POVERTY AND REEFS

VOLUME 1
A GLOBAL OVERVIEW

DFID Department for International Development

UNESCO

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PREFACE

We live in a complex world where change is happening at ever increasing speeds and nothing can be dealt with in isolation from the forces that affects it. Increasing globalisation has meant that what happens in one place of the world affects other parts far away. Climate change is one example of the outcome of these global forces, which threatens to disrupt and alter much of the world around us. Coral reefs are one of the early indicators of this change; they are fragile and respond quickly to adverse pressures. These pressures are increasing and coral reefs are coming under greater threat. Their decline is a warning to us all.

Coral reefs are not just valuable as indicators of change; they have intrinsic value and contribute to local and global economies. Recently this has been widely studied and reported, improving our perception of the significance of reefs. While we may value coral reefs as an important part of our global environment, many people depend upon reefs for their very survival. These people include some of the poorest in the world and they derive many benefits from coral reefs that enable them to sustain their impoverished livelihoods in spite of great difficulties. They benefit, not just from the food the reef provides, but also in many other ways that contribute to the physical, social, economic, spiritual and cultural aspects of their lives. These benefits are complex and we are only just beginning to fully appreciate their relationships with and importance for the poor.

The decade that has taken us from the adoption of Agenda 21 in Rio de Janeiro in 1992 to the convening in Johannesburg of the World Summit on Sustainable Development in 2002, has been marked by the growth of increasing disparities between the worlds of the 'haves' and the 'have-nots'. Despite significant progress in implementing many of the principles and strategies outlined in Agenda 21, the promise of sustainable development remains unfulfilled. This mixed state of affairs was dramatically captured by the *Millennium Declaration*, which places poverty alleviation at the top of the agenda in International Development.

Whilst we all agree that coral reefs need to be protected, we also need to improve our understanding of the complex relationships between the poor and reefs and to ensure that conservation is carried out in equitable ways. Much attention has been given to coral reef conservation, but at times this has taken place with the exclusion of the local people, who depend on coral reefs. As acknowledged at the WSSD, if we are to achieve our common goal of equitable and sustainable development it is now imperative that greater emphasis is placed on the increasing inequalities and importance of human and social development. The poor have much to teach us about the environment that they live in and we can benefit greatly from working in partnership with them.

Poverty and Reefs represents a significant milestone in our understanding of this relationship. We hope it will contribute to the global debate on coral reefs and help to open new and more inclusive avenues to work with the poor and vulnerable who depend on coral reefs for their livelihood.

The study also represents an important collaboration bringing together the poverty and developmental focus of DFID with the scientific-based environmental work of IOC/UNESCO. The study was commissioned by DFID and research in South Asia was carried out in cooperation with local counterparts and communities who are part of the Global Coral Reef Monitoring Network (GCRMN) South Asia node, established by DFID and IOC/UNESCO. We hope that this association will stimulate further action, sharing of experiences and discussion, strengthening our understanding to find new approaches to integrate poverty and environmental concerns in support of sustainable and equitable development.

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NOMENCLATURE

ANET	The Andaman and Nicobar Islands Environment Team
BBP	Better Banana Programme
CARESS	The Centre for Action Research on Environment, Science and Society
CBD	Convention on Biological Diversity
CCAM	Caribbean Coastal Area Management
CITES	Convention on International Trade in Endangered Species
CMT	Customary Marine Tenure
CORDIO	Coral Reef Degradation of the Indian Ocean
DFID	Department for International Development (UK Government)
DOD	Indian Department of Ocean Development
EIA	Environmental Impact Assessment
FAO	Food and Agriculture Organisation of the United Nations
GBR	Great Barrier Reef
GCRMN	Global Coral Reef Monitoring Network
GCRMN South Asia	Regional node of the Global Coral Reef Monitoring Network in India, Maldives and Sri Lanka
GDP	Gross Domestic Product
GEF	Global Environment Facility
GOMMBR	Gulf of Mannar Marine Biosphere Reserve
ICRAN	International Coral Reef Action Network
ICRI	International Coral Reef Initiative
ICRMN	Indian Coral Reef Monitoring Network
ICZM	Integrated Coastal Zone Management
IDPPE	Instituto Nacional de Desenvolvimentoda da Pesca de Pequena Escala (National Institute for the Development of Small Scale Fishing, Mozambique)
IDT	International Development Targets
IFAD	International Fund for Agricultural Development
IOC	Intergovernmental Oceanographic Organisation
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for the Conservation of Nature
MPA	Marine Protected Area
NGO	Non-Governmental Organisation
OECS	Organisation of Eastern Caribbean States
PBFMC	Portland Bight Fisheries Management Council
RIPS	Rural Integrated Project Support, Tanzania
RLA	Reef Livelihoods Assessment Project funded by DFID, implemented by IMM
SCL	The DFID-funded Sustainable Coastal Livelihoods Project implemented by IMM

SLA	Sustainable Livelihoods Approach
SPEECH	The Society for People's Education and Economic Change
SPREP	South Pacific Regional Environment Programme
TPDF	Tanzanian People's Defense Force
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Education, Science and Culture Organisation
US	United States
WB	World Bank
WRI	World Resources Institute
WSSD	World Summit on Sustainable Development

BACKGROUND

BACKGROUND TO THE REEF LIVELIHOODS ASSESSMENT PROJECT

The *Reef Livelihoods Assessment* (RLA) *Project* was funded by DFID UK and managed and implemented on their behalf by IMM Ltd of Exeter UK. The project began in November 2001 and was completed by November 2002.

The aim of the RLA project was to ***use a livelihoods approach to assess the wider, more qualitative, value of coral reefs to vulnerable coastal communities.*** This knowledge is intended ***to contribute to informing DFID's future policy on support for reefs and coastal communities as a strategy for poverty alleviation.*** It is also hoped that the work will contribute to wider global policy development in the area of poverty and reefs.

The International Development Target (IDT) of reducing poverty by a half by 2015 is reflected in DFID's Target Strategy Paper, 'Halving World Poverty by 2015: economic growth, equity and security', which recognises that the livelihoods of poor people must be at the centre of any strategy for poverty reduction.

Reefs are mainly found in developing countries where a substantial proportion of the population is living in poverty. Dependence on coral reefs, particularly subsistence fishing, is often quoted as being vital to the livelihoods of many poor indigenous coastal communities but what that dependency consists of is unclear.

To influence policy-makers, economic valuation has been used at national levels as a tool to demonstrate that sustainable use and conservation of coral reefs can generate economic benefits, and avoid the costs associated with coral reef destruction. However, very few valuations, if any, have assessed the wider value of coral reefs at a local livelihoods level, or the value of coral reefs to coastal poor people.

The Sustainable Livelihood Approach (SLA) provides a way of understanding both the complexity and holistic nature of the lives of vulnerable coastal communities. This was used during the project to develop a wider context of value, incorporating all aspects of peoples' lives and using value systems defined by the poor themselves. This provides a much broader understanding of the benefits derived from coral reefs, as well as how and why these benefits have changed over time, and how they may be sustained, enhanced or substituted for in the future. This information is critical for the development of policy regarding support for coral reefs and coastal communities as a strategy of poverty alleviation. It will also contribute more widely to economic and policy research targeting coral reefs and coastal communities, in the pursuit of coral reef management and sustainable development.

