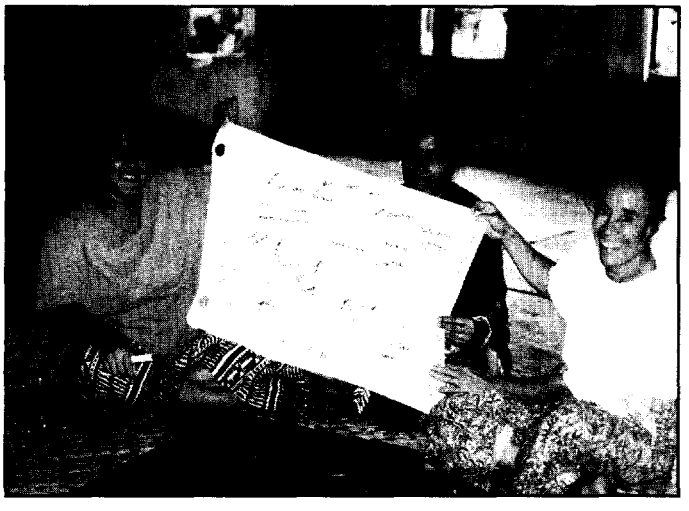


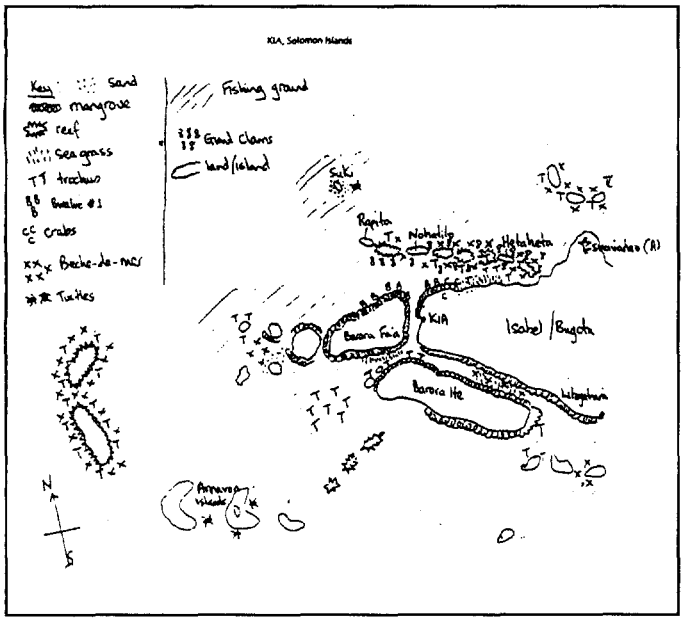
Figure 5. The Study Questionnaire

such sensitive matters as village leadership and conflicts was collected from key respondents. The study team also conducted rapid site assessments to determine the type of land use, ecological conditions, and the level of village development (for example, whether there was public electricity available 24 hours a day).

The study distinguished between information which was clearly subjective — such as perceptions of success and awareness of coastal management — and objective site characteristics which could be subject to response bias, such as past conflicts with poachers. In the latter case, the answers were verified by posing the same question to one or two other respondents until a consistent answer was obtained. Perceptions of management success, which are subjective by nature, were obtained through interviews with small focus groups of resource users (see "Indicators of Success").







Figures 6-8 (from top to bottom): Resource user groups draw site maps in Mua-i-vuso, Fiji; a women user group with a completed site map in Satitoa, Samoa; a site map in Kia, Solomon Islands, showing the location of key habitats and resources.

An abbreviated version of the questionnaire was applied to supplementary sites. At the national level, country specific information was obtained through interviews with fisheries and environmental agencies. Information on public awareness was obtained by asking a newspaper editor how often articles on coastal resource management appeared in the national press. On sites assisted by external partner organizations (e.g. governments or NGOs), the study team also interviewed the partner agency to assess their views of the partnership process. Lessons of experience learned during the implementation of the survey are summarized in Annex A.

INDICATORS OF SUCCESS

There is no precise definition of what constitutes successful management of coastal resources. It could be defined as the ecological impact of management, but it could just as easily be its impact on household income. For two reasons, the study considered only perceived ecological impact. First, the human impact is more difficult to assess due to the countries' different socio-economic conditions; and second, the impact of management on coastal resources is usually considered to be the most relevant issue to coastal managers in the Pacific.

Since no baseline data on the study sites were available, the study team used a method similar to that of the ICLARM-URI/CRC survey (Pomeroy and Pollnac 1997). To mimic a time dimension, community respondents were asked to state their perceptions of ecological trends over a period of about a decade. As guideposts, the study team used easily remembered events, such as the military coup in Fiji and a cyclone in Samoa. Respondents were then asked whether the indicator was stable, declining or improving. If declining, they were asked whether it was declining "a lot", or declining "a little". This allowed the study team to group the responses into a simple five point ordinal scale, as shown in Fig. 9.

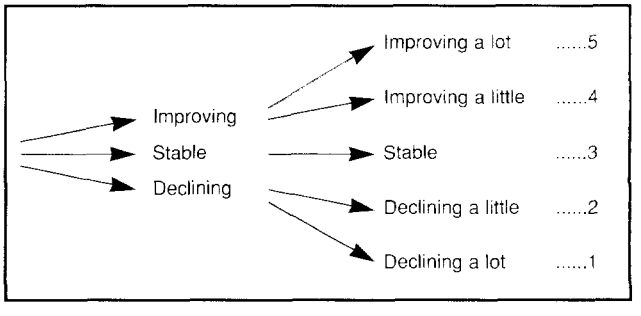


Figure 9. Perceptions of Trends in Indicators of Impact (for CPUE and Habitats)

The study collected the following "perceptions of success" or "indicators of success":

- ***Trends in Perceived Catch per Unit of Effort of Key Resources.*** In the absence of other factors, one of the first signs of successful management is an increase in catch per unit of effort (CPUE). Using the five-point scale shown in Fig. 9, respondents were asked for their perceptions of CPUE trends of three key resources. Respondents were allowed to select the resources that were most important to them. CPUE trends were phrased in terms of easily observable measures — for example, how long it took to fill a bucket with fish.

- ***Trends in Condition of Habitats.*** Respondents were asked to state their perceptions of trends for three key habitats, previously identified with the help of maps drawn by resource users (see Fig. 8).

- ***Trends in Threats to the Site.*** Respondents were asked to state three key threats affecting their site and to report the extent to which the threats had diminished or increased over the past decade. A scale similar to that in Fig. 9 was used, but since threats negatively affect the success of a site, a value of "5" in this scale (threats have increased a lot) meant a worse trend than a value of "1" (threats have been reduced a lot).

- ***Assessment of Compliance.*** Compliance with existing management rules was the only indicator that did not rely on trends. It was assessed as the perceived compliance at the present time, using a four-point scale ("4" indicating full compliance and "1" indicating no compliance). All respondents at each site were asked about their perceptions of compliance with the same five management rules, which had previously been identified by a knowledgeable villager with no connection to the respondents. This was done to prevent possible bias (as respondents might tend to choose rules that were easier to comply with) and to obtain a fairly good sample of compliance perceptions across different management rules. To the extent possible, the five rules included at least one indigenous management rule, a national rule, and a "conservation" rule (i.e. those rules introduced specifically to protect a particular coastal resource or habitat).

Simple PRA techniques were used to help obtain the information. Perceptions were gathered from small focus groups of two to six respondents. Six groups (on average) were interviewed at each focus site, and three groups at each supplementary site. To ensure a representative cross-section of resource users, one-third of the groups were men, one-third were women and one-third were village elders (Fig. 10). In total, the study collected the perceptions of 133 focus groups across all sites.

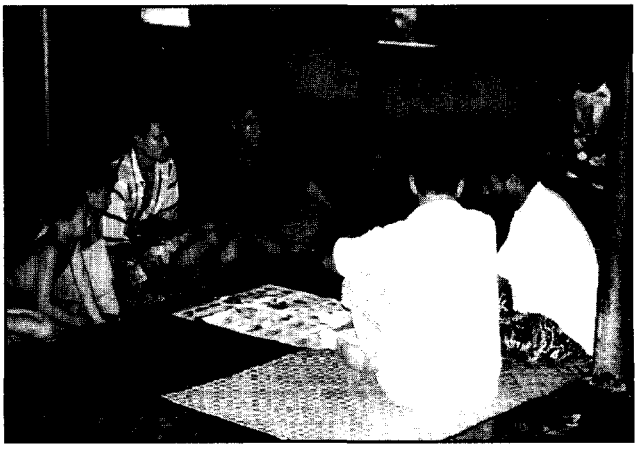


Figure 10. A focus group interview in Satitoa, Samoa. Respondents were asked to state their perceptions of trends in catch per unit of effort of key resources, habitats, threats, and their assessment of compliance with management rules. Each focus group interview lasted 60–90 minutes.

FACTORS INFLUENCING SUCCESS

The study also collected information on factors judged to influence the successful management of coastal resources at the site level. These are referred to as "success factors" throughout the study (see Chapter VI). Since it was not possible to know ahead of time which questions would best reflect a particular factor, two or three questions were asked for each factor.
With few exceptions, all factors were collected at the site level. Some factors external to the site had to be collected at the national level — such as "enabling legislation," or the extent to which national legislation encouraged community-based management (Table 1). In addition, information on some variables judged to be important to management success — for example, traditional knowledge, attitudes towards coastal management and concern for future generations — could not be captured accurately within the short time allotted to each site survey.

ANALYSIS OF THE RESULTS

The study results are outlined in Chapters IV to VII. Chapter IV shows the characteristics and location of the study sites. Chapter V examines the indicators of success. Chapter VI relates these indicators to explanatory "success factors". Chapter VII examines key coastal management issues addressed by the study.

The study relied on a mixture of qualitative and quantitative analysis to produce the final results. Qualitative analysis provided insights into the reasons for perceived trends (Chapter V), as well as most

Table 1: Potential Factors Affecting Coastal Management Success

External Factors	Site-Specific Factors	Process Factors
Government support to community initiatives	**Strength and quality of leadership**	**Presence of external partners**
Political will ☆	**Social cohesion**	**Community involvement in coastal management planning and implementation**
Enabling legislation ☆	**Strength of marine tenure**	**Conflict resolution**
Availability of external funds and support ☆	**Dependency on coastal resources**	**Quality of external partnerships**
Emphasis on coastal management (from the part of national agencies) ☆	**Awareness of management benefits/ Attitudes towards management**	**Extent to which management is based on custom (presence of indigenous management rules)**
Private sector activities	**Cultural requirements to harvest**	**Benefit/cost sharing arrangements**
Perceived relevance of national management rules	**Population density**	**Participation by user groups in management decisions**
Awareness of high level decision makers ☆	**Settlement patterns**	Flexibility of management
External shocks:	**Conflicts**	Presence of 'movers and shakers'
Natural disasters	**Conservation value**	Information flow
Market shocks	Population homogeneity	Continuous external inputs
Political events	Village education	
Destructive fishing technology shocks	Integration into markets	
Development projects	Village age	
Pollution shocks	Existence of clear boundaries	
	Population growth	
	Type and intensity of external threats	
	Level of community development	
	High islands vs. low islands	
	Resource system productivity	
	Presence of non-contiguous fishing areas	
	Tourism development	
	Private sector development	
	Land use	
	Proximity to urban centers	

Factors in bold were those identified by the advisory committee as the most important to management success prior to the start of the survey.
☆ *Information on these factors was collected at the national level. All other factors were collected at the site level.*

of the results on key management issues (Chapter VII). The quantitative analysis relied on the following techniques:

- ***Descriptive statistics*** such as frequency distributions (Chapters V and VII) were used, for example, to describe the percentage of sites visited by government officials during the past decade, or the percentage of responses perceiving habitat declines.

- ***Non-parametric statistics*** were used to interpret the perceptions of success (Chapter V). This analysis allowed the team, for example, to determine whether certain types of threats (e.g. pollution) were perceived to be increasing while other threats were declining; and what types of management rules were perceived as having the highest degree of compliance. The statistics compared the differences between the mean perception ratings given for the different rules to determine whether they were statistically significant. A significant result indicated that certain rules were indeed perceived as being more complied with than others.

- ***Econometric analysis*** (Chapter VI), including ordinary least squares and ordered probit analysis, was used to model the impact of various factors on the perceptions of success in accordance with the study's analytical framework. This analysis was used to isolate the effect of individual factors: for example, it analyzed the impact of natural disasters on the perceptions of success, while holding all other factors constant.

- ***Principal component analysis*** was used to group the four perceptions of success indicators into an "aggregate perceived success" index (Chapter V). It was also used to see how particular "factors of success" were associated (Chapter VI); it allowed the team to see, for example, whether villages with high social cohesion tended also to have strong local leadership.

- ***Simple correlations*** were used to see how certain variables varied together — for example, to see whether countries that recognize marine tenure systems also have a relatively high prevalence of indigenous management rules (Chapter VI). This statistic was used only as a last resort, since correlations do not isolate the effect of individual variables. However, it was useful in cases where a clear cause-effect relationship could not be proven.

Annex B provides details on the quantitative methods used by the study.

KEY ASSUMPTIONS AND LIMITATIONS

The analysis had to take into consideration the complex structure of the data, which were structured at four levels: countries (5 in number), site characteristics (31), focus groups (133) and, for each focus group, perceptions of different resources, habitats, threats and compliance with management rules (377 to 665 observations, depending on the indicators). All observations were used in the econometric analysis. The data were corrected for statistical errors that may arise from clustering at different levels (see Chapter VI). Simple frequency distributions for the perceptions of success also used the full sample (Chapter V). Where it was important to present the average results per site — for example, to display the most important threats per country — the number of observations in focus sites was made equal to that of supplementary sites. To compare perceptions of success between different resources, habitats or threats, the study team faced a methodological difficulty: most non-parametric statistical tests assume that the observations are independent. While the different focus groups were independent, the ratings given to three different resources by the same focus group were not. To minimize this problem, the study team created a semi-independent set of observations which eliminated any duplicate observation within a focus group: for example, if the group gave the CPUE trend for two kinds of reef finfish, only one was included in the sample (the one ranked highest in importance).

In interpreting the study results, it is very important to recall that the sites were not chosen at random. They were selected according to specific criteria (see Fig. 4). The results are therefore those derived from the 31 study sites and should not be considered fully representative of Pacific Island conditions.

The CPUE indicator needs to be interpreted with care: first, community perceptions can differ from reality. The study results should therefore be viewed as the perceptions of the study communities, rather than the actual status of coastal resources in the Pacific. Second, a negative or positive trend does not always reflect a failure or success of management. CPUE could be increasing simply because of improved technology. For this reason, the study team analyzed not only the perceived trends, but also the reasons given for the trends (Chapter V). The potential limitations of the CPUE indicator were discussed with the study advisors early in the study design, and it was agreed that the indicator remained useful as a reflection of local perceptions and to compare relative trends across different resources and site characteristics.

A major objective of the study was to shed light on how different factors affected the success of coastal resource management. Several issues made this estimation particularly challenging. First, the existing knowledge on which factors are most important for coastal management success remains scarce. A large number of variables had to be considered, with little guidance as to which ones were the most important. Second, although perceptions of success were collected from 133 focus groups, most explanatory variables varied only across 31 sites. This constrained the number of 'degrees of freedom' and consequently the number of variables that could be used in the analysis.[6] Third, the survey was the first of its kind in the Pacific Islands, and there was no way to know which survey questions would work best in the varied socio-cultural settings of the sites.

In the absence of baseline data and a common intervention across the sites, it is inherently difficult to prove a cause-effect relationship between success factors and perceptions of success. Many of the policy and management process factors were by nature "endogenous". It is difficult to determine, for example, whether trends were perceived to be improving because of a visit by a government official or because government officials tended to visit sites with poor (or good) trends. The same difficulty determining causality arose with such factors as the presence of external partners, conflicts, dependency on resources, and most policy variables (see Chapter VI).

While perceptions were stated over a ten-year period, most explanatory variables reflected conditions at the time of the survey. For the purposes of analysis, it had to be assumed that site conditions had not changed significantly during the period. This is not an unreasonable assumption about many of the socio-cultural and ecological characteristics of the site (e.g., number of ecosystems), but it may be more problematic for other variables included in the analysis (such as dependency on resources). In addition, there is the possibility that there were inherent site characteristics not captured by the study which could account for variations in stated perceptions. While the study attempts to deal with these constraints as far as possible, they should be kept in mind when interpreting the results.

[6] If a sample is limited, the data do not have sufficient variance to distinguish between the effect of many different variables.

IV. The Study Sites

The 31 sites ranged in size from 0.6 square kilometers in Papa (Samoa) to 2,360 square kilometers in Luaniua (Ontong Java, Solomon Islands). The sample included two urban sites (Koror in Palau and Honiara Fishing Village in the Solomon Islands), five periurban sites and twenty-four rural sites. Several of the rural sites were very isolated and lacked regular transportation.

Village populations ranged from 67 in Niu (Solomon Islands) to about 17,000 in Koror (Palau). The average population density was 218 per square kilometer (of the site), but this varied considerably between the small Samoan sites, which averaged 1,026 persons per square kilometer, and the larger sites in the Solomon Islands, with an average population density of only 11. Population growth was relatively low in the study sites, an average of 2.1 percent a year. Half of the six sites in Tonga and two sites in Fiji had negative population growth (Figure 11 and Table 2).

Eight sites, including all sites in Tonga and Cooksin and Honiara Fishing Village in the Solomon Islands, lacked any form of customary marine user rights and were operated under open access regimes. All of the remaining sites had some form of customary marine tenure.[7]

Classifying the sites according to their conservation status was a difficult task. The only recent list of marine conservation areas is that of the 1999-2002 Action Strategy for Nature Conservation in the Pacific Island Region (SPREP, 1998). This list is flawed, however, as it includes several sites where the conservation value is doubtful, while other sites recognized nationally as conservation areas are not included (e.g., Aleipata in Samoa). Community-based conservation areas are defined as "any area . . . wherein resources are either protected to some degree or managed for sustainable use, or both, with the active involvement and support of community resource users and owners." This classification is so broad that it encompasses nearly all study sites. For

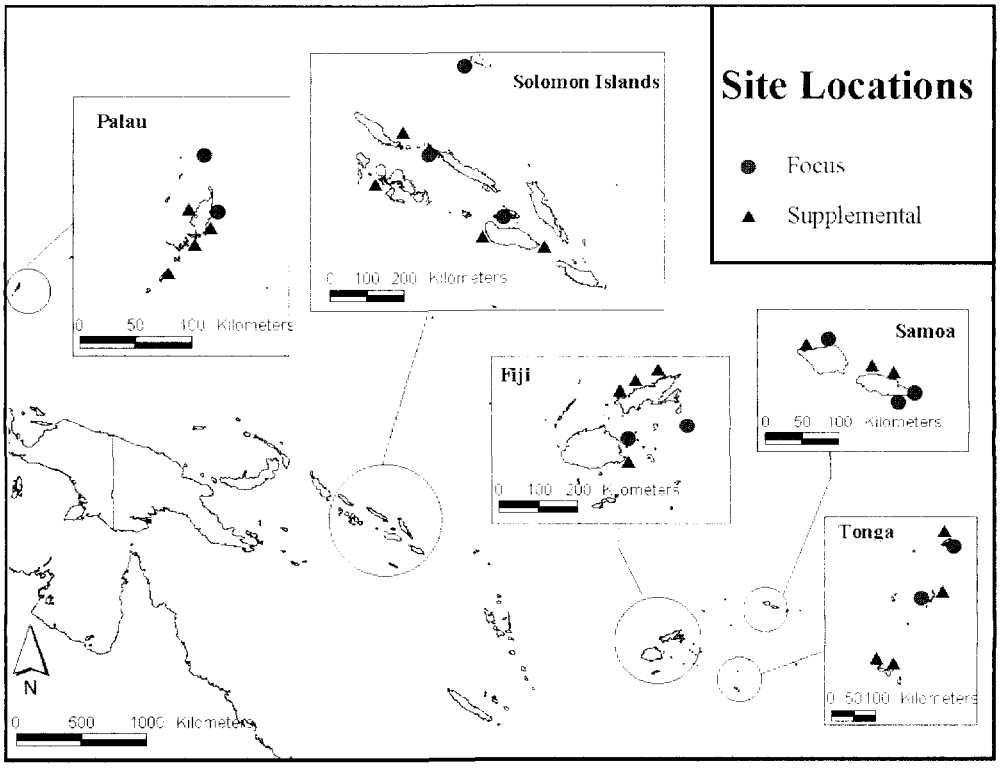


Figure 11. Location of the Study Sites

[7] In the customary marine tenure systems prevalent in the Pacific, traditional users often have the right (but not always the ability) to exclude nontraditional users from the site's coastal territory.

Table 2. Key Characteristics of the Survey Sites

Country	Site Name	General Location	Type	Conservation Site?	External Partners?	Site Size (km²)	Population Density (People/ Site Area)	Urban/ Peri-Urban?	High/ Low Island	No. Ecosys-tems	Village Develop.	Ease of Marketing Perishable Products***	% Income from Fisheries/ Tourism	Strength Of Marine Tenure****	Sanctu-aries Present?	Alternative Income Generation (AIGs) Introduced?
Fiji	*Dromuna*	SE Viti Levu, near Rewa river delta	Suppl.	No	No	130.0	0.8	Yes	High	8	Medium	Easy	84	Medium	No	Yes
	Ucunivanua	Verata (SE Viti Levu, SW Ovalau)	Focus	Yes*	Yes	1,300.0	0.2	No	High	10	Medium	Easy	60	Strong	Yes	No
	Susui	Northern Lau group, off Vanuabalavu	Focus	Yes**	No	6.5	13.9	No	High	7	Low	Medium	60	Strongest	Yes	No
	Galoa	Galoa Isl, off NW Vanua Levu	Suppl.	No	No	1,655.0	0.2	No	Low	8	Low	Easy	80	Medium	No	No
	Vunivutu	N Central Vanua Levu	Suppl.	No	No	71.0	3.6	No	High	7	Medium	Easy	50	Weak	No	No
	Nakawaga	Mali Isl., off N Central Vanua Levu	Suppl.	No	Yes	220.0	0.6	Yes	Low	8	Low	Easy	80	Strong	No	No
Tonga	Koulo	Lifuka Island, Ha'apai Cons. Area	Suppl.	Yes*	No	12.0	18.8	Yes	Low	8	High	Easy	35	Open Access	No	Yes
	Lofanga	Lofanga Island, Ha'apai Cons. Area	Focus	Yes*	No	20.0	6.0	No	Low	7	Low	Medium	40	Open Access	No	Yes
	Falevai	SW Kapa Island, Vava'u Group	Focus	Yes**	Yes	5.0	28.2	Yes	High	6	Medium	Easy	35	Open Access	Yes	Yes
	Tu'anekivale	Eastern Vava'u	Suppl.	No	No	2.0	181.0	No	High	6	High	Easy	10	Open Access	No	No
	Nukuhetulu	N Central Tongatapu Isl.	Suppl.	Yes*	Yes	3.0	121.7	Yes	High	3	High	Easy	10	Open Access	No	No
	Ha'atafu	Ha'atafu Marine Reserve, NW Tongatapu	Suppl	Yes*	Yes	4.0	61.8	No	High	6	High	Easy	40	Open Access	No	No
Samoa	Fusi	Safata, S Central Coast of Upolu	Focus	Yes**	Yes	4.5	177.8	No	High	8	High	Easy	20	Weak	Yes	Yes
	Satitoa	Aleipata, Eastern End of Upolu	Focus	Yes**	Yes	1.5	400.0	No	High	6	High	Easy	25	Strong	Yes	Yes
	Manase	N Central Savaii	Focus	No	No	1.3	132.3	No	High	7	High	Easy	50	Strongest	No	Yes
	Papa	Western end of Savaii	Suppl.	No	No	0.6	1,246.7	No	High	4	Low	Medium	5	Strongest	No	No
	Solosolo	N Central Upolu, east of Apia	Suppl.	Yes**	Yes	1.2	2,500.0	No	High	3	High	Easy	5	Strongest	Yes	Yes
	Lealaalii	N Central Upolu, west of Apia	Suppl.	No	No	1.0	1,700.0	No	High	4	High	Easy	0	Strongest	No	No
Solomons	Fishing Village	Honiara	Focus	No	No	22.0	36.4	Yes	High	10	High	Easy	75	Open Access	No	Yes
	Luaniua	Ontong Java Atoll	Focus	Yes**	No	2,360.0	0.7	No	Low	7	Low	Difficult	70	Strong	No	Yes
	Kia	Arnavon Marine Cons. Area, NW Isabel	Focus	Yes*	Yes	1,204.0	1.3	No	High	9	Low	Medium	81	Strong	Yes	Yes
	Cooksin	Arnavon Marine Cons., Wagina Island	Suppl.	Yes*	Yes	112.0	5.4	No	High	7	Low	Medium	70	Open Access	Yes	Yes
	Naro	Western end of Guadalcanal	Suppl.	Yes**	No	10.0	32.2	No	High	9	Medium	Easy	30	Strongest	Yes	No
	Niu	Niu Isl., Marau Sound, E Guadalcanal	Suppl.	No	No	25.0	2.7	No	Low	7	Low	Medium	30	Strong	No	Yes
	Onne	Marovo Lagoon, Western Province	Suppl.	Yes*	Yes	48.0	1.7	No	High	9	Low	Medium	43	Strong	Yes	Yes
Palau	Ngiwal	Central E Babeldaob Island	Focus	Yes*	Yes	9.5	25.3	No	High	8	Medium	Easy	17	Strongest	Yes	Yes
	Kayangel	Kayangel Atoll, off N Babeldaob	Focus	Yes*	Yes	1050	1.7	No	Low	8	Medium	Medium	35	Strongest	Yes	Yes
	Peleliu	Peleliu Isl., SE Koror	Suppl.	No	No	71.0	8.1	No	High	7	Medium	Easy	43	Strongest	No	No
	Koror	Near Ngerukewid/Ngerumekaol/ Ngemelis area, Koror	Suppl.	Yes*	Yes	665.0	25.5	Yes	High	8	High	Easy	35	Strongest	Yes	Yes
	Melekeok	Central E Babeldaob, S Ngirwal	Suppl.	Yes**	No	11.0	23.7	No	High	8	Medium	Easy	19	Strongest	No	Yes
	Ngaremlengui	Ngeremeduu, central W Babeldaob	Suppl.	Yes*	Yes	26.0	10.8	No	High	7	High	Easy	27	Strongest	Yes	Yes

Sites in:																
Fiji	6	*Focus Sites*	12	*Conservation Sites*	20	*Avg. Site Size: 262 km²*	*Urban/Peri-Urban:*	7	*Village Development*		*Ease of Marketing:*		*Strength of Tenure*		*Sites w/ Sanctuaries:*	14
Tonga	6															
Samoa	6	*Supplementary*	19	*Non-Conservat. Sites*	11		*Rural:*	24	*High*	12	*Easy*	22	*Strongest*	12	*Sites w/o Sanctuaries:*	17
Solomons	7								*Medium*	9	*Medium*	8	*Strong*	7		
Palau	6			*Sites w/ Partners*	15	*Avg. Pop. Density: 218*	*High Islands:*	7	*Low*	10	*Difficult*	1	*Medium*	2		
				Sites w/o Partners	16		*Low Islands:*	24					*Weak*	2	*Sites with AIGs:*	19
													Open Access	8	*Sites w/o AIGs:*	12
Total	31						*Average No. of Ecosystems: 7*				*Average % of Income from Fisheries/Tourism: 41%*					

* - Site Listed in Regional Action Plan for Nature Conservation for the Pacific Islands (SPREP, 1998).

** - Site Not listed in regional list but either (a) recognized by the country as a conservation area; or (b) where community is undertaking conservation activities.

*** - Ease of marketing: Easy — Traders come to the site and/or village sellers can access markets for perishable products; Medium — Can be done but involves much planning/costs; Difficult Very difficult/impossible. Integration into markets refers only to perishable products, since trade in non-perishable products is not normally constrained by distances.

**** - Strongest: village leaders have the power (if they so wish) to exclude all non-villagers; Strong- village leaders have the power to exclude all non-customary users; Medium-leaders outside the village have the power to exclude outsiders; Weak-not possible to exclude outsiders; Open Access – Traditional user rights non-existent or eroded. This factor was derived from interviews with community leaders.

the purposes of this study, sites which were listed in the regional Action Strategy, recognized nationally as conservation areas, or which were found to have community-based interventions contributing to coastal resource conservation (e.g., sanctuary areas) were classified as conservation sites. Using this designation, the study sample included 20 conservation and 11 non-conservation sites.

About half (15) of the study villages had "external partners" or external organizations assisting the community in managing coastal resources. With one exception (Nakawaga, Fiji), all partner-assisted sites were also conservation areas.

The percentage of village income derived from fisheries or marine tourism ranged from nearly zero in Lealaalii (Samoa), to 84 percent in Dromuna (Fiji), with an average of 41 percent.

Dependence on coastal resources was highest in Fiji and Solomon Island sites, and was generally inversely proportional to remittances, which were particularly high in Tongan and Samoan sites (about 30 percent). Six sites depended heavily on coastal areas for food, while eight had access to alternative sources of fresh meat or fish (Fig. 12).

Seven of the sites were low-lying islands, while 24 were high islands. The sites were well distributed with respect to the level of village development: about 30 percent lacked amenities such as public transportation and electricity, while 40 percent had a relatively high level of development. About half of the sites attracted tourism or private sector investments.

Residents of most of the villages in Palau used advanced fishing techniques, while most of the sites in Samoa, Solomon Islands, and two sites in Tonga did not. The proportion of fishing harvest said to be taken by outsiders was particularly high at Fijian sites (an average of 48 percent). As many as 77 percent of the sites — all those without open access regimes — had adopted indigenous rules for managing coastal resources, and about half had established marine sanctuaries. Further details on individual site are provided in a separate Appendix to this report (see World Bank, 2000b).

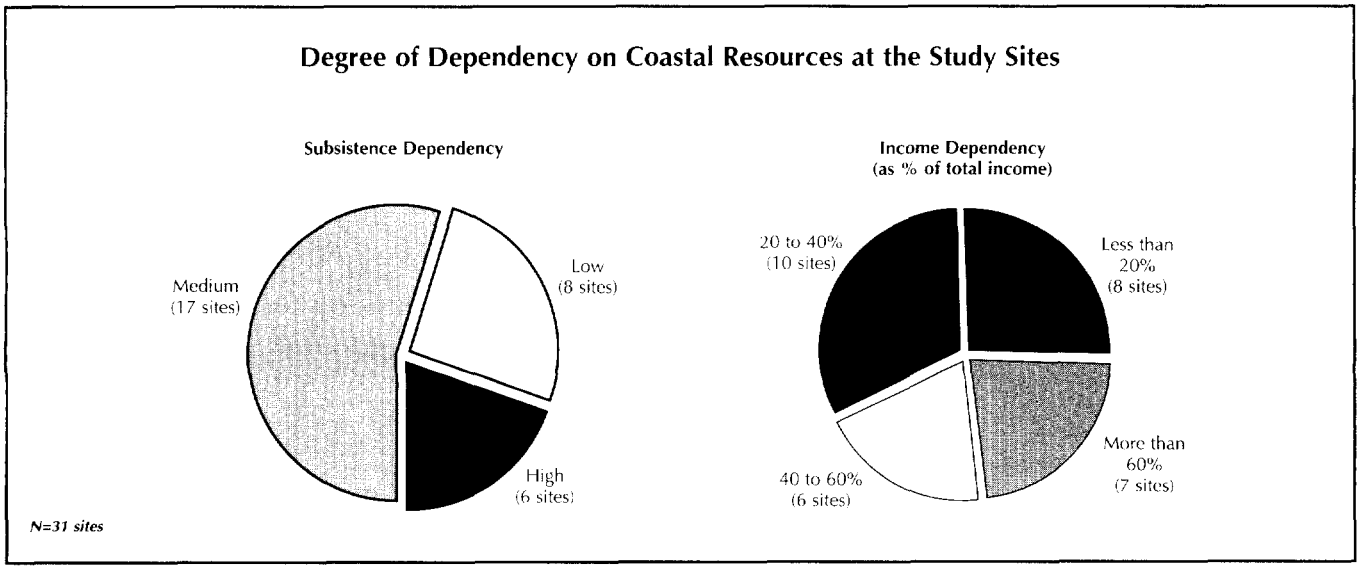


Figure 12. Community Dependence on Coastal Resources at the Study Sites.

V. Perceptions of Success

This chapter examines the communities' perceptions of the four indicators of coastal resource management success: trends in CPUE, trends in habitats, trends in threats, and trends in compliance with coastal management rules.

As a first step in the analysis, the vernacular names of resources, habitats, management rules and threats were translated into English and clustered into broader categories: for example, emperors, groupers, and coral cod were grouped as "reef finfish." Similarly, garbage and oil pollution were clustered into the category "pollution." This allowed the study team to compare the stated perceptions of management success for the various categories to determine whether there were significant differences. The categories reflected the way communities use specific resources: for example, beche-de-mer (sea cucumber) is targeted as a distinct fishery and was therefore considered as a separate group. Annex B shows the categories used in the analysis.

Are Stated Perceptions True Perceptions?

During the study design, several experts expressed the view that villagers might not reveal their true perceptions. They might try to please interviewers or interpret questions differently than intended. If this bias existed, it would tend to result in inconsistent answers between similar respondents: for example, one elderly group might say that reef finfish declined a lot, while another elderly group from the same site would state that finfish had in fact improved. Since two groups of women, elders and men were interviewed at focus sites, a comparison of their answers allowed the study team to test for such bias.

The results showed that the responses were consistent. No statistically significant differences were found in the answers provided by similar user groups to the same resources, threats or management rules.[8] The exception was habitat perceptions, where significant differences were found. Overall, however, the answers were remarkably similar.

Do Perceptions Differ between Elderly, Men, and Women Resource Users?

The study found no statistically significant differences between the perceptions of elders, men, and women groups for any of the four success indicators, indicating consistency in stated perceptions among these different user groups.[9]

PERCEIVED TRENDS IN CATCH PER UNIT OF EFFORT

The study collected 399 perceptions of trends in catch-per-unit of effort (CPUE). Each of the 133 focus groups was asked to state their perceptions of trends in the CPUE of their three most important coastal resources (Figure 13). Only 39 responses (10 percent of the total) indicated an improving CPUE during the last decade. As many as 310 responses (78 percent) perceived a negative trend in harvest productivity during this period.