The RLA project work started with a broad overview of the literature associated with reefs and poverty and this was distributed to an Internet Advisory Group for comments. Progress and suggestions were posted on the project website (www.ex.ac.uk/imm/rla.htm).

Combining this overview with the SLA, the project developed and tested an appropriate field method together with a partner organisation at the first case study location in the Gulf of Mannar, India. The method was then applied in case studies at two further sites in South Asia and one in East Africa. This research provided an understanding of the nature of poverty amongst reef dependent communities, as well as a picture of the nature and extent of reef benefits to all aspects of the livelihoods of the poor. This research is presented in four case study reports.

The case studies were implemented by partner organisations as follows:

- Cabo Delgado, Mozambique: Kusi Lda and IDPPE
- Gulf of Mannar, India: SPEECH (The Society for People's Education and Economic Change)
- Andaman Islands, India: ANET (The Andaman and Nicobar Islands Environmental Team)
- Lakshadweep Islands, India: CARESS (The Centre for Action Research on Environment, Science and Society) (desk study only)

(All partner organisations in India are part of the GCRMN South Asia network and have been involved in regional socio-economic training and monitoring activities)

IMM also worked with CORDIO in Kenya to incorporate examples of their work into the report. The teams from the partner organisations received training from IMM in the use of the RLA field method and the field work was then co-ordinated and the reports harmonised by IMM staff.

The RLA outputs are presented in two volumes, the first and current, Volume 1: A Global Overview, is based on an overview of literature and experience on the value of reef-related benefit flows to poor coastal communities and is illustrated with examples from the case studies. The second, Volume 2, is a compilation of the four case study reports.

BACKGROUND TO VOLUME 1: A GLOBAL OVERVIEW

Volume 1: A Global Overview is intended as a discussion document to stimulate and open up the debate surrounding poverty and coral reefs. It was produced, as described above, in response to a specific demand for information, which contributed to informing a policy decision within DFID UK and it is hoped that this understanding may inform discussion more widely. Specific policy guidance for DFID was provided in separate reports and only the more generic aspects of that guidance are included in this overview.

The overview approaches the debate from an entirely people and poverty perspective. In doing so it uses existing information combined with new insights developed from the RLA case study research and presents it in a way which some readers may find challenges their current view point. For most people view reefs from a predominantly resource-based perspective and they understand the people who interact with and use reefs in terms of what impact their activities have on reefs and how harmful impacts can be controlled or minimized to ensure reef conservation. In the Global Overview, we attempt to view reefs in terms of the poor who are dependent on reefs for their livelihoods, how the reefs benefit the poor, how changes in the reef have impacted the lives of the poor and how the poor have responded and coped with these changes. It also considers wider responses to reef issues and how these interventions have impacted on the lives of the poor.

The document is presented in five chapters.

Chapter one provides an outline of the global and regional distribution of coral reefs and the different types of people who depend upon reefs, focusing on poor reef stakeholders and areas where poverty and reefs coincide.

Chapter two is the main section of the report and provides an overview of the different reef-related benefit flows to the poor. This chapter is based on an analysis of benefit flows using the sustainable livelihoods framework and includes much of the RLA case study results. Its focus is on the positive benefits which the reef provides to all aspects of the livelihoods of the poor. It does not consider the cost of those benefits on the status of the reef resource, this aspect is dealt with, in terms of how that cost impacts on the lives of the poor, in the following chapter.

Chapter three reviews the changes that are occurring in the benefit flows to the poor from the reef and briefly considers why these are occurring. Again, these changes are considered in terms of their impacts on the lives of the poor and how the poor have responded to change, for this reason the ecological aspects and consequences of change are not considered in any detail.

Chapter four briefly reviews some of the different reef-related interventions that now affect the lives of reef-dependent poor and briefly assesses their impact on the poor. Once again, the poverty and people focus shifts the attention away from the reef resource and considers interventions in terms of how they have benefited poor reef stakeholders. This provides a different perspective from that normally encountered, which primarily considers interventions in terms of how they have benefited the health of the reef resource. This is not to discredit or diminish the good intentions of many interventions focused on the reef resource and its conservation, but it is to take a different view point.

Chapter five discusses the findings from the previous four chapters and evolves some principles for addressing poverty-related reef issues. It also looks at the policy implications of the findings and suggests some ways forward. It does not attempt to provide solutions, but rather suggests a new orientation for the future, one which will require further support and work to achieve. It is also an orientation, which is not entirely new in the wider context of sustainable and pro-poor development. Indeed, the poverty–reef debate has much to learn from people-focused pro-poor sustainable development elsewhere.

EXECUTIVE SUMMARY

A diversity of different people worldwide depend on coral reefs for many different reasons. Many millions of these people are poor and for them the coral reef represents an important resource which contributes to many aspects of their livelihood. However, the ability of the reefs to provide income and food security and buffer seasonal and periodic hardships is being eroded. Coral reef ecosystems are extremely sensitive to change and easily suffer from disturbance. Reef degradation is removing many of the benefits on which the poor depend, climate change threatens further loss, and well-meaning polices aimed at conserving threatened reefs are often excluding the poor from access to benefit flows. The impact of these changes varies between different stakeholders, but in general the poor are finding that their livelihoods are being stressed more than most and they are the least able to respond.

The policy formulation and implementation environment surrounding reef-dependent people is only partially focused on those people, the main emphasis is on reef conservation. Many of the key international institutions and initiatives concerned with coral reefs are those whose primary objective is nature conservation. There is a considerable short-fall in the required skills, awareness, attitudes and institutional orientation required to respond effectively to reef-related poverty. However, there is a growing awareness of this deficiency and recognition that coral reef conservation cannot meet its desired objectives without better consideration of poverty issues and the sustainable livelihoods of the reef-dependent poor. This change in thinking has also been encouraged by the shifting priorities of international donor agencies and governments towards poverty alleviation.

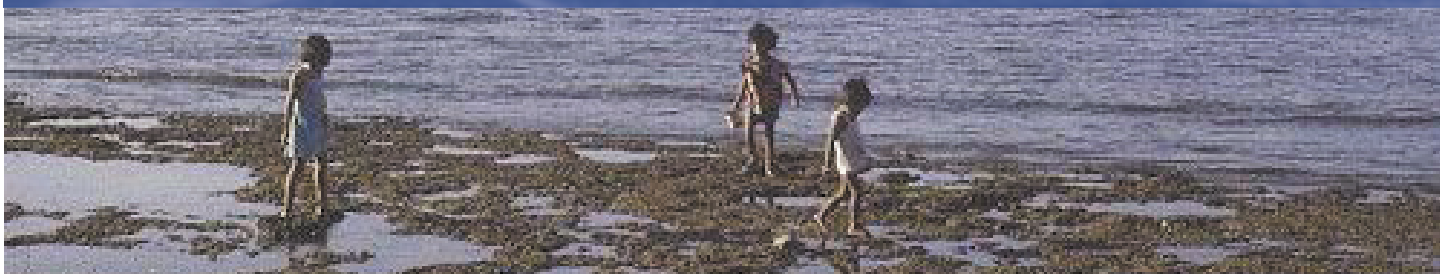
There is an urgent need for guidance and support amongst coral reef practitioners, agencies and initiatives to assist the changes needed to address poverty and reef-related issues more effectively. Unless this is achieved in the near future many poor people will confront greater levels of hardship than they have faced before and many coastal communities above the poverty line will start to fall into poverty. The implications for International Development Targets are serious in terms of both people moving back into poverty, and an increasing trend in the loss of reef-based environmental resources. As highlighted at the recent World Summit on Sustainable Development held in Johannesburg in 2002, failure to address International Development Targets will seriously undermine our ability to achieve sustainable development.

There is a need for a major drive to re-orient the current approaches to reefs and reef-dependent people. At the macro-level there is a need for a change in the global policy framework that shifts the focus from reef conservation to the sustainable and equitable use of reef ecosystems where poverty reduction is a central theme rather than a means towards an end. This requires a large degree of awareness raising, consensus building, policy reform and the uptake of a new array of policy instruments. These need to be based on a much better understanding of the issues facing the reef-dependent poor. There is a growing willingness to accept this kind of reform but a lack of coordinated understanding about how to achieve it. Support at the macro-level is also required to reflect the interconnected nature of reef problems and to deal with the interstitial and dispersed nature of reef-dependent poverty.

At the meso-level there is a need for substantial capacity building in coastal community development and poverty reduction approaches. This applies not only to governments in countries where reef dependence is an issue, but also to regional intergovernmental and NGO agencies concerned with these issues. Many of the approaches that need to be applied have still to be developed, some are currently being developed and others exist but need to be brought together and applied to reef issues.

At the micro-level there is much to be done in understanding the nature of reef-dependent poverty. This study has shown that there is already a large amount of information out there but this has rarely been brought together to provide a cohesive body of knowledge that can inform policy. The poor have even more to teach us about the way they live with, use and manage their reefs. From this, new approaches to sustainable livelihoods, livelihood enhancement, poverty reduction, and reef management can begin to be developed.

CHAPTER 1 GLOBAL OVERVIEW: POVERTY AND CORAL REEFS



Source: John McManus, http://www.reefbase.org

1.1 INTRODUCTION

Understanding the relationship between poverty and coral reefs requires not only an understanding of who the different stakeholders are and how they interact with the reef, but also where those reefs are around the world.[1] This overview of poverty and coral reefs first looks at the global extent of coral reefs and where they are concentrated, it then discusses the different groups of stakeholders associated with reefs and begins to describe the nature of poverty in the coast. Finally, it goes on to discuss the numbers of reef-dependent people around the world and describes each major region where poverty and reefs interact.

1.2 THE GLOBAL EXTENT OF CORAL REEFS

Coral reefs are found in tropical waters throughout the world and cover an estimated 600 000 km^2, of which 284 300 km^2 occur in near-surface shallow waters close to the coastline of over 100 countries (Bryant *et al.*, 1998; Spalding *et al.*, 2001, see Figure 1). The greatest cover of shallow reef occurs in the South Pacific, followed by Southeast Asia, the Indian Ocean, Middle East, Caribbean and finally the Atlantic (Table 1). In terms of the relative importance of the coast to people living in these regions, Figure 2 indicates that in Southeast Asia, South Pacific, parts of South Asia, East Africa, and the Caribbean high proportions of the population are living in coastal areas. Where significant proportions of the coastline are bordered by coral reefs, such as Southeast Asia, Eastern Africa and the South Pacific (Table 1), the extent of interaction with reefs is likely to be greatest. Furthermore, in regions of high population density, such as Southeast Asia and the Indian Ocean, the number of people likely to be interacting and dependent on coral reefs will also be high. It has been estimated that almost half a billion people live within 100 km of a coral reef, and most of these are living in Southeast Asia and the Indian Ocean (Figure 3).

TABLE 1 REGIONAL DISTRIBUTION OF CORAL REEFS

Region	*Reef area (km^2)* [1]	*Proportion of coastline bordered by reef (%)* [2]
South Pacific	**116 220**	**26.4**
Australia	48 960	
Papua New Guinea	13 840	
Fiji	10 020	
Southeast Asia	**87 760**	**37.6**
Indonesia	51 020	
Philippines	25 060	
Malaysia	3600	
Indian Ocean	**31 930**	
South Asia	**15 490**	**20.7**
Maldives	8920	
India	5790	
Sri Lanka	680	
Eastern Africa	**12 620**	**35.2**
Tanzania	3580	
Madagascar	2230	
Mozambique	1860	
Middle East	**21 450**	
Saudi Arabia	6660	
Egypt	3800	
Eritrea	3260	
Caribbean	**20 360**	**23.5**
Bahamas	3150	
Cuba	3020	
Mexico	1780	
Western Atlantic	**2 820**	
USA, Atlantic	1250	
Brazil	1200	
Bermuda	370	

[1] Data for shallow reef areas from Spalding *et al.*, 2001
[2] Data from Burke *et al.*, 2000

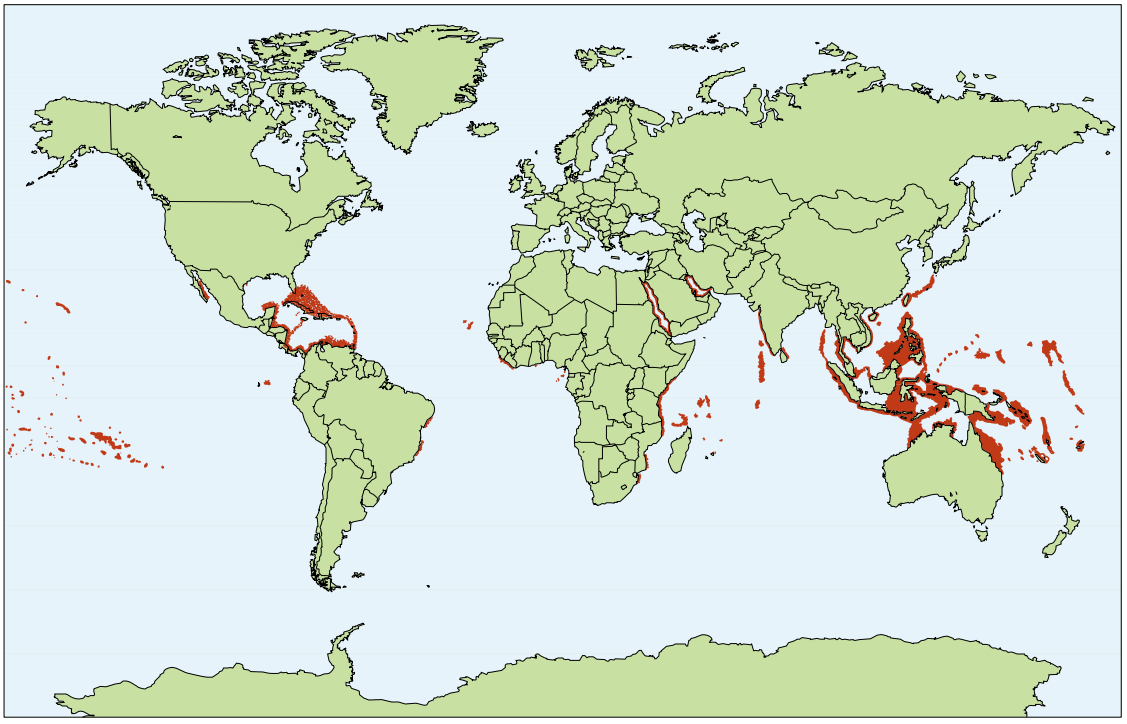
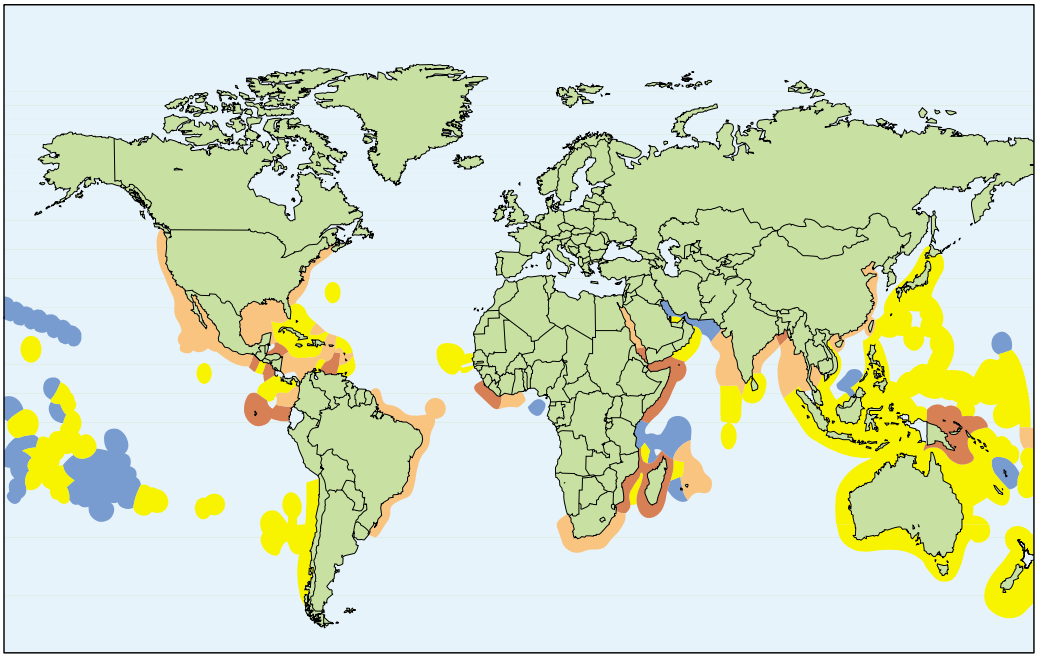