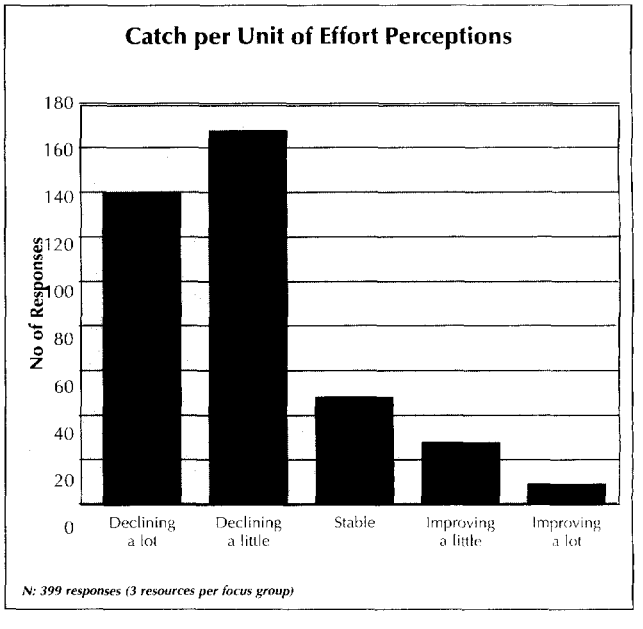


Figure 13 - Overall Distribution of Community Perceptions of Catch per Unit of Effort Trends

[8] The test statistic used was a Wilcoxon Signed Rank Test to compare differences in means (see Table B.1, Annex B).

[9] This result held in all cases, whether comparing answers for the most important resource or threat, or for any particular resource, habitat, threat, or management rule. The test statistic used was a Kruskal-Walis test (see Table B.1, Annex B).

There were only 11 responses in six sites (3 percent of the total) where perceptions of an improving CPUE were thought to be related to coastal resource management. These included prevention of destructive fishing (2 sites), creation of sanctuaries (2 sites), controls in harvesting particular species (2 sites), and a ban on external fishermen (1 site), with one site (Fusi) citing two different management rules. The majority of the reasons given for CPUE improvements were unrelated to management: they included falling prices, population movements, alternative sources of income, and recovery from cyclones (Table 3).

Table 3. Reasons Stated for Perceptions of Improving CPUE

Site	Resource	Trend	Reason Stated for the Improving Trend
Ucunivanua, Fiji	Finfish	5	Ban on external commercial fishing
	Finfish	5	Stopped issuing external licensing
Vunivutu, Fiji	Shellfish	4	Effort has been reduced; many people are catching finfish (instead)
Koulo, Tonga	Beche-de-Mer	5	The more harvested, the more they grow
Lofanga, Tonga	Emperor	5	Expanding into new fishing areas
	Giant Clam	4	N/A
	Seaweed	5	N/A
Falevai, Tonga	Wrasse	4	Expanding fishing area
	Acanthuridae	4	Expanding fishing area
Tu'anekivale, Tonga	Lobster	4	Only a few lobster divers because of dangerous rough waters
	Turbo	4	Protected species and people are afraid of it, so they do not exploit
Ha'atafu, Tonga	Beche-de-Mer	4	The more it is harvested, the more it grows
	Urchin	4	Gleaning is done in different areas, allowing other areas to replenish
	Turbo	4	Gleaning is done in different areas, allowing other areas to replenish
	Octopus	4	Greater knowledge and familiarity with octopus habitat
	Giant Clam	4	Few people dive these days
Fusi, Samoa	Turtle	4	Unknown. Cyclone and maybe government ban
	Trevally	4	Banning dynamiting
	Mullet	5	Recovery from early 1990's cyclone
	Crab	4	Ban on destructive fishing methods
	Big urchin	5	N/A
	Small urchin	5	N/A
Satitoa, Samoa	Giant Clam	5	Fish sanctuary
Manase, Samoa	Soldier Fish	4	Enforcement of ban on destructive fishing and alternative income sources for 2 fishermen who target soldier fish
	Mullet	4	Effective ban on PNG Kava (fish poison)
	Surgeon Fish	4	Effective ban on PNG Kava
	Turbo	4	Effective ban on PNG Kava
	Turbo	5	N/A
Papa, Samoa	Turbo	4	Less people harvesting
	Oyster	4	People especially women fishers live away from the beach
	Crab	4	The shift of village inland results in less exploitation
Kia, Solomon Isl.	Finfish	4	Very big area for fishing and the village has areas that are unexploited
Cooksin, Solomon Isl.	Finfish	4	Technology changes (improved technology)
Ngiwal, Palau	Beche-de-Mer	5	The area has been conserved
Kayangel, Palau	Giant Clam	4	*Only for home consumption, so harvesting clams is controlled*
	Giant Clam	4	*N/A*
Ngaremlengui, Palau	Beche-de-Mer	4	*Few people harvesting*

CPUE Trend: 4-Improving a little; 5-Improving a lot. N/A – Reason not specified.

The reasons for perceived declines in CPUE were also examined.[9] Excess fishing (usually caused by an increase in commercial extraction) was the most frequent answer provided. Other reasons included destructive fishing practices, improvements in fishing technology, cyclones, increased population, the use of nets and night diving, siltation, pollution, coral destruction, and habitat degradation. The use of nets and night diving were frequently cited as a cause for CPUE decline. At three sites where causeways were built (Koulo, Tuanekivale, and Ngiwal), respondents perceived them as responsible for negative trends in CPUE. Perceived causes for CPUE decline also differed by country: external fishers were frequently cited in Fiji, destructive fishing in Samoa, population increase in the Solomon Islands, and speed boat disturbances in Palau.

[9] It could be argued that some sites might have new fisheries, and that this could account for a perceived initial decline in CPUE. However, the vast majority of the focus groups failed to note any major changes in the relative importance of resources over the past decade.

Do Perceptions of CPUE Trends Vary by Resource Group?

The study found no statistically significant differences in the CPUE trend perceptions for the various resource groups (Fig. 14). However, pairwise comparisons indicated that the perceived CPUE of beche-de-mer (BDM) may be declining more than that of shellfish, clams, reef finfish, and octopus.[11]

PERCEIVED TRENDS IN COASTAL HABITATS

The study collected a total of 396 perceptions of trends in key coastal habitats. Although the most common perception was that habitats were declining (206 responses or 52 percent of the total), 88 responses (22 percent) perceived an improvement in habitat trends (Fig. 15).

The reasons given for the perceived trends varied by habitat type (Table 4). For coral reefs, reef flats, seagrass, and mangroves (the most important habitats identified by the communities), the reasons given for perceived declines included cyclones, increases in siltation, pollution, destructive fishing, and natural processes. With the exception of bans on mangrove cutting, the reasons offered for mangrove and seagrass improvement were unrelated to coastal resource management. Some of these, such as increased sedimentation and causeway construction, were actually cited as reasons for declines in other types of habitats and CPUE trends.

The majority of the reasons given for improvements of reef habitats, by contrast, were related to management practices — these included compliance with existing rules, fishing closures, and prohibition of destructive practices such as derris root use (a fish poison).

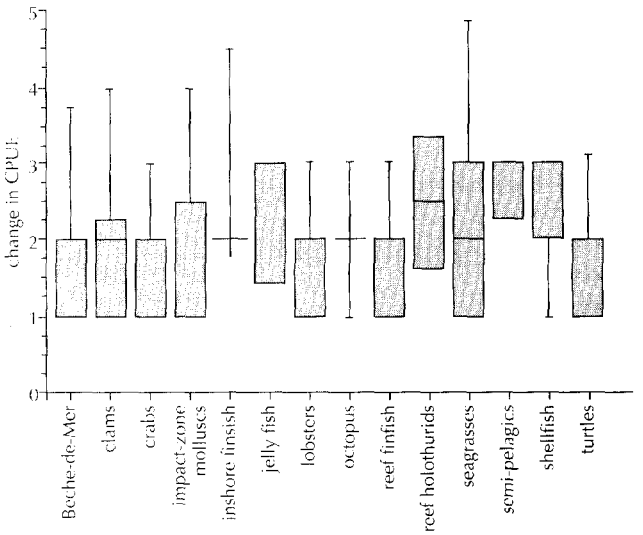


Figure 14. Distribution of CPUE Perceptions among Resource Groups

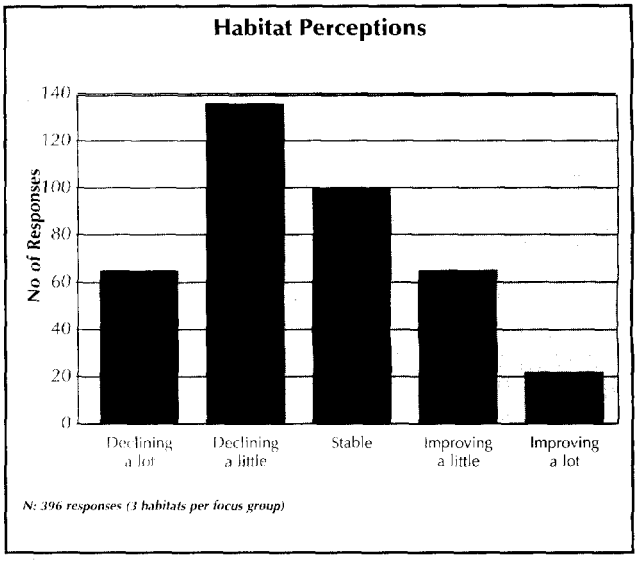


Figure 15. Overall Distribution of Community Perceptions of Habitat Trends

[11] The study used a Kruskal-Wallis test to determine whether there were statistically significant differences in the average CPUE trend stated for the different groups (see Table B.1, Annex B). Pairwise comparisons used a Mann-Whitney rank test to compare the average CPUE rating for two resources groups at a time. The Mann-Whitney rank test for beche-de-mer (as compared to other resources) was only significant at the 10 percent level.

Table 4. Reasons Stated for Improved and Declining Trends in Coastal Habitats

Habitat	Perceived Improved Trends (No. of Responses)	Main Reason for Improved Trends	Perceived Declining Trends (No. of Responses)	Main Reasons for Declining Trends
Reef	12	***Bans on certain types of fishing*** ***Less Derris root use*** *Good rule enforcement* *Reef closures*	26	***Cyclones*** ***Destructive fishing*** *Infestation by crown-of-thorns starfish* *Weather changes* *Coral extraction* *Natural processes* *Coral smashing during fishing operations*
Reef Flat	5	*Natural recovery* *Good compliance with rules*	11	*Cyclones* *Destructive fishing, especially derris use*
Mangrove	26	***Cutting ban*** ***Natural processes and/or re-vegetation*** ***Weaker current due to causeway*** ***Increased sedimentation***	27	***Developments projects in or near mangrove areas*** ***Pollution*** ***Cutting of mangroves for firewood and building materials*** *Population increase* *Increased siltation*
Seagrass	20	***Shallower water therefore more habitat*** ***Less disturbance*** *Increased siltation* *Natural processes* *Causeway construction* *Not sure.*	40	***Cyclones*** ***Increased siltation*** *Natural causes* *Speedboats* *Pollution* *Filled in by sand* *Not sure*

Most common reasons in bold.

Do Perceptions of Habitat Trends Vary by Habitat?

The study results indicated that there were significant variations in the perceived trends of the various habitats (Fig. 16).[12] Pairwise comparisons showed that seagrasses were perceived to be declining less than inter-tidal areas and lagoons. Similarly, mangrove habitats were perceived as having declined less than inter-tidal areas, lagoons, and reefs.

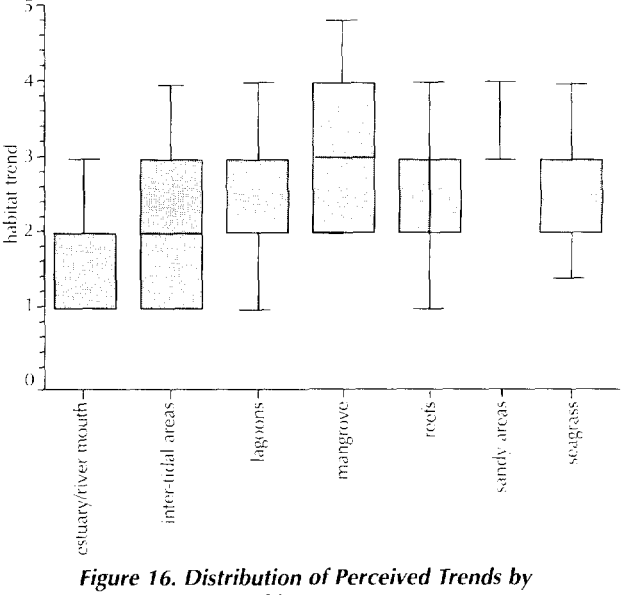


Figure 16. Distribution of Perceived Trends by Habitat Group

[12] Kruskal-Wallis tied p-value < 0.0001.

PERCEIVED COMPLIANCE

The study collected 648 perceptions of compliance with management rules. Each focus group was asked how it perceived the compliance with five coastal management rules previously identified for the site.

The majority of the responses indicated full compliance with management rules (334 responses or 51 percent of the total). About 15 percent of the responses (94) believed that there was no compliance and that the rules were simply ignored (Fig. 17).

Table 5 shows the reasons most often given for poor and good compliance. Poor compliance was perceived to be associated with poor enforcement, unawareness of the rules, a need for income, and turtle-eating habits (in Fiji, Solomon Islands, and Palau). Perceptions of full compliance were most often associated with the existence of deterrents for violations, rather than voluntary restraint.

Do Compliance Assessments Vary by Type of Rule?

Compliance assessments seemed to vary significantly by type of rule (Fig. 18).[13] Pairwise statistical tests showed that protected areas, closed seasons, and destructive fishing practice rules (e.g., bans on derris root) were perceived as resulting in significantly better compliance than rules such as size limits, bans on the harvest of certain species, and restrictions on outsiders.[14] The study found, however, no statistical difference in the perceived compliance between conservation rules and other types of rules.[15]

Rules enforced by buyers or exporters were another type of rule that was perceived to have high compliance. Compliance with turtle rules, by contrast, was generally perceived to be poor (see Chapter VII "Relevance of National and Local Management Regulations").

Table 5. Reasons Stated for Perceived Compliance with Coastal Management Rules

	Lack of Compliance	Full Compliance
Country		
Fiji	Need for income	Respect for chief
	Outsiders do not follow rules	Respect for customs
	Lack of enforcement	Strict punishment
	Turtle eating part of culture	Has seen the damage of
	Rules unknown	destructive practices
Tonga		Aware of rule and its benefits
		Afraid of being taken to court
		Easy to detect violations
Samoa	Poor enforcement	Good enforcement
		Fear of being fined
		Severe penalties
		Easy to detect violations
Solomon	Need for income	Product cannot be sold
Islands	Poor enforcement	(buyers don't purchase)
	Turtles are traditional food	Good enforcement
	Need for food	Afraid of police and courts
	Law unknown	Respect for chief's decision
	Over-population	
Palau	Poor enforcement	Cannot be sold
	Cannot resist turtle food	(buyers will not purchase)
	Unaware of law	Good enforcement
		Strong penalties
		Afraid of fines
		Easy to monitor compliance

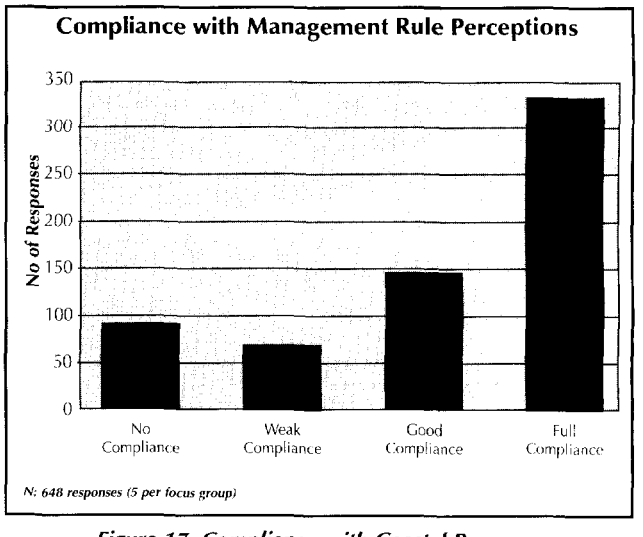


Figure 17. Compliance with Coastal Resource Management Rules

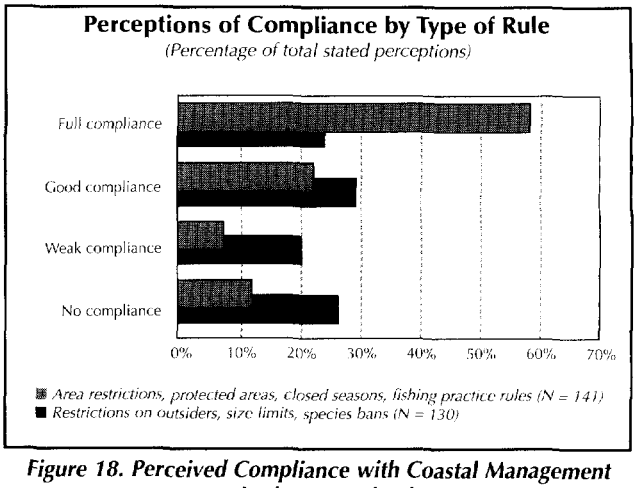


Figure 18. Perceived Compliance with Coastal Management Rules by Type of Rule

[13] Kruskal-Wallis tied p-value result < 0.0001.
[14] Mann-Whitney rank test significant at 5% level.
[15] Conservation rules were defined as those whose purpose is to conserve a particular species or habitat.

Do Compliance Assessments Vary by the Origin of the Rule?

A question which has policy implications is whether perceived compliance varies according to the origin of the management rule — for example, are rules established by the community itself (local rules) complied with more often than national regulations (national rules)? Statistical analysis showed that national rules that have been adopted as local rules were perceived as achieving greater compliance than either purely local or purely national rules (Fig. 19). These are national rules such as bans on the use of derris root which were seen as relevant at the local level, and subsequently adopted and enforced by local leaders.

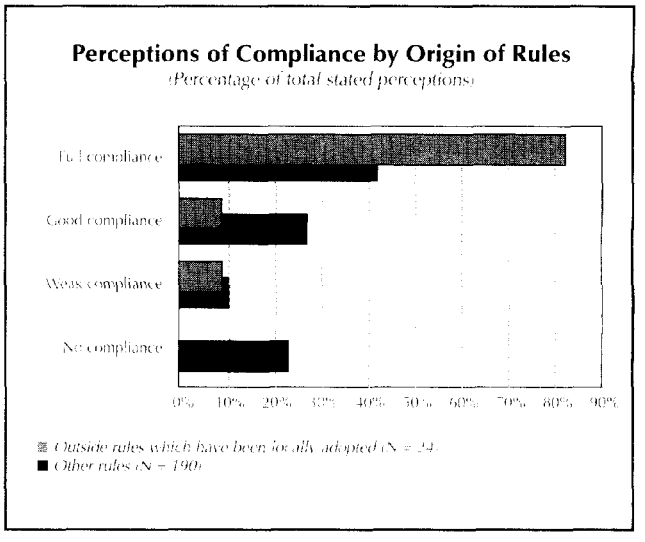


Figure 19. Perceived Compliance with Coastal Management Rules by Origin of the Rule

PERCEIVED THREAT TRENDS

The focus group sessions produced a total of 377 perceptions of trends in threats to coastal resources. Fig. 20 shows the distribution of threat perceptions. A total of 189 responses (50 percent of the total) perceived threats as having increased over the past decade, while 140 responses (37 percent) perceived a decrease.

Do Trend Perceptions Vary by Threat?

Variations in the perception of trends by type of threat are displayed in Fig. 21. Pairwise comparisons showed that pollution was perceived to be increasing faster than other threats to coastal resources, while destructive fishing practices were perceived to have declined the most.[16]

Fig. 22 shows the distribution of threats reported to have either decreased or increased substantially. Destructive fishing accounted for 56 percent of the threats perceived to have declined a lot. Pollution and overfishing (primarily commercial fishing), on the other hand, accounted for 23 percent and 38 percent of the responses on threats perceived to be increasing a lot.

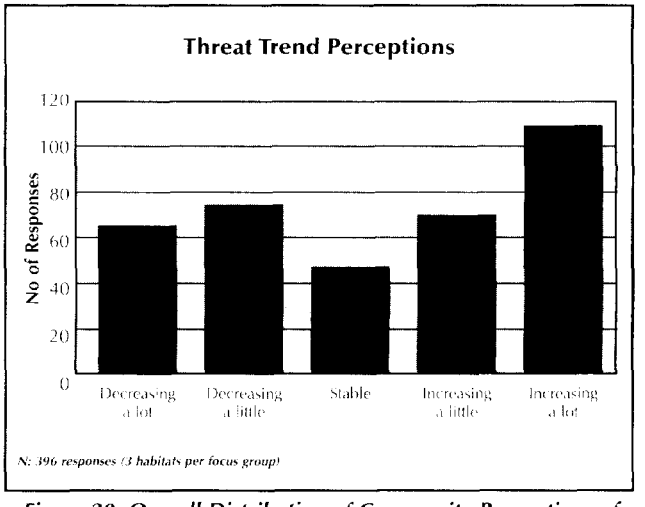


Figure 20. Overall Distribution of Community Perceptions of Trends in Threats to Coastal Resources

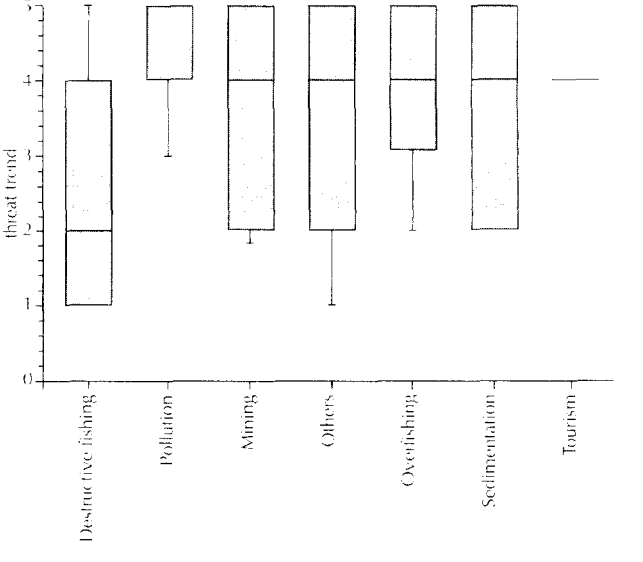
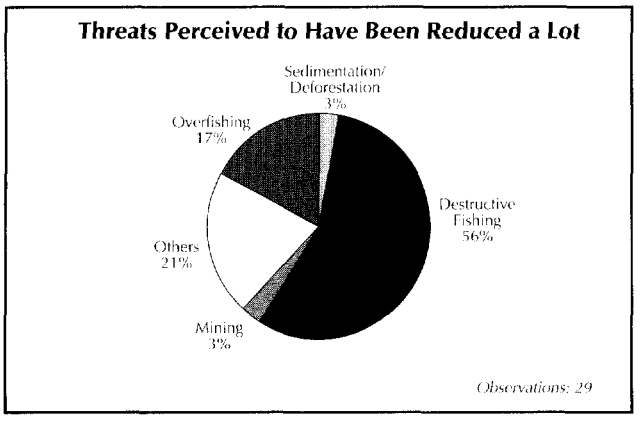


Figure 21. Distribution Perceived Trends by Type of Threat

[16] The Mann-Whitney rank test was significant at the 5% level. 'Destructive fishing' (e.g., poison or explosives fishing) was separated from 'Overfishing' in the survey since it relates to practices that are generally outlawed. Destructive fishing did not include cyanide poison use, which was not reported in the study sites.



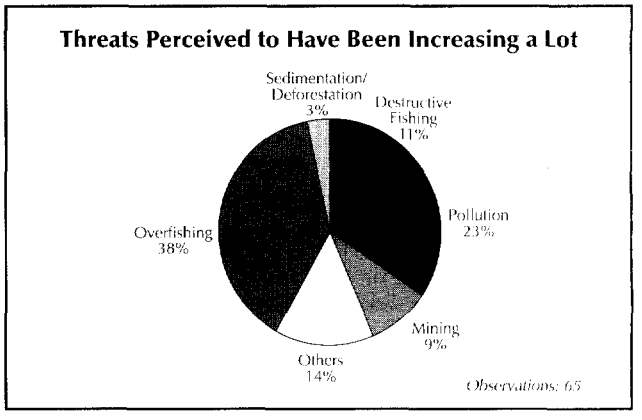


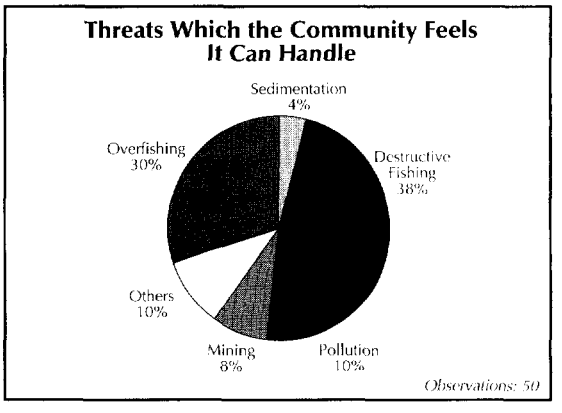
Figure 22. Distribution of Threat Types of Perceived Trend

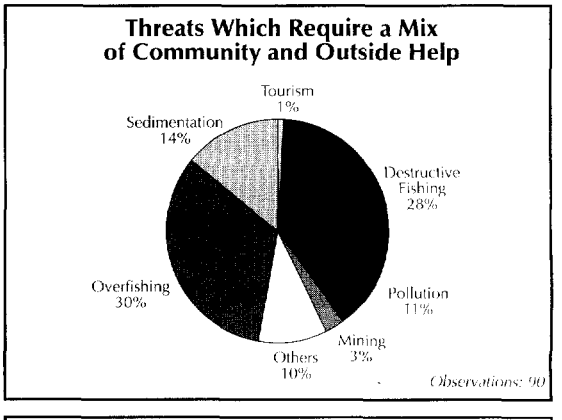
Which Threats Can be Handled by the Community and Which Require Outside Help?

In general, respondents felt that destructive fishing and certain types of overfishing were threats that could be handled at the community level. Outside help was believed necessary, however, in dealing with pollution, overfishing by outsiders, and other threats such as dredging, construction of causeways, and drilling for oil (Fig. 23).

Sites in Samoa and Tonga differed greatly in their views of the degree to which the communities could handle threats to coastal resources. Respondents in Tonga, where there is an open access system and little local management, felt that local communities could handle only 22 percent of the most important threats and that outside support was needed for as many as 72 percent of the threats. By contrast, Samoan respondents felt that the communities could handle 61 percent of the threats, and that the remaining could be addressed through a combination of community and outside help (Samoan sites were smaller, though). In Fiji, Solomon Islands and Palau, communities felt that the majority of the most important threats required a mixture of community and outside help.[17]

The study team made an assessment of whether the majority of the perceived threats identified by the communities at each site could potentially be handled at the local level. For example, the use of derris root was deemed to be addressable locally, while upstream siltation (largely beyond the control of the communities) was not. The next step was to determine whether most of the threats that could be addressed locally were in fact being handled by the





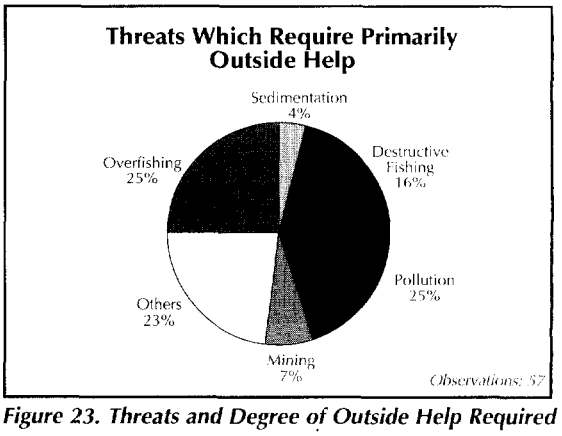


Figure 23. Threats and Degree of Outside Help Required

[17] This included 72 percent of the threats in Fiji and Palau, and 62 percent in the Solomon Islands.

communities. The results are summarized on Table 6 below. They indicate that at nearly half of the sites where it was believed that threats could be managed locally, the threats were not being addressed by the community (see also Chapter VII "Limitations of Community-Based Management Regimes").

Table 6. Extent to which Threats were being Addressed by Local Communities

	No. of Sites	
	Yes	No
Are most threats addressable at the local level?	21 (68%)	10 (23%)
Are locally manageable threats actually being addressed?	11 (52%)	10 (48%)

Are there Differences in the Most Important Threats by Country?

There appeared to be differences in the most important threats by country (Fig. 24).[18] Overfishing and destructive fishing were deemed to be very important threats in Samoa, Tonga, and Fiji sites. By contrast, communities in Solomon Islands and Palau sites identified a multiplicity of threats, many of them originating from activities on land. Some of the threats were unexpected: algae blooms, for example, were mentioned in Susui (Fiji), Kia (Solomon Islands), and Ngiwal (Palau). The construction of causeways was perceived as having a detrimental effect on coastal resources at all locations where causeways were found, namely Koulo and Tu'anekivale in Tonga, and Ngiwal (Palau). Disturbances caused by outboard motorboat engines were noted in Luaniua (Solomon Islands) and most sites in Palau.

AGGREGATE TREND PERCEPTIONS

The survey used four indicators of the impact of coastal resource management — perceptions of trends in CPUE, habitats, threats, and compliance. Could these indicators be combined to give a multi-dimensional picture of perceived ecological trends?

To test this, the study team used the aggregate responses given by each focus groups to the four indicators—their perception of all threat trends affecting a site, for example. These aggregate answers were not used elsewhere in the analysis because they masked important variations across resources, habitats, threats, and management rules. They were also generally more optimistic than perceptions about specific resources, habitats, or threats. This may indicate that targeted resources tend to be in worse shape than site resources as a whole. Alternatively, it may indicate that respondents find it more difficult to state perceptions for such an abstract concept as all the threats affecting their site.

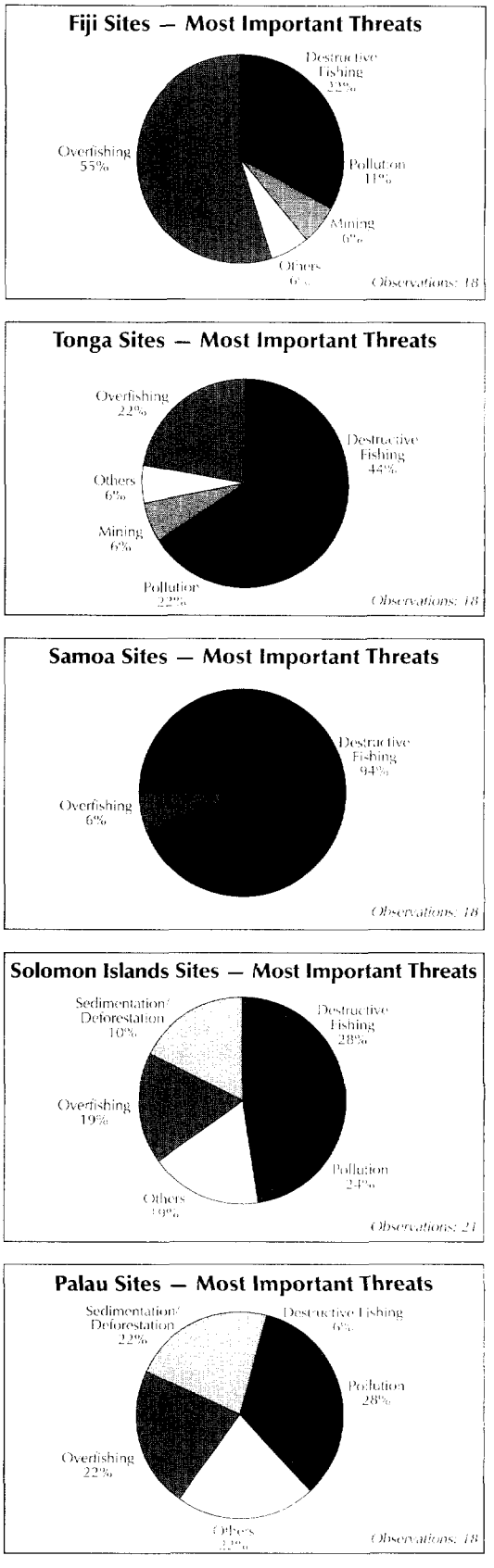


Figure 24. Most Important Threats to Coastal Resources by Country Reported at the Study Sites

[18] This takes into account only the most important threat reported by each focus group.

The aggregate responses for all four indicators were combined into an "aggregate perceived success index" using a principal component analysis (Chapter III). The focus group responses were then averaged for each site, giving an overall score. The results showed a fairly even distribution of study sites across the index.

The above scores were then compared with the study team's own assessment of site "success", based on rapid ecological observations and the team's own judgment of management impact (Table 7). The team found quite a few differences between its own assessment and the assessments of the communities, which could be due to the different criteria used. Some sites judged as moderate successes by the study team were perceived by local inhabitants as having poor ecological trends. Conversely, several sites where residents felt that the trends were improving were considered moderate failures by the study team. In the first instance, the communities' pessimistic assessment was largely due to perceptions of a worsening trend in CPUE. The study team's positive assessment, on the other hand, was based on the success of specific management rules and a high level of local awareness. All of the second type of sites had open access regimes. The study team's low assessment of these sites was based on the lack of management and the relatively high level of resource degradation. The communities' positive assessments were based primarily on perceptions of good compliance and improvement in habitats.

SUMMARY OF KEY RESULTS AND INTERPRETATION

The study was based on the assumption that stated perceptions reflected the true perceptions of the villagers. From experience in the field and comparison of results, it appeared that this was generally true. The study found strong consistency in the perceptions of groups of similar characteristics, indicating that the methodology accurately captured the communities' perceptions of ecological trends. If there had been inter-group differences, the smaller samples taken at supplementary sites — where only three focus groups were interviewed — might have been insufficiently representative of the sites' conditions. The results indicate that this was not a major problem in the survey.