Figure 1 Global distribution of coral reefs.
Map source: http://www.reefbase.org/



Data shown represent the percentage of a country's population who live within 100 km of the coast

Source WRI
Note: for some small island nations where no data was provided, coastal pop. % has been assumed to be 100%.

- 0–25%
- 26–50%
- 51–75%
- 76–100%

Displayed areas represent approximate marine areas for coral reef countries. These do not represent official country borders.

Figure 2 Proportion of population living on the coast.
Map source: http://www.reefbase.org/

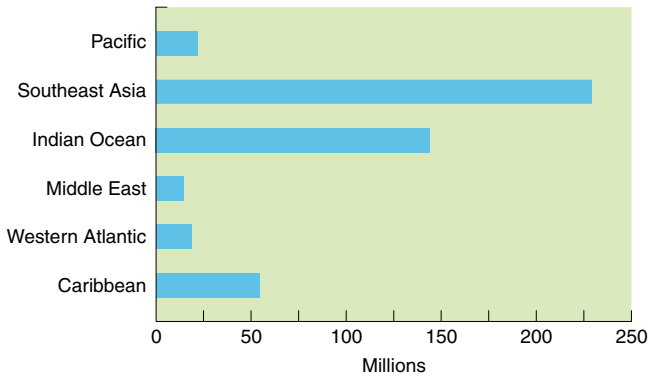


Figure 3 Number of people living within 100 km of the coast.
From: Bryant *et al.*, 1998

BOX 1 CONSUMERS OF CORAL REEF PRODUCTS

Coral reef resources provide a diversity of products for consumption, both for those living on the coast, inland communities and increasingly by people in developed countries, living far away from the reef itself.

In many coastal communities adjacent to coral reefs, the reef provides the only accessible source of protein for the poor. Small discards and damaged fish are often crucial sources of cheap or free protein for the elderly and poor female-headed households.

Dried reef fish are often an important trading commodity between the coast and inland communities and provide valuable protein sources to households inland.

1.3 CORAL REEF STAKEHOLDERS

The number of people who are dependent on coral reefs is unknown. This is partially because dependence is such a variable and ill-defined concept, and partially because the statistics on the relationship between people and reefs are poor.

Coral reefs stakeholders are many and their livelihoods are diverse and vary in the type and extent of their dependence on coral reef resources. Stakeholders may be considered as those living adjacent to the reef, whose livelihood revolves around the direct extraction, processing and sale of reef resources and whose homes and land are sheltered by the reef from wave action. Those who harvest products from the reef include both men and women, young and old, who can directly access shallow near-shore reefs by foot. Reef stakeholders may also include the many people who consume reef products, both locally and far away (Box 1), those that use the near-shore reef and coastal environment as a dumping ground for waste, those who visit the reef for recreation, or those whose interest in the reef is for research and study.

The dependence of these different reef stakeholders varies, from those whose association is full time, to part time users and those who only occasionally depend on the reef. Some may depend on the reef only on a seasonal basis, but that dependence can be absolute and at such times the reef becomes a critical *keystone resource*, without which their survival would be threatened. Others may only come to depend on it occasionally, when it acts as a vital *safety net*, which enables them to overcome extreme hardships or crises. In this way, those not generally considered as 'reef users', such as farmers, may also be reef-dependent at certain times, when, for example, the reef provides crucial resources enabling households to overcome seasonal lows in agricultural production, or occasional and severe droughts.

Other people are much more indirect users of the reef, such as people in wider society who value the reefs existence but who may never use it. These different broad groups of stakeholders can be represented as shown in Figure 4 below.

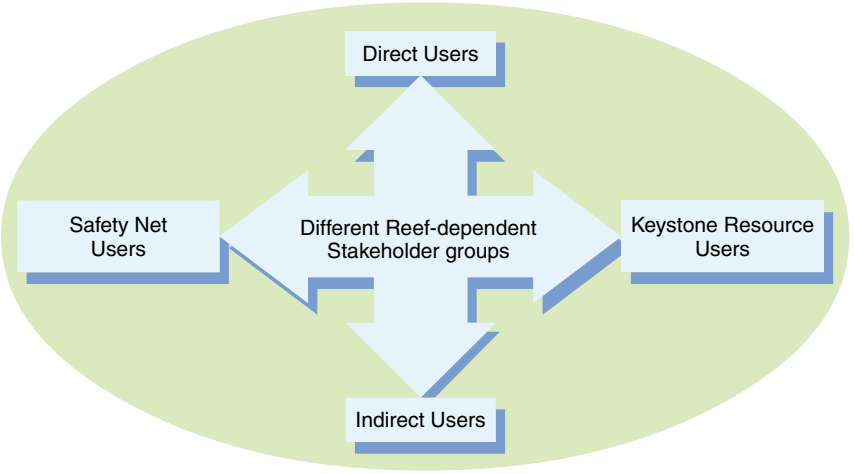


Figure 4 Key categories of reef users.