There were two exceptions to the above conclusion. Habitat perceptions were found to differ across groups of similar characteristics. This could, however, be due to different interpretations of a particular habitat: an elderly group could be referring to the reef *pass* while a second elderly group might be thinking about the reef *flat*. The fact that the same focus groups showed no significant differences in responses to the other three indicators suggests that the answers were robust.

While there was no major incentive to misstate CPUE, habitat, and threat perceptions, there could have been incentives to overstate the degree of compliance. Violation of management rules is a sensitive subject. Villagers might suspect that the study was associated with enforcement or might have been reluctant to portray the community negatively to outsiders. Thus, the proportion of responses (51 percent) asserting full compliance with coastal management rules may be too high. Despite this potential bias, the study found no evidence that compliance perceptions were inconsistent, and the indicator remains useful in comparing the perceived compliance between different management rules.

One of the most surprising results of the study was the overwhelming perception that resources were declining. Out of 399 responses, only 3 percent perceived an increase in CPUE that was associated with management

Table 7. Comparison of Village Perceptions with Study Team's Assessment

Site	Village Perceptions		Study Team Assessment
Sites with Perceived Negative Ecological Trends by the Villagers but Judged Moderately Successful by the Study Team			
Luaniua	***Aggregate Success Index: -0.84***		***Study Team Assessment: Moderate Success***
	CPUE:	8% stable/increasing	• Despite strong commercial pressure on beche-de-mer, trochus, and giant clam, resources are still moderately abundant.
	Habitats:	33% stable/increasing	
	Threats:	23% stable/decreasing	• There is indigenous management, and local leaders are somewhat successful in restricting local effort;
	Compliance:	47% full/good	• Many people feel that bans are good and should be extended.
Onne	***Aggregate Success Index: -0.56***		***Study Team Assessment: Moderate Success***
	CPUE:	0% stable/increasing	• Taboo area appears successful
	Habitats:	77% stable/increasing	• Good understanding of the need for resource management
	Threats:	55% stable/increasing	
	Compliance:	33% full/good	
Sites with Perceived Positive Ecological Trends by the Villagers but Judged Moderately Unsuccessful by the Study Team			
Tu'anekivale	***Aggregate Success Index: + 1.49***		***Study Team Assessment: Moderate Failure***
	CPUE:	33% stable/increasing	• Overfished resources
	Habitats:	88% stable/increasing	• Sedimentation from causeway
	Threats:	75% stable/increasing	
	Compliance:	93% full/good	
Ha'atafu	***Aggregate Success Index: + 1.36***		***Study Team Assessment: Moderate Failure***
	CPUE:	78% stable/increasing	• Degraded fisheries resources
	Habitats:	77% stable/increasing	• Lack of indigenous rules
	Threats:	0% stable/decreasing	• Outsiders appear to ignore national rules
	Compliance:	100% full/good	

interventions. Since most study sites were implementing some form of coastal management, the paucity of management rules cannot be faulted for this result. Rather, more attention needs to paid to the causes of unsuccessful management. In addition, the fact that many of the causes of perceived CPUE and habitat declines—such as siltation, pollution, and poaching—cannot be effectively addressed through community action has important implications for future coastal management in the Pacific Islands.

The study found that successful management was associated most often with coral reefs than with other habitats. The perceived faster decline of inter-tidal areas, lagoons and reefs relative to other habitats may reflect the relative importance attached by communities to these habitats, rather than actual ecological differences. On the other hand, the results are consistent with experience in other regions, which indicates that reefs tend to be among the coastal habitats most impacted by human activities, but also among those most likely to recover from management. The results indicate that special attention should be devoted to inter-tidal areas, lagoons and reefs in view of their perceived importance to local communities.

Study results showed relatively good compliance with buyer-enforced regulations, protected areas, closed seasons and restrictions on destructive fishing practices. The study also revealed particularly good compliance for national rules adopted by local leaders and the importance of effective enforcement at the site level. The implications of these findings are discussed further in Chapter VIII.

The analysis of threat perceptions indicates that communities perceived pollution as being the most rapidly rising threat, while destructive practices were perceived to have declined the most.[19] In general, the study found potential for stronger community action in handling local threats. However, the fact that many of the fastest rising threats were beyond the control of the coastal villagers and could not be handled through fisheries management alone indicates that more needs to be done to assist local communities—particularly in addressing land-based threats, infrastructure impacts (such as that caused by causeways), and commercial harvests by external operators.

The differences between the study team's assessment and the perceptions of local villagers (Table 7) could be due to the different criteria used. The study team assessed the site conditions at one point in time and included judgments about the existence of management and degree of awareness that were not directly comparable to the villagers' perceptions of ecological trends. A similar discrepancy between community perceptions and that of project managers was found by Pomeroy, Pollnac et al. (1997) in a survey of coastal communities in the Philippines.

Community perceptions appear nevertheless to be affected by site-specific factors, such as the degree of awareness, dependency on resources, and the productivity of the sites' natural ecosystems (see Box 2). The relevance of these factors is discussed further in Chapter VI.

Box 2 - How do Community Perceptions Compare Across Sites of Different Characteristics?

Ontong Java vs. Honiara Fishing Village

Luaniua on Ontong Java atoll has often been cited as a success story in community coastal resource management. On the other hand, Honiara Fishing Village with its degraded environment appears to be an obvious management failure. The residents of these sites do not see it this way. At Luaniua, none of the CPUE trends for 24 identified resources were perceived to be positive or stable over the past ten years. Furthermore, none of the groups at Luaniua anticipated a stable or increasing CPUE in the near future. The residents of Honiara Fishing Village, however, were much more optimistic. Six of the perceptions for 21 resources indicated stable CPUEs and two of the focus groups believed the CPUE trend would remain stable in the future.

How can the communities perceptions be so counter-intuitive? The answer may be related to biological, behavioral, and psychological factors. The most likely are:

- The Honiara Fishing Village is located in an area which is biologically more productive than Luaniua. There are two major rivers flowing into the Honiara site. There is no such nutrient and freshwater input into Luaniua.
- Many Fishing Village residents are able to compensate for a drop in CPUE by ranging further afield and using more efficient gear (longer nets or larger boats). At Luaniua, the villagers do not have the luxury of exploring alternative fishing grounds, as their atoll is located more than 150 km from the closest neighboring island.
- At Luaniua the residents are more involved with coastal resource management than at Honiara Fishing Village where there are few, if any, local management rules for coastal resources. In short, the Luaniua residents have invested more energy in coastal management and therefore may be more sensitive to changes in their coastal resources. Hence, they could be quick to notice such changes as declines in CPUE.
- There are a variety of alternative income sources in Honiara Fishing Village, but little besides coastal resources in the isolated Luaniua. Like a person with only a small balance in a bank account, people in Luaniua are worried about resource levels, and may be more sensitive to any changes in their harvest.

The above suggests that management interventions may be particularly critical in small, resource poor, isolated islands with a high dependency on coastal resources.

[19] The latter result should be interpreted with some caution, since there may have been a tendency to underreport illegal practices conducted by the villagers themselves. Nonetheless, this result held in further analysis (see Chapter VI) and could not be explained solely by a decline in destructive practices in any particular country (such as Samoa).

VI. Success Factors

While Chapter V examined the communities' perceptions of success, this chapter analyzes how different factors — site characteristics, factors external to the sites, and factors related to management processes — affect perceived management success. A qualitative assessment of the most important factors is provided first, followed by the results of the quantitative analysis. Major findings are summarized at the end of the chapter. The chapter relies largely on econometric methods and may appeal primarily to readers with a quantitative background. The methods used for the quantitative analysis are explained in further detail in Annex B.

QUALITATIVE ASSESSMENT

Based on field observations, the following factors appeared to be the most important in influencing coastal management success:

- ***Government support for local management initiatives.*** Interviews at sites where government support had been substantial (e.g., sites in Samoa) suggest that this is an important factor in management success.

- ***Natural disasters.*** Cyclones were often cited as a major cause of habitat decline. Conversely, many respondents noted improvements in catch per unit of effort after devastating cyclones.

- ***Introduction of new or destructive technology.*** Destructive fishing practices, such as poison fishing and the introduction of more efficient fishing technology, were the second and third most frequent reasons cited for CPUE declines (after excess harvesting).

- ***Quality of local leadership.*** The quality of village leadership appeared to influence the degree of enforcement, adoption of management rules, attitudes towards destructive practices, and collaboration with external partners in restricted access sites. Leadership quality did not appear to have the same importance in open-access sites.

- ***Greater awareness of management benefits and of the impact of destructive fishing practices.*** This seemed to be a major factor in the adoption of effective management actions, such as well-enforced bans on destructive practices and adoption of national regulations as local rules. Local awareness of the impact of destructive practices also appeared to be important.

- ***Type and intensity of threats.*** This factor appeared to be very important, particularly when involving siltation.

- ***Effectiveness of enforcement.*** Communities perceived poor enforcement as a major reason of non-compliance with management rules.

MULTIVARIATE ANALYSIS

The quantitative analysis relied primarily on multivariate, discrete variable modeling[20] to examine the effect of individual variables on perceptions of success, while holding all other variables constant.

The analysis used all CPUE, habitat, threat, and compliance perceptions for the dependent variables. In order to do this, a correction had to be made to account for the complex structure of the data, which were structured at four levels — country, sites, focus groups, and, for each focus group, perceptions for different resources, habitats, threats and rules. Within each of these four clusters, the observations were correlated, causing most estimators which assume independent observations to result in biased standard errors. To avoid this, the study team used a correction that allowed the standard errors to be calculated under the assumption of stratified, clustered, random sampling (with stratification by country and clustering by site). These estimators allow for correlation within the clustering units, and yield variance estimates which are approximately unbiased or biased towards more conservative estimates.[21]

This model may be viewed as a special case of a more specific model involving separate equations for each resource, threat, habitat and rule category. Had there been equal sample sizes for each of these equations, it would have been possible to estimate these specific models and test for the equality of the coefficients. However, given the unequal and in some cases small samples, it was necessary to assume that the regression coefficients were equal across the different equations, i.e., that factors such as population density affected the CPUE of reef finfish and beche-de-mer in the same manner. This allowed the team to

[20] Discrete variable modeling is appropriate when the dependent variable is not continuous. In the study sample, the four indicators of success were measured on an ordinal scale and their distribution was modeled by an ordered probit model. The "aggregate perceived success" index is continuous and was therefore modeled by ordinary least squares regression. In practice, no major differences were found between these two estimation methods.

[21] See Stata (1999), Vol. 1: 321-333; Vol. 4:15-30.

Table 8. Results of the Multivariate Analysis for Success Factors - Basic Model

Success Factors	CPUE Trends	Habitat Trends	Threat Trends[a]	Compliance	Aggregate Success
		Ordered Probit Models			*Ordinary Least Squares*
Palau[♦]	0.394	0.356	0.436	1.107**	0.168
Samoa[♦]	0.300*	-0.731	0.121	0.672	-0.065
Solomon Islands[♦]	-0.179	-0.216	0.979**	-0.326	-0.930**
Tonga[♦]	0.254	0.476	1.870**	1.247*	0.266
Recent Government Visits	-0.099*	-0.007	0.121**	0.029	-0.152**
Income Dependence on Coastal Resources	0.006	0.008	0.005	0.005	0.001
Natural Disasters	0.489**	0.378*	0.188	0.404*	0.751**
Quality of Leadership	0.098	0.097	-0.359**	0.084	0.256*
Inability to Exclude Outsiders	0.194*	0.069	-0.227**	0.166	0.191*
Presence of Pollution	-0.104	-0.709**	--	0.362**	-0.314*
Population Density	0.000**	0.000	-0.000*	0.000	0.000
Number of Ecosystems	0.080	-0.094	-0.147**	0.168	0.139
Equal Sharing of Cost/Benefits	0.219**	0.080	-0.430**	0.210	0.318**
Presence of Destructive Fishing Practices[♦]	--	--	-0.652**	--	--
Presence of Land-Based Threats[♦]	--	--	0.478*	--	--
Presence of Overfishing Threats[♦]	--	--	0.284	--	--
Type of Rule: National rules adopted locally[♦]	--	--	--	0.924**	--
Type of Rule: National rule[♦]	--	--	--	-0.193	--
Constant (for OLS regression)	--	--	--	--	-1.767**
First ordinal rating[b]	1.269**	-1.199**	-2.310**	1.731*-	--
Second ordinal rating	2.500**	-0.062	-1.414**	2.226-	--
Third ordinal rating	3.083**	0.741	-0.947	2.889-	--
Fourth ordinal rating	3.752**	1.653**	-0.273		
N	399	396	377	442	124
F-Stat Degrees of Freedom	13,14	13,14	15,12	15,12	13,14
Probability Value of F test	0.0022	0.0302	0.0001	0.0049	0.0007
R-square					0.52

[a] Threat trends are rated inversely to the other indicators, i.e. a high rating indicates an increasing threat.
[b] This is analogous to the constant on ordinary least squares regressions.
[♦] The significance of these variables needs to be assessed in comparison with the omitted variables: "Fiji" (for countries), "other threats" (for presence of specific threats), and "indigenous rules" (for types of rules).
Significance levels: * significant at p<0.1; ** significant at p <0.05.

build a general model for CPUE, habitats, threats and compliance.[22] An aggregate success model was also derived using the "aggregate perceived success index" introduced in Chapter V.

As explanatory variables, the study team selected the ten factors that appeared to be the most important for management success (see Table B.5, Annex B). The factors were chosen based on empirical evidence, the qualitative assessment, and input from the study's advisory committee. They included government visits to the sites, dependence on coastal resources for income, natural disasters, quality of leadership, the inability to exclude outsiders, presence of pollution, population density, ecosystem diversity, presence of indigenous rules and a factor reflecting the degree to which a village shared the benefits and losses of resource management among its members ("equal sharing of costs/benefits"). In addition, the model included variables to account for country-specific effects. The "presence of indigenous rules" factor was subsequently dropped from the analysis because it was highly and negatively correlated with the Tongan sites, which lacked indigenous rules.

For the threats and compliance indicators, specific dummy variables (coded "1" for presence and "0" for absence") were also included. For the threat indicator, three variables were inserted to account whether the threat was a destructive fishing practice, a land-based threat (such as siltation, pollution, logging and mining), or overfishing. For the compliance indicator, two dummy variables were inserted to indicate whether the management rule for which the compliance assessment was stated was a national rule, or whether it was a national rule adopted locally. Significance was then compared to the omitted variables, "all other threats" and "indigenous rules". The results of this basic model are shown in Table 8.

Numerous variables were excluded from the basic model because of analysis limitations and, in some cases, because the survey had failed to measure the variable reliably. National-level variables could not be included because they tended to be highly endoge-

[22] If separate coefficients for each resource category had been allowed in a multi-equation model, then many more parameters would have had to be estimated, and the standard errors would have been higher. Table B.11 (Annex B) shows the results of a specific equation model for reef-related trends. In practice, the results were similar to those obtained through the general model shown in this chapter.

nous (see below). In addition, they only varied at the national level and hence would have been perfectly correlated with the country variables. Similarly, several management process factors (e.g., conflicts, length of partnership) were excluded because of endogeneity problems or because they would have limited the sample size.[23] These variables were analyzed primarily through qualitative assessments (Chapter VII).

Degree of awareness and enforcement effectiveness, two success factors found to be important in the qualitative analysis, could not be included in the model because they depend on site characteristics and processes (i.e., they are not intrinsic explanatory variables). Enforcement effectiveness was captured by the compliance success variable.

Endogeneity. Endogeneity arises when a clear cause/effect relationship between explanatory and dependent variables cannot be demonstrated. Two of the explanatory variables in the basic model were believed to be endogenous: "government visits" (the last time an official visited the site to discuss coastal management issues), and "income dependence" (the percent of income derived from coastal resources and tourism). It is not possible, for example, to determine whether dependence on coastal resources leads to management interventions or whether deteriorating trends lead to a change in the degree of dependence.

The presence of endogenous factors can bias the results of the analysis. The study team attempted to control for endogeneity by estimating a two-stage least squares model, in which the two factors were regressed against a set of instrumental variables explaining government visits and income dependence without otherwise being related to the perceived success indicators. Unfortunately, no good instruments could be found in the data set to explain these two factors, and the instrumental variables model resulted in imprecise estimates (Annex B).

Given the weakness of the instrumental variables model, the basic model was estimated again excluding the two endogenous variables (Table 9). Although some variables changed in significance, there was

Table 9. Results of the Multivariate Analysis for Success Factors - Without Endogenous Variables

Success Factors	CPUE Trends	Habitat Trends	Threat Trends*	Compliance	Aggregate Success
	Ordered Probit Models				*Ordinary Least Squares*
Palau•	0.174	0.011	0.166	0.889**	0.237
Samoa•	0.198	-0.949*	-0.127	0.481	0.015
Solomon Islands•	-0.096	-0.289	0.760*	-0.462*	-0.797*
Tonga•	0.498	0.271	1.140**	0.867	0.897
Recent Government Visits	--	--	--	--	--
Income Dependence on Coastal Resources	--	--	--	--	--
Natural Disasters	0.523**	0.364**	0.112	0.391*	0.815**
Quality of Leadership	0.032	0.077	-0.281**	0.106	0.161
Inability to Exclude Outsiders	0.099	0.054	-0.114	0.205**	0.062
Presence of Pollution	-0.082	-0.707**	--	0.363**	-0.269
Population Density	0.000	-0.000	-0.000*	0.000	0.000
Number of Ecosystems	0.097	-0.072	-0.145**	0.173*	0.145
Equal Sharing of Cost/Benefits	0.131*	0.040	-0.371**	0.206*	0.229**
Presence of Destructive Fishing Practices•	--	--	-0.606**	--	--
Presence of Land-Based Threats•	--	--	0.482*	--	--
Presence of Overfishing Threats•	--	--	0.343	--	--
Type of Rule: National rules adopted locally•	--	--	--	0.915**	--
Type of Rule: National rule•	--	--	--	-0.169	--
Constant (for OLS regression)					-1.830**
First ordinal rating**	0.971*	-1.615**	-2.623**	1.445*	--
Second ordinal rating	2.179**	-0.489	-1.739**	1.941**	--
Third ordinal rating	2.751**	0.311	-1.278**	2.602**	--
Fourth ordinal rating	3.425**	1.226*	-0.615	--	--
N	399	396	377	442	124
F-Stat Degrees of Freedom	11,16	11,16	13,14	13,14	11,16
Probability Value of F test	0.1203	0.0150	0.0000	0.0029	0.0164
R-square					0.48

* Threat trends are rated inversely to the other indicators, i.e. a high rating indicates an increasing threat.
** This is analogous to the constant on ordinary least squares regression and indicates the ratings on the ordinal scale dependent variable.
• The significance of these variables needs to be assessed in comparison with the omitted variables: "Fiji" (for countries), "other threats" (for presence of specific threats), and "indigenous rules" (for types of rules).
Significance levels: * significant at p<0.1; ** significant at p <0.05.

[23] Information associated with partnerships could only be assessed at the 15 sites which had external partners. Including these variables in the analysis would have cut the sample size by half.

strong consistency in the standard errors and only a minor variation in the coefficients of the two models.

INTERPRETATION OF KEY RESULTS

Country Effects. Among the study countries, sites in Samoa had better perceived CPUE trends than sites in Fiji and the Solomon Islands, but worse habitat trends than sites in Palau or Tonga. Tonga and Solomon sites had significantly worse trends in threats than Palau, Samoa, or Fiji.[24] Perceived compliance with management rules was better in Palau sites than in Fiji and the Solomon Islands. Tongan sites also seemed to fare better in perceived compliance than sites in the Solomon Islands and slightly better than sites in Fiji.

Government Support. Given the endogeneity issue, no conclusions could be drawn from the econometric analysis regarding the impact of recent government visits on perceived coastal management success. However, indications from sites where there is substantial government support to village-level management indicate that this factor may be quite important in influencing management success.

Dependence on Resources. "Income dependence," the second endogenous variable, did not appear to play a determining role in any of the perceptions of success. A similar result was obtained when modeling the degree of dependence on coastal resources for subsistence purposes. Experience at some sites (e.g., Galoa) suggests that the more dependent the community is on coastal resources, the more difficult it is to put harvesting controls into place. On the other hand, most sites that were effective in limiting their own harvesting (e.g., Luaniua) were highly dependent on coastal resources. It is therefore possible that in some instances dependence acts as a deterrent and in other instances as an incentive for community action in coastal resource management.

Natural Disasters. The significance of "natural disasters" was consistent with the qualitative result findings, indicating rapid resource recovery following a cyclone event.

Quality of Leadership. "Quality of leadership" appears to be important in controlling threats and of moderate significance in determining the aggregate success index[25]. It is likely that leadership is also significant in determining other trends but may not have been well captured by the survey questionnaire.[26]

Exclusion of Outsiders. The "inability to exclude outsiders" variable was puzzling at first. Given the nearly perfect correlation between open access and Tongan sites, open access sites appeared to have worse threat trends than sites with restricted access, which is consistent with empirical evidence.[27] The results indicated, however, that in all other sites, the *less* capable the village was in excluding outsiders, the better the compliance, CPUE and threat trends. One possible explanation was that sites which were able to exclude outsiders also had a high incidence of threats which typically could not be handled by the community. But does the ability to exclude outsiders help control threats which can be handled locally? To explore this question further, the study team related the variable to threats which the community believed it could handle. When this variable was included, the coefficient was no longer significant, which is consistent with the finding that many communities are not handling local threats effectively (see Chapter V). It is also possible that sites with strong customary marine tenure traditions are more sensitive to compliance violations (Box 2).

The inability to exclude outsiders is not a continuous variable, and the results need to be interpreted with caution. When the variable was decomposed into its underlying categories, it showed that in cases where decisions to exclude outsiders were made at above the village level (e.g., by paramount chiefs in Fiji), the sites tended to have significantly negative trends in CPUE and low compliance. This is consistent with villagers reports in Fiji that non-resident leaders occasionally grant licenses to outside fishermen, a practice that was viewed negatively by the communities[28].

[24] The significance was tested through an adjusted Wald test. The results reflect mean differences across countries after controlling for other factors (and not differences in raw means).

[25] Threat trends need to be interpreted as the reverse of other trends: i.e., a negative and significant relationship means that sites with good leadership tend to have better control over threats.

[26] Because the leadership questions in the original survey were found to be unreliable, the study team made a general assessment as to whether the site leadership was of low, medium, or high quality. This was based on the observed local respect commanded by the chiefs, and their ability to deal with coastal management efforts. While in general probit models require that explanatory variables following an ordinal ranking (e.g., high, medium, low) be transformed into dummy variables, further analysis indicated that treating quality of leadership as continuous did not affect the final results (see Annex B).

[27] As indicated by the significant and positive sign of the Tonga variable.

[28] The results may also reflect recent trends in countries with strong marine tenure (such as Palau) where poaching by external fishers is increasing (R. Johannes, personal communication). This effect was not, however, captured by the Palau country dummy.

Given the difficulties in interpreting the variable, perhaps the most that can be said is that in restricted access sites, the study found no strong evidence that a village's ability to exclude outsiders influenced perceptions of success. A principal component analysis, however, suggested that the ability to exclude outsiders is associated with a higher number of indigenous rules and the presence of clear site boundaries (Annex B).

Number of Ecosystems. The greater the "number of ecosystems," the lower the perceived threats, indicating that in ecologically richer areas threats are spread over a greater number of habitats. Thus, habitat deterioration may not be perceived to be as acute than in lower diversity areas.

Type of Threat. The presence of "pollution" seemed to have a significantly negative effect on perceived habitat trends. Consistent with the findings of Chapter V, "destructive fishing practices" appeared to be increasing more slowly than other threats at the study sites. There was also some evidence that "land-based threats" were rising faster than other threats, except for overfishing.

Type of Management Rule. The results of the multivariate analysis confirmed the earlier study findings that "national rules which have been adopted locally" had significantly higher perceived compliance than either purely national or local rules. No significant differences were noted in the perceived compliance with purely national or purely local rules.

Population Growth and Density. Population growth rates ("population pressure") did not seem to affect perceptions of success. The results seemed to indicate, however, that the higher the population density, the lower the perceived threats and the better the CPUE. The study team believes that this apparently contradictory finding may reflect the fact that the variable is likely capturing other site characteristics: for example, sites with high population density tended to have relatively undeveloped fishing technology. When technology was accounted for in the CPUE model, population density was no longer significant.[29] Perhaps more significant is the indication that population pressure may not be as relevant a cause of coastal resource decline in the Pacific as previously believed.

Equal Sharing of Costs and Benefits. A significant variable associated with most success indicators was the extent to which management benefits and costs were shared equally among community members ("equal sharing of costs/benefits"). This is consistent with study findings that unequal distribution of benefits is one of the most important causes of intra-village conflict (see Chapter VII).

OTHER QUANTITATIVE RESULTS

How do External Factors Influence Success?

As seen, the structure of the survey was not conducive to a quantitative assessment of the impact of national policies on coastal resource management. However, some conclusions can be drawn from simple correlation coefficients and qualitative assessments (Chapter VII). Correlation coefficients do not assume a cause/effect relationship. They simply examine whether perceptions of success are high (or low) at sites possessing certain characteristics. A significant coefficient indicates that the two vary together. The key disadvantage of this analysis is that it does not isolate the effects of a particular factor. Supportive national legislation, for example, could be negatively correlated to habitat trends in a certain country, but this could simply mean that factors other than legislation are affecting local habitats.

Enabling Legislation. There is little evidence from the correlation analysis that national legislation is related to the perceptions of success at the site level. The study team examined three regulatory variables: (a) whether the government recognized marine user rights; (b) an index of enabling legislation supporting community-based management; and (c) a fisheries legislation index. These variables tended to be significantly — and negatively — related to perceived success. This could mean that countries with strong enabling legislation (e.g., Solomon Islands) are also experiencing worsening ecological trends for reasons unrelated to legislative support.

By contrast, national recognition of customary marine tenure and enabling legislation in support of community-based management were highly correlated to the presence of indigenous rules at the site level

[29] A study reviewer suggested that sites with higher population density may have access to tinned fish as an alternative source of protein. They could therefore exert less pressure on coastal resources than more remote (or sparsely populated) sites. However, the correlation between population density at the study sites and access to tinned fish (or meat) was relatively low (0.08).

(Table 10). But how does enabling legislation relate to the presence of national rules adopted locally (which seem to have the highest compliance)? The correlation analysis indicates that a legislative framework allowing communities to adapt national rules to their own conditions appears to be the more important enabling factor. This type of rules were found primarily in Samoa, which does not recognize customary marine tenure (hence the negative correlation shown in Table 10).

Table 10. Correlation Between Indigenous Coastal Management Rules and Enabling Legislation at the National Level

Correlation between	Presence of Indigenous Rules	Presence of National Rules Adopted Locally
Recognition of Customary Marine Tenure*	0.58***	-0.25***
Enabling Legislation Supporting Community Management	0.40***	-0.12***
National Legislation Allowing Communities to Adapt National Rules to Own Conditions	N/A	0.23***

***significant at p <0.001. * - For this index, see Table 14, Chapter VII.

External Support for Coastal Resource Management. The proportion of staff time dedicated to coastal resources management in national fisheries agencies was significantly correlated with perceived success. The frequency of newspaper articles on coastal resource issues (a proxy for awareness among high-level decision makers) was also positively related to perceived success, except for habitat trends (Table 11). By contrast, the level of donor financing (annual budget spent per area of country) was related only to perceptions of compliance, but this factor is known to be important in countries such as Samoa. Political will was not well captured by the questionnaire, but it is likely to play an indirect role in influencing other important factors such as support for community-level initiatives. The degree of government support at the site level is discussed further in Chapter VII.

Table 11. Correlation between External Support and Perceived Success of Coastal Resource Management at Study Sites

Correlation between	CPUE Trends	Habitat Trends	Threat Trends	Compliance
Fisheries Departments % Staff time dedicated to coastal resource management	0.158***	-0.133***	-0.294***	0.171***
Frequency of newspaper articles on coastal management	0.145***	-0.152***	-0.411***	0.142***
Annual donors budget per sq. km	-0.020	-0.022	-0.010	0.173***

***Significant at p<0.01 level.

External Shocks. Shocks were defined as major events affecting the coastal resources of a site. As previously discussed, natural disasters appeared to have the strongest impact on perceived trends. Among other shocks, the introduction of destructive technologies was negatively correlated with perceived compliance.

Which Site Characteristics Appear to Influence Perceived Success?

Qualitative and quantitative analyses revealed a number of site characteristics that seemed to significantly affect perceptions of success: community awareness, quality of leadership, type and intensity of threats, and ecosystem diversity all appeared to be important.

To explore further the impact of other site characteristics on perceived management success, the study team built two variations of the basic model, which included sets of additional site characteristics (see Table 12).

The models showed that village education appeared to have a negative impact on perceived habitat trends. This could indicate that communities with a higher level of education are more aware of habitat degradation or, alternatively, that educated communities tend to be located close to urban areas where habitat destruction is more common.

Settlement patterns appeared to have a negative effect on perceived habitat and threat trends, but a positive effect on compliance. The conservation value of a site appeared to be negatively related to habitat trends. This could indicate that these sites are subject to high levels of habitat degradation. The level of fishing technology was found to have a positive impact on perceived CPUE. The most logical explanation is that sites with better fishing technology and larger boats are able to explore alternative fishing grounds. The analysis found no significant effect for tourism benefits, cultural requirements to harvest, social cohesion, or ease of marketing. Only at Tongan sites were cultural harvesting requirements (e.g., communal harvests for a feast or a funeral) sufficiently large to have a bearing on management success.

A number of other site characteristics could only be tested through simple correlations with the perceptions of success variables (see Table B.2, Annex B).

Table 12. Significance of Additional Site Characteristics[1]

	CPUE	Habitats	Threats*	Compliance	Aggregated Success
Success *Site Characteristics Model I:*					
Percentage of completed village projects: Social Cohesion	0.003	0.011	-0.001	-0.010	0.016
Village Education	0.004	-0.013**	-0.002	-0.005	-0.003
No. of close-by villages: Settlement Patterns	-0.003	-0.014**	0.008**	0.013**	-0.004
Ease of marketing perishable products: Market Integration	-0.116	0.057	-0.055	-0.059	0.062
Presence of External Partners	-0.153	-0.146	0.460**	0.205	-0.076
Site Characteristics Model II: [2]					
Cultural Requirements to Harvest	-0.135	-0.116	0.133	0.131	-0.021
Level of Fishing Technology	0.621**	-0.033	0.196	-0.344	0.231
No. of ecological features: Conservation value	-0.017	-0.238**	0.012	-0.049	-0.131
Benefits from tourism	-0.090	0.078	0.034	0.076	-0.051

Significance levels: * significant at p<0.1; ** significant at p <0.05.

[1] - Complete model results are shown on tables B.18 and B.19, Annex B.

[2] - Ordinary least squares regression results. The ordered probit results were almost identical.

*Threat trends are rated in the inverse: a high rating indicates an increasing threat.

Urban sites were associated with higher threats, but also with higher compliance. The age of a village appeared to be positively correlated with more positive habitat, compliance and threat trends. Sites located in high islands seemed, in general, to have lower threats and better compliance than sites located in low islands. High islands can include highly productive areas (e.g., large lagoons with substantial estuarine and mangrove systems) that are generally more resilient to harvesting pressure than low islands or atolls. The presence of clear site boundaries, on the other hand, was negatively correlated with compliance, but this could be due to the inability of the correlation coefficient to distinguish between the effect of other factors.

The way site characteristics were associated across the study sites was assessed with a principal component analysis. Sites with high social cohesion also tended to be older settlements, have better systems of leadership, have higher education, and have better compliance with management rules (see Table B.21, Annex B). Larger sites tended to have greater ecosystem diversity and other important conservation features (e.g., presence of turtle-nesting areas, sea bird rookeries). Sites with greater diversity of land use tended to have higher conservation value, larger populations, and more abundant coastal resources. Sites with highly developed fishing technology also had a high dependence on coastal products and were generally further away from urban markets. The level of village development was positively associated with the degree of market integration, but negatively associated with dependence on coastal resources for subsistence use.

Which Key Processes are Most Conducive to Management Success?

Management processes tend to be highly endogenous. It is not certain, for example, whether sanctuaries have helped improve resource trends or whether they were introduced as a response to declining trends. While this section provides a few quantitative results, management processes related to conflict, external partners, the introduction of sanctuaries, and alternative income generation were primarily analyzed qualitatively and are discussed in Chapter VII.

It was seen in the basic model that equality of benefits and losses was an important predictor of perceived success. The fact that external partners were found to be associated with higher threat trends (Table 12) may simply indicate that the partners tend to intervene in sites which naturally attract higher threats. The multivariate analysis, however, showed no significant differences in perceptions of success between conservation and nonconservation sites.

The principal component analysis indicated that sites with external partners were associated with the presence of sanctuaries and the introduction of alternative income generation. The presence of indigenous rules was generally associated with local control over resources and a higher benefit derived from external site users. Curiously, villages which shared the benefits and losses of management equally among its members also had a relatively low participation of youth and women in decisionmaking. Pure democracy (one person, one vote) was not found at any site. On the other hand, all village governance systems had mechanisms to give most segments of the com-

Table 13. Most Significant Success Factors Found at the Study Sites - Summary Results

Factor	Effect on Perceived Success Indicators			
External Factors:				
Natural disasters	↑ CPUE	↑ habitats	↑ compliance*	↑ aggregated success
Site Characteristics:				
High quality of village leadership	↓ threats	↑ aggregated success *		
Larger number of coastal ecosystems	↓ threats			
Presence of pollution	↓ habitats	↑ compliance	↓ aggregated success *	
Presence of destructive fishing practices	↓ threats			
Presence of land-based threats	↑ threats *			
Higher village education	↓ habitats			
Presence of other settlements nearby	↓ habitats	↑ threats	↑ compliance	
Higher fishing technology	↑ CPUE			
Higher number of conservation/ecological features	↓ habitats			
Awareness of management benefits	Qualitative assessment indicates that it is important to overall success			
Management Processes:				
Equal sharing of benefits/losses of management	↑ CPUE	↓ threats	↑ compliance *	↑ aggregated success
Presence of national rules adopted locally	↑ compliance			
Effectiveness of enforcement	Qualitative assessment indicates that it is important to overall success			

↑ Indicates that the factor causes the indicator to be rising faster; ↓ indicates that the factor causes the indicator to be declining faster.
Aggregated success represents a weighted measure of all four success indicators derived through principal component analysis.
** Weakly significant (at the 10 percent level).*

munity a say in the decisionmaking process. Collaboration among neighboring communities appeared to be important in Fiji, where coastal areas are commonly shared by several villages.