These key groups of stakeholders are made up of a wide range of different groups of people whose lives often intersect and interact as shown in Figure 5 below.

1.4 NUMBERS OF PEOPLE DEPENDENT ON REEFS

With such a diverse range of coral reef stakeholders, it is not surprising that estimates of the number of people dependent on reefs vary widely, according to the definition of reef dependence or reef stakeholder applied. Moberg and Folke (1999) stated that in over 100 countries with coral reefs along their coastlines, at least tens of millions of people are likely to depend on coral reefs for part of their livelihood or for part of their protein intake. According to the International Coral Reef Action Network (ICRAN), 'An estimated one billion people currently depend on fish for food, income and livelihood, at least 85% of whom rely principally on fish as their major source of protein' (ICRAN, 2002). The International Coral Reef Initiative (ICRI) extends this figure further by saying that fish catches from shallow coastal waters dominated by coral reefs, in Asia alone, are estimated to support 1 billion people (ICRI, 2002b).

In spite of these impressive figures for reef dependence, the situation remains poorly understood except in localised situations. One of the most data-rich areas of reef dependence is that of small-scale fishers. According to an IFAD study small-scale fishers are identified as a functionally vulnerable group amongst the rural poor (Jazairy *et al.*, 1992). For many small-scale fishers the reef represents an important resource, whose diversity and physical complexity favours low investment and low technology small-scale production. From an analysis of the numbers involved in this stakeholder group it is clear that throughout the world many millions of people are dependent on coral reef fisheries employment alone (Box 2). However, it will become clear from future sections that benefits from fisheries are only part of the complex benefit flows that reefs produce.

1.5 CHARACTERISTICS OF REEF-DEPENDENT POVERTY

Among those people dependent on coral reefs the numbers living in poverty is significant. Two-thirds of all countries with reef areas are developing countries, one quarter of which are least developed countries (UNDP, 2002). According to the UNDP Human Development Index ranking (2002), one third of all countries ranked as Low Development have coral reefs, while nearly a half of the Medium Development countries have reefs. In 1999, the largest proportion of people living on less than 1US$ a day was found in Sub-Saharan Africa, followed by South Asia, Latin America and the Caribbean, and East Asia and the Pacific (UNDP, 2002). This picture is largely unchanged since 1990 as illustrated in Figure 6, which indicates high levels of poverty in Eastern Africa, South Asia, Southeast Asia and Western Caribbean, regions which are also associated with large areas of coral reef, as described in the following section (1.6).

Beneath the global and regional pictures and aggregate figures, the reality of poverty in coastal areas is far more complex.

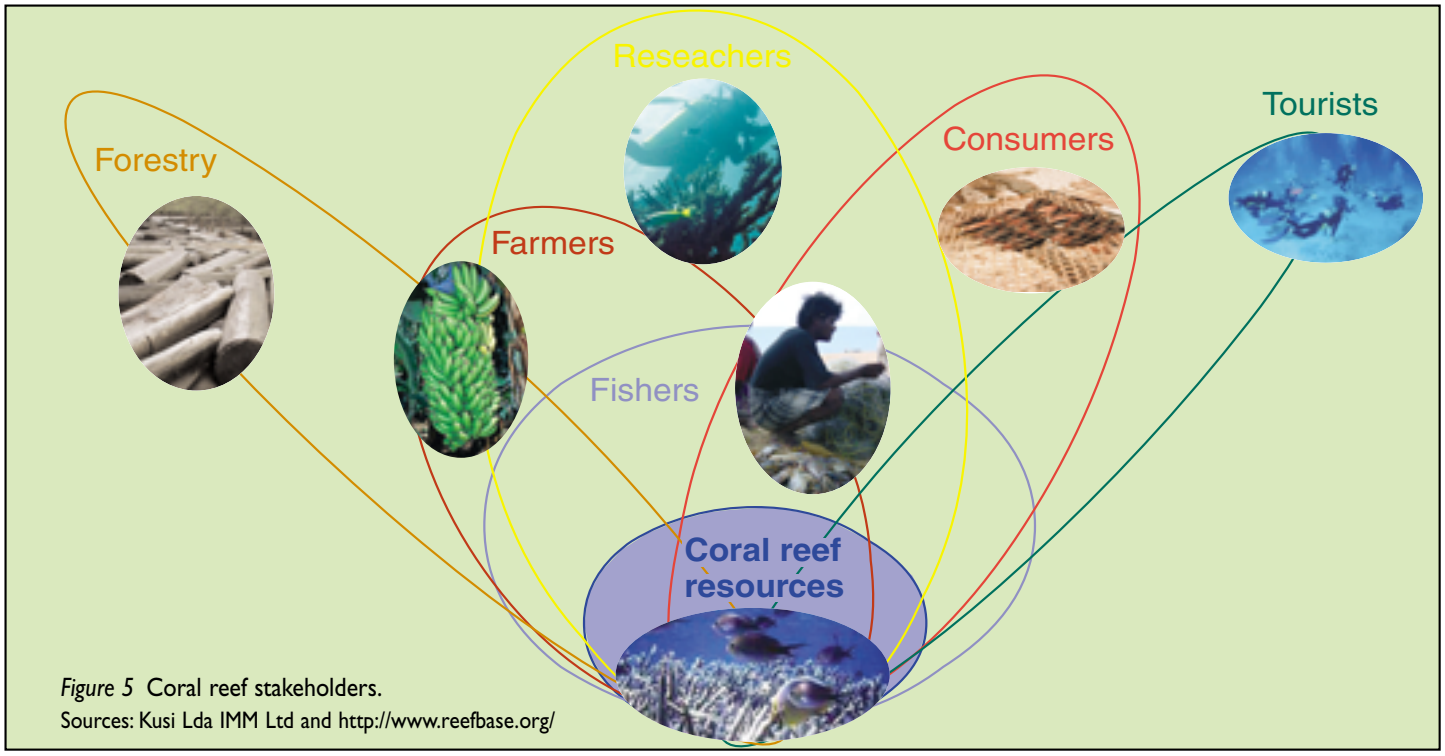


Figure 5 Coral reef stakeholders.
Sources: Kusi Lda IMM Ltd and http://www.reefbase.org/

BOX 2 GLOBAL DISTRIBUTION OF NUMBERS INVOLVED IN FISHERIES PODUCTION

The most recent global estimates suggest that around 36 million people are involved in fisheries and aquaculture (FAO, 1999c) and around 30 million of these people originate from coral reef countries.[a]

It has also been estimated that 95% of fishers worldwide are small-scale, representing more than 20 million primary producers plus a further 20 million small-scale processors, marketers and distributors, totalling approximately 40 million people worldwide (McGoodwin, 2001).

The regional distribution of fishers indicates that most fishers are found in Asia (85%), followed by Africa (7%).[b] With extensive near-shore coral reef areas in Southeast Asia and the Indian Ocean it is likely that many millions of small-scale fishers are dependent on coral reefs for their livelihoods.

[a] Compiled from WRI, 2000.
[b] FAO Fisheries Information, Data and Statistics Unit, 1997.