SUMMARY OF KEY RESULTS

The previous sections discussed the interpretation of the findings on key success factors. Table 13 summarizes the most important success factors found by the study and their relation to the perceived success indicators.

For several potentially important factors, the study results were inconclusive: a cause/effect relationship between national policies and coastal management success could not be demonstrated through the quantitative analysis. The level of government support to community initiatives is believed to be important, but its impact could only be assessed qualitatively (see Chapter VII).

Open access sites were generally associated with higher perceived threats to coastal resources. However, contrary to current thinking, the study failed to find a significant relation between the ability to exclude outsiders and perceived success. Similarly, higher population density did not appear to result in worsening perceived trends at the study sites.

Population growth, ease of marketing, social cohesion, income dependence, cultural requirements to harvest, and tourism benefits were not found to be significant in influencing perceived success at the study sites.

VII. Key Issues

This chapter examines a number of coastal management issues based on the study findings. The issues include:

- Coastal resource use conflicts;
- The level of government support to community initiatives;
- The relevance of different coastal resource management rules;
- Characteristics of open access sites;
- External partnerships;
- The perceived effect of sanctuaries as a coastal resource management tool;
- The perceived impact of alternative income generation programs; and
- Limitations of community-based management.

The results are based on simple descriptive analysis of the survey results as well as study team observations.

CONFLICTS

Of the 31 sites, 26 (84 percent) reported conflicts with outsiders regarding coastal resource use. These conflicts usually fell into three categories: conflicts with poachers; disputes over boundaries; and disputes with external commercial operators. The most commonly reported conflict was poaching and other forms of unauthorized fishing, frequently involving night diving or collection of commercial species such as trochus. The second most common conflict involved boundary disputes and conflict over offshore reef ownership. This occurred even in Fiji where, starting in 1958, the Native Fisheries Commission spent years delineating fishing rights boundaries. Several sites reported conflicts with outsiders over commercial operations, particularly when it involved commercial licenses to external fishers.

External disputes seemed to vary by country. In the Solomon Islands sites, conflicts involving residents from open access sites occurred when they trespassed on nearby coastal areas where local communities had exclusive use rights. No physical altercations were reported in Tongan sites, perhaps because of cultural traits. In Samoan sites, conflicts appeared to arise because the village councils' long-established practices of excluding outside users from community waters is not consistent with the Constitution, which does not recognize exclusive user rights.[30] Samoa presented both some of the best examples of conflict resolution as well as some of the worst conflicts, with some disputes involving physical violence and destruction of property.

Six sites (19 percent of the sample) reported intra-village conflicts. These generally arose when certain individuals or families were seen as benefiting disproportionately from external commercial operations. Examples include traditional leaders benefiting from licenses issued to external fishers, or the involvement of certain community members in a new tourist resort or a pearl farm. Specific examples of local conflicts reported at the study sites are shown on Box 3.

Box 3. Examples of Coastal Resource Use Conflicts Reported at Study Sites

Conflicts Over Resource Use

Galoa, Fiji: Resource use conflicts occurred mainly with outsiders. A few years back, a group of Nausori fishers were chased from the site. Prior to this, the Tikina meeting had made a resolution that no outsider should be granted a fishing license, but the Tui Lekutu ignored the decision. The incident was reported to the Tikina Concil and the Provincial Council, where it was resolved.

Luaniua, Solomon Islands: Resource use conflicts arose when commercialization of resources became important. A major catalyzing event occurred when a Luaniua businessman brought in a collection vessel and made ownership claims on reefs adjacent to his land. This event led to a temporary breakdown of alternating trochus and beche-de-mer harvesting bans, and resulted in a weakening of chiefly authority over coastal resources. Conflicts also arose over the ownership of floating logs, which were important for canoe building and firewood. The chiefs usually resolved this type of conflicts. Little conflict was reported with non-Ontong Java people.

Peleliu, Palau: Ongoing boundary disputes caused conflicts between Koror state rangers and Peleliu fishers, mainly over trochus harvests and fishing in Koror state's no-take zones. There was also some conflict between net fishers and tourism diving operations.

[30] Under Article 104 of Samoa's Constitution, all land lying below the high water mark is vested in the State. Legally, therefore, all Samoans have equal access rights to coastal areas.

Table 14. Indicators of National Assistance to Coastal Resource Management

	Fiji	Tonga	Samoa	Solomon Islands	Palau
I. Enabling Legislation					
Does the Legislation:					
Authorize traditional users to define marine boundaries for exclusive use?	Yes	No	No	Yes	Yes
Recognize customary marine tenure?	Yes	No	No	Yes	Yes
Allow community representatives to legally implement indigenous rules?	No	No	Yes	Yes	Yes
Allow for communities to adapt national rules to their own conditions?	No	No	Yes	No	Yes
Allow local leaders to enforce legislation?	Yes	No	Yes	Yes	Yes
Provide for a forum for conflict resolution?	No	Yes	Yes	No	No
Are there traditional mechanisms of conflict resolution not requiring national laws?	Yes	Yes	Yes	Yes	Yes
Provide for full agreement from coastal users before a coastal area is declared as a conservation/protected area?	No	No	Yes	Yes	Yes
Provide for full agreement from coastal users before permits are given for coastal development	No	Yes	Yes	Yes	No
Percentage of "Yes" answers	44%	33%	78%	78%	78%
II. Agency Support to Coastal Resources Management					
Fisheries Divisions:					
Estimated % Staff-Time Allocated to Fisheries Management Activities	12%	20%	50%	15%	17%
Support to Community Initiatives in Coastal Resource Management	Yes	Yes	Yes	Yes	Yes
Enforcement Support to Coastal Resource Management	Medium	Minor	Minor	Major	Minor
Collection of Statistics on Commercial Coastal Production	Major	Medium	Major	Medium	Medium
Collection of Statistics on Subsistence Fisheries	Medium	Minor	Minor	Absent	Minor
Stock Assessment for Coastal Fisheries	Medium	Minor	Medium	Minor	Minor
Environment Divisions:					
Support to Community Initiatives in Coastal Resource Management	Yes	Yes	Yes	Yes	No
III. Estimated Annual Donor Assistance per Square Kilometer of Surface (US$)*	21	114	194	16	666

Responses are as stated during an interview with Fisheries and Environmental Agencies' staff, and could reflect the subjective judgments of the respondents.
**- Likely to be underestimated.*

GOVERNMENT SUPPORT FOR COMMUNITY INITIATIVES

Government support for community-based management is often seen to be a key contributor to coastal resource management success. Although this could not be demonstrated through the quantitative analysis (Chapter VI), the evidence collected by the study remains useful in analyzing the level of government assistance at the study sites.

Table 14 summarizes the various indicators of national assistance to local-level coastal management initiatives, according to information provided by senior government officials. The proportion of public expenditures allocated to coastal management would provide a good indication of national priorities, but this information was not available for most of the countries. The estimated proportion of fisheries agencies' staff time devoted to coastal resources management averaged 23 percent in the study countries.

Perhaps a better indicator of government support is how recently an official visited the villages to provide advice on coastal resources management (Fig. 25). Fifteen sites (48 percent) had never been visited, and an additional 3 sites had not received a visit in the previous 10 years. Fiji and Samoan sites had the highest proportion of recent visits (two-thirds of the sites). Half of the sites visited were also receiving external donor assistance in coastal resource management, suggesting that part of the visits were being supported by donor funds. The results indicate that local management of coastal resources does not rank high among government priorities.

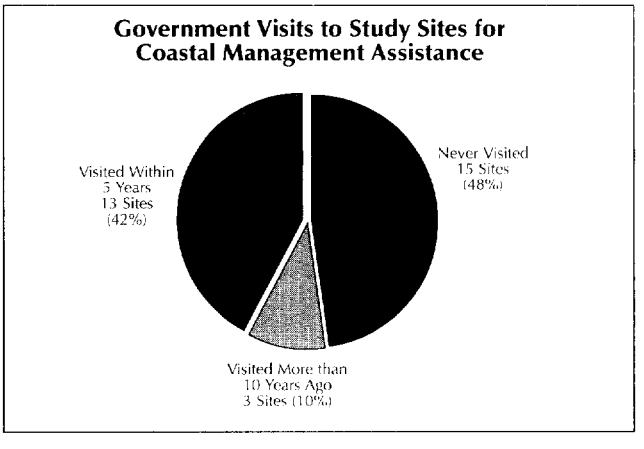


Figure 25. Government Visits to Study Sites

Can government support for community-based management be effective? Recent efforts by the government of Samoa indicate that it can (Box 4).

RELEVANCE OF NATIONAL AND LOCAL MANAGEMENT REGULATIONS

To assess the familiarity of villagers with national coastal resource management rules, the study team asked knowledgeable resource users to name five national regulations. At 13 sites (42 percent) the respondents were unable to identify at least five national rules. Because these individuals appeared to be better informed than the average users, this result suggested fairly low awareness of national rules at study sites. Village isolation does not explain this finding, since almost half of these 13 sites were on the same island as the fisheries and environmental agency headquarters. In Palau, however, only one village was unable to identify national rules. This higher degree of awareness may be related to a brochure produced by the Palau Division of Marine Resources and SPC on national fishing laws.

Most respondents believed that local rules were easier to enforce than national regulations. Exceptions to this included open access sites, which lacked local rules. In addition, respondents from Niu and Onne (Solomon Islands) stated that national rules were easier to enforce because of the existence of a court system.

As seen in Chapters V and VI, the study found that there was a high level of compliance with two types of national rules:

- *National rules which have been adopted locally.* Interviews in Fiji and Samoa found that when national rules were seen as practical, needed and relevant, they were sometimes adopted by traditional leaders as local rules. Rules in this category showed significantly higher compliance than either national or local rules.

- *Buyer-enforced rules.* Interviews in the Solomon Islands and Palau indicated that compliance with rules enforced by buyers or exporters was high (Box 5).

Local adoption of national regulations offers the best of both worlds as far as coastal resources are concerned: national rules that are sound from a biological and legal perspective are made effective through enforcement at the local level. They also have the advantage of being legally backed by a court of law (see "Limitations of Community-Based Management Regimes"). This suggests that local awareness programs aimed at village leaders may be an important way to increase compliance with coastal management rules in the Pacific.

Buyer-enforced rules are only applicable to export commodities or commodities which are brought together at particular locations, and their enforcement requires strong political will. In two of the study countries, little was being done to enforce limits on the sizes of trochus at button processing factories or limits on lobster sizes at restaurants, despite the critical levels of these two resources. By contrast, the enforcement of the crocodile ban in the Solomon Islands appeared to be effective (Box 5).

There was a perception at many study sites that compliance with turtle bans was quite poor. The two rea-

Box 4. The Samoa Fisheries Program: An Example of Government Support to Community-Based Coastal Resource Management

Can Government Support to Community-Based Management Be Effective?

The Samoa Fisheries Division started implementing the Fisheries Extension Program in 1997, under AusAID assistance. The program aimed to assists communities in developing and implementing their own fisheries management plans. Assistance provided by extension staff was largely demand driven. In general, it was provided when a village council (fono) approached the Fisheries Division for assistance.

Of the 72 villages assisted by the program, 53 produced fisheries management plans and 48 have established their own sanctuaries. The program also assisted communities in formulating their own management rules and making them legally binding through the issuance of by-laws. If community follow-up is an indication of Government assistance impact, the Samoa experience was effective. Up to 50 percent of the Fisheries Division staff time is now estimated to be spent on coastal management assistance.

Sources: King, Faasili and Taua (1998); Village Fisheries Extension Program (1997); Fa'asili (1997) and study observations.

Box 5. Compliance with Buyer-Enforced Rules: The Experience of Crocodile Trade in the Solomon Islands

The contention that buyer-enforced regulations are effective is supported by the crocodile trade in the Solomon Islands. According to villagers, there is presently a national ban on killing crocodiles (except in cases where human lives are in danger). Even though crocodiles are despised by many Solomon Islanders, this national level rule appears to be effective and field reports indicate that the abundance of crocodiles is increasing. The key to success is that the killing ban is supported by an apparently well-enforced ban on the export of crocodile skins. During the course of the field work, the study team often heard remarks from villagers such as "there is no market for crocodile skins so why go through all the work of killing crocodiles...".

sons cited for poor compliance was that the rules conflict with the communities' cultural obligations (such as the custom, at some sites, of giving turtles to the chiefs) and that "turtle meat was just too tempting to resist."

Another key observation was that simple rules (e.g., a ban on dynamite fishing) seemed to enjoy a greater understanding than more complicated arrangements (e.g., a ban on harvesting trochus between January and May). A majority of the local rules were simple (Fig. 26), and their perceived compliance was significantly greater than compliance with more complex regulations. It also appears that many national rules that directly affect community management are so complex that they baffle local beneficiaries, and are consequently ignored (Box 6).

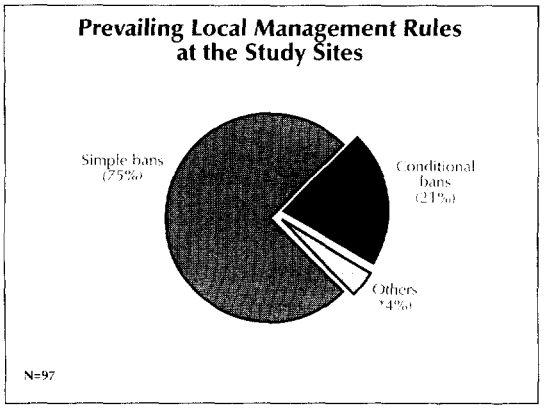


Figure 26. Types of Local Rules Found at Study Sites

Finally, the study's finding that sanctuaries, closed seasons and restrictions on destructive fishing practices were perceived as being better complied with than other types of rules (Chapter V) suggests that more should be done to apply and enforce these types of regulations.

CHARACTERISTICS OF OPEN ACCESS AREAS

Coastal management experts generally consider open access conditions — where there is no restriction of access to a coastal area — as a constraint to the effective management of coastal resources.

Eight of the sites (26 percent) were open access areas: they included all six sites in Tonga, and the Honiara Fishing Village and Cooksin in the Solomon Islands. In Tonga, the 1875 Constitution, the 1887 Royal Proclamation, and the Land Act of 1927 abolished traditional claims of local control over fishing areas and gave all Tongans the right of equal access to national waters. In the two Solomon Island sites, open access prevailed because the villages were resettled in areas owned by the government.

Box 6. National Coastal Management Regulations vs. Simplicity

An example of a national rule affecting community management which is **not** simple is Section 13 on the protection of native customary rights in the current Fiji Fisheries Act:

"Notwithstanding anything contained in the Rivers and Streams Act, it shall be an offence for any person to take fish on any reef or any kay (cockle) or other shellfish bed in any area in respect of which the rights of any mataqali or other division or subdivision of the Fijian people have been registered by the Native Fisheries Commission in the Register of Native Customary Fishing Rights, unless he shall be a member of such mataqali, division or subdivision of the Fijian people who does not require a license under section 5 to take such fish or shall first have obtained a permit to do so from the Commissioner of the Division in which such area is situated provided that such permits shall not be necessary in the case of persons taking fish (other than by way of trade or business or as an employee of a person carrying on the trade or business of a fisherman) with hook and line, or with a spear or portable fish trap which can be handled by one person; and any such permit may exclude fishing for particular species of fish, or may exclude fishing in any particular areas, or may exclude fishing by any particular methods, or may contain any combination of such exclusions".

Sentences often heard at the study sites were that "the simpler the management arrangement, the better it will be understood by simple villagers," and that "the villagers understand bans."

Open access sites shared the following characteristics:

- ***Lack of Indigenous Rules.*** Except for Honiara Fishing Village,[11] all open access sites lacked local management rules (Fig. 27). The prevailing attitude was, "why should we place restrictions on ourselves if these rules cannot be applied to outsiders"? The existence of open access appeared to be a powerful disincentive to the creation of local rules. Since knowledge of national rules was weak, the net effect at these sites appeared to be a near-absence of coastal resource management.

- ***Conflict.*** Even though the study could not determine whether conflicts over coastal resource use were more prevalent at open access sites, most of the conflicts at the two Solomon Island sites appeared to be with neighboring communities which had restricted access to their waters. In Tonga, fishing by outsiders in waters adjacent to the community tended to cause villagers to feel "angry inside."

[11] Residents in Honiara Fishing Village identified six local rules, but many villagers seemed unaware of them or indicated that they applied to very small coastal areas directly in front of village houses.

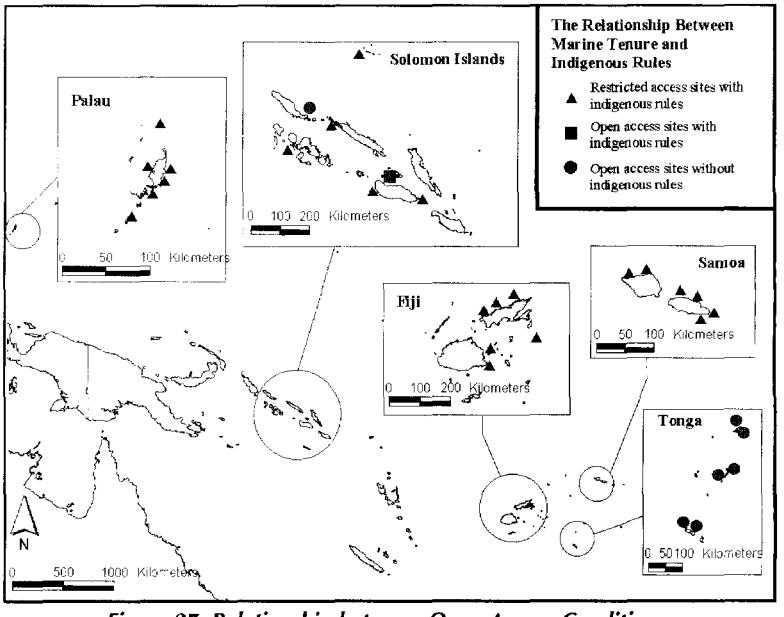


Figure 27. Relationship between Open Access Conditions and Local Coastal Management Rules

- ***Less Effective Management of Threats.*** As seen in Chapter VI, Tongan sites perceived threats as increasing faster than sites in other countries. In addition, six of the eight open access sites ranked threats to coastal resources higher than the average for all sites. Tongan sites also felt that as many as 72 percent of the most important threats could only be controlled with help from outside the community. This suggests that local control of threats is thought to be less effective where open access prevails. It should be noted, however, that no discernible differences could be detected in the perceptions of CPUE, habitats and compliance between open access and restricted access sites.

- ***Less Awareness of Management Benefits.*** Perception interviews included several questions aimed at judging awareness of the benefits of resource management among respondents[32]. The study team then made a subjective judgment on whether the focus group seemed aware of the benefits. There was generally a lower level of awareness in open access sites (Fig. 28). This is perhaps to be expected, since the absence of local rules means that residents in open access areas are less exposed to coastal management (Box 7).

Experts on coastal resource management usually believe that open access is an important disincentive to effective coastal resource management. The results of this study support that view.

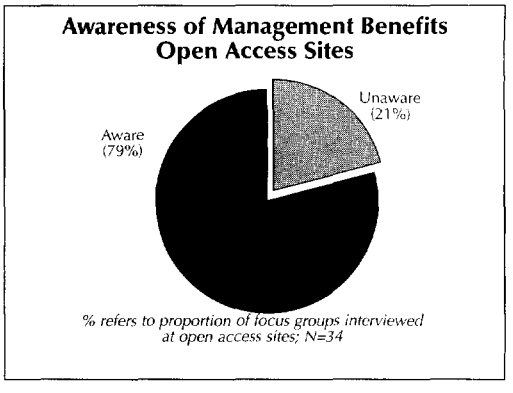


Figure 28. Awareness of Coastal Resource Management Benefits Among Villagers in Open Access and Restricted Access Sites

PARTNERSHIPS

Several external organizations were involved in assisting the 31 communities in managing coastal resources. A total of fifteen sites (48 percent) had

[32] Questions included asking why certain trends were perceived as declining or increasing and asking what could be done to improve the situation in the future.

Box 7. Open Access versus Restricted Access

Open Access vs. Restricted Access – The Case of Honiara Fishing Village and Naro

The fishing village in Honiara is a typical open-access site while Naro, another study site on the same island, is a more typical Melanesian community with a restricted access regime. The two villages differ considerably in their degree of urbanization, commercial orientation, religion, and alternative employment. Nonetheless, some contrasting features are worth noting:

- At Naro, solutions offered to reverse declines in catch per unit of effort revolved around management, especially effort reduction: "taboo areas", "allow reef to recover", "bans", "more effective enforcement and management" were typically cited. At Honiara Fishing Village, many of the solutions offered revolved around better technology, alternative fishing grounds, and restrictions on external polluters and vessels.
- Although Naro was more remote than the Honiara Fishing Village, there was a greater knowledge of national regulations.
- Although Honiara Fishing Village is an unrestricted urban area, residents felt that only 25 percent of the harvest was caught by people from outside the village. By contrast, Naro people felt that 40 percent of their harvest was caught by outsiders, even though they were regularly excluded from village waters. This could reflect a higher sensitivity of Naro people towards what they perceived to be a violation of their site rules.

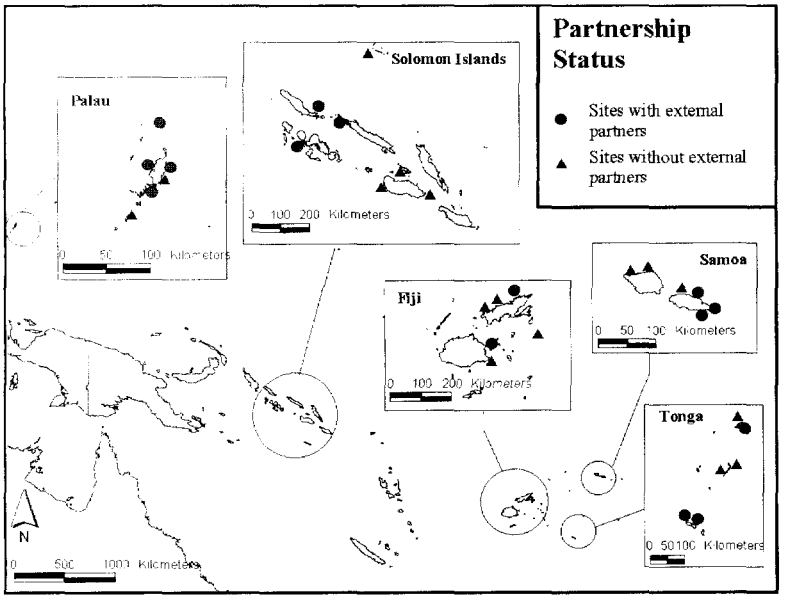


Figure 29. Location of Sites with External Partnerships

external partners (Fig. 29). With the exception of Ha'atafu (Tonga), all of the partnerships had been established during the 1990s. Since the presence of an external partner was used as a criterion in site selection, it is not possible to draw conclusions regarding the prevalence of partnerships in the study countries. It was observed, however, that partnerships were not common in Fiji but were widespread in Samoa (government-type partnerships) and Palau (NGO-type partnerships). Seven external partners were NGOs (in Fiji, Solomon Islands and Palau), seven were government agencies (in Samoa, Tonga, Fiji, and Palau), and one was an individual volunteer (in Tonga).

The study was not designed to judge the effectiveness of external partnerships, but some insights into their effectiveness can be gained from comparing the perceptions of the community and of the external partner on key aspects of the partnerships (Table 15):

- ***Perceived partnership benefits.*** Communities tended to emphasize short-term, tangible benefits (such as the US$200 prize awarded to the best giant clam circle in Tonga)[33], while external partners emphasized process-oriented benefits, such as reinforcement of a village's traditional management efforts. This suggests that if a partnership can produce some short-term benefits to keep the community interested, longer-term benefits may be more attainable.
- ***Perceived flaws in partnerships.*** Community perceptions of the partnerships flaws frequently centered on unkept promises, inadequate consultation, and slowness in achieving benefits. From the perspective of external partners, the key failures of the partnerships were villagers not fulfilling their commitments.
- ***Decision to address the problems.*** In as many as half of the partnerships, community representatives believed that the decision to address coastal management was taken by the external partner. Many partners, on the other hand, perceived the initiative as coming from the community.

[33] Clam circles involve arranging giant clams in such a way that it maximizes the potential for fertilization.

Table 15 – Coastal Resource Management Partnerships: Examples of Community and Partners' Perceptions

Site in:*	Perspective from:	Decision to Address the Problem Taken by:	Key Perceived Benefits	Key Perceived Flaws	Key Threats	Key Interventions By External Partner
Fiji	Community	Both	Recognition and support of gillnet ban by the Government; Government commitment to assist in monitoring;	None	Waste from timber mill Night diving Sand mining	Establishing a reef conservation area; Community based management plan and monitoring
	Partner	Village	Well managed traditional fishing area; Nearshore resource abundance increased.	None		
Tonga	Community	Partner	The possibility of replenishing the reefs with clams; The US$200 won for best clam circle	Village council was not involved	Damage to corals due to iron bars used in reef fishing	Introduction of sanctuary
	Partner	Partner	Establishment of a clam sanctuary Demonstration that community can implement conservation measures	Failure to get the villagers to actively maintain the sanctuary		
Samoa	Community	Village	An increase in fish abundance in the fish reserve	Not fulfilling promise of trochus/ mussel introduction	Use of derris root and laundry bleach for poison fishing, dynamiting, small mesh sizes and overfishing	Production of management plans and maintenance of giant clams
	Partner	Village	Establishment of a fish reserve	Lack of community commitment		
Solomons	Community	Unclear	Increased awareness Assistance in building eco-tourism lodge Resource increases in taboo areas	Too much talk and no action Very slow Unkept promises of visits to the village	Night diving, live reef fish trade, net fishing, garbage, over-population, motorized canoes	Provision of information and assistance with participatory planning
	Partner	Village	Reef closure Increased awareness Changing uses of coastal products Strengthened community structures Commitment to sustainable use Plan for coastline replanting and management	More technical support and information could have been given		
Palau	Community	Village	Maintaining enthusiasm for management over the long-term; Rekindled enthusiasm for conservation; Children awareness	Flaws will become evident only in several years when it will be apparent whether closed area has recovered	Road construction, outboard engine disturbance, overharvesting, siltation	Information and advice for the establishment of a conservation area; Monitoring and information dissemination to the community
	Partner	Village	A focal point for cooperation among villagers which transcends community fractions	Conservation objectives and benefits still not defined		

* The sites are not identified, since it was not the study's intention to provide comparisons of partnership impact.

- ***Information Absorption.*** The study found considerable differences in the perspectives of communities and external partners regarding information provided by external partners. At one village, for example, the residents said that no resource management information had been provided to the village, or at best had been provided to only a few individuals. On the other hand, the external partner said that much information had been provided by way of 100 copies of two videos, booklets in the local language, and discussions in churches and schools. At another site, the partner organized several workshops, provided posters and publications, and provided several long- and short-term consultants to assist the community. Despite these efforts, the residents' awareness of the partner's objectives appeared to be low. A typical answer was, "something about not killing turtles." Similar findings appeared at other sites. The findings suggest that even in small communities, the time and resources required for full consultation and raising of awareness can be very high.

- ***Introduction of new processes and institutions.*** Study results indicated that it can take a long time for external partners to introduce new processes or institutions intended to change the way the community operates. In some cases, this process can exceed the partners' funding horizon.

- ***Site Threats and Partnerships.*** Comparison of partners' interventions with the types of threats found at the study sites indicated that partners typically operate through community management plans, which may be insufficient to address some of the external threats (e.g., waste from a timber mill, pollution, road construction). Control over threats is also a dynamic process. At one study site the partner was successful in reducing one threat, only to have another emerge that the partnership was unable to address. This suggests that management plans need to be kept flexible to address rapid changes in threats to coastal resources.

Despite the above constraints, all sites with partnerships perceived benefits to be substantially greater than failures.

Overall, partnerships fell into two broad categories:

(i) ***Category A:*** These included partnerships where the initiative to work at the site was taken by the external partner. These partnerships were typically found at conservation sites of recognized international importance.

(ii) ***Category B:*** These were partnerships where the partner had been asked by the community to help with a village management initiative (e.g., the establishment of a village sanctuary) or for help in emulating a neighboring village's initiative.

Sustainability can be a major concern in Category A partnerships. Category B partnerships were usually associated with a more durable in-country presence, such as a national NGO or a government agency. Satisfaction with Category B partnerships (both by the partners and the community) seemed to be pronounced. Several villagers commented that having an external 'honest broker' who could be relied upon to give quick and sound management advice was more important than a more elaborate partnership. Naturally, this is appropriate when the goals of the partner and the community coincide — category B partnerships may not be able to address certain conservation needs. It is unlikely, for example, that a community would request assistance in restricting cultural traditions, such as the eating of turtles. For these situations, a Category A partnership may be more appropriate. Although the time frame required for Category A partnerships was much longer than that for Category B partnerships, donors supporting Category A partnerships generally had a shorter funding horizon than national agencies and local NGOs which typically supported Category B partnerships.

Findings in this section are consistent with the growing realization in the Pacific Island conservation community that longer-term funding is needed to support local marine conservation initiatives. The history of Category B partnerships in Palau and Samoa (where the amounts spent per target village on coastal resource management assistance can be as low as US$270 per year) also indicates that at sites where the community is willing to take action on coastal management, external partners can be effective with relatively low levels of funding.

MARINE SANCTUARIES

Marine sanctuaries have received much attention in the Pacific region. Given the uncertainties involved in estimating sustainable stock levels in multispecies fisheries, many scientists argue that sanctuaries are preferable to regulations involving specific species or fishing gear. Sanctuaries, the experts argue, allow resources to reproduce and grow undisturbed, contributing both to species protection within the sanctuary as well as replenishment of surrounding areas.

Several study countries — most notably Palau and Samoa — have placed high reliance on sanctuaries as a coastal resource management tool. Given these stakes, some experts worry what will happen if the sanctuaries fall short of expectations. Could faith in all management interventions dissipate? Are sanctuaries seen as an excuse to do little else?

A variety of terms are used in the Pacific to describe marine sanctuaries: taboo areas, conservation areas, and fish reserves are some of the most common. For the purposes of this study, the term "sanctuary" denotes a coastal area in which all extractive activities have been banned for substantial periods of time (Fig. 30).

Although most of the 14 sanctuaries found at the study sites were established in the last five years, one sanctuary dated from 1956 and another from the mid-1970s.

Figure 30. A village sanctuary in Upolu, Samoa. The sanctuary boundaries are delineated by wooden stakes.

It appears that older sanctuaries were created by national governments without much dialogue with nearby communities, whereas the newer sanctuaries were started either by the communities themselves (4 sites) or with the assistance of an external partner (7 sites).

Community perceptions of the impact of sanctuaries were generally favorable. The abundance of key species inside sanctuaries was perceived to be increasing (Table 16). Negative trends were mentioned only in two relatively older sanctuaries in

Table 16. Summary of Communities' Perceptions of Sanctuaries at Study Sites

Site	Years Since Establishment	Introduced Through	Key Species	Perceptions of Trends in Target Species Abundance
Ucunivanua	1.2	NGO Partner	*Anadara, Mud Lobster*	Improving a little
			Other Shellfish:	No change
Susui	Long ago	Village	*Finfish:* closure	Large improvement after closure for one year
Falevai	8	Individual Partner	*Giant Clam:*	Improvement after one year
Ha'atafu	20+	Government	*Unknown*	
Fusi	3	Government	*Groupers:*	Improving a little
			Other Finfish:	Improving a lot
			Giant Clam:	Stable
Satitoa	1	Government	*Caranx, Mullet, Emperor:*	Improving a lot
Solosolo	1	Village	*Finfish:*	Improving a little
Kia	3	NGO Partner	*Turtles:*	Improving a little
			Trochus, Beche-de-mer, Giant Clam	Improving a lot
Cooksin	3	NGO Partner	*Turtles, Beche-de-mer, Giant Clam:*	Improving a little
			Trochus, Milkfish:	Improving a lot
Onne	1	NGO Partner and Village	*Beche-de-mer, Trochus, Reef Fish:*	Improving a little
			Giant Clam, Lobster:	Improving a lot
Ngiwal	1	Village	*Unknown*	
Kayangel	2	Village	*Parrotfish:*	Improving a little (monitoring results)
Koror	42	Government	*Dugong:*	Declining a little
			Trochus:	Improving a little
			Turtle, Giant Clam, Groupers:	Improving a lot
Ngaremlengui	14	Village	*Dugong, Giant Clam:*	Declining a little
			Turtle:	Stable
			Rabbitfish:	Improving a little

Palau. There was also considerable optimism about the sustainability of sanctuaries. At 10 of the 14 sites (71 percent), community members believed the sanctuary would continue to exist after five years (Fig. 31). Compliance with closed areas was also perceived to be significantly better than compliance with rules such as size limits or bans on catching certain species (Chapter V).

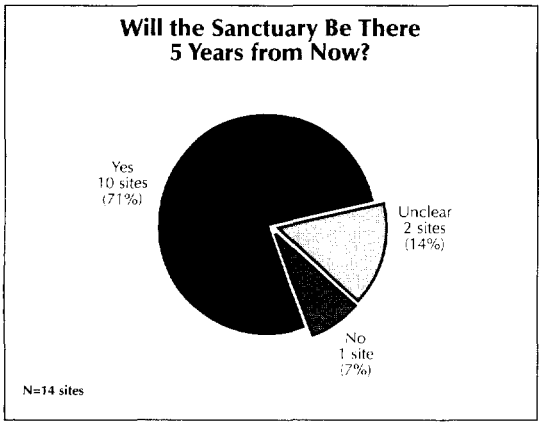


Figure 31. Communities Perceptions of Sanctuary Sustainability

Despite the generally favorable perceptions from the communities, the study found three issues involving sanctuaries that should be addressed in future coastal management interventions:

- ***Availability of monitoring information.*** The study found only a few sites where monitoring records were readily available to the community, even though monitoring had been carried out in most cases with the assistance of external partners. When this happens, the value of monitoring as a way to maintain community support can easily be lost.