As recent DFID-funded research has indicated (Box 3) the coastal ecosystem, on the interface between land and sea, is one of the most dynamic environments in which poor people live. This dynamism provides opportunities for the poor, but it also creates threats. Coasts are associated with high levels of development, particularly around ports and urban centres and associated with tourism developments. At the same time the coast is vulnerable to frequent storms, cyclones, floods and coastal erosion, which make it a dangerous place to live. This physical hostility often discourages those with a choice from settling, and so provides space for the poor to live in otherwise marginalized coastal areas. The dynamic nature of the coast combined with the fragmented development and often hostile conditions, can also result in poor infrastructure and weak support services. Such conditions are likely to particularly affect the poor, who typically have poor access to support systems and are 'hidden' or excluded from development.

At the same time, near-shore coastal resources can provide a rich and accessible resource for the poor. Shallow coral reef resources represent an accessible open access resource, which is highly diverse and productive, and provides an important resource for poor people living on the coast or migrating there to escape hardships and access new opportunities. Given the number and diversity of reef stakeholders, coral reef resources clearly provide a considerable range of benefits. Those benefits on which the livelihoods of poor stakeholders depend are discussed in detail in the following chapter.

1.6 REGIONAL DISTRIBUTION OF CORAL REEFS AND POVERTY

Based on our current understanding of the global distribution of poverty and coral reefs, six areas are particularly important. Four of these regions stand out as poverty-reef hotspots for their high

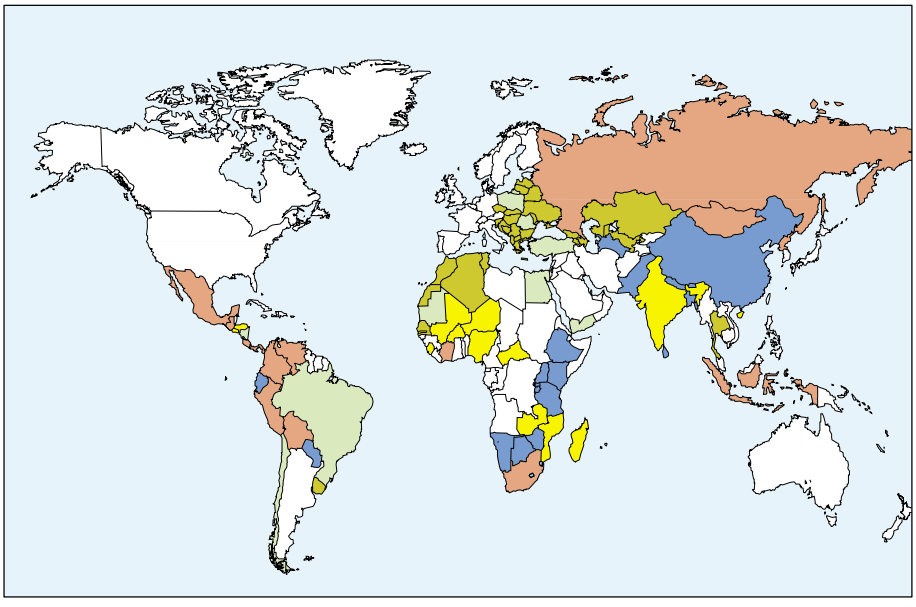


Figure 6 1990 global distribution of people living on less than 1 US$ a day.
Map source: adapted from http://www.povertymap.net/ Rozenblat (2000)

BOX 3 CHARACTERISTICS OF COASTAL POVERTY

Research carried out by the DFID-funded *Sustainable Coastal Livelihoods* Project in India, Bangladesh and Sri Lanka investigated the features and causes of poverty affecting coastal communities. Although, in India and Sri Lanka as in many other countries, much development has been concentrated in coastal areas, poverty is still widespread. However, this poverty is frequently masked by the developments in agriculture, industry, tourism and urban areas often associated with the coast. The poor fall into the gaps between this development and become hidden. This interstitial nature of coastal poverty often obscures it from the view of development planners leaving the poor out of the development equation.

A significant feature of the coastal areas studied is that they frequently 'attract' the poor as they offer a range of easily-accessible livelihood opportunities that are often not available in inland areas. Poorer groups living in coastal communities exploit a diverse range of resources from both land and sea and from the interface between the two. Many of these resources, such as marine fisheries, mangrove areas, coral reef resources, rivers and estuaries, are 'open-access' which means that the poor are able to make use of them, even when other opportunities are limited. In addition to the features that characterise poverty everywhere – poor health, poor shelter, food insecurity, and poor overall quality of life – dependence on a diverse range of activities reliant on open-access resources is a significant feature of the livelihoods of the poor in coastal areas. The open-access nature of many of these resources makes them vulnerable to overexploitation or 'occupation' when there are clear economic advantages of doing so. For example, coastal swamps may be converted to aquaculture ponds removing them from the range of resources available to the poor. As the demand for fish products increases, coastal waters may become the scene of conflict between poor artisanal fishers and larger-scale mechanised operations. This means that, while the coast offers opportunities for the poor, these are opportunities that are often 'fragile' and vulnerable to changes that may ultimately result in them becoming inaccessible to poorer resource users.

Case study research carried out as part of the DFID-funded Reef Livelihoods Assessment Project in India and Mozambique, revealed certain characteristics peculiar to poor communities dependent on coral reef resources. Coral reefs differ from many other coastal resources used by the poor in that they can not so easily be 'occupied' and alienated from public access for purely economic motives in the same way as many other coastal resources. Their shallow and complex physical structure and high biodiversity do not lend themselves to intensive exploitation and economies of scale, so they often remain 'open-access' even when other coastal resources have been 'privatised'. This, however, is changing as tourism and conservation lay claim to large areas of reef. The accessibility of coral reefs provides important opportunities for the poor, including the young, old and women, to directly harvest resources on foot and by hand, or using simple, cheap and locally available technology. For female-headed households and widows, who are frequently some of the poorer and more marginalized households in the communities, the accessible reef resources provide a vital source of food and income.

Significantly, the principle threats to poor people's access to coral reefs are the degradation and disappearance of the reefs themselves.

(see: www.ex.ac.uk/imm/SCL.htm)

levels of poverty affecting large numbers of people and extensive areas of coral reef, namely: Eastern Africa, South Asia, Southeast Asia, and Western Caribbean. The Pacific also has a very large coral reef area with a high percentage of the population being dependent on the reefs. However, the overall population figures are significantly smaller in global terms. Finally, the Eastern Caribbean has a much smaller reef area than the other key areas and a smaller population.

Of these six areas, the South Pacific is known to have the largest expanse of shallow coral reef, where a very high percentage of the population depend directly on the reef, and where local economies are highly vulnerable to future large-scale reef damage. Southeast Asia is home to the second largest area of reef in the world, as well as the largest number of people employed in fisheries and aquaculture, many of whom are likely to rely on the reef resources which occupy almost 38% of the region's coastline (Tables 1 and 2). However, in terms of poverty it is Eastern Africa and South Asia where the greatest proportion of people are found living below international and national poverty lines (Table 2).

TABLE 2 REGIONAL DISTRIBUTION OF REEFS AND POVERTY

Region	*Reef area (km²)*[1]	*Total population (millions)*[2]	*Proportion of population living below 1US$ a day*[3]	*Proportion of population living below national poverty lines*[4]	*Average GDP per capita (US$)*[5]	*Total number employed in fisheries and aquaculture*[6]
South Pacific	116 220	29	n/a	34	6 812	83 396
Southeast Asia	87 760	1 795	19	26	6 749	20 482 876
South Asia	15 490	1 284	28	34	2 653	7 716 793
Eastern Africa	12 620	108	37	40	3 385	296 123
Western Caribbean	11 750	171	14	34	5 240	485 887
Eastern Caribbean	4 730	47	11	24	7 261	86 782

Note: data not available for all countries, as shown in Tables 3–8 (n/a).

1 Data for shallow reef areas from Spalding *et al.*, 2001

2 Data from UNDP Human Development Report 2002 and US Census Bureau 2000

3 Data from UNDP Human Development Report 2002, except for Vietnam and Cambodia (data source: Asia Development Bank, 2002)

4 Data from UNDP Human Development Report 2002, with the exception of Maldives and Mayanmar (data source: Asian Development Bank, 2001), Comoros, Belize and the Seychelles (data source: World Bank, 2002)

5 Data from UNDP Human Development Report 2002

6 Number employed in fishing and aquaculture includes the number of people employed in commercial and subsistence fishing (both personnel on fishing vessels and on shore), operating in freshwater, brackish and marine areas, and in aquaculture production activities. Data from WRI (2000) referring to estimates made between 1996–1999 from the FAO Fishery Information, Data and Statistics Unit.

Beneath these regional statistics, however, considerable variation exists in terms of reef area, poverty and numbers of fishers and other reef dependents. These variations are summarised in the following sections, details of the individual countries for the four poverty-reef hotspot regions are shown in Annex 1.

1.6.1 Eastern Africa

Countries on the coast of mainland Eastern Africa and Madagascar are some of the poorest countries in the world, while the small islands off their coasts include both poor, and developed countries. Coral reefs border 35% of the coast of mainland Eastern Africa and encircle many of the smaller barrier and offshore islands (Table 3).

In terms of reef area four countries stand out: Tanzania, Madagascar, Mozambique and Seychelles. Of these Tanzania, Madagascar and Mozambique have a Low Human Development Index. Tanzania has a large and rapidly growing coastal population and is bordered by the largest area of shallow coral reef in

TABLE 3 EASTERN AFRICA COUNTRY POVERTY AND REEF STATISTICS

Country	*Reef area (km²)*[1]	*Total population (millions)*[2]	*Human Development Index rank*[7]	*Population living below 1US$ a day (%)*[3]	*Population living below national poverty line (%)*[4]	*GDP per capita (US$)*[5]	*Number employed in fisheries and aquaculture*[6]
Tanzania	3580	34.4	Low	19.9	51.1	501	92 529
Madagascar	2230	15.5	Low	63.4	70	799	83 310
Mozambique	1860	17.9	Low	37.9	n/a	861	20 000
Seychelles	1690	0.079	Medium[8]	n/a	16	9 974	1330
Mauritius	870	1.2	Medium	n/a	10.6	9 107	8408
Somalia	710	7.25	n/a	n/a	n/a	n/a	18 900
Kenya	630	30	Medium	26.5	42	1 022	59 565
Mayotte	570	0.156	n/a	n/a	n/a	n/a	3600[9]
Comoros	430	0.7	Medium	n/a	47	1 429	7676
Reunion	<50	0.72	n/a	n/a	n/a	n/a	805

Notes 1–6 as in Table 2

7 Data from UNDP Human Development Report, 2002. High Human Development rank (1–48); Medium Human Development rank (49–126); Low Human Development rank (127–162)

8 Estimated rank based on available data (UNDP, 2002)

9 Number of active fishers from Spalding *et al.*, 2001.

Eastern Africa, which is found along most of the coast and surrounding offshore islands (Spalding *et al.*, 2001). Livelihoods are still based predominantly on agriculture and fishing, with estimates of the numbers of full-time marine fishers ranging from 10 000 to 15 000, who predominantly operate from small non-mechanised craft (FAO 2001c).

Mozambique ranks as the sixth poorest country in the world. Coral reefs dominate the northern coast of Cabo Delgado, one of the poorest provinces in the country, and Nampula province. Reefs are also found scattered along the southern coast.

In Madagascar coral reefs are widespread in the north and off the southwest coast, and support fishery activities, which are mainly focused on reef formations and reef-associated species, accounting for 43% of the total production and involving approximately 50 000 people living in 1250 villages (Gabrie *et al.*, 2000).

Kenya although classified as Medium Human Development Index, has a large fisheries-dependent population many of whom live on the coast and depend on reefs. Coastal areas are densely populated and coral reefs border much of the coastline and surround offshore islands and barrier islands in the north (Spalding *et al.*, 2001). A large small-scale marine fishery operates along the coast associated with the coral reef and near-shore resources.

1.6.2 South Asia

The coastal nations of South Asia are some of the most populated countries, with significant proportions of the population living in coastal areas. South Asia also represents one of the world's poorest regions, second to Eastern Africa in terms of the proportion of people living on less than 1US$ a day (Table 2). Coral reefs border nearly 21% of the coastline, varying greatly in extent from vast expanses of reef in the Maldives, to only limited areas in Bangladesh and Pakistan (Table 4).

India is one of the lower ranking Medium Human Development countries, with over a third of its population living on less than 1 US$ a day (Table 4). India's coastal areas are heavily populated, but coral reefs are limited to only two main areas of the mainland coast: the Gulf of Mannar, in the south, and the Gulf of Kutch, in the northwest, with the remaining reefs associated with the remote islands of Lakshadweep off the west coast and the Andaman and Nicobar Islands off the east coast. Reef fisheries have been estimated to contribute to between 5 and 10% of the total marine landings (Pet-Soede *et al.*, 2000; White and Rajasuriya, 1995, respectively), but contribute significantly to the subsistence and income of coastal fishing communities in the four reef areas.

The Maldives has the highest ranking Human Development Index of all the South Asian coastal nations. It is also the country with the greatest expanse of coral reef, associated with a chain of 22 coral atolls running 800 km from north to south and including 1200 low coralline islands, of which 199 are inhabited. Coral reefs are the foundation of life on the Maldives, providing land area, construction materials, the source of bait fish for a large tuna fishery, and supporting smaller reef fisheries for limited local consumption and growing exports. Island and reef-based tourism also represents a significant industry.

Sri Lanka has a Medium-level Human Development Index with fringing coral reefs estimated to occur along approximately 2% of the coastline mainly in the northwest and east (Spalding *et al.*, 2001), patchy reefs also occur in the southwest and in deeper waters off the west coast. Near-shore fisheries have been estimated to contribute to 60% of total landings in 2000 (NARA, 2001), of which 15 to 50% are estimated to be reef-associated species (Berg *et al.*, 1998; Spalding *et al.*, 2001, respectively).

1.6.3 Southeast Asia

Southeast Asia is home to the largest coastal population in the world and some of the greatest expanses of shallow coral reef (Figures 1 and 2). In terms of poverty, all classified countries fall in the Medium Human Development group, with the exception

TABLE 4 SOUTH ASIA COUNTRY POVERTY AND REEF STATISTICS

Country	*Reef area (km^2)*[1]	*Total population (millions)*[2]	*Human Development Index rank*[7]	*Population living below 1US$ a day (%)*[3]	*Population living below national poverty line (%)*[4]	*GDP per capita (US$)*[5]	*Number employed in fisheries and aquaculture*[6]
Maldives	8920	0.3	Medium	n/a	40	4423	19 108
India	5790	992.7	Medium	44.2	35	2248	5 958 744
Sri Lanka	680	18.7	Medium	6.6	25	3279	146 188
Bangladesh	<50	134.6	Low	29.1	35.6	1483	1 320 480
Pakistan	<50	137.6	Low	31	34	1834	272 273

Notes 1–6 as in Table 2.
Note 7 as in Table 3.