- ***Enforcement.*** At many sites, poaching was the main reason for community discussions on whether a sanctuary should continue to exist. A typical attitude was that, "community X is poaching, so why should we ban harvesting so that community X can benefit"? At several locations, particularly where large sanctuaries had been established, there was an expectation that the sanctuary would be opened up once resources were replenished. In one village in the Solomon Islands, this led to feelings of disappointment and an increase in poaching when an external partner was perceived to have failed to keep a promise to open up the sanctuary.

- ***Sanctuary Location and Size.*** Location and size appear to be critical to a sanctuary's effectiveness. The closed area needs to cover a substantial part of the habitat of the targeted resources. At the same time, many communities are reluctant to close down their richest fishing grounds. As a result, sanctuaries in many villages were either very small or were situated in barren areas, undermining their effectiveness.

One curious finding was that villagers perceived large increases in resource abundance even where it did not appear to be biologically possible. For example, several respondents claimed that there had been remarkable increases in finfish in a small sanctuary located in a barren sand habitat. This finding was discussed with several biologists, who had encountered similar cases where villagers perceived overstated benefits from sanctuaries. It appears that part of this perception may have been caused by curiosity about the impact of the sanctuary and, hence, a much closer scrutiny of the area by the community.

These findings suggest that sanctuaries provide a benefit that transcends their ecological impact. The presence of a sanctuary in a community seems to act as a catalyst for increasing interest, knowledge, and awareness of coastal resource management. Abstract discussions of management may be too sophisticated for many villagers, but a visible area in which harvesting is banned seems to provoke thought and discussion leading to greater understanding of management issues. The study team was told on several occasions that even if a sanctuary had no impact on resource abundance, it could be considered successful if it increased community awareness of management issues.

ALTERNATIVE INCOME GENERATION

One of the most common strategies used in the Pacific to reduce pressure on coastal resources is to promote alternative sources of income (AIGs). This strategy is based on the assumption that much of the overexploitation is caused by a need for cash and food, and that communities would harvest less if they had other ways to generate income. Income generating programs introduced for the explicit purpose of alleviating pressure on coastal resources were found at 18 sites (58 percent of the total). They included aquaculture (10 sites), tuna fishing (10 sites) and deep slope fishing (10 sites), with some sites having more

[14] Lessons of experience from other regions indicate, however, that occupational mobility among traditional fishers tends to be low (R. Pollnac, personal communication).

than one activity. Tourism, farming, handicrafts, and infrastructure work were also found at various sites, but in general these were not introduced as a coastal resource management strategy. Table 17 (see next page) shows the community perceptions of the three most common alternative income programs.

Aquaculture. For the most part, the benefits of aquaculture programs were perceived to be poor (Box 8). Six out of ten communities with such programs believed that aquaculture had brought no significant benefits. None of the communities perceived aquaculture to have reduced exploitation of coastal resources, while two communities said it was too early to tell. Several respondents said that the problem with subsistence-type aquaculture was the large amount of work required relative to fishing. Commercial aquaculture operations were frequently perceived as facing difficulties with marketing their products.

Box 8. Introducing Aquaculture as an Alternative Source of Income: the Example of Fusi, Samoa

Fusi Village was fortunate to have been the recipient of many aquaculture projects over the years: they included green mussels (1984), Pacific oysters (1986), and giant clams (1996). FAO (1992) noted that the lagoon near Fusi had "considerable potential for bivalve culture." During the survey the study team assessed the village's market access and found that it was quite easy to market perishable products. Fusi also received solid technical assistance during these efforts.

Despite all these favorable conditions, Fusi residents feel that the results have been disappointing. The study team asked several groups in Fusi about the benefits of past aquaculture efforts. The replies indicated that there were very few or no benefits to date. This raises questions as to the impact of similar aquaculture projects in other sites with less favorable conditions.

Tuna Fishing. Pacific Island tuna stocks are generally believed to be abundant. Thus, deep tuna handlining, long-lining, and fish aggregation devices (FADs) to facilitate artisanal tuna fishing have been commonly introduced as alternative income generation programs. At six of the ten sites where tuna fishing had been introduced, villagers perceived no significant reduction in pressure on coastal resources. At two sites, however, it was felt that there had been a moderate to substantial reduction, in part due to the availability of tuna by-catch sold at the village level. In the view of villagers at one site, the new artisanal tuna fishery did not necessarily divert much effort away from coastal areas, because the crews on the new vessels were not coastal fishers (they were said to be farmers or mechanics). There was also a feeling that most of the benefits went to the most affluent community members, since ownership of a large boat was often a prerequisite for participation in the program.

Deep Slope Fishing. Promotion of deep slope fisheries in the Pacific started in the early 1970s through the efforts of the then South Pacific Community (SPC). Much of the promotion was carried out through fisheries centers, which provided ice, fishing gear, and a marketing venue for the catch. Of the ten study sites where deep slope fisheries had been introduced, respondents at three said that there was a moderate/substantial reduction of exploitation of coastal resources, while six perceived no significant impact. Villagers at three sites said the ice plants introduced to support deep slope fishing had actually intensified exploitation of coastal resources because the ice enabled villagers to market their catch in distant urban markets.

Respondents were also asked whether fishers would be willing to change their occupation, as a mechanism for reducing pressure on coastal resources. At 14 sites (80 percent of the total), respondents said they would be willing to change if the alternative occupation offered better income. Asked whether they would be willing to change to non-fishing occupations, respondents at 10 sites responded affirmatively (Fig. 32). However, there were substantial differences across sites and countries. At sites where there was a strong reluctance to change, villagers said that fishing was a hobby which provided both cash and food, unlike other forms of employment.

In answer to questions about the best alternative income programs to alleviate pressure on coastal resources, villagers mentioned agriculture (6 sites), carpentry/carving (3), tourism (2), handicraft production (2), aquaculture (2), fishing, eco-forestry, sports-fishing, and government jobs (1). Palau accounted for three of the sites where alternative income programs were perceived as relatively successful. All of these three sites benefited from multiple income opportunities in tourism, farming and construction. Even though the sample is small, these results suggest that a broader range of income opportunities may need to be explored in any future alternative income generation programs[34].

[34] Lessons of experience from other regions indicate, however, that occupational mobility among traditional fishers tends to be low (R. Pollnac, personal communication).

Table 17. Community Perceptions of Impact of Key Alternative Income Generation Schemes

Sites	AQUACULTURE			DEEP SLOPE FISHING		OFFSHORE FISHING		
	Type	**Benefits**	**Was Coastal Resource Extraction Reduced?**	**Benefits**	**Was Coastal Resource Extraction Reduced?**	**Type**	**Benefits**	**Was Coastal Resource Extraction Reduced?**
1	Seaweed	Very little	Not significantly					
2				4 boats now involved in deep slope fishing	Moderately – snapper now makes up most of the 4 boats' catch	FAD	Only a few trips were made by people from this village	Not significantly
3				1 subsidized vessel; 2 vessels now use the technique	Substantially			
4	Giant Clam	Trip to workshop; 250 free baby clams; Too early to judge other benefits	Too early to determine	Income for 2 fishermen	Moderately	FAD	N/A good weather	Moderate reduction during
5	Green mussels Pacific Oyster Giant Clam	None	Not significantly			Alia tuna boats	N/A	N/A
6	Giant Clam	None yet	Too early to determine	Employment, some food	Some but not great because deep slope fishermen were former farmers	Alia tuna boats; FAD	Employment/Food	Not significantly
7						Alia tuna Boats	Employment/Food	Substantially: all by-catch sold in village
8	Giant Clam	None (all clams died within two weeks)	N/A					
9						FAD	Occasional fishing by 8 of 25 motorized village canoes	Not significantly because the canoes which fish around FADs would fish in offshore areas
10	Seaweed	None	Not significantly					
11	Giant Clam	None	Not significantly	Availability of ice	Ice has increased opportunity to market coastal products in urban areas, so effort on coastal resources may have increased	FAD	FAD lasted only one week	N/A
12				Availability of ice allows for marketing of fresh fish in urban area	Not significantly as villagers must share a vessel and fishing groups must wait up to one year for their turn			
13	Giant Clam Corals	Cash	Not significantly	N/A	Not significantly			
14				No benefits	Not significantly			
15	Shrimp Milkfish Giant Clam	Shrimp —US$390 from 3 harvests Giant Clam – None	Not significantly			Tuna trolling	Techniques learned still used today	Not significantly – only small amount of tuna trolling at present
16				Training in deep slope techniques; Availability of ice	May have increased pressure on coastal resources as the ice intended for tuna/bottomfish can now be used f or coastal resources	Tuna/ Bottomfish Center	Training in bottomfish Techniques; Ice availability	May have increased pressure on coastal resources as the ice intended for tuna/bottomfish can now be used to market coastal resources
17	Giant Clam	N/A	N/A					
18				Training, some income	Not significantly because during easterly winds it is too rough to fish outside the reef	Unspecified offshore fishing	Training, some income	Not significantly because during easterly winds it is too rough to fish outside the reef

FADs - Fish Aggregation Devices; Alia — type of tuna boat in Samoa. N/A – Response not provided.

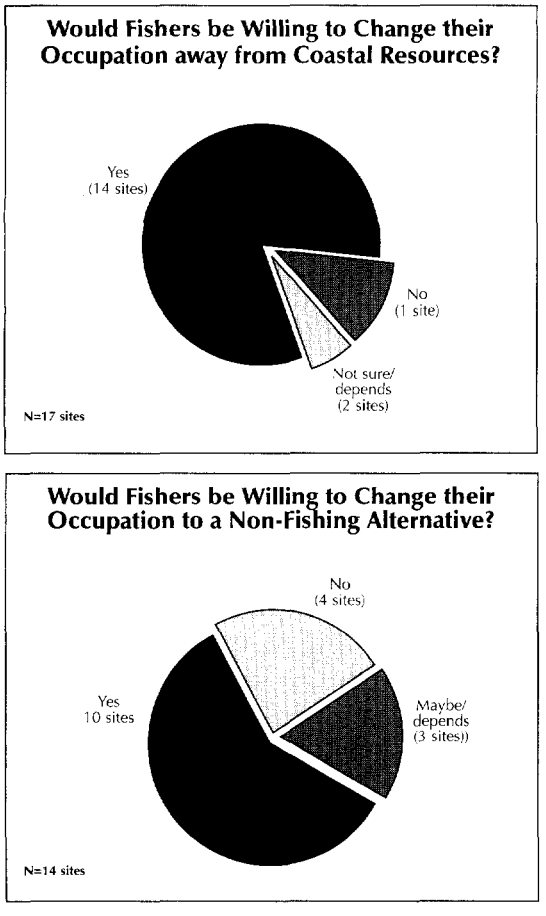


Figure 32. Community Perceptions of Occupational Alternatives

LIMITATIONS OF COMMUNITY-BASED MANAGEMENT

The experience of Pacific Island countries with centrally based coastal resources management, as mentioned earlier, has been poor. There is a growing consensus among experts that much of the management needs to be carried out by local communities. Others argue, however, that reverting to old systems of community management may not be possible because of changing conditions. Observations at the study sites shed some light on the potential limitations of community management and may help to identify areas where external help is most needed.

Many communities do not appear to be effective in restricting their own harvesting effort. Overfishing was one of the key threats to coastal resources identified at the site level, and was the most frequently given reason for harvest declines. With the exception of open access sites and sites where indigenous rules were made by leaders external to the village (e.g., high chiefs in Fiji), most communities had adopted mechanisms to restrict outsiders from their coastal waters. However, 12 villages (39 percent) lacked any rules dealing with restrictions on local fishing (Box 9).

Box 9. Can Communities Restrict Their Own Harvesting Effort?

Many residents in Susui, a village in the Lau Islands group (eastern Fiji) perceive excessive local fishing effort to be a major problem. Overfishing by Susui villagers was the major reason cited for declines in shellfish, finfish and beche-de-mer. The village leadership authority appeared intact, the quality of leadership was perceived to be high, and all six focus groups interviewed appeared to be aware of the benefits of coastal resource management. Despite these favorable conditions, none of the indigenous rules addressed local effort restrictions.

Restricting local effort can be difficult for socio-economic reasons. Some communities, however, are willing to make this sacrifice for longer-term gains. For years, Ontong Java in the Solomon Islands imposed alternating bans on beche-de-mer and trochus. During the visit to Luaniua Village in Ontong Java (Solomon Islands), the study team was told that this scheme had been suspended indefinitely for a variety of reasons. The study team offered its opinion on the desirability of the scheme and spoke about its benefits during a wrap-up meeting attended by community members. In late January 1999, the team learned that Luaniua Village had not only reinstated the management regime, but placed a two-year ban on harvesting both trochus and beche-de-mer.

Nine sites appeared to be actively enforcing restrictions to reduce local harvesting effort. Their key characteristics are summarized in Table 18. The sites had two fairly frequent characteristics: the presence of external partners (6 sites) and large fishing grounds (3 sites). This suggests that the presence of partners may serve as a catalyst for community action.[35] There were only three sites where the community restricted its own harvesting effort without the presence of external partners (Galoa, Luaniua and Naro). Those sites differed in many ways, but they shared a high quality of leadership and, with the exception of Naro, a heavy dependence on coastal resources.

Table 18. Study Sites Enforcing Management Rules to Restrict Local Fishing Effort

Site	Key Characteristics
Ucunivanua	Very large site, external partner
Galoa	Very large site
Nakawaqa	External partner
Solosolo	Very small site, substantial formal employment, external partner
Luaniua	Very large site, few cash income alternatives
Naro	Relatively low dependence on coastal resources
Onne	External partner
Ngiwal	External partner
Kayangel	Moderately large area, external partner

N/A - Not available

Some threats cannot be addressed solely by local communities. It was seen before that in a third of the study sites (10 sites), the majority of the threats to coastal resources could not be addressed solely by the community (Table 6, Chapter V). Even in sites where most of the threats could be handled locally, there were particular threats that were perceived to require outside help. These included logging, siltation, infrastructure developments such as roads, causeways and dredging, various forms of pollution, and poaching by outsiders. It was also mentioned that many communities did not appear to be dealing effectively with threats that ordinarily could be handled at the community level. In general, this situation was found (i) in open access areas lacking indigenous rules; (ii) where new threats were rapidly appearing; (iii) where rules were made by chiefs whose authority covered several villages; and (iv) where the perceived threats to one group in the community benefited another group in the community.

There are uncertainties about the legal status and enforcement of customary laws. At several sites, particularly in Fiji and in the Solomon Islands, village leaders complained that there was little they could do to punish offenders within the village. Social ostracism may have been effective in the past, but its effectiveness seemed to have declined in recent times. Although customary law is recognized in many Pacific Islands, it is usually allowed if it does not conflict with national law, and there are uncertainties about whether punishments such as physical beatings and property fines are consistent with national laws, which require due process.[36]

In the isolated villages of Niu and Onne in the Solomon Islands, the study team was told that national laws were easier to enforce than indigenous rules because of the existence of a court system. In other sites (e.g., Kia) there was a heavy reliance on police for enforcement, rather than traditional village institutions. At several sites in Fiji, constraints on the enforcement of village rules appeared to have a negative effect on the effectiveness of local management. Palau did not appear to have the same problem because of a close correspondence between "communities" and "states," and the status accorded to state rules. In Samoa, it appears that national recognition of village by-laws has helped to make local enforcement effective, but many indigenous rules do not have by-law status and may conflict with national laws. This problem was not found in Tongan sites because of the absence of indigenous rules.

Communities may need technical back-up. Indigenous Pacific Island communities possess a wealth of knowledge about their coastal resources which provides the basis for local management decisions. However, they may lack access to recent biological findings which could assist them in improving local management — for example, how long trochus larvae float before settling, a factor that is important in the establishment of trochus reserves. At several sites there was eagerness to learn more about the technical aspects of management, such as in Satitoa (Samoa), where women groups asked the study team to inform them on how best to restore an important invertebrate resource. The provision of expert advice also could be important to sites where local beliefs can be detrimental to management, such as in Ha'atafu (Tonga), where several residents erroneously claimed that the more beche-de-mer was harvested, the more it grew.

Increasing commercialization can lead to conflict of interest when village leaders become direct beneficiaries. As seen earlier, commercial operations appeared to be responsible for much of the conflict within the communities. It was observed at several sites that commercial enterprises which normally would have been restricted by local management were able to circumvent the rules by forming alliances directly with village leaders. Because these enterprises were relatively new, many communities seemed to lack ways to prevent conflicts of interest between the leaders' management responsibilities towards the community and their business interests.

The study findings indicate that further efforts may be needed to both catalyze community action and to assist communities in their management efforts.

[36] For an examination of this subject from a legal perspective, see Pulea (1993).

ARE COASTAL RESOURCE MANAGEMENT OBJECTIVES BEING MET?

It is often argued that the objectives of coastal resource management and conservation programs in the Pacific are to optimize benefits from resource use.

This was not found at the study sites. Although the goals of community-based management were rarely explicitly stated, they tended to be much more basic: preventing further decline or the collapse of important resources, preventing habitat degradation through control of destructive fishing techniques, and conserving endangered species. The political will, management tools, and social context of the 31 sites did not appear to be anywhere near capable of achieving objectives that revolved around yield optimization.

If this observation holds true through future research, the information needed for site management can be seen in a different light. Although considerable effort has been devoted to quantitative stock assessment in the Pacific, an examination of the 97 local management rules found at study sites revealed no obvious cases where they would not have been adopted without such research. Rules on minimum size of trochus may be the exceptions. This indicates that lack of complex stock assessment work may not be as much of a constraint to coastal resource management in the Pacific as previously believed. Perhaps more urgent are efforts to further understand the socio-economic incentives affecting coastal resource management at the local level, complemented by simple and well targeted ecological research with direct management application. This finding may have implications for future coastal management work in the region.

VIII. Key Lessons Learned

"Our children will find it difficult to support daily needs" *(Nakawaga, Fiji)*

"If regulations are enforced (resources) will improve, otherwise continue to decline" *(Tu'anekivale, Tonga)*

"All gone..." *(Kia, Solomon Islands)*

"If present rate of depletion persists, there will be no resources in 10 years" *(Koror, Palau)*

"With conservation efforts on sanctuaries and bans on destructive fishing, things should get better" *(Satitoa, Samoa)*

KEY LESSONS LEARNED

This study sought to address a number of questions relevant to the management of coastal resources in the Pacific Islands: What are the community perceptions of key ecological trends? What are the factors most likely to affect site management? What are the limitations of community-based management and where is external assistance most needed? The study also examined the relevance of national legislation to coastal communities, and the perceived effect of partnerships, marine sanctuaries and alternative income generation programs at the site level. These are complex issues for which a definite answer cannot be obtained without further research. However, a number of lessons can be derived from the study which can help guide future efforts in coastal resource management in the Pacific.

Community groups in general perceived coastal resources to be declining. The quotations shown above were extracted from survey questionnaires and illustrate how villagers viewed the future of their coastal resources. They also reflect one of the most important findings of this study: in general, communities believed their resources had declined over the past ten years. Moreover, some 21 of the 31 sites (67 percent) believed that coastal resources would continue to decline in the future in the absence of strong interventions (Fig. 33). In the midst of this somber outlook there was, however, an element of hope: five out of six sites in Samoa believed that resources would improve because of recent management efforts. This holds some hope that with immediate interventions, the perceived decline of coastal resources in the Pacific Islands can be contained.

Some coastal management experts and policy makers in the Pacific believe that while resources in coastal

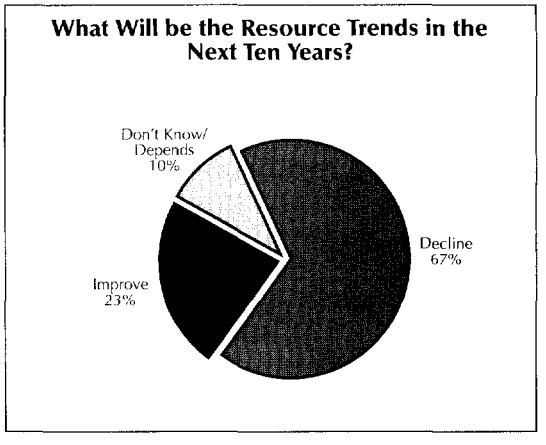


Figure 33. Community Perceptions of Future Trends for Coastal Resources

areas adjoining urban centers and densely populated villages are generally overexploited, coastal resources at isolated sites are still sustainable.[37] The community perceptions obtained through this study challenge the view that coastal resources in isolated locations remain healthy. Several sites where resource trends were perceived to be worsening were relatively isolated and had low population densities. This suggests that the impact of a few efficient commercial fishers on the exploitation of fragile coastal ecosystems should not be overlooked.

Communities perceived very few recovering trends that were related to management. The study team found surprisingly few examples where perceived improvements in coastal resources were associated with management interventions. Where this was cited, it involved the prevention of destructive practices, sanctuaries, controls in harvesting of particular species, and bans on external fishers.

[37] For further discussions on coastal resource status and population pressures, see Adams, Dalzell and Farman (1997).

Few national regulations were seen to be relevant at the local level. The study found that communities were not familiar with many of the national rules designed to manage coastal resources. In general, the simpler and clearer the national regulations, the more likely they were of being followed at the local level. Rules enforced by buyers/exporters were also perceived to have high compliance. A surprising finding from the study was the perceived high compliance with national rules adopted locally rules by traditional leaders. These rules were perceived to have better compliance than either purely national or purely local rules, pointing to the need for outreach and awareness programs targeted at local leaders.

Some threats were perceived to be rising faster than others. Overall, communities perceived pollution as the fastest growing threat to coastal resources, while destructive fishing was perceived as having declined the most. Overfishing, destructive fishing, pollution, and siltation — in the Solomon Islands and Palau — were perceived to be the most important threats to coastal resources at the study sites.

Communities need external help. The fact that land-based threats and commercial fishing (another fast-rising threat) cannot for the most part be handled by communities alone leads to an inescapable conclusion: communities need external help in managing their coastal resources, albeit perhaps of a different kind than presently received. At the same time, the study found that more could be done by the communities themselves to restrict local harvesting and to control local threats. The study also found that communities had difficulties enforcing local rules when they were seen to conflict with national laws, and in preventing abuses of authority by traditional leaders.

Catalytic actions can be effective. The study found several examples where catalytic processes were effective in triggering community action: marine sanctuaries seemed to play an important role in increasing community interest and awareness in coastal resource management. The crocodile ban in the Solomon Islands also appeared to have increased local awareness of coastal management impact. Several villages in the Solomon Islands reported that because the crocodile ban had been so successful, they now saw the advantages of using bans for other marine resources. Visits by external coastal management experts seemed also to be an effective way to convey ideas to the communities in a different way than their usual interaction with external partners. Finally, the presence of external partners seems to have acted, at some sites, as a catalyst for community efforts to restrict their own harvest.

The most effective external partners play the role of honest brokers. Partnerships between communities and external institutions assisting them in the management of coastal resources appeared to be most effective where the external partner played the role of an honest broker, providing technical expertise on demand and building upon existing institutions and processes. External partners seeking significant changes in these processes may need to remain involved for longer periods than would normally be supported by donor financing.

Most alternative income generation programs were not perceived to be successful. The study findings on alternative income generation suggest that programs focussing primarily on fisheries and aquaculture alternatives have not been successful in reducing pressure on coastal resources. In some cases, the introduction of ice plants to assist offshore and deep slope fisheries appears to have opened up new markets for coastal resources. This suggests that should there be future efforts to create alternative income generation programs, a wider range of income opportunities outside the fisheries sector should be explored.

Open access constraints community action. Open access regimes seemed to severely constrain local action. Most open access sites lacked local rules to manage coastal resources and placed a high reliance on government interventions to help alleviate threats. Even though compliance with existing regulations was perceived to be good, study team observations indicated that resources were heavily degraded through overexploitation. When asked what the community could do to improve coastal resource trends in the future, a villager from an open access site gave what may be a typical answer: "Nothing. We think we have overfished the resources and will have to look at other people's sea resources (we will be forced to steal other people's reefs)."

What are the external factors most likely to support site management? Even though no definite conclusions could be reached, the study provided some indications of the type of national programs that may be needed to support community-based management of coastal resources: simple and clear national regulations, an enabling framework facilitating the adoption and enforcement of local rules, assistance to communities on demand on the technical aspects of resource management, and further inter-sectoral collaboration among government agencies and upstream communities to address land-based threats.

What are some of the most relevant site characteristics? The study findings could help guide regional and national coastal resource management programs seeking to prioritize site interventions. If the objective

of the program is to target sites with the most urgent needs, priority should go to areas which are resource-poor (e.g., isolated atolls), highly dependent on coastal resources, and subject to the severest threats.

National programs could have different goals, however. If the objective is to select sites with the greatest chances of success, priority should be given to sites where there is high natural resilience to ecosystem degradation and fewer external threats (in particular, threats which cannot be controlled at the site level). Key socio-cultural criteria might include the presence of wise and respected traditional leaders and some degree of awareness of the benefits of coastal resource management. To the extent possible, the sites should benefit from restriction of access by outsiders to the village fishing area. There should also be few conflicts caused, for example, by surrounding settlements or an unequal sharing of the benefits of commercial resource exploitation.

What are some of the processes most conductive to successful management? Among management processes, the capacity of the community to regulate its own harvesting effort and effective local enforcement seem to be among the most important determinants of perceived management success. This suggests that a key element of external interventions should be programs aimed at raising the awareness of local leaders of the need for and benefits of local effort reduction. The emergence of new threats also calls for flexible and adaptive management systems capable of handling threats as they arise.

Table 19. Examples of Community Recommendations for Future Action to Improve the Status of their Coastal Resources

Country	Recommendations
Fiji	**Better enforcement of existing regulations** **Stop issuing licenses to outsiders (commercial fishermen)** **Moratoriums (especially for shellfish) and bans on specific resources (except for subsistence)** Bans on destructive practices, night diving and compressors Alternative income generation and better education for children to increase job opportunities Set up marine reserves
Tonga	**Enforce national regulations** **Stop destructive fishing** **Partition coastal areas into village zones;** Close traditional areas to outsiders and give villagers authority to make local rules; outsiders can keep user rights but subject to village regulations Awareness programs of the benefits of the laws and impact of destructive fishing practices Restrict quantities harvested Impose seasonal bans and closures Stop or reduce fishing in inshore areas
Samoa	**Enforcement of village rules and heavy penalties** **Increase severity of penalties especially for outsiders/poachers;** Village council should amend penalties to be a little more severe: e.g., 40-50 sows for violation of village marine rules Strengthen village councils Enforce and restrict destructive fishing practices Reduce harvesting Set quotas, size limits Encourage alternative income generation (in tourism)
Solomon Islands	**Set aside more conservation/taboo areas;** enforce tabu areas strictly **Ban important species (e.g. trochus, beche-de-mer) for 1-2 years, or even as long as 3-4 years** Lengthen periodic closures (up to 5-10 years); open only to subsistence fishing Ban commercial sales of important species; Alternate bans and impose seasonal closures Set quotas Develop alternative sources of income (land based) Keep outsiders out
Palau	**Establish more conservation areas** **Establish and implement bul (taboo) system** **Protect nursing, spawning aggregation sites** **Boats should have designated passages to avoid damaging important habitats** **Seasonal restrictions and bans** **Limit exports** More awareness programs for both locals and foreigners Prohibit non-Palauans from fishing around the reef Reinforce focus on pollution Enforce size limits; ban gill nets; stricter enforcement Reseed clam areas and develop mariculture

Most frequent recommendations in bold.

GENERAL RECOMMENDATIONS

The recommendations made by the communities themselves to improve the condition of their coastal resources were revealing. In village after village, people whose livelihood depended on exploitation of coastal resources argued for stricter enforcement of existing rules and additional regulations to limit harvesting. In some cases, the call for stricter action came from traditional gleaners who viewed commercial harvesting as threatening their subsistence needs. More generally, the recommendations seemed to reflect a wish to subordinate the individual needs of the most efficient and destructive operators for the long-term benefit of the community (Table 19).

The adoption of extended bans on fishing for trochus and beche-de-mer by Luaniua (Ontong Java), a village in the Solomon Islands which depends on coastal resources for 70 percent of its income, shows that communities can be willing to make large sacrifices for long-term benefits if they are aware of the benefits of management and have strong local leadership. In general, however, communities could be doing more to regulate their own harvest and manage local threats. Purely centralized or purely community-based systems are unlikely to succeed in addressing the challenges facing coastal resources in the Pacific. Rather, co-management systems capitalizing on each partner's comparative advantage are likely to be needed. The recommendations which follow suggest ways where external interventions could be better targeted to support and strengthen this approach.

1. ***Restrict harvesting effort.*** The study indicates that overfishing is one of the most important threats found at the study sites. This problem is only likely to worsen in the future and cannot be addressed solely through enforcement of current laws. Steps should be taken to the increase the communities' ability to regulate fishing effort. This may require:

    - Raising the awareness of traditional leaders about the benefits of regulatory measures to restrict or ban certain types of commercial operations;

    - Provisions in national legislation which permit greater control over the level of commercial harvesting effort, such as restrictions on the number of commercial licenses;

    - Imposing point-of-export or point of collection restrictions on traded coastal resources (e.g., trochus processing factories); and

    - Judicious creation of marine sanctuaries;

2. ***Integrate coastal resource management with management of activities on land.*** The study indicates that coastal resource management in the Pacific Islands cannot be treated solely as a fisheries management issue. Several of the key threats are land-based: infrastructure development, pollution, and deforestation all affect coastal resources in ways that neither the local communities nor fisheries or environmental agencies can control on their own. Lack of cohesive coastal use policies among the responsible institutions also constrains their effectiveness. There is an urgent need for government institutions with different responsibilities over coastal areas to collaborate with local communities in responding to the intersectoral nature of these coastal management challenges. Donors and other external partners should also recognize that a narrow sectoral focus is unlikely to meet current needs.

3. ***Target national legislation more closely to local needs.*** The effectiveness of national coastal management legislation could be improved by:

    - Campaigns to disseminate national rules more broadly to traditional decisionmakers;

    - A supportive legal framework to encourage community leaders to adopt relevant national legislation as village rules, e.g., in the form of by-laws;
    - Further enactment and effective enforcement of buyer/exporter enforced rules, which appear to have high compliance at the local level;

    - Legal experts assisting governments in reviewing national management rules should pay careful attention to ensure that the rules are simple and understandable at the local level. Consultation with village leaders and resource users could help tailor these rules more closely to community needs. Lessons of experience from previous legislative reviews and perspectives other than from officials of the national government should also be obtained.

4. ***Support collaborative and stronger enforcement.*** Study results indicate that compliance with management rules depends on the existence of effective deterrents for violations. It is recommended that national governments support collaborative enforcement with lower levels of government and community leaders. It is also recommended that coastal managers help publicize successful prosecutions and associated penalities.

5. ***Increase management assistance to coastal communities.*** While there is growing recognition of the value of community-based coastal resource management, the level of support provided by government agencies does not appear to be sufficient to meet the needs of coastal communities. It is recommended that fisheries and environmental agencies realistically appraise the present level of assistance to coastal resource management in view of the urgent need to reverse current trends. There should be a recognition that, in many cases, what is needed is an "honest broker" arrangement in which the communities can obtain quick, impartial, and sound technical advice. Such short-term assistance, combined with awareness raising, appears to be the most urgent needs at the present time. Accordingly, it is recommended that fisheries and environmental agencies establish programs to give coastal communities periodic management-oriented visits and/or advice through appropriate media (e.g., radio).

    - National government agencies should help prioritize external donor assistance for community initiatives in coastal resource management. Donor assistance should be tied to encouraging a long-term government commitment to community assistance rather than being seen as freeing up government resources to be used for other purposes.

    - In general, environmental agencies have more experience in community-level coastal management work and in attracting the interest of external partners. Conversely, fisheries departments are more involved in actual coastal resource decision making. There is clearly a greater need for fisheries, environmental, and other relevant departments to collaborate more closely in supporting community needs.

    - There is a need to develop stronger incentives for government provision of management assistance. The work of coastal extension workers should be sufficiently recognized and rewarded.

    - The importance of regional organizations should not be overlooked. More efforts could be directed at coastal resource management assistance, which appears to receive less donor support than aquaculture, for example. The International Waters Program coordinated through SPREP would also be a good opportunity to develop a Pacific solution to integrated coastal planning which takes into account traditional structures and local systems of governance.

6. ***Promote sound external partnerships for coastal resource management.*** The study revealed a number of characteristics of good external partnerships which should be considered in future programs:

    - A long-term commitment by the external partner to work with the community;

    - The provision of information to the community in many different forms as a central feature of the partnership;

    - An efficient administrative support;

    - Reliance by the external partner on indigenous institutions and processes to the greatest extent possible;

    - Production of tangible benefits early in the collaboration;

    - Promotion of solutions which are technically and financially sound;

    - Partner efforts to act primarily as a catalyst for community-driven decisions.

7. ***Promote marine sanctuaries.*** The study found good reasons to promote a greater use of marine sanctuaries in the Pacific region, given both their perceived impact on conservation and their catalytic role in generating community interest in coastal resource management. However, resource users should understand that creating a sanctuary does not eliminate the need for other management interventions. The following considerations should be taken into account in establishing marine sanctuaries:

    - All stakeholders should have a clear understanding of the sanctuary's objective and how long the sanctuary is to remain closed;

    - All resource users should be made aware of the realistic benefits that can be expected from a sanctuary as well as the time frame for these benefits. Exaggeration of the benefits is likely to be counterproductive in the long term;

    - The community should understand that benefits of a sanctuary are related to its size and location. It is unlikely, for example, that a small sanctuary placed on a sandy habitat

will produce substantial increases in resource abundance;

- Poaching can undermine community support to keep a sanctuary closed. Therefore, surveillance and enforcement of strict "no-take" rules are crucial to a sanctuary's viability;

- The results of ecological monitoring are important in ensuring continuing community support for the sanctuaries, if they can demonstrate increases in resource abundance. Steps should be taken to ensure that monitoring records are made available to resource users.

8. ***Use alternative income generation programs cautiously.*** The study found that alternative-income generation programs relying on aquaculture, offshore fishing, or deep-slope fishing have not, in general, been successful in reducing harvesting pressure on coastal resources. It was also noted that several of the more successful external partners did not provide alternative income as part of their assistance to the communities. This suggests that should future alternative income generation programs be supported, they may need to take a broader look at the range of potential income opportunities available to the community (including, where appropriate, tourism, user fees, agriculture, retailing). Past experience also suggests that alternative income generation programs should be directly linked with site management, rely on existing marketing channels, and take into account the occupational patterns and business capacity of the target beneficiaries.

9. ***Conservation programs.*** Many of the preceding suggestions are relevant to marine conservation programs in the Pacific. Two additional recommendations are offered:

   - The study found that perceived compliance with turtle regulations was very low. It is recommended that a detailed review of successes and failures in turtle management be conducted, from both an historic and regional perspective.

   - Communities perceived coral reefs, inter-tidal areas and lagoons as among the most threatened of the coastal habitats. Should this finding be supported by future ecological surveys, priority attention should be given to the management of these habitats.

COUNTRY-SPECIFIC RECOMMENDATIONS

Fiji

- It is recommended that Fiji reactivate buyer/exporter enforced rules, given their perceived effectiveness in Palau and the Solomon Islands;

- To the extent possible, the strengths of the Fijian chief system should be built upon. Community leaders should be sensitized to the benefits of important national legislation on coastal resource management and encouraged to promote its adoption at the community level.

- National authorities should emphasize the importance of community restrictions on local harvesting effort. Conversely, local communities may need help in controlling the issuance of licenses to external fishermen.

- The honorary fish warden system allowing specific community members to carry out prevention, detection, and enforcement of fisheries laws should be further enhanced.

Tonga

- One recommendation overshadows all others. The failure of centrally-based management, together with the urgent need to prevent further declines in coastal resources, indicate that a change from the present open access system is needed. Giving communities the ability to restrict outsiders from fishing in inshore areas and to adopt local management rules consistent with national regulations would provide a powerful incentive to conserve resources in the future.

Samoa

- Assistance to the establishment of new sanctuaries should consider their appropriate placement and dimensions, in order to minimize any discrepancies between the communities' expectations and the likely ecological benefits of the sanctuaries. Sanctuary monitoring should also seek to distinguish between the impact of recent management interventions and natural cyclone recovery, as there is a risk that lack of perceived improvements in resource abundance could undermine future community support for sanctuaries.

- Care should be taken to integrate externally-sponsored coastal management projects into the work programs of government departments.

- An effort should be made to develop a national policy on coastal resource management, to harmonize village fisheries management plans, establish guidelines for marine protected areas, and enact village by-laws.

- Since destructive fishing appears to be worse in Samoa than in any other of the countries surveyed, consideration should be given to stronger enforcement of penalties for their use.

Solomon Islands

- Given the perceived level of resource degradation, it is recommended that a major effort be undertaken to encourage communities to adopt new local rules, such as enforcement of taboo areas and periodic fishing closures for certain species or areas.

- National regulations should be publicized more widely.

- The importance of coastal resource management should be recognized in the work programs of the fisheries and environmental agencies, and national and provincial staff should be encouraged to make more frequent visits to coastal communities. Activities of donors and non-governmental organizations should not be considered a substitute for this assistance.

- Because in many villages there is the perception that aquaculture is an alternative to coastal resource management, care should be taken to dispel that view.

- Given the impact of land-based threats on coastal resources, it is recommended that efforts be made to involve government agencies, traditional leaders, community groups, and external partners in efforts to address their upstream impacts on coastal areas.

Palau

- A clear development policy for the sustainable management of coastal areas in Palau needs to be developed;

- The roles of the national government, local governments, and traditional leaders in coastal resource management may need to be further clarified;

- Given community perceptions of rapidly declining coastal resources and the reliance of the Palau economy on healthy coastal ecosystems, it is recommended that additional government resources be channeled to coastal resource management programs and that government agencies be encouraged to play a stronger role in coastal resource management;

- In accordance with community recommendations, there should be greater reliance on traditional closure systems (*bul*), and greater protection of important spawning and nursery grounds. The impact of motor boats on coastal habitats should also be minimized by restricting the zones where the boats are allowed to pass.

SUGGESTED AREAS FOR FUTURE RESEARCH

A number of areas for future research are suggested by the study:

- **Comparison of community perceptions with ecological assessments of coastal resource status.** While an understanding of community perceptions is essential for national coastal resource management policies, they do not necessarily reflect the real status of coastal resources at a particular site. It would be important to complement the results of this study with a rigorous ecological assessment across a large number of sites, and taken at different points in time. This could serve two purposes: first, it would serve to confirm local perceptions of regional resource trends; second, it would allow a better targeting of awareness efforts in sites where community perceptions were found to differ from ecological reality.

- **An analysis of the institutional mechanisms to address land-based threats.** A Pacific solution to integrated coastal zone management is urgently needed to address land-based threats to coastal resources. This needs to take into account the sectoral structure of most Pacific Island governments and the nature of donor support.

- **Institutional arrangements for co-management.** Based on the results of this study, further research is needed on the optimal arrangements for co-management between coastal communities and national governments.

- **The feasibility of future alternative income generation programs.** Given the perceived low success with fisheries-based alternative income programs, there is a need to investigate whether income alternatives outside the fisheries sector remain a viable option to alleviate pressure on coastal resources in the Pacific.

- **Impact of national policies.** Further research should be conducted on the impact of national policies on coastal resource management success.

- **The impact of population pressure on coastal resource exploitation.** The findings of this study indicate that population pressure may not be as important a factor in coastal resource exploitation as previously believed. If confirmed, this could indicate that more attention needs to be paid to controlling the impact of the most efficient fishers on coastal resources. The study results on this subject, however, remain indicative and warrant further investigation.

The present study departed from conventional survey methods by relying heavily on the perceptions of coastal communities. This produced useful insights as well as some unexpected findings that are relevant to the management of coastal resources in the Pacific. This experience indicates that careful attention should be given to the views of coastal communities. It is those villagers who are dependent on coastal resources, who play a major role in the success of management, and who have the greatest stake in whether the system succeeds of fails.

Annex A. Key Lessons Learned in the Implementation of the Study Survey

This study was the first of its type in the Pacific Island region. As with any untested methodology, parts of the survey produced better results than others. The following lessons of experience are offered for the benefit of future survey teams.

✔ ***Lesson 1. Collaboration Among Experts Pays Off.*** The study relied on collaboration between experts of many different backgrounds: a regional team and advisory panel with solid experience in the region, and a World Bank team with a quantitative background. Inputs were obtained from fisheries experts, anthropologists, resource economists, econometricians, biologists, participation specialists, traditional orators, and even sports champions, who facilitated discussions with the communities. At times, the experimental nature of the survey design and analysis was frustrating to the study team, but the study would not have succeeded without this collaboration.

✔ ***Lesson 2. It Can Take a Long Time to Develop the Survey Instrument.*** Contrary to expectations, it took a full eight weeks to develop the study questionnaire. The initial participation of the national experts and community specialists was essential to revise the questionnaire and adjust it to field conditions. Even with extensive testing, the reliability of some questions could only be assessed after the survey had been applied. It was important to include 2-3 questions per factor, since it allowed the team to select the most reliable variables for the analysis.

✔ ***Lesson 3: Some Aspects Worked Better than Expected.*** The participatory rural appraisal (PRA) tools, in particular the site maps, were very useful in stimulating initial interest and allowing the study team to understand how communities perceived their habitats and resources. The five-point scale used for the indicators of success was also easily understood by the villagers. The ability to deconstruct perceptions of success in different habitats, threats, and management rules and to compare their relative rating was an unexpected benefit from the study. The qualitative assessment of key issues and the extent to which the study relied on quantitative techniques also exceeded the initial expectations at the study concept stage.

✔ ***Lesson 4: Some Aspects Worked Worse than Expected.*** The lack of empirical theory on which to base a prioritization of success factors was a major constraint to the study. It forced the study team to collect information on a large number of factors, which limited the time available for qualitative assessments. The relatively small number of sites also constrained the analytical ability to distinguish between the different factors. The study was also less successful in analyzing the impact of policy and process variables on coastal resources. Finally, some factors — e.g., quality of leadership, social cohesion, traditional knowledge and tenure — were very difficult to capture accurately. It is suggested that in the future these factors be assessed through aggregated socio-cultural indices aimed at capturing the multi-faceted nature of these variables.

✔ ***Lesson 5: Some Indicators of Success Were Better than Others.*** Among the indicators of success, perceived CPUE trends and threat trends were found to be the most reliable. The compliance indicator had inherent bias problems, but led to useful comparisons between different types of management rules. The habitat indicator provided little additional value: in many instances, respondents perceived habitats as the 'origin of the resource' and hence their perceptions were similar to those about CPUE. Given time constraints (each perception interview took an average of 60-90 minutes), it is recommended that this indicator be dropped in future surveys, and replaced with a stronger emphasis on the reasons why certain trends are felt to exist.

✔ ***Lesson 6: Accept the Village Pace.*** The study team had to adjust to the pace and events of the village life, and allow for inevitable interruptions in the survey plan. At one site, the team was nearly attacked by a crocodile, who was found trying to climb into the house they were sleeping in. At another village the team was interrupted by a traditional banishment, followed by a brawl, a funeral, and a long honorary title ceremony. While undoubtedly a longer stay would have helped gained further trust and collaboration between the study team and the villagers, given the very intensive survey questionnaire, five days was probably the maximum time that villages were able to provide without outlasting the team's welcome. The best information was collected in the initial two days of the visit. Under

the survey's time and budget constraints, this implied tradeoffs between collecting large amounts of quantitative data and obtaining more qualitative information necessary to derive lessons of experience. Another important observation is that it was very difficult to sample the respondents randomly. The rigid traditional structures of many Pacific Island communities made it difficult to walk into a household and start an interview. Hence, focus groups were arranged through large village meetings, or through the assistance of village leaders.

✔ ***Lesson 7: Stated Perceptions have Limitations but Need to be Understood.*** Stated perceptions can be influenced by several factors, such as particular site characteristics or awareness of respondents. Hence, a '3' stated at a particular site could be equivalent to a '5' stated at a different site. The degree of bias that this introduces depends on how well the cause of the variation is captured by the survey instrument. While many factors were taken into account, awareness is by itself an impact variable and it should not be treated the same way as other exogenous success factors. However, there may be grounds to include a proxy variable for awareness (e.g., education) in future perception analyses.

✔ ***Lesson 8: Trends in Success Variables were Sometimes Unrelated to Management.*** In future surveys of this type, there may be merit in relating more closely the perceptions of CPUE and threat trends to specific management interventions. One way this could be done would be to ask respondents to state the trend from the time a specific management rule was introduced. This approach would have the advantage of allowing a closer assessment of management impact. The key disadvantage is bias. As with the compliance indicator, there may be reasons why respondents would want to respond a certain way — they could be reluctant to admit that a particular indigenous rule had failed, for example. This approach would also have to rely on well informed respondents, able to associate the impact of particular rules with resource trends.

✔ ***Lesson 9: To Evaluate Policies and Processes, Endogeneity Needs to be Addressed.*** In future surveys, there may be merit in identifying instrumental variables affecting key endogenous policy and process variables — for example, to collect information on what determines government visits to a site or what influences a partner's site selection. This would allow for a quantitative assessment of how these policies and processes affect perceived success.

Based on this experience, how should a future survey be formulated? First, it would be useful to complement it with ecological impact assessments taken at different points in time. This could make it possible to compare stated perceptions with standard monitoring results and derive an actual estimate of the status of coastal resources. Second, the survey should be more judicious in the number of explanatory factors collected. It is hoped that the findings of this study would help orient this selection. Third, it may be useful to conduct a random site selection to be representative of the region's conditions. Fourth, the survey should make an effort to collect explanatory variables of key policy and process factors. Fifth, the survey should develop a series of questions to capture difficult variables, such as leadership and social cohesion. Finally, it is recommended that surveys of this type reserve one to two days at a site for purely qualitative assessments and village discussions.

Annex B. Quantitative Methods and Results

This technical annex provides details on the methodology used in the quantitative analysis and the main quantitative results. The annex begins by describing the process of constructing and refining the data set used in the quantitative analysis. Next, the annex describes how indicator categories were aggregated in order to facilitate the analysis. This is followed by a description of how nonparametric statistics were used to provide preliminary information about the indicators of success. The annex concludes by describing the econometric analysis, including model selection, econometric methods used, and estimation results.

A. DATA SET CONSTRUCTION AND REFINEMENT

Data was collected at three levels: national, site, and focus group. First, national questionnaires were used to collect data from fisheries and environmental agencies. Next, community level data were collected at 31 sites. These 31 sites were divided into 12 focus and 19 supplementary sites. At the focus sites, six to eight focus groups were interviewed to collect data on their perception of success. At the supplementary sites, three focus groups were interviewed. A total of 133 focus groups were interviewed at the 31 sites. The stratified nature of the data collection process dictated how the final data set was constructed.

Each site survey, including both site and focus group data, was coded into an Excel file in the field. Given the large size of the site survey, the qualitative data was eliminated from these files. Excel macros were used to make the focus and supplementary site files consistent so that they could be combined into a single data set. Finally, the site level data were separated from the focus group level data. Throughout this process, the coded files and resulting data sets were checked against the paper surveys to ensure data errors were not introduced as the data set was constructed. Additionally, all of the questions in randomly selected site files were checked against the paper surveys. Randomly selected questions across all of the site files also were checked against the paper surveys. Finally, if coding issues could not be resolved by consulting the paper surveys, the field study team provided clarifications.

The five national questionnaires also were coded in the field. The qualitative questions were eliminated from the national questionnaires. Once again, the coded files were checked against the paper surveys to ensure that errors were not introduced as the data set was created.

Initially, six data sets were created. The first data set included data collected at the national level and involved 5 observations. The second data set included data collected at the site level and therefore included 31 observations. The last four data sets included data collected from the focus groups on the four indicators of perceptions of success: catch per unit effort (CPUE) trends, habitat trends, threat trends, and compliance assessments. Each focus group was asked to provide their assessment of the CPUE trend for three resources, the habitat trend for three habitats, the threat trend for three threats, and assessment of compliance with five management rules. Given the 133 focus groups, this resulted in data sets of 399 observations for CPUE, 396 observations for habitats, 377 observations for threats, and 648 observations for compliance assessment.

These six individual data sets were combined into a single data set by replicating the national and site level data to fill in the 665 rows of observations for the compliance assessment. Missing observations were added to the CPUE, habitat, and threats data sets to add them to this data set. Thus, the final data set contained 665 rows of data and 172 columns of questions. However, most of the explanatory data in the data set varied across only 31 sites or 5 countries, while data on the indicators of success varied across either 399 or 665 observations. Exceptions to this were specific explanatory variables associated with indicator categories – for example, whether the management rule was national or local. These varied across all 377 to 648 observations, depending on the indicator.

B. AGGREGATION OF INDICATOR CATEGORIES

Resource Categories

Focus groups provided their perceptions of CPUE trends for three resources. The resources mentioned by the 133 focus groups were then grouped into the 14 resource categories shown in Figure B.1.

Habitat Categories

Focus groups also provided their perceptions of habitat trends for three habitats. The habitats identified by the 133 focus groups were then grouped into 7 habitat categories (see Figure B.2).

Rule Categories

Focus groups provided their compliance assessment for five management rules. The management rules mentioned by the 133 focus groups were then grouped into 10 management rule categories (see Figure B.3).

Threat Categories

The threats identified by focus groups were classified during the site surveys. The field study team classified threats as: pollution; siltation/sedimentation/deforestation; destructive fishing; mining; overfishing; or other. Additionally, the focus groups were asked "which threats can the village handle and which require outside help?" Threats were then classified according to their responses: "threat can be handled by village"; "threat requires outside help"; and "threat requires a mixture of village/outside help".

Figure B.1 Resource Groups and Associated Resource Names

FISH

Reef Finfish
emperor
finfish
reef fish
sea perch
siganidae (rabbit fish)
travally
wrasse
grouper
acanthuridae
balistidae
coral cod
eel
snapper
soldier fish
surgeon fish
trigger fish
unidorn fish

Inshore Finfish
larval fish
milk fish
mullet
rastrelliger 1
rastrelliger 2
lethrindae (hoputu)

Semi-Pelagics
euthynnus (bonito)
shark

INVERTEBRATES

Shellfish
bivalve shells
gafarium (to'o)
kaloa'a (kaikoso)
modiolus (kuku)
shellfish
spider conch (lambis)
strombus gastropod

Crabs
crab
mangrove crab
mudcrab
prawn

Octopus
octopus

Clams
clam
giant clam (tridacna)
Oyster

Jellyfish
jellyfish

Reef Holothurids
sea urchin (tukumisi)
anemone (lumane)

BDM
BDM (sea cucumber)

Impact-Zone Mollusks
turbo
trochus
topulangi

Lobster
lobster (crayfish)

OTHERS

Seaweed
seaweed
seagrass

Turtle
turtle

Figure B.2 Habitat Groups and Associated Habitat Names

Reefs
barrier reef
barrier reef flat
coral reef
fringing reef
live reef
offshore patch reef
outer reef flat
outer reef flat
outer reef zone
reef
reef flat
inshore reef
trochus reef
pass
wave impact zone

Seagrass
seagrass
patch reefs and sea grass
seagrass and associated coral

Lagoons
lagoon landward of barrier reef
lagoon near barrier reef
lagoon patch reef
lagoon seaward of reef
lagoon/inside BIR
centre of lagoon
inshore lagoon
BDM (reef and open) areas
DAB

Inter-tidal Areas
inter-tidal area
inter-tidal sandy beach
rocky inter-tidal
sandy beach inter-tidal area
stony area inter-tidal
stony place
rocky shore

Mangrove
mangrove

Sandy Areas
muddy gravel sand
sandy area
sandy beach

Estuary/River Mouths
estuary
estuary Lotosami
river mouth

Figure B.3 Management Rule Groups and Associated Management Rule Names

Destructive Fishing Practices Rules
chloroxing ban
compressor ban
damselfish netting
derris ban
dynamite ban
explosive fishing
fish fencing ban
fish fencing ban (seasonal)
fish poisoning ban
gillnet ban
hookah ban
net mesh size limits
night diving ban
PNG Kava ban
PNG Kava growing ban
scuba fishing ban
netting ban except for festivals
coral pounding

Species Bans
2 year kaikoso ban
alternating trochus-BDM ban
BDM ban
coral collection ban
conditional crocodile ban
crayfish with eggs ban
pearl oyster ban
turtle ban
small fish and invertebrates ban

Other Rules
mangrove export ban
harvest to chief

Size Limits & Other Rules
clam size limits
lobster size limits
size limits
trochus size limit
turtle rules
travally rule
PL 4-18 (catch restrictions)
BDM and white teat fish limits
dugong protection law

Closed Seasons
grouper closed seasons
mangrove crab seasonal limits
reef fish seasonal ban
Saturday fishing ban
Sunday fishing ban
trochus closed seasons
turtle closed season
kanahe fishing seasonal closure

Protected Area Rules
conservation area rules
marine conservation areas
reserve area
reserve fishing ban
sanctuary rules
conservation area for clams
clam circle rules

Restrictions on Outsiders
exclude outsiders
fishing by non-OJ residents ban
fishing license required for outsiders
no license for outsiders
outsider spear fishing ban
outsiders require permission
restrictions on fishing in other clan's reefs
restrictions on outside fishing
tourist catch and release law
ban on outside fishing

Area Restrictions
tabu area
tabu area (trochus reef)
netting ban (inside of reef)
ban on catching baitfish in front of village
ban on catching tridacna in front of village

Commercial Fishing Restrictions
commercial fishing ban
commercial teleher fishing ban
commercial tridacna sale ban

Permits & Licenses
dive permits
boat registration
fishing license fees

C. DESCRIPTIVE AND NON-PARAMETRIC STATISTICS ANALYSIS

Before conducting the econometric analysis, various descriptive and nonparametric statistics were calculated.

Explanatory Variables

Various descriptive statistics were calculated for the large number of explanatory variables contained in the data set. Correlation coefficients were calculated for over 120 potential explanatory variables with the four indicators of success. Since many of the explanatory variables were either ordinal or categorical, three different types of "correlation" coefficients were calculated (depending on the variables type): Pearson correlation coefficient, Cramer's V, and the Spearman rank correlation coefficient. Additionally, for close to 100 of these explanatory variables, additional descriptive statistics and graphs were calculated: mean, standard deviation (of the mean), standard error (of the mean), minimum and maximum, a histogram, and a bivariate scattergram of the variable against the 31 sites.

Dependent Variables

The data collected from the focus groups on the perceptions of success were analyzed using a number of descriptive and non-parametric test statistics. In general, the purpose of the analysis was to assess how the different indicators of success varied across different categories. For example, focus groups were asked to provide their perceptions on the CPUE trend for three different resources (e.g., shellfish, reef fish, and trochus). Descriptive and nonparametric statistics were then used to determine whether perceptions of CPUE trends were higher for reef fish than for shellfish.

Nonparametric statistics were used, given the highly non-normal distributions of the four indicators of success. The two main non-parametric statistics used were the Kruskal-Wallis test and the Mann-Whitney U test. The Kruskal-Wallis test is a nonparametric version of a one-way analysis of variance by ranks and tests the null hypothesis that all categories come from the same distribution. Similarly, the Mann-Whitney U is the nonparametric version of a two group unpaired t-test and tests the null hypothesis that two categories come from the same distribution. Both test statistics test whether there is variation across categories. The primary difference is that the Mann-Whitney U statistic is used when two categories are being compared and the Kruskal-Wallis test statistic is used when three or more categories are being compared.

These nonparametric test statistics were applied to see if the indicators of success varied across the different categories (i.e., different resources for CPUE, different habitats, different threats, and different management rules). Typically, the Kruskal-Wallis test statistic was first calculated to determine if all of the different categories were equivalent in terms of the perception of success measure. If the test statistic was significant (indicating that some of the categories did come from different distributions), then the Mann-Whitney U was used, pair by pair, to determine which types differed. The results are presented in the following sections.

The structure of the study's data set created some difficulties for calculating these non-parametric statistics. The observations in the data set were not independent, since the data set was based on repeated sampling from each focus group (i.e., each focus group provided perceptions of CPUE trends for three resources). Furthermore, a single focus group could provide multiple measures on a single indicator category (e.g., a focus group may provide CPUE trends for both wrasse and emperor fish, both of which fell in the "reef finfish" category). The second problem was solved by creating a "semi-independent" sample which ensured that any particular focus group provided, at most, one indicator measure per indicator category. With this problem solved, limiting the data set to a particular indicator category ensures an independent sample (i.e., only one response per focus group). However, some of the non-parametric statistics which are based on comparisons across indicator categories rely on the "semi-independent" sample which could have a single focus group providing an indicator measure to more than one indicator category.

The Kruskal-Wallis test statistic was also used to determine whether the indicators of success varied across the different focus group types (i.e., men, women, and elders). These test statistics were calculated after limiting the data set to a single indicator category, thus ensuring an independent sample. The test statistic was calculated for four resource categories (CPUE), seven habitat categories, six threat categories, and seven rule categories. None of the test statistics were significant at the 10 percent level, indicating that perceptions of success were very consistent across the different group types. This test statistic was also calculated using the entire sample (no longer an independent sample), and once again none of the test statistics were significant at the 10 percent level (see Table B.1).

Additionally, a Wilcoxon signed rank test was used to assess whether similar focus group (i.e., two groups of men, or two groups of women) from the same site

Table B.1. Tied P-values for nonparametric test statistics

Non-parametric test statistic	CPUE	HABITAT	THREAT	COMPLIANCE
Kruskal-Wallis test for variations between indicator Categories	0.0854	0.0001	0.0001	0.0001
Wilcoxon test for variations in perceptions of focus groups of similar characteristics	0.5314	0.0129	0.5574	0.4758
Kruskal-Wallis test for variations in perceptions of elderly, women and men focus groups	0.5193	0.8076	0.4962	0.8069

The Kruskal-Wallis test for variations in perceptions of elderly, women and men focus groups is based on the entire sample.

gave similar responses for the four indicators of success. The sample used to calculate this test statistic was limited to focus sites, since only these sites had more than one focus groups of a particular type (in general, interviews were conducted with two men's focus groups, two women's focus groups and two elder's focus groups at each focus site). To create the paired data set necessary to calculate the test statistic, indicator measures were paired by the same type of focus group and by the same indicator category — e.g., the CPUE perceptions of two elderly focus groups from the same site for the same category ("reef finfish", for example) were compared.

The Wilcoxon signed rank test was not statistically significant (at the 10 percent level) for CPUE, threats, and compliance, but was statistically significant (at the 5 percent level) for habitat trends (see Table B.1). Therefore, for three of the four indicators of success, focus groups of the same type and at the same site give very similar perceptions of success for the same indicator category. This shows considerable consistency in these perceptions. The significant Wilcoxon signed rank test statistic for habitat trends indicated that focus groups' perceptions of these trends were less consistent. This is not surprising, given the more abstract nature of "habitats" relative to CPUE, threats, and compliance. This lack of consistency, however, implies that greater caution should be taken when interpreting the results from analyses based on this habitat trend variable (especially if interpreting the perceived habitat trend variable as reflecting the underlying ecological situation).

Perceptions of CPUE Trends

Each focus group provided their perception of CPUE trends for three different resources. Fourteen resource categories were then created to categorize these specific resources: reef finfish; inshore finfish; semi-pelagics; shellfish; crabs; octopus; clams; jellyfish; reef holothurids; beche-de-mer; impact-zone mollusks; lobsters; seaweed; and turtles. The Kruskal-Wallis test statistics indicated that there was weak statistical evidence that CPUE trends varied across these resource categories (see Table B.1). Mann-Whitney test statistics indicated that the CPUE trend for beche-de-mer was statistically lower than shellfish, clams, reef finfish, or octopus. Since the mean CPUE trend for all fourteen resource categories indicated that they all faced a declining trend, the nonparametric analyses suggest that the CPUE trend for beche-de-mer is falling faster than that of shellfish, clams, reef finfish, and octopus.

Perceptions of Habitat Trends

Each focus groups provided their perceptions of habitat trends for three habitats. Seven habitat categories were then created from the responses: estuaries and river mouths; inter-tidal areas; lagoons; mangroves; reefs; sandy areas; and seagrass. The Kruskal-Wallis test statistic indicated that there is strong evidence that the habitat trend varies across these categories (see Table B.1). Furthermore, the Mann-Whitney statistics revealed that seagrass areas and mangroves were perceived to be declining more slowly than inter-tidal areas and lagoons (mangroves were also declining more slowly than reefs). Thus, these perceptions of habitat trends indicate that inter-tidal areas, lagoons, and reefs are faring worse than seagrass areas and mangroves.

Perceptions of Threat Trends

Perceptions of threat trends were collected for three threats from each focus group. Thirteen threat categories were created from these responses: commercial/development threats; deforestation; destructive fishing practices; market pressures; new technologies; outside users; overexploitation; poaching; pollution; population; tourism; under-sized harvesting; and other threats. The Kruskal-Wallis test statistic indicated that there is variation across these thirteen threat categories (see Table B.1). The Mann-Whitney test statistics showed that pollution threats were increasing faster than deforestation, new technologies, outsider user threats, and overexploitation, while destructive fishing practices were increasing more slowly than these threats.

Additionally, the field study team classified the threats into six broad categories: destructive fishing; pollution; mining; over-fishing; sedimentation; and others.

The Kruskal-Wallis statistic indicated that there was variation across these categories as well. Mann-Whitney test statistics supported the previous results that perceived pollution threats were increasing faster than over-fishing, sedimentation, and other threats, while destructive fishing practices were increasing more slowly (destructive fishing practices were increasing more slowly than mining threats as well).

Perceptions of Compliance

Compliance assessments were collected for five management rules for each focus group. Ten rule categories were then created: area restrictions (e.g., taboo areas); closed seasons; commercial fishing restrictions; fishing practices restrictions; permits; protected area rules; restrictions on outsiders; size limits; species bans; other rules. The Kruskal-Wallis test statistic indicated that there was variation in perceptions across these rule categories (see Table B.1) and Mann-Whitney statistics helped divide these categories into two types: relatively high and low compliance. The relatively high compliance rules included: area restrictions; closed seasons; fishing practice rules; and protected area rules. The relatively low compliance rules included: restrictions on outsiders; size limits; and species bans.

Additionally, the field study team classified rules into the following categories: local rules; outside rules; locally-adapted outside rules; local conservation rules; and outside conservation rules. A Kruskal-Wallis test statistic indicated that there was variation across these categories. Mann-Whitney statistics further indicated that locally-adapted outside rules had better perceived compliance than the other rule categories.

D. CORRELATION BETWEEN PERCEPTIONS OF SUCCESS AND EXPLANATORY VARIABLES

Pairwise correlation matrices were calculated for the four indicators of success and a large number of the explanatory variables. These correlation coefficients were particularly useful for assessing the relationship between the indicators of success and explanatory variables which could not be included in the multivariate regressions. The correlation coefficients were grouped by site characteristic; external factors, and process factors.

Site Characteristics

Thirty site characteristic variables were correlated with the four indicators of success (see Table B.2).

Table B.2. Pairwise correlation coefficients with site characteristics

Explanatory Variables	CPUE	HABITAT	THREAT	COMPLIANCE	SUCCESS
inability to exclude outsiders	0.1403**	0.1519**	0.1702**	0.1499**	0.1182
quality of leadership	0.0658	0.1023*	-0.1087*	0.1905**	0.2382**
percent projects completed	0.1166*	0.1075*	-0.192**	0.367**	0.4541**
education level	0.1071*	0.0246	-0.1477**	0.1967**	0.3354**
marketing perishable goods	0.0676	-0.1565**	-0.1714**	0.0937*	0.1647
distance to urban center	-0.0766	-0.0248	0.1596**	-0.236**	-0.22*
village age	0.1065*	0.1299**	-0.3523**	0.2113**	0.4185**
number of close villages	0.0334	-0.1801**	0.1513**	0.056	-0.081
cultural requirement to harvest	0.0418	0.0768	-0.0134	0.1475**	0.1357
clear site boundaries	-0.0972	-0.0851	-0.1024*	-0.2133**	-0.1878*
Population density	0.0525	-0.082	-0.2511**	0.0877*	0.1876*
Population growth rate	-0.1184*	-0.2801**	0.1302*	-0.2451**	-0.3629**
Awareness of actions	-0.0387	-0.1476**	-0.1964**	-0.1696**	-0.0997
number of indigenous rules	-0.073	-0.3096**	-0.1818**	-0.142**	-0.1542
level of fishing technology	-0.0733	0.0694	0.2928**	-0.088*	-0.187*
income dependence	-0.0794	-0.0002	0.2115**	-0.242**	-0.331**
Subsistence dependence	-0.1386**	-0.085	0.3277**	-0.2531**	-0.3788**
Pollution	-0.0297	-0.2167**	0.3122**	0.0594	-0.1874*
Destructive fishing	0.1811**	0.0385	-0.3735**	0.1944**	0.4072**
Conflicts	0.0366	-0.1191*	0.2229**	-0.0839*	-0.2089*
village development	0.1191*	-0.0514	-0.1873**	0.3236**	0.2907**
high island	0.0556	0.0088	-0.2621**	0.1012**	0.2143*
number of ecosystems	-0.0658	-0.0854	0.11*	-0.1417**	-0.2446**
habitat diversity	-0.1316**	-0.1571**	0.0432	-0.2581**	-0.3338**
Contiguous fishing areas	0.0995*	-0.0749	0.2082**	0.2067**	0.0585
receives tourism benefits	0.01	0.02	-0.0744	-0.0754	-0.0211
land use diversity	0.0208	-0.1761**	-0.0145	0.046	-0.0756
urban site	-0.0648	-0.0567	0.2493**	0.0771*	-0.1564
private sector development	0.0108	-0.0769	0.005	-0.0463	-0.0981
Conservation site	0.0022	-0.0183	0.0156	0.0972*	0.0988

Notes: * = $p<0.05$; ** = $p<0.01$.

Table B.3. Pairwise correlation coefficients with external factors

Explanatory Variables	CPUE	HABITAT	THREAT	COMPLIANCE
justification for outside rules	0.0756	0.0246	-0.2815**	0.1813**
government visit	-0.0302	0.0036	-0.2063**	0.0733
agency support to crm	-0.0872	-0.1918**	-0.1998**	-0.2607**
supportive national legislation	-0.0799	-0.2611**	0.1834**	-0.188**
national legislation for fisheries	-0.1294**	0.161**	0.401**	-0.1665**
government recognizes user rights	-0.2263**	-0.0963	0.2426**	-0.2597**
frequency of newspaper articles on crm	0.1453**	-0.1519**	-0.4114**	0.1418**
crm priority in national develop plan	-0.0505	-0.2043**	-0.1653**	-0.2634**
percent of fisheries staff working on crm	0.1581**	-0.1333**	-0.294**	0.1709**
annual donors budget on crm	-0.0202	-0.0215	-0.0104	0.1725**
natural disasters	0.1549**	-0.1122*	-0.1206*	0.1053**
market shocks	-0.0407	0.0631	-0.081	0.0674
development project shocks	-0.0968	0.1606**	0.0005	-0.0521
destructive fishing technology shocks	-0.0914	0.036	0.005	-0.1867**

Notes: * = p<0.05; ** = p<0.01.

External Factors

Fourteen external factor explanatory variables were correlated with the four indicators of success (see Table B.3). Many of these variables were collected through interviews with fisheries and environmental agencies. These variables could not be included in multivariate regressions (which also include country dummy variables), since they would have been perfectly correlated with the country variables included in that analysis.

Process Factors

Eleven process factor variables were correlated with the indicators of success (see Table B.4). The potential endogeneity of most of these variables excluded their use in the multivariate regressions.

E. ECONOMETRIC ANALYSIS

The primary objective of the econometric analysis was to determine the factors which contributed to successful coastal resource management in the Pacific Islands. The following econometric issues are discussed below: model selection; estimation issues and methods; basic model results; estimation results for alternative model specifications; and open access and indicators of success.

Model Selection

Two factors made selecting the model to estimate particularly challenging. First, there was an almost complete lack of empirically testable models in the literature on coastal resource management. Second, the literature on coastal resource management spans various disciplines, resulting in a large number of potential variables to explain successful coastal resource management. These two factors result in a large number of potentially important variables to include in the model with little of no theory to guide the selection process.

Furthermore, the nature of the data set required limiting the number of variables included in the model. Although data on the indicators of success were collected from 133 focus groups, most explanatory variables were collected at the site level. Because of this, the effective degrees of freedom were limited to the 31 sites. The choice of variables to include in the model was further complicated by the presence of

Table B.4. Pairwise correlation coefficients with process factors

Explanatory Variables	CPUE	HABITAT	THREAT	COMPLIANCE
partner present	0.03	-0.0481	-0.0083	0.0641
length of partner involvement	0.1041	0.0975	0.4218**	-0.0421
quality of partnership	-0.0776	-0.2837**	-0.1764*	-0.0358
village role in partnership	-0.1389	-0.1283	0.1859*	-0.1393*
clear goals of partnership	-0.0509	-0.2531**	-0.0315	0.1142*
indigenous rules have changed with time	-0.1070*	-0.1649**	-0.0487	-0.2283**
influential individuals present	0.1147	-0.0336	-0.2192**	0.2378**
partner has provided information	-0.1131	-0.2125**	0.0506	-0.1041
indigenous rules present	-0.1267*	-0.2495**	-0.1478**	-0.2037**
sanctuary present	0.0553	-0.0357	-0.1343**	0.0557
alternative income generating activities	-0.0141	-0.1112*	0.1337**	0.0367

Notes: * = p<0.05; ** = p<0.01.

Table B.5: Variable names and their description

VARIABLE	NAME DESCRIPTION
Dependent Variables	
CPUE	perception of changes in catch per unit effort over the past decade
Habitat	perception of habitat trends over the past decade
Threats	perception of threat trends over the past decade
Compliance	perception of level of compliance with management rules
Success	Factor scores from a principal component analysis used to weight the four indicators into an aggregated success variable
Explanatory Variables	
Palau	Country dummy variable for Palau ("1" – Palau site; "0" – Other sites)
Samoa	country dummy variable for Samoa ("1" – Samoa site; "0" – Other sites)
Solomon	country dummy variable for Solomons ("1" – Solomons site; "0" – Other sites)
Tonga	country dummy variable for Tonga ("1" – Tonga site; "0" – Other sites)
government visit	index of last year a government official visited the site
income dependence	percent of income from coastal resources and tourism
natural disasters	dummy variable for whether the site had experienced a natural disaster
quality of leadership	study team's assessment of the quality of site leadership
inability to exclude outsiders	ordered variable measuring the inability of local leaders to exclude outsiders
pollution	dummy variable of whether pollution threats were identified at the site
population density	ratio of village population to the site size (persons/km square)
number of ecosystems	number of distinct ecosystems identified by the study team e
quality factor	factor scores for a principal component capturing the degree of equality and involvement of user groups in coastal resource management
threat type-destructive fishing	threat type dummy variable for presence of destructive fishing practices threats
threat type: land-based threats	threat type dummy variable for presence of land based threats
threat type-over fishing	threat type dummy variable for presence of over fishing
rule type-local/national rules	rule type dummy variable reflecting presence of locally adopted national rules
rule type-national rules	rule type dummy variable for presence of national rules

variables collected through national questionnaires, which only varied across the 5 countries. This relatively complex structure of the data set placed significant constraints on which variables could be included in the basic model.

In the end, five basic models were estimated. These models were similar in terms of their explanatory variables and differed by their dependent variables. The five dependent variables used in the analysis were: CPUE, habitat, threats, compliance, and success. CPUE measures the focus group's perception of the ten year trend in catch per unit effort for specific resources. Habitat measures the focus group's perception of the ten year trend for specific habitats. Threats measures the focus group's perception of the trend in specific threats. Compliance measures the focus group's perception of the level of compliance with specific management rules.

Data were collected on each of these four indicators of success for specific resources, habitats, threats, and rules. In addition, measures of the "overall" level of these four indicators were also collected. A factor analysis was conducted on these four overall indicators and the factor scores were used as weights to construct an aggregate success variable.

An initial specification of the basic model was selected by choosing the ten variables which captured the most important determinants of successful coastal resource management as determined by the literature, the Study's expert workshop, and the results of the qualitative analysis. The ten independent variables selected included: government visits; income dependence; natural disasters; quality of leadership; inability to exclude outsiders; pollution; population; equality factor; and presence of indigenous rules. Four dummy variables also were included to capture country fixed effects. In addition, dummy variables were included to capture the different indicator "categories": different categories for CPUE; different habitat categories; different threat categories; and different categories of management rules for the compliance indicator (see Table B.5). While most of the explanatory variables varied only across the 31 sites, the category explanatory variables varied across all 377-648 survey observations, as did the dependent variables.

Numerous variables were excluded from the initial specification because of the constraint on degrees of freedom and, in some cases, because the survey had failed to measure the variables reliably. Furthermore, a number of different questions from the survey could proxy for a particular variable included in the initial basic model. These various proxies for each variable were analyzed to determine which worked best in the basic model. This analysis involved both calculating

correlation matrices and estimating alternative specifications of the basic model.

The results from this analysis resulted in a number of changes to the initial specification of the basic model. First, the presence of indigenous rules was dropped from the model because it was almost perfectly correlated (negatively) with the Tonga country dummy variable. The pollution variable also was dropped from the threats model, since it was partially captured by the land-based threat type dummy variable. A number of proxies were also switched in the basic model: population density was used instead of population growth; income dependence was used instead of a question measuring the degree of subsistence dependence on coastal resources; and the indexed version of government visits was used instead of a dummy version.

After the final set of explanatory variables was determined, the two sets of dummy variables were tested for their contribution to the basic model by calculating a test statistic for their joint significance as well as examining the estimation results when they were dropped from the model. The country dummies were jointly significant at the 5 percent level for the CPUE, threats, compliance, and success regressions, but not jointly significant in the habitat regression. Given their high level of significance in four of the five regressions and the likely important role of country fixed effects, the country dummies were kept in all five basic models.

Similarly, the joint significance of the indicator category dummies was tested in the CPUE, habitat, threats, and compliance regressions (such indicator category dummies are not appropriate for the success regression since it is an aggregate measure based on "overall" resources, habitats, management rules and threats trends). The indicator category dummies were jointly significant at the one percent level in the threats and compliance regressions but not significant in the CPUE and habitat regressions. Given these results, the indicator category dummies were dropped from the CPUE and habitat regressions but kept in the threat and compliance regressions.

Estimation Issues and Methods

A number of estimation issues had to be addressed. The first resulted from the structure of the survey, with data collected at the country, site, and focus group levels. Another issue resulted from the ordinal nature of some of the dependent and explanatory variables. The last key issue was the endogeneity of some of the explanatory variables.

Survey Structure

Three different surveys were used to collect the necessary data. The first two surveys were used at the focus and supplementary sites where most of the difference was in the number of focus groups interviewed (three in the supplementary sites and six to eight in the focus sites). The third survey was used to collect national level data from the fisheries and environmental ministries in each country. The different levels at which data was collected resulted in a relatively complicated data set.

In total, 133 focus groups were interviewed in 31 sites in five countries. Additionally, each focus group was asked to provide trends for three resources (for CPUE), three habitats, three threats, and five management rules (for compliance). Thus, the data set contained four data levels (or strata): country, site, focus group, and specific resource, habitat, threat or rule. This structure results in a maximum number of observations on the dependent variables of 377 to 399 for CPUE, habitats and trends and 665 for compliance. The survey involved multistage sampling, i.e. the data were clustered at the country, site, focus group and within focus group levels. Within each cluster, the observations are correlated and are not independent. Because most econometric estimators assume independence, the standard errors would tend to be biased if no correction was done to take into consideration the clustering of the data. To accommodate the complex structure of the data set, the analysis used a correction that allowed the standard errors to be calculated under the assumption of stratified, clustered, random sampling (with stratification by country and clustering by site). The variance estimators used in the analysis allow for any amount of correlation within the clustering units, and allow for secondary clustering. While not explicitly accounting for clustering by focus group, the standard error calculation accounts for this by allowing for a flexible correlation structure within sites. In multistage designs such as the one used by this study, the correlation yields variance estimates that are either approximately unbiased or biased towards more conservative estimates (see Stata Manual, Release 6, Vol. 1, pages 321-333, and Vol. 4, pages 15-30). Therefore, the standard errors should be approximately correct.

Additionally, some of the variation within the final level of the data set (for specific resources, habitats, rules, and threats) is controlled for by including indicator type dummy variables as described earlier.

The single equation ordinary least squares (OLS) or ordered probit model may be viewed as a special case of a more general multi-equation model in which there is a separate equation for each resource

(threat, etc.) thus allowing the regression coefficients to vary by type. Had there been equal samples for each such equation, it would have been feasible to estimate this more general model and to test for the equality of the coefficients across equations. However, given the unequal and in some cases small samples, it was necessary to impose the restriction that all the regression coefficients except for the intercepts are equal across equations, leading to a single-equation OLS or ordered probit model. Single categories indicator models were estimated for the most frequently cited resources, habitats, etc, and are displayed in Table B.10. Aside from the survey design issues discussed above, the standard errors for this single-equation model are correct provided that the cross-equation restrictions that were imposed are indeed valid. If separate coefficients for each resource had been allowed for in a multi-equation model, then many more parameters would have had to be estimated and the standard errors would have been commensurately higher.

Ordinal Dependent and Independent Variables

Another feature of the data set was that most of the dependent and three of the explanatory variables were ordinal instead of continuous variables. Because of the ordinal nature of the dependent variables, an ordered probit model was estimated to check the robustness of the ordinary least squares (OLS) regression estimates. Additionally, the ordinal explanatory variables were converted into dummy variables to assess the impact of treating them as continuous variables on the model estimates.

Endogeneity

Two of the explanatory variables used in the basic model were considered to be endogenous. The government visits variable measured the last time a government official visited the site. It is possible that government visits lead to improvements in the indicators of success. Alternatively, government officials may visit sites because they are successful (or because they are having serious problems). *A priori,* it is not possible to state whether government visits cause success or vice versa.

The variable income dependence measures the percent of income from coastal resources and tourism. The results from the qualitative analysis suggest that sites which are more dependent on coastal resources will have higher incentives to manage them well and therefore will be more successful. It is also possible that sites with a deteriorating resource base (i.e., unsuccessful sites) will become more dependent upon the remaining resources. Once again, *a priori,* it is not possible to determine whether dependence leads to success or whether lack of success leads to dependence.

The potential endogeneity of these two variables was addressed in two ways. First, an instrumental variables regression attempted to control for their endogeneity in the basic model. Unfortunately, since the survey was not designed to identify and collect data on good instruments, instruments had to be chosen from the data collected. Ultimately, five variables were chosen to serve as the two endogenous variables: ease of access to the site; level of private sector development; level of tourism development; whether the site was located on a high island; and the overall level of village development.

In addition to the instrumental variables regression, the basic model was re-estimated excluding the two endogenous variables. The results from this regression were compared to the basic model estimates to assess whether including these potentially endogenous variables had a large impact on the estimates of the exogenous independent variables.

Model Estimation Results

Various models were estimated using different methods in an effort to address the estimation issues raised above. In all cases, the basic model is the point of departure for addressing these estimation issues. Given the basic model results, first the endogeneity issue was addressed and then the ordinal data issue. This section presents the model results and the next section interprets these results.

Basic Model

The final specification of the basic model included country dummy variables for all five regressions. However, there were two differences between the five basic model regressions. First, indicator category dummy variables were included in the threats and compliance regressions and not in the other three regressions. Second, the pollution variable was dropped from the threats regression since the type of threats present at the site was already picked up by the threat type dummy variable for land- based threats.

The coefficient estimates for the OLS estimation of the final basic model are presented in Table B.6. In the basic model and all of the following regressions, the survey structure was accounted for by setting the strata and clusters at the country and site levels, respectively.

Table B.6: Regression coefficients for the basic model

Independent variables	INDICATORS				
	CPUE	HABITAT	THREATS	COMPLIANCE	SUCCESS
Palau	0.338*	0.306	0.558	0.961**	0.168
Samoa	0.351**	-0.656	0.175	0.507	-0.065
Solomon	-0.144	-0.229	1.040**	-0.378	-0.930**
Tonga	0.273	0.473	2.124**	1.011	0.266
government visit	-0.083**	-0.015	0.117**	0.018	-0.152**
income dependence	0.005*	0.007	0.008	0.003	0.001
natural disasters	0.390**	0.365*	0.223	0.333*	0.751**
quality of leadership	0.083	0.088	-0.417**	0.083	0.256*
inability to exclude outsiders	0.157**	0.074	-0.268**	0.151	0.191*
Pollution	-0.057	-0.678**	—	0.196	-0.314*
population density	0.000	0.000	-0.000**	0.000	0.000
number of ecosystems	0.063	-0.078	-0.139**	0.155*	0.139
equality factor	0.192**	0.072	-0.446**	0.133	0.318**
Constant	0.609	2.666**	4.151**	0.632	-1.767**
threat type-destructive fishing	—	—	-0.688**	—	—
threat type: land-based threats	—	—	0.526*	—	—
threat type-over fishing	—	—	0.318	—	—
rule type-local/national rules	—	—	—	0.713**	—
rule type-national rules	—	—	—	-0.211	—
Number of observations	399	396	377	442	124
R-squared	0.1201	0.1745	0.4520	0.2599	0.5239
F statistic	9.26	3.99	18.08	6.56	6.49
F stat degrees of freedom	13, 14	13, 14	15, 12	15, 12	13, 14
Probability > F	0.0001	0.0153	0.0000	0.0011	0.0007

Notes: * = p<0.1; ** = p<0.05.

Models Addressing the Endogenous Variables Issue

One of the problems with the basic model was that the government visits and income dependence variables were likely endogenous (the negative coefficient on the government visits variable in the CPUE, habitats and success regressions and the positive coefficient in the threat regression supports this conjecture – government officials might be visiting sites which were having more problems). Three different regressions were run to try to address this endogeneity. First, an instrumental variables (IV) model was estimated. Compared to the basic model, standard errors were much higher, the magnitude on many coefficients changed considerably, and some coefficients switched signs. The higher standard errors in the IV model compared to the basic model suggested that good instruments for these endogenous variables did not exist in the present data set. Looking at the first stage regressions supports the weakness of the instruments, since the set of instruments was not jointly significant in any of the first stage regressions. Finally, the magnitude and sign of the coefficient estimates was not very consistent between the IV and basic models. Overall, the IV model appeared to be a particularly weak model, given the survey data set.

The lack of good instruments meant that it was not possible to correct for the endogeneity of these two variables through a two-stage least squares regression method. Thus, two other approaches were used to address the endogeneity issue. First, the endogenous variables were dropped from the basic model (see Table B.7).

Second, the government visits variable was dropped from the regression, and the income dependence variable was replaced with the remittances variable. The remittances variable measured the percent of income from external sources and is potentially less endogenous than the income dependence variable. The coefficient on the remittances variable was only significant at the 10 percent level in the success regression. Comparing this regression with the basic model, the standard errors were very similar, while some variation in the magnitude of the coefficient estimates (but not their signs) resulted in some variables being significant in one regression but not in the other. This was also true for the regression where both endogenous variables were dropped from the regression: standard errors were remarkably consistent, while some variation in the magnitude of the coefficients affected whether individual variables were significant or not.

Models Addressing the Ordinal Data Issues

Four of the dependent variables and three of the explanatory variables were ordinal. The issue of ordinal dependent variables can be solved by estimating an ordered probit model (see Table B.8). The results from this ordered probit model were very consistent

Table B.7: Regression coefficients for the basic model without endogenous variables

	INDICATORS				
Independent variables	**CPUE**	**HABITAT**	**THREATS**	**COMPLIANCE**	**SUCCESS**
Palau	0.155	0.026	0.170	0.830**	0.237
Samoa	0.269	-0.838*	-0.150	0.382	0.015
Solomon	-0.078	-0.278	0.791*	-0.458*	-0.707*
Tonga	0.484	0.340	1.352**	0.793	0.897
government visit	—	—	—	—	—
income dependence	—	—	—	—	—
natural disasters	0.421**	0.362*	0.136	0.327**	0.815**
quality of leadership	0.025	0.068	-0.358**	0.099	0.161
inability to exclude outsiders	0.078	0.055	-0.164**	0.173	0.062
pollution	-0.047	-0.681**	—	0.193	-0.269
population density	0.000	-0.000	-0.000**	0.000	0.000
number of ecosystems	0.079	-0.060	-0.125**	0.158*	0.145
equality factor	0.116**	0.032	-0.407**	0.130	0.229**
constant	0.851**	3.017**	4.626**	0.807	-1.830**
threat type-destructive fishing	—	—	-0.657**	—	—
threat type: land-based threats	—	—	0.519*	—	—
threat type-over fishing	—	—	0.385	—	—
rule type-local/national rules	—	—	—	0.710**	—
rule type-national rules	—	—	—	-0.200	—
Number of observations	399	396	377	442	124
R-squared	0.1012	0.1680	0.4369	0.2583	0.4775
F statistic	4.21	3.78	25.49	7.15	3.24
F stat degrees of freedom	11, 16	11,16	13, 14	13, 14	11,16
Probability > F	0.0048	0.0081	0.0000	0.0004	0.0164

Notes: * = p<0.1; ** = p<0.05.

Table B.8: Regression coefficients for the ordered probit model

	INDICATORS				
Independent variables	**CPUE**	**HABITAT**	**THREATS**	**COMPLIANCE**	**SUCCESS**
Palau		0.394	0.356	0.436 1.107**	—
Samoa	0.300*	-0.731	0.121	0.672	—
Solomon	-0.179	-0.216	0.979**	-0.326	—
Tonga	0.254	0.476	1.870**	1.247*	—
Government visit	-0.099*	-0.007	0.121**	0.029	—
Income dependence	0.006	0.008	0.005	0.005	—
Natural disasters	0.489**	0.378*	0.188	0.404*	—
Quality of leadership	0.098	0.097	-0.359**	0.084	—
Inability to exclude outsiders	0.194*	0.069	-0.227**	0.166	—
Pollution	-0.104	-0.709**	—	0.362**	—
Population density	0.000**	0.000	-0.000*	0.000	—
Number of ecosystems	0.080	-0.094	-0.147**	0.168	—
Equality factor	0.219**	0.080	-0.430**	0.210	—
Cut 1	1.269**	-1.199**	-2.310**	1.731*	—
Cut 2	2.500**	-0.062	-1.414**	2.226	—
Cut 3	3.083**	0.741	-0.947	2.889	—
Cut 4	3.752**	1.653**	-0.273	—	—
Threat type-destructive fishing	—	—	-0.652**	—	—
Threat type: land-based threats	—	—	0.478*	—	—
Threat type-over fishing	—	—	0.284	—	—
Rule type-local/national rules	—	—	—	0.924**	—
Rule type-national rules	—	—	—	-0.193	—
Number of observations	399	396	377	442	—
F statistic	5.14	2.87	11.27	4.75	—
F stat degrees of freedom	13, 14	13, 14	15, 12	15, 12	—
Probability > F	0.0022	0.0302	0.0001	0.0049	—

Notes: * = p<0.1; ** = p<0.05.

Table B.9: Regression coefficients for the ordered probit model with all dummy variables

Independent variables	INDICATORS				
	CPUE	HABITAT	THREATS	COMPLIANCE	SUCCESS
Palau	0.119	0.631	0.832	0.038	—
Samoa	-0.137	-0.202**	0.333	0.026	—
Solomon	-0.711**	0.064	1.309**	-0.883**	—
Tonga	0.283	1.536**	2.008**	0.244	—
government visit 1	0.693**	0.526**	-0.809**	0.581**	—
government visit 2	-0.757**	-0.209	0.430	-0.428*	—
government visit 3	0.902**	-0.373	-0.057	-0.997**	—
government visit 4	-0.443**	-0.098	0.404**	0.201	—
income dependence	0.005	0.016*	0.007	-0.003	—
natural disasters	0.778**	0.800**	0.116	0.574**	—
quality of leadership 1	0.076	0.161	-0.396*	0.858**	—
quality of leadership 2	0.060	0.587	-0.703**	0.490*	—
inability to exclude outsiders 2	0.214	-0.115	0.191	-0.549*	—
inability to exclude outsiders 3	-0.750**	0.403	0.269	-0.073	—
inability to exclude outsiders 4	0.621**	1.395**	-0.451	-0.108	—
inability to exclude outsiders 5	0.691**	-0.537	-0.767*	0.622	—
pollution	-0.234*	-0.886**	—	0.274*	—
population density	0.000**	0.001**	-0.000*	0.000	—
number of ecosystems	0.147**	-0.081	-0.221**	0.125	—
equality factor	0.208**	0.057	-0.413**	0.214**	—
cut 1	1.225**	-0.359	-2.256**	0.357	—
cut 2	2.480**	0.825	-0.343*	0.894	—
cut 3	3.070**	1.661**	-0.876	1.600**	—
cut 4	3.750**	2.607**	-0.194	—	—
threat type-destructive fishing	—	—	-0.685**	—	—
threat type: land-based threats	—	—	0.526*	—	—
threat type-over fishing	—	—	0.291	—	—
rule type-local/national rules	—	—	— 1.149**	—	
rule type-national rules	—	—	—	-0.083	—
Number of observations	399	396	377	442	—
F statistic	19.15	7.74	6.11	22.75	—
F stat degrees of freedom	17, 10	17, 10	19, 8	19, 8	—
Probability > F	0.0000	0.0011	0.0066	0.0001	—

Notes: * = p<0.1; ** = p<0.05.

with the basic model and suggested that the basic model estimates were robust to the ordinality of the dependent variables.

The ordinal explanatory variables can be dealt with by creating dummy variables for the various levels of the ordinal variable (and excluding one of the dummy variables). The results in Table B.9 indicate that it may be a poor assumption that these ordinal variables can be treated as continuous variables. In general, if it were the case that they could be treated as continuous variables, one would expect that the associated dummy variables would have coefficients with the same sign. This is the case for quality of leadership but not for government visits or the inability to exclude outsiders. Furthermore, the signs on the coefficients on the individual dummy variables differed from one regression to the next. These results suggest caution when interpreting the coefficient estimates for the government visits variable and the inability to exclude outsiders variable in regressions where they are treated as continuous variables.

Final Model

Given these endogeneity and ordinality issues, a final model was estimated using an ordered probit specification and dropping the two endogenous variables (see Table B.10). The results are generally consistent with the basic model estimated by OLS.

Individual Indicator Category Models

The ordered probit models were also estimated restricting the samples to a single indicator category: CPUE for reef finfish; habitat for reefs; threats for over fishing; and compliance for destructive fishing rules. Table B.11 reports these regression results. The sample size for these regressions was smaller than the number of focus groups (133) since each focus group

Table B.10: Regression coefficients for the ordered probit model without endogenous variables

	INDICATORS				
Independent variables	**CPUE**	**HABITAT**	**THREATS**	**COMPLIANCE**	**SUCCESS**
Palau	0.174	0.011	0.166	0.889**	—
Samoa	0.198	-0.949*	-0.127	0.481	—
Solomon	-0.096	-0.289	0.760*	-0.462*	—
Tonga	0.498	0.271	1.140**	0.867	—
government visit	—	—	—	—	—
income dependence	—	—	—	—	—
natural disasters	0.523**	0.364*	0.112	0.391*	—
quality of leadership	0.032	0.077	-0.281**	0.106	—
inability to exclude outsiders	0.099	0.054	-0.114	0.205**	—
pollution	-0.082	-0.707**	—	0.363**	—
population density	0.000	-0.000	-0.000*	0.000	—
number of ecosystems	0.097	-0.072	-0.145**	0.173*	—
equality factor	0.131*	0.040	-0.371**	0.206*	—
cut 1	0.971*	-1.615**	-2.623**	1.445*	—
cut 2	2.179**	-0.489	-1.739**	1.941**	—
cut 3	2.751**	0.311	-1.278**	2.602**	—
cut 4	3.425**	1.226*	-0.615	—	—
threat type-destructive fishing	—	—	-0.606**	—	—
threat type: land-based threats	—	—	0.482*	—	—
threat type-over fishing	—	—	0.343	—	—
rule type-local/national rules	—	—	—	0.915**	—
rule type-national rules	—	—	—	-0.169	—
Number of observations	399	396	377	442	—
F statistic	1.89	3.31	14.72	4.87	—
F stat degrees of freedom	11, 16	11, 16	13, 14	13, 14	—
Probability > F	0.1203	0.0150	0.0000	0.0029	—

Notes: * = p<0.1; ** = p<0.05.

Table B.11: Regression coefficients for the ordered probit model for individual indicator categories

	INDICATORS				
Independent variables	**CPUE for reef finfish**	**HABITAT for reefs**	**THREATS for over fishing**	**COMPLIANCE for destructive fishing rules**	**SUCCESS**
Palau	0.819**	—	-0.248	—	—
Samoa	0.504	-1.581**	0.736	0.236	—
Solomon	1.019**	0.121	0.821*	-1.844*	—
Tonga	0.338	-1.145	1.874**	1.560	—
government visit	-0.201**	-0.151*	0.187**	0.102	—
income dependence	0.026**	0.007	-0.001	-0.003	—
natural disasters	0.505**	0.274	0.090	0.511	—
quality of leadership	0.323*	0.629*	-0.364	-0.326	—
inability to exclude outsiders	0.320**	0.424**	-0.270	0.073	—
pollution	-0.214	-0.432	—	0.624	—
population density	0.001**	0.000	-0.001**	0.000	—
number of ecosystems	0.146	-0.458**	-0.095	0.411**	—
equality factor	0.713**	0.457**	-0.512**	0.255	—
cut 1	3.166**	-2.959**	-2.987**	1.702	—
cut 2	4.958**	-1.676	-1.946*	2.336*	—
cut 3	5.663**	-0.796	-1.350	3.249**	—
cut 4	6.489**	0.678	-0.729	—	—
Number of observations	112	103	84	86	—
F statistic	6.41	5.98	8.82	1.95	—
F stat degrees of freedom	13, 14	12, 9	12, 12	12, 5	—
Probability > F	0.0007	0.0058	0.0003	0.2388	—

Notes: * = p<0.1; ** = p<0.05.

was allowed to choose the resources and threats for which they would provide CPUE and threat trends. Thus, while 112 focus groups gave CPUE trends for reef finfish, only 84 gave threat trends for over fishing. Additional regressions based on different indicator categories become more problematic as the samples become smaller (e.g., only 47 focus groups provided CPUE trends for beche-de-mer, the second most often mentioned resource).

Comparing the results from these two sets of regressions reveals that they are qualitatively very similar. This suggests that aggregating across different resources, habitats, threats and rules, as was done in the first set of models, does not affect the qualitative nature of the estimation results (although, of course, there were some differences between the coefficient and standard error estimates for the two sets of models since they were based on different samples).

Interpretation of the Coefficient Estimates

Assessing the significance of individual coefficient estimates required looking across the different models to determine whether or not the statistical evidence was strong. The results from the previous section indicated that the variables government visit and income dependence were likely endogenous. While their endogeneity did not appear to have a major impact on the estimates of the other variables, it did make interpretation of their coefficient estimates very difficult. The ordinal nature of the variables government visits and inability to exclude outsiders also made interpretation of their coefficient estimates difficult. Once again, however, it appeared that the coefficient estimates for the other variables were robust to the ordinality of these variables.

Additionally, there were a number of non-statistical issues which had to be considered when interpreting the results from any of the regression models. Perhaps most important among these nonstatistical issues was the fact that the dependent variables measured the focus group's perceptions of success, which may have differed from an ecologically based measure of success. Local perceptions are likely to be a crucial element of successful ecological management, but different factors may be significant determinants of perceptions of success and successful ecological management.

Another nonstatistical issue was the timing of the dependent and explanatory variables. Three of the dependent variables were measures of the perceptions of the trend over the past ten years. By contrast, some of the explanatory variables were measured at different points during this ten year period (e.g., natural disasters) while some of the dependent variables were measured at the time of the survey. For the latter group of variables, it had to be assumed that they measured site attributes that had not changed since before the beginning of the past decade if they were to be considered as "explanatory" variables. The lack of dependent and explanatory variables whose timing was appropriately matched (i.e., the explanatory variable taking place before the dependent variable) raises concerns over the ability to discern a causal relationship between these variables.

CPUE

Looking across the various models estimated, it was possible to assess whether there was strong or weak evidence for a particular variable being a determinant of catch per unit effort (CPUE). There was strong statistical evidence that the variables Samoa, government visits, natural disasters, inability to exclude outsiders, and the equality factor were significantly related to CPUE (see Table B.12). However, the government visits variable had both endogeneity and ordinality problems and the inability to exclude outsiders variable had ordinality problems. The interpretation of the remaining significant variables is discussed below.

The significant positive sign on the Samoa variable indicated that Samoa had a higher CPUE relative to Fiji (the excluded country dummy variable). Natural disasters also had a positive impact on perceived CPUE which may be explained by ecosystem recovery after natural disasters. Another possible interpretation is that natural disasters destroy fishing boats and gear, reducing total fishing effort and increasing CPUE. Finally, the sites rating higher on an equitable sharing of benefits and losses from coastal resource management had more positive CPUE trend perceptions.

Habitat

The various models for the habitat trend dependent variable indicated that there was strong evidence that the natural disasters and pollution variables were significant determinants of perceived habitat trends (see Table B.13). As in the CPUE regressions, natural disasters had a positive impact on the habitat trend (with a similar interpretation). In contrast, the presence of pollution threats had a negative impact on habitat trends. The natural interpretation is that pollution threats result in worse habitat trends.

Table B.12: Regression coefficients for CPUE

	CPUE Regressions for different Model Specifications				
Independent variables	**basic model**	**no endogeneity model**	**probit model**	**probit model with dummies**	**final model**
Palau	0.338*	0.155	0.394	0.119	0.174
Samoa	0.351**	0.269	0.300*	-0.137	0.198
Solomon	-0.144	-0.078	-0.179	-0.711**	-0.096
Tonga	0.273	0.484	0.254	0.283	0.498
government visit	-0.083**	—	-0.099*	—	—
income dependence	0.005* -	—	0.006	0.005	—
natural disasters	0.390**	0.421**	0.489**	0.778**	0.523**
quality of leadership	0.083	0.025	0.098 -	—	0.032
inability to exclude outsiders	0.157**	0.078	0.194* -	—	0.099
pollution	-0.057	-0.047	-0.104	-0.234*	-0.082
population density	0.000	0.000	0.000**	0.000**	0.000
number of ecosystems	0.063	0.079	0.080	0.147**	0.097
equality factor	0.192**	0.116**	0.219**	0.208**	0.131*
constant	0.609	0.851**	—	—	—
cut 1	—	—	1.269**	1.225**	0.971*
cut 2	—	—	2.500**	2.480**	2.179**
cut 3	—	—	3.083**	3.070**	2.751**
cut 4	—	—	3.752**	3.750**	3.425**

Notes: * = p<0.1; ** = p<0.05.

Table B.13: Regression coefficients for Habitat

	Habitat Regressions for different Model Specifications Independent variables				
Independent variables	**basic model**	**no endogeneity model**	**probit model**	**probit model with dummies**	**final model**
Palau	0.306	0.026	0.356	0.631	0.011
Samoa	-0.656	-0.838*	-0.731	-1.202**	-0.949*
Solomon	-0.229	-0.278	-0.216	0.064	-0.289
Tonga	0.473	0.340	0.476	1.536**	0.271
government visit	-0.015	—	-0.007	—	—
income dependence	0.007	—	0.008	0.016*	—
natural disasters	0.365*	0.362*	0.378*	0.800**	0.364*
quality of leadership	0.088	0.068	0.097	—	0.077
inability to exclude outsiders	0.074	0.055	0.069	—	0.054
pollution	-0.678**	-0.681**	-0.709**	-0.886**	-0.707**
population density	0.000	-0.000	0.000	0.001**	-0.000
number of ecosystems	-0.078	-0.060	-0.094	-0.081	-0.072
equality factor	0.072	0.032	0.080	0.057	0.040
constant	2.666**	3.017**	—	—	—
cut 1	—	—	-1.199**	-0.359	-1.615**
cut 2	—	—	-0.062	0.825	-0.489
cut 3	—	—	0.741	1.661**	0.311
cut 4	—	—	1.653**	2.607**	1.226*

Notes: * = p<0.1; ** = p<0.05.

Threats

There was strong statistical evidence that a large number of variables were significant determinants of threat trends (see Table B.14). These included: Solomon; Tonga; government visits; quality of leadership; inability to exclude outsiders; population density; number of ecosystems; the equality factor; and destructive fishing practices threat type. Non-statistical problems with some of these variables encourages caution in interpreting the statistical results. Once again, the government visits variable was likely endogenous, and both the government visits and inability to exclude outsiders variables faced ordinality problems.

Possible interpretation of the remaining variables was as follows. Both the Solomon and Tonga dummy variables were positively related to threats. Since a higher threat rating indicates greater threats, this results indicated that both the Solomons and Tongan sites had a higher level of threats relative to Fijian sites. Since all six Tonga sites were characterized by open access (out of a total of eight open access sites in the data set), the Tonga variable was a close proxy of the presence of open access. With this interpretation, the

Table B.14: Regression coefficients for Threats

Independent variables	Threat Regressions for different Model Specifications Independent variables				
	basic model	no endogeneity model	probit model	probit model with dummies	final model
Palau	0.558	0.170	0.436	0.832	0.166
Samoa	0.175	-0.150	0.121	0.333	-0.127
Solomon	1.040**	0.791*	0.979**	1.309**	0.760*
Tonga	2.124**	1.352**	1.870**	2.008**	1.140**
government visit	0.117**	—	0.121**	—	—
income dependence	0.008	—	0.005	0.007	—
natural disasters	0.223	0.136	0.188	0.116	0.112
quality of leadership	-0.417**	-0.358**	-0.359**	—	-0.281**
inability to exclude outsiders	-0.268**	-0.164**	-0.227**	—	-0.114
pollution	—	—	—	—	—
population density	-0.000**	-0.000**	-0.000*	-0.000*	-0.000*
number of ecosystems	-0.139**	-0.125**	-0.147**	-0.221**	-0.145**
equality factor	-0.446**	-0.407**	-0.430**	-0.413**	-0.371**
constant 4.151** 4.626**	—	—	—		
cut 1	—	—	-2.310**	-2.256**	-2.623**
cut 2	—	—	-1.414**	-1.343*	-1.739**
cut 3	—	—	-0.947	-0.876 -1.278**	
cut 4	—	—	-0.273	-0.194	-0.615
threat type-destructive fishing	-0.688**	-0.657**	-0.652**	-0.685**	-0.606**
threat type: land-based threats	0.526*	0.519*	0.478*	0.526*	0.482*
threat type-over fishing	0.318	0.385	0.284	0.291	0.343

Notes: * = p<0.1; ** = p<0.05.

positive sign on the Tonga country dummy indicated that sites with open access conditions had higher levels of threats.

The quality of leadership variable has a negative relation with threats, indicating that threats trends were perceived to be better where there was stronger local leadership. Additionally, the negative sign on the equality factor indicated that more equitable distribution of losses and benefits lowered the perceived threat trend. Finally, the greater the number of ecosystems at a site, the lower the perceived threats, possibly indicating that ecologically richer areas allow threats to be spread over a greater number of resources.

One particularly puzzling relationship was the negative coefficient on the population density variable, indicating that greater population density lowers threats. The magnitude of the coefficient was small, since the population density variable was measured on a much larger scale from the other variables, ranging from a fraction to 2,500 (there was wide variation in both village population – the numerator – and site size – the denominator).

Finally, comparing the different types of threats, destructive fishing practices appeared to have a lower threat trend relative to the "other threats" category. There was weak evidence that land based threats (including pollution, sedimentation, and mining) had a higher threat trend than the excluded "other threats" category.

Compliance

There was relatively strong statistical evidence that the variables Palau and local/ national rules were significant determinants of perceived compliance (see Table B.15). The positive coefficient on the Palau variable indicated that perceived compliance was better in Palau relative to Fiji. The positive coefficient for the local/national rules variable indicated that national rules that were locally adopted had greater perceived compliance than purely local rules (the excluded dummy variable).

There was weaker evidence that natural disasters led to greater compliance, but the interpretation of this result was less clear than in the CPUE and habitat regressions. Finally, there was also somewhat weaker evidence that the Solomon variables had a significant coefficient (see Tables B.17 and B.22). The negative sign on the Solomon coefficient would indicate that perceived compliance was lower in the Solomon Islands relative to Fiji.

Success

There was strong statistical evidence that the Solomons, government visits, natural disasters variables, and the equality factor were significant determinants of the aggregate success indicator (see Table B.16). There was weaker evidence that the quality of leadership, inability to exclude outsiders, and pollution also determined perceptions of success. However, the government visits and inability to

Table B.15: Regression coefficients for the Compliance

	Compliance Regressions for different Model Specifications				
Independent variables	**basic model**	**no endogeneity model**	**probit model**	**probit model with dummies**	**final model**
Palau	0.961**	0.830**	1.107**	0.038	0.889**
Samoa	0.507	0.382	0.672	0.026	0.481
Solomon	-0.378	-0.458*	-0.326	-0.883**	-0.462*
Tonga	1.011	0.793	1.247*	0.244	0.867
government visit	0.018	—	0.029	—	—
income dependence	0.003	—	0.005	-0.003	—
natural disasters	0.333*	0.327**	0.404*	0.574**	0.391*
quality of leadership	0.083	0.099	0.084	—	0.106
inability to exclude outsiders	0.151	0.173	0.166	—	0.205**
pollution	0.196	0.193	0.362**	0.274*	0.363**
population density	0.000	0.000	0.000	0.000	0.000
number of ecosystems	0.155*	0.158*	0.168	0.125	0.173*
equality factor	0.133	0.130	0.210	0.214**	0.206*
constant	0.632	0.807	—	—	—
cut 1	—	—	1.731*	0.357	1.445*
cut 2	—	—	2.226	0.894	1.941**
cut 3	—	—	2.889	1.600**	2.602**
rule type-local/national rules	0.713**	0.710**	0.924**	1.149**	0.915**
rule type-national rules	-0.211	-0.200	-0.193	-0.083	-0.169

Notes: * = p<0.1; ** = p<0.05.

Table B.16: Regression coefficients for Success

	Success Regressions for different Model Specifications				
Independent variables	**basic model**	**no endogeneity model**	**probit model**	**probit model with dummies**	**final model**
Palau	0.168	0.237	—	—	—
Samoa	-0.065	0.015	—	—	—
Solomon	-0.930**	-0.707*	—	—	—
Tonga	0.266	0.897	—	—	—
government visit	-0.152**	—	—	—	—
income dependence	0.001	—	—	—	—
natural disasters	0.751**	0.815**	—	—	—
quality of leadership	0.256*	0.161	—	—	—
inability to exclude outsiders	0.191*	0.062	—	—	—
pollution	-0.314*	-0.269	—	—	—
population density	0.000	0.000	—	—	—
number of ecosystems	0.139	0.145	—	—	—
equality factor	0.318**	0.229**	—	—	—
constant	-1.767**	-1.830**	—	—	—

Notes: * = p<0.1; ** = p<0.05.

exclude outsiders variables need to be interpreted with some caution, given the endogeneity and ordinality issues.

The negative coefficient on the Solomon variable indicated a lower aggregate perceived success in the Solomons relative to Fiji. Once again, both the natural disasters and the equality factor variables were positively related to perceptions of success. Similarly to other regressions, quality of leadership had a positive impact while pollution had a negative impact on the aggregate success indicator (although the statistical evidence was relatively weak).

Open Access and Indicators of Success

Although there were problems with the inability to exclude outsiders variable because of its ordinality, it was still puzzling that this variable had a positive sign in the CPUE regression and a negative sign in the threats regression. In other words, it appeared that weaker marine tenure in restricted access sites were associated with a more positive CPUE trend and a lower level of threats. The interpretation of these results requires further discussion.

First, the ordinality issue is likely a major constraint on how the inability to exclude outsiders variable can be interpreted. The ordered probit model with dummy variables for the levels of the inability to exclude outsiders variable indicates that not only do these dummy variables have opposite signs within a single regression, but individual dummy variables switch signs across the four regressions. This result indicates that treating the variable as a continuous variable is likely not a good assumption.

The cause of this problem is likely the result of the wording of the question in the survey:

"What best characterizes the marine user rights of this village:

- *The village leaders would have the power, if they so decided, to exclude all non-villagers from the site.*
- *The village leaders would have the power, if they so decided, to exclude all outsiders except other people with traditional user rights over the site*
- *Traditional leaders external to the village have the power to exclude all outsiders except people with traditional user rights over the site*
- *Not possible to exclude outsiders because they do not obey traditional user rights*
- *Traditional user rights inexistent or eroded. Open access prevails."*

The first two possible responses and the final response seem to represent a natural order from total power to exclude outsiders to total open access. The third and fourth responses, however, address somewhat different issues. The third response, in particular, was prevalent in sites in Fiji, where paramount chiefs who may not be village residents had the right to issue licenses to external fishers (an act that was seen negatively by the communities). Given the mixed nature of the possible responses, it is not surprising that the dummy variables for the individual levels of the ordinal variable switched signs within and across regressions.

Even if these ordinality problems did not exist and the variable could be correctly treated as a continuous variable, there were additional issues in terms of how the variable's coefficient estimate should be interpreted. Since all of the regressions include a Tonga country dummy variable which is a close proxy for open access sites, the inability to exclude outsiders picks up differences among the non-open access sites. Therefore, the positive coefficient in the CPUE basic model needs to be interpreted as saying that "among non-open access sites, a lower ability to exclude outsiders was associated with a higher CPUE trend." Similarly, the negative coefficient in the threats regression needs to be interpreted as "among non-open access sites, a lower ability to exclude outsiders was associated with a lower threat trend." However, even these qualified interpretations are puzzling.

A number of additional regressions were estimated to assess whether the results from the basic model were robust to different model specifications. First, the Tonga observations (i.e., open access sites) were dropped from the basic model. Unsurprisingly, these results were very similar to the basic model, which included the Tonga sites and a Tonga country dummy (the inability to exclude outsiders variable was significant at the 5 percent level in both the CPUE and threats regressions).

Next, a dummy variable was created which was equal to one if either of the first two responses from the inability to exclude outsiders variable were picked. A model was estimated using this dummy variable in place of the inability to exclude outsiders variable. This dummy variable was less significant in the CPUE regression (only significant at the 10 percent level) but still significant at the 5 percent level in the threats regression.

Finally, to investigate the threat regression further, an interaction variable was created by multiplying the inability to exclude outsiders variable with a dummy variable which indicated whether the threat could be handled at the local level. This interaction variable is intended to capture the idea that local management regimes should only be expected to manage threats that can be handled at the local level. When the inability to exclude outsiders variable was replaced with this interaction variable, it was no longer significant in the threat regression (whether estimated with OLS or an ordered probit model).

Summarizing the results from these various models, it appeared that the inability to exclude outsiders variable has a significant problem in terms of its ordinality. Additionally, the interpretation of its coefficient estimates was complicated by the inclusion of the Tonga country dummy, which is a good proxy for open access sites. Finally, when the variable was corrected to account for which threats can be handled locally, it was no longer a significant determinant of the perceived threat trend.

Table B.17: Additional variables and their description

VARIABLE NAME	DESCRIPTION
Project completion percent	percent of community projects attempted that were completed (a proxy for social cohesion)
Education	percent of village population with secondary and tertiary education
Partnership	presence of a management partner at the site
Ease of marketing perishables	ease of marketing perishables at the site
Close villages	number of close villages (a proxy for settlement patterns)
Cultural harvest requirement	presence of cultural requirements to harvest coastal resources
Level of fishing technology	level of fishing technology at the site
Number of ecological features	number of distinct ecological features (e.g., turtle nesting areas, rookeries)
Local benefits from tourism	does the community receive benefits from tourism?
Conservation site	is the site designated a conservation site?
Sanctuary	presence of a sanctuary at the site
Rule type 2-destructive fishing practices	rule intended to limit destructive fishing practices
Rule type 2-protected area rules	rule intended to conserve protected areas
Rule type 2-outsiders restricted	rule intended to restrict access by outsiders
Rule type 3-simple rules	rule is a simple ban or other easily understood rule
Rule type 4-conditional rules	rule is a conditional rule such as seasonal ban or size limits
Rule type 4-simple rules	rule is a simple ban
Rule type 5-conservation	rule is a conservation rule

Alternative Specifications

In addition to the basic model (and the associated models which attempted to address some of the main estimation issues), a number of alternative specifications were estimated to shed light on other aspects of coastal resource management in the Pacific. A complete listing of the variables used in these alternative specifications is given in Table B.17. These variables were included in the different models to address specific questions.

The Extended Model: OLS and Ordered Probit Estimation

An extended version of the basic model was estimated by both OLS and ordered probit with very similar results to the basic model (see Table B.18 for the ordered probit results for CPUE, habitat, threats, and compliance, and the OLS results for success). The five variables added to the basic model were: project completion percent (a proxy for social cohesion), education, partnerships, ease of marketing perishables, and close villages. In general, the extended model attempts to determine if these additional variables are significant determinants of perceptions of success.

The OLS and ordered probit models indicated the following relationships: education had a negative impact on perceived habitat trend; partnerships were associated with higher threats; and the presence of close villages decreased the habitat trend and increased the threat trend but decreased the compliance assessment. There were some puzzling results here. The fact that partnerships were associated with higher levels of threats may indicate the variable is endogenous. Also, the negative relation between education and habitat trend may indicate that more educated sites are more aware of habitat degradation. Finally, the presence of close villages had a mixed impact on the various indicators of success: a positive influence on compliance but a negative impact on the other trends.

Site Characteristics Model

An important issue in coastal resource management is how management funds should be allocated among competing sites to ensure success. A variety of

Table B.18: Ordered probit coefficients for the extended model (OLS results for success)

	INDICATORS				
Independent variables	**CPUE**	**HABITAT**	**THREATS**	**COMPLIANCE**	**SUCCESS**
Palau	0.344	0.283	0.146	1.154**	0.053
Samoa	0.358**	-1.250**	0.127	0.641	-0.165
Solomon	-0.007	-0.511**	0.805**	-0.686*	-0.731
Tonga	0.010	-0.437	2.330**	1.597**	-0.034
Government visit	-0.114**	-0.161**	0.139**	0.064	-0.203**
Income dependence	0.005	0.005	0.004	0.004	0.000
Natural disasters	0.546**	0.543**	0.064	0.271	0.753**
Quality of leadership	0.093	0.338	-0.547**	0.072	0.276
Inability to exclude outsiders	0.257**	0.311**	-0.381**	0.047	0.219
Pollution	-0.076	-0.847**	—	0.391**	-0.436**
Population density	0.000**	0.001**	-0.001**	0.000	0.000
Number of ecosystems	0.122**	-0.017	-0.177**	0.068	0.132
Equality factor	0.229**	0.006	-0.442**	0.279**	0.303**
Project completion percent	0.003	0.011	-0.001	-0.010	0.016
Education	0.004	-0.013**	-0.002	-0.005	-0.003
Partnership	-0.153	-0.146	0.460**	0.205	-0.076
Ease of marketing perishables	-0.116	0.057	-0.055	-0.059	0.062
Close villages	-0.002	-0.015**	0.008**	0.013**	-0.004
Cut 1 1.860**	-0.145	-3.214**	-0.373		—
Cut 2	3.094**	1.040	-2.310**	0.136	—
Cut 3	3.678**	1.879**	-1.837**	0.811	—
Cut 4	4.351**	2.823**	-1.150	—	—
Constant	—	—	—	—	-2.885**
Threat type-destructive fishing	—	—	-0.598*	—	—
Threat type: land-based threats	—	—	0.551*	—	—
Threat type-over fishing	—	—	0.384	—	—
Rule type-local/national rules	—	—	—	0.945**	—
Rule type-national rules	—	—	—	-0.119	—
Number of observations	399	396	377	442	124
R-squared	—	—	—	—	0.5419
F statistic	3.97	5.22	10.83	2.97	4.81
F stat degrees of freedom	18, 9	18, 9	20, 7	20, 7	18, 9
Probability > F	0.0200	0.0078	0.0018	0.0728	0.0104

Notes: * = p<0.1; ** = p<0.05.

site characteristics was included in a single model to assess which factors were associated with success (see Table B.19). In general, the model did not provide particularly strong evidence on which of these additional characteristics were good predictors of success. In fact, none of the additional site characteristics were statistically significant in more than two of the five regression models.

Basic Model plus Conservation Site Variable

The conservation site variable was added to the basic model to assess whether conservation status had a significant impact on perceptions of success. The conservation site variable was not significant in any of the five regressions.

Basic Model plus Sanctuary Variable

Similarly, the sanctuary variable, when added to the basic model for the habitat regression, was not a significant determinant of the habitat trend.

Alternative Rule Type Specifications

Finally, a number of different categories of management rules were tested in the compliance regression. The basic model included two dummy variables: outside rules and local/national rules (with the dummy variable for local rules excluded). Four alternative rule type specifications were tested: fishing practice rules, protected area rules, and restrictions on outsiders (with the dummy for "other" rules excluded);

Table B.19: OLS regression coefficients for the site characteristics model

	INDICATORS				
Independent variables	**CPUE**	**HABITAT**	**THREATS**	**COMPLIANCE**	**SUCCESS**
Palau	-0.418	0.119	0.824	0.932*	-0.442
Samoa	1.003**	-0.812*	0.465	0.394	0.428
Solomon	-0.445	-0.319	1.680**	-0.538	-0.918
Tonga	0.601	0.062	1.346**	0.794	0.800
income dependence	-0.003	0.016**	0.005	0.005	0.002
quality of leadership	0.059	0.006	-0.248	-0.016	0.043
inability to exclude outsiders	0.039	0.077	-0.076	0.084	-0.108
pollution	0.029	-0.473**	—	0.171	-0.231
population density	0.000	0.000	-0.001**	0.000	0.000
number of ecosystems	0.092	-0.039	-0.260**	0.093	0.093
project completion percent	-0.012*	0.004	0.006	0.004	0.005
marketing perishables	0.027	0.147	-0.149	-0.057	0.205
close villages	0.002	-0.010**	0.007**	0.005	0.001
cultural harvest requirement	-0.135	-0.116	0.133	0.131	-0.021
level of fishing technology	0.621**	-0.033	0.196	-0.344	0.231
number of ecological features	-0.017	-0.238**	0.012	-0.049	-0.131
ocal benefits from tourism	-0.090	0.078	0.034	0.076	-0.051
constant	1.742**	2.267**	3.924**	1.566	-1.161
threat type-destructive fishing	—	—	-0.647*	—	—
threat type: land-based threats	—	—	0.615**	—	—
threat type-over fishing	—	—	0.410	—	—
rule type-local/national rules	—	—	—	0.767**	—
rule type-national rules	—	—	—	-0.111	—
Number of observations	399	396	377	442	124
R-squared	0.0961	0.2057	0.4177	0.2608	0.4118
F statistic	2.97	5.89	29.77	7.92	1.68
F stat degrees of freedom	17, 10	17, 10	19, 8	19, 8	17, 10
Probability > F	0.0419	0.0035	0.0000	0.0027	0.2028

Notes: * = p<0.1; ** = p<0.05.

simple rules (with the dummy variable for "all other" rules excluded); simple rules and conditional rules (with the dummy variable for "other" rules excluded); and conservation rules (with the dummy variable for nonconservation rules excluded). The results are presented in Table B.20.

Of the four alternative specifications, the binary classification of rules as simple rules versus all other rules showed that simple rules had greater compliance. There was also weak evidence that simple rules were more complied with than other rules when the dummy variable was included for conditional rules.

F. FACTOR ANALYSIS

Given the relatively large number of explanatory variables, a factor analysis was used to determine if there were patterned interrelationships within the data. The resulting "factors" may represent more general phenomena that can then be examined in terms of their relationship to the dependent variables. Sixty-four variables were included in the factor analysis. The first step was to examine the variables to determine if there are any obvious groupings. This resulted in 5 obvious categories: social, ecological, economic, coastal zone management process, and shock variables. The next step was to determine if there are patterned relationships within each of the 5 sets of variables. To accomplish this goal, each set of variables was factor analyzed using the principal component analysis technique and varimax rotation (an orthogonal rotation). The screen test was used to determine the optimal number of factors to be rotated. The results of these analyses are presented in Tables B.23 through B.27. Interpretations of these principal component analyses for each of the five sets of variables accompany the tables.

With the factor analysis completed, component scores were created to represent the position of individual villages on each of the components. The component scores are the sum of the component coefficients times the sample standardized variables. These coefficients are proportional to the component loadings. Hence, items with high positive loadings contribute more strongly to a positive component score than low or negative loadings. Nevertheless, all items contribute (or subtract) from the score. Hence, items with moderately high loadings on more than one component (e.g., village age in the analysis presented in Table B.21) contribute at a moderate level to the component scores associated with each of the components. This type of component score provides the bestrepresentation of the data since they are stan-

Table B.20: Regression coefficients for compliance assessment for various categories of rule types

	COMPLIANCE ASSESSMENT OLS REGRESSION RESULTS				
Independent variables	**basic rule types**	**four rule types**	**simple rules**	**broad rule types**	**conservation rules**
Palau	0.961**	0.233	0.911**	0.935**	0.829*
Samoa	0.507	0.474	0.465	0.494	0.446
Solomon	-0.378	-0.896**	-0.504*	-0.509*	-0.522
Tonga	1.011	0.785	0.553	0.538	0.631
government visit	0.018	-0.031	-0.014	-0.016	0.013
income dependence	0.003	0.001	0.004	0.004	0.003
natural disasters	0.333*	0.001	0.265	0.248	0.336
quality of leadership	0.083	0.057	0.140	0.142	0.095
inability to exclude outsiders	0.151	0.022	0.161	0.161	0.152
pollution	0.196	0.279**	0.150	0.146	0.142
population density	0.000	0.000	0.000	0.000	0.000
number of ecosystems	0.155*	0.121	0.068	0.074	0.121
equality factor	0.133	0.037	0.102	0.108	0.130
constant	0.632	1.888**	1.215*	1.216*	0.922
rule type-local/national rules	0.713**	—	—	—	—
rule type-national rules	-0.211	—	—	—	—
rule type-fishing practices	—	0.228	—	—	—
rule type-protected area rules	—	-0.562	—	—	—
rule type-outsiders restricted	—	-0.169	—	—	—
rule type-simple rules	—	—	0.343**	—	—
rule type-conditional rules	—	—	—	-0.140	—
rule type-simple rules	—	—	—	0.439*	—
rule type-conservation	—	—	—	—	-0.108
Number of observations	442	431	648	648	442
R-squared	0.2599	0.3107	0.2448	0.2462	0.2259
F statistic	6.56	9.67	9.21	13.43	6.66
F stat degrees of freedom	15, 12	16, 11	14, 13	15, 12	14, 13
Probability > F	0.0011	0.0003	0.0001	0.0000	0.0008

Notes: * = p<0.1; ** = p<0.05.

dardized with a mean of zero and a standard deviation of one. These component scores can then be used in a multivariate regression analysis.

Social Variables

The principal component analysis of the social variables is displayed in Table B.21. The majority of the items loading highest on each of the two components in Table B.21 provides some indication of patterns of interrelationships of the items in the sample villages. In turn, these patterns can be interpreted as dimensions of social variables.

The items loading most highly on component one (either negative or positive) refer to rules (e.g., bound-

Table B.21. Principal component analysis of social variables

	Principal Components	
Explanatory Variables	**Local Control**	**Competence**
Inability to exclude outsiders	0.880	0.089
Other villages with traditional user rights	0.765	-0.106
Number of indigenous rules	-0.735	-0.368
Ratio of village to traditional users	-0.692	0.044
Boundaries clear to villagers	-0.668	0.277
Boundaries clear to outsiders	-0.588	-0.189
Number of outside rules	0.516	-0.011
Completed development projects (percent)	0.044	0.775
Secondary & tertiary education (percent)	-0.005	0.678
Compliance with local decisions	0.024	0.618
Village age	-0.492	0.558
Quality of leadership	0.270	0.490
Level of conflict	0.246	-0.441
Extent to which village discusses issues	0.128	0.314
Important decision makers outside village	-0.374	-0.198
Eigenvalues	3.971	2.595
Percent of total variance	26.472	17.301

Table B.22. Principal component analysis of ecological variables

Explanatory Variables	Principal Components		
	Ecosystem Diversity	Land Use Diversity	Population Pressure
Site size	0.780	0.007	-0.022
Turtle nesting area	0.764	-0.004	-0.230
Invertebrate abundance	0.762	0.110	0.190
Sea bird rookery	0.758	-0.053	-0.012
No. of distinct ecosystems	0.508	0.306	-0.133
Abundance of resources	0.242	0.763	-0.087
Forest land available	-0.333	0.756	0.045
Diversity of land use	-0.310	0.642	0.253
Conservation value	0.031	0.603	-0.639
Population	0.177	0.542	0.141
Traditional user pop. density	-0.428	-0.114	0.749
Traditional user population	0.033	0.172	0.650
Population growth rate	0.236	0.377	0.597
Fish spawning area	0.472	0.143	0.518
Village population density	-0.340	0.044	0.454
Conservation area	0.004	0.242	-0.429
Urban area	-0.031	-0.014	0.311
One village island	0.300	-0.140	-0.308
Alternate fishing area	-0.216	-0.494	0.226
High island	-0.472	0.494	0.221
Eigenvalues	3.844	3.106	2.899
Percent of total variance	19.218	15.530	14.497

aries and user rights) and enforcement. Using a cut-off magnitude of 0.4, the variables loading negatively were: number of indigenous rules; ratio of village to traditional users; boundaries clear to villagers; boundaries clear to outsiders; and village age. The variables loading positively were: inability to exclude outsiders; other villages with traditional user rights; and the number of outside rules. This factor can be interpreted as representing the degree of local control. The factor included sites that: had strong indigenous rules; were able to exclude outsiders; and did not have conflicting control over their resources (i.e., few outside rules and non-villagers with traditional user rights).

Items loading a high positive on component two can be interpreted as reflecting internal community competence. The level of conflict variable (which loads highly negative) reflected a lack of organizational competence. The bottom two variables in the table had relatively low loadings on both factors and can be disregarded in this analysis. Together, the two components accounted for 44 percent of the variance in the data set, a modest but respectable amount.

Ecological Variables

The principal component analysis of the ecological variable set is displayed in Table B.22. The variables loading highest on the first component in Table B.22 were related to ecosystem diversity. The larger the site the greater the chance there are numerous ecosystems. The high loading for number of distinct ecosystems supported this interpretation. There were also relatively high loadings associated with the presence of turtle nesting areas, bird rookeries, invertebrate abundance, and fish spawning areas — all suggesting ecosystem diversity. Most of the items loading high on the second component were related to land use diversity. The moderate loading associated with a high island clearly supports this interpretation, since there are more distinct terrestrial ecological zones on high islands. Size of population, but not population density, also had a moderate loading on this component, probably because with more land use options a large population can be more widely spread throughout the available area. Finally, component three consisted primarily of population pressure related variables. The moderate loading of fish spawning area was difficult to interpret, but the loading was minimally different from its loading on the first component. Together, the three components accounted for 49 percent of the variance in the ecological variables data set.

Economic Variables

The three components resulting from a principal component analysis of the set of economic variables accounted for 70 percent of the variance in the data set (Table B.23). Items loading highest on the first component were related to commercial, high technology fishing. Items loading highest on the second were all related to tourism development, and the two loading highest on the third component were related

Table B.23. Principal component analysis of economic variables

Explanatory Variables	Principal Components		
	Commercial Fishing	Tourism Development	General Development
Level of resource use technology	0.815	0.064	-0.054
Perishable market proximity	-0.804	0.010	0.063
Coastal products & tourism income (%)	0.654	0.076	-0.434
Level of tourism development	0.018	0.904	0.098
Resort area present	-0.147	0.888	-0.170
Degree of benefits from tourism	0.355	0.709	0.136
Ease of marketing perishables	-0.050	0.168	0.847
Level of village development	-0.370	0.190	0.773
Dependence on subsistence/shell fishery	0.013	0.301	-0.633
Eigenvalues	2.025	2.273	1.968
Percent of total variance	22.501	25.254	21.865

Table B.24. Principal component analysis of coastal zone management process variables

Explanatory Variables	Principal Components		
	Intervention	Control	Equality
Presence of major partner	0.877	0.077	0.015
Presence of a sanctuary	0.862	0.002	0.244
Alternative income opportunities	0.540	-0.098	-0.228
Local benefit from outside users	0.059	0.807	0.020
Indigenous rules for crm	-0.010	0.672	0.110
Young involved in decision making	-0.166	0.669	-0.523
Losses from crm shared equally	-0.260	-0.118	0.704
Benefits from crm shared equally	0.165	0.277	0.605
Females involved in decision making	-0.285	0.297	-0.323
Eigenvalues	2.011	1.745	1.364
Percent of total variance	22.347	19.384	15.156

to village development and marketing infrastructure. It is not surprising that dependence on subsistence fishing had a high negative loading on the third component, since this variable is usually associated with a lower level of development in Pacific Islands.

Coastal Zone Management Process Variables

The principal component analysis of the coastal zone process variables resulted in three components, accounting for 57 percent of the variance in the data set (see Table B.24). The first component reflected aspects of intervention such as the presence of external partners, existence of sanctuaries, and the development of alternative income generating opportunities. Local control over the resources was the common thread that tied together the variables loading high on the second component. The final component reflected the equal sharing of both benefits and losses from coastal resource management. Involvement of females in decision making did not load highly on any component.

External Shock Variables

The principal component analysis of the shock variable set is presented in Table B.25. The first component of the analysis of the shock variables was related to shocks external to the local community, both natural and manmade. It is important to note that natural shocks (natural disasters such as typhoon, tsunami, etc.) loaded negatively on this component, and the manmade external shocks (e.g., market for production, political events) loaded positively. Hence, a high negative value would indicate external natural shocks and a high positive would indicate external manmade shocks. The second component reflected primarily local shocks, such as pollution and development projects. This component was "reflected" (high negative loadings), implying that a high negative score indicates the presence of these local shocks, while a high positive indicates their absence. Finally, the third component was difficult to interpret since it had only one high positive loading, other shocks, which were not specified in the survey, and a high negative, fishing technology. Together, the three

Table B.25. Principal component analysis of shock variables

Explanatory Variables	Principal Components		
	External	Local	Mixed
Natural disaster	-0.752	0.356	0.178
Pollution	0.068	-0.777	-0.007
Market	0.579	0.330	0.159
Political event	0.622	0.094	-0.119
Development project	-0.170	-0.771	0.109
Fishing technology	0.288	0.192	-0.720
Other shocks	0.078	0.076	0.815
Eigenvalues	1.410	1.485	1.265
Percent of total variance	20.138	21.217	18.069

components accounted for 59 percent of the variance in the shock data set.

Multiple Regression Analysis using the Factor Analysis Results

The principal component analysis of 64 explanatory variables, divided into 5 logical groupings, resulted in a total of 14 factors.

These 14 factors were then regressed against the five indicators of success. The results of these regressions, however, were not particularly robust and were more difficult to interpret than the regression analysis using individual variables. In the end, the quantitative analysis incorporated the results of the factor analysis by using the equality factor in the regressions reported in the previous section.

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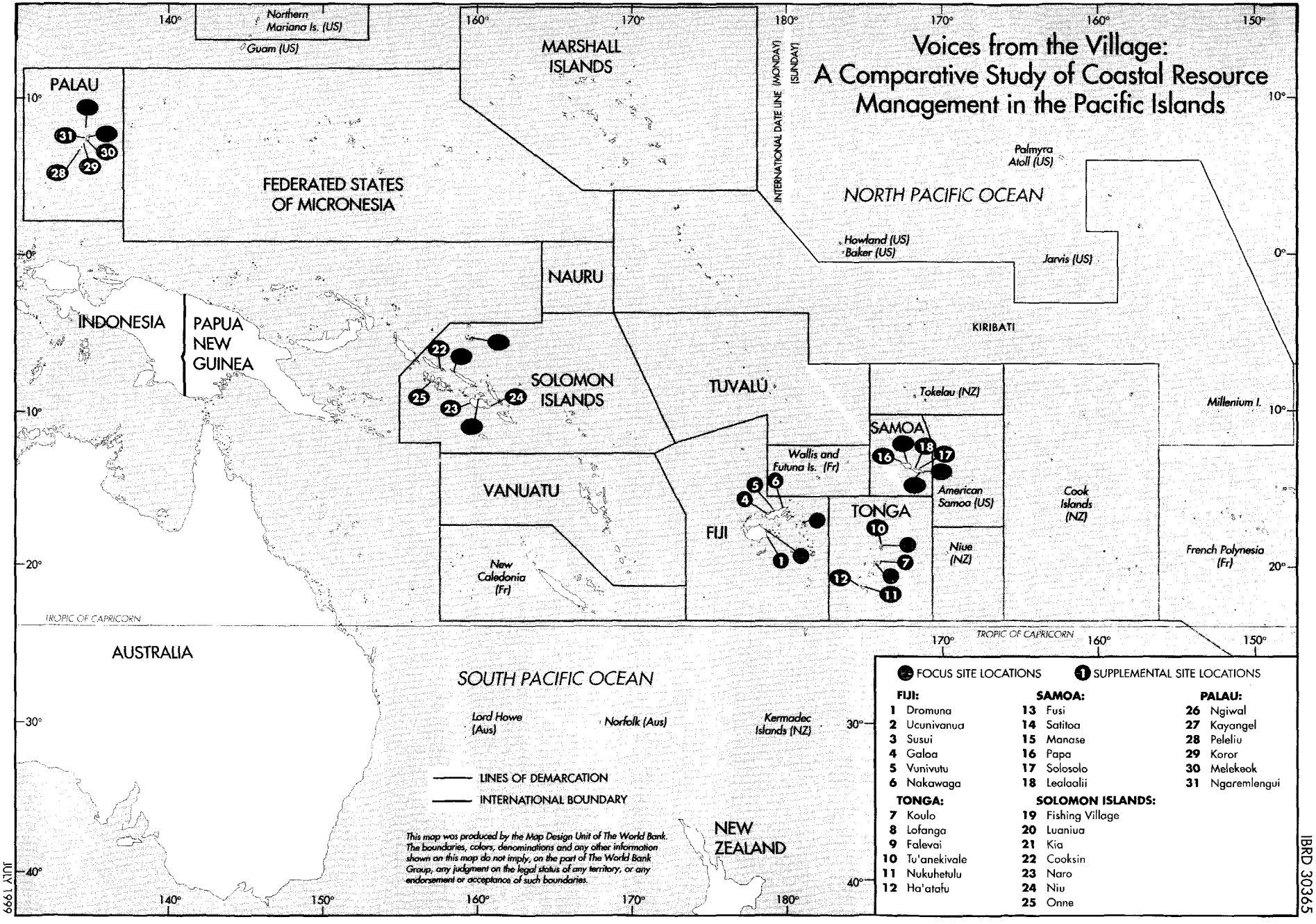
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TONGA:
7 Koulo
8 Lofanga
9 Falevai
10 Tu'anekivale
11 Nukuhetulu
12 Ha'atafu
SAMOA:
13 Fusi
14 Satitoa
15 Manase
16 Papa
17 Solosolo
18 Lealaalii
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19 Fishing Village
20 Luaniua
21 Kia
22 Cooksin
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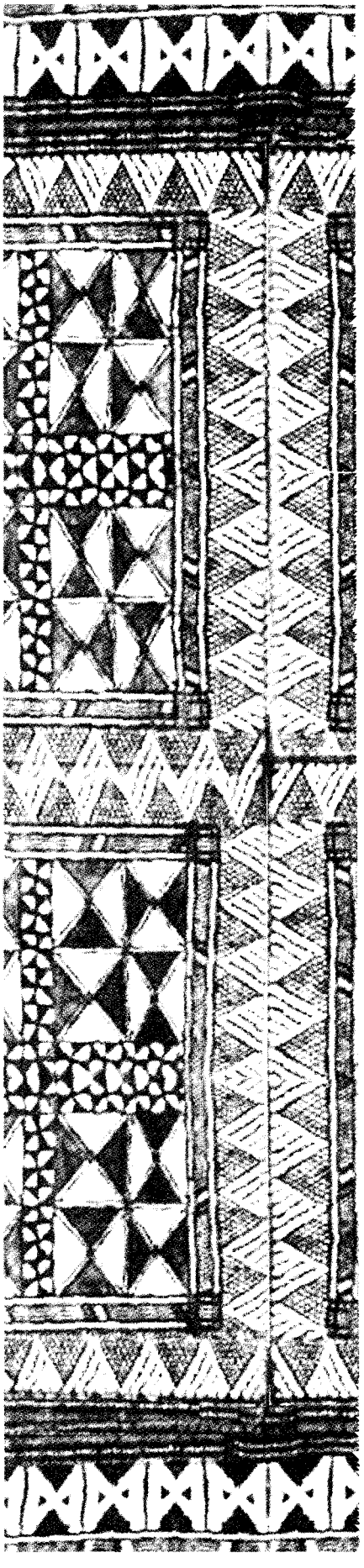

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