TABLE 5 SOUTHEAST ASIA COUNTRY POVERTY AND REEF STATISTICS

Country	*Reef area (km^2)*[1]	*Total population (millions)*[2]	*Human Development Index rank*[7]	*Population living below 1US$ a day (%)*[3]	*Population living below national poverty line (%)*[4]	*GDP per capita (US$)*[5]	*Number employed in fisheries and aquaculture*[6]
Indonesia	51 020	209.3	Medium	7.7	27.1	2857	5 118 571
Philippines	25 060	74.2	Medium	n/a	36.8	3805	990 872
Malaysia	3600	21.8	Medium	n/a	15.5	8209	100 666
Thailand	2130	62	Medium	2	13.1	6123	354 495
Myanmar	1870	47.1	n/a	n/a	22.9	1027	610 000
China	1510	1264.8	Medium	18.5	4.6	3617	12 233 128
Vietnam	1270	77.1	Medium	32	50.9	1860	1 000 000
Taiwan, China	940	22.19	n/a	n/a	n/a	n/a	n/a
Brunei Darussalam	210	0.3	High	n/a	n/a	17 868	1355
Singapore	100	3.9	High	n/a	n/a	20 767	364
Cambodia	<50	12.8	Medium	36	36.1	1361	73 425

Notes 1–6 as in Table 2.
Note 7 as in Table 3.

of Brunei and Singapore ranking as High Human Development countries (Table 5). However, as with the other regions discussed here, this ranking disguises the nature of coastal poverty, and in many countries in Southeast Asia the coastal population includes some of the poorest people, whose livelihoods are becoming progressively more vulnerable (see Chapter 3).

The two countries with the largest reef area in Southeast Asia are Indonesia and the Philippines. Indonesia has more than 56 million people living on less than 1 US$ a day. The majority of the population live on the coast, which stretches over 95 000 km encompassing over 17 000 islands (including sandbanks and rocks), of which 6000 are inhabited. Shallow coastal waters are home to 18% of the world's coral reefs, the largest extent associated with any single nation (Spalding *et al.*, 2001). 80% of Indonesia's fisheries production has been estimated to originate from small-scale production in near-shore waters (UNEP, 1996). It has also been estimated that the coral reefs, which dominate the near-shore, form the foundation of livelihoods and food security for hundreds of thousands of subsistence fishers (Cesar, 1996).

In the Philippine Archipelago most of the population lives in coastal areas, which are bordered by the third largest expanse of coral reef associated with a single nation (Spalding *et al.*, 2001). Reef fisheries constitute 10% of the total fish production in the Philippines and as much as 70% of the total harvest on some small islands (Cesar, 1996; White and Cruz-Trinidad, 1998, respectively). It has been estimated that more than one million small-scale fishers depend directly on reef fisheries for their livelihood and coral reefs contribute significantly to protein supplies, in a country where more than 50% of animal protein is derived from marine fisheries and aquaculture (White and Cruz-Trinidad, 1998).

Malaysia, Thailand, Myanmar, China and Vietnam also have large reef areas. Of these, Myanmar and Vietnam stand out as having a high number of people employed in fisheries and aquaculture.

1.6.4 Western Caribbean

The Western Caribbean countries are among some of the poorer and most populated countries in the Wider Caribbean. Around 60% of the coral reefs in the Wider Caribbean are found in this region (Tables 2 and 6), as well as 84% of the total numbers employed in fisheries and aquaculture.

Cuba, Mexico, Belize and Jamaica have over a 1000 km^2 of reef each. All have Medium Human Development Index ranks, although the GDP per capita in Jamaica is notably low (Table 6). The reef fisheries provide an important contribution to the livelihoods and food security of many coastal people in all of these countries. The importance of fisheries to livelihoods is particularly noticeable in Mexico and Colombia where a high number of people are recorded as employed in fisheries and aquaculture.

1.6.5 Eastern Caribbean

There are no countries in the Eastern Caribbean with a reef area over 1000 km^2 but there are many countries with reefs (Table 7). The largest expanses of reef occur in Dominican Republic, followed by Puerto Rico, Venezuela, Haiti and Netherlands Antilles. Of these Venezuela, Dominican Republic and Haiti have a high number of people employed in fisheries and aquaculture. Haiti in particular has a Low Human Development Index rank.

1.6.6 South Pacific

The reef area of the South Pacific is dominated by the Great Barrier Reef of Australia. Half of the countries listed in Table 8

TABLE 6 WESTERN CARIBBEAN COUNTRY POVERTY AND REEF STATISTICS

Country	*Reef area (km^2)*[1]	*Total population (millions)*[2]	*Human Development Index rank*[7]	*Population living below 1US$ a day (%)*[3]	*Population living below national poverty line (%)*[4]	*GDP per capita (US$)*[5]	*Number employed in fisheries and aquaculture*[6]
Cuba	3020	11.142	Medium[8]	n/a	n/a	n/a	11 865
Mexico	1780	97.4	Medium	12.2	10.1	8297	262 401
Belize	1330	0.2	Medium	n/a	33	4959	1872
Jamaica	1240	2.6	Medium	3.2	34.2	3561	23 465
Costa Rica	970	3.9	High	6.9	n/a	8860	6510
Colombia	940	41.4	Medium	11	17.7	5749	129 410
Honduras	810	6.3	Medium	40.5	53	2340	21 000
Panama	720	2.8	Medium	10.3	37.3	5875	13 062
Nicaragua	710	4.9	Medium	n/a	50.3	2279	14 502
Cayman Islands	230	0.035	n/a	n/a	n/a	n/a	1800

Notes 1–6 as in Table 2.
Note 7 and 8 as in Table 3.

have a reef area greater than 1000 km^2, the largest after Australia being Papua New Guinea, followed by Fiji, Marshall Islands, French Polynesia, New Caledonia, the Solomon Islands, Federated States of Micronesia, Vanuatu and Kiribati. Of these Papua New Guinea, Solomon Islands, Fiji and Kiribati have the highest numbers of people dependent on fisheries, mostly inshore reef fisheries. Samoa with a relatively small reef area also has a significant number of fishers.

The Pacific's dependence on reefs represents a particular, and rather unusual, case. Most of the countries in the Pacific that have been ranked, rank as Medium Human Development Index countries, but this belies the degree of vulnerability that these communities are exposed to. The smaller island states depend on the reef, not only for their main source of food security and livelihood for the majority of the people, but also as a critical barrier from the erosive forces of the sea, and as the main source

TABLE 7 EASTERN CARIBBEAN COUNTRY POVERTY AND REEF STATISTICS

Country	*Reef area (km^2)*[1]	*Total population (millions)*[2]	*Human Development Index rank*[7]	*Population living below 1US$ a day (%)*[3]	*Population living below national poverty line (%)*[4]	*GDP per capita (US$)*[5]	*Number employed in fisheries and aquaculture*[6]
Dominican Republic	610	8.2	Medium	3.2	20.6	5507	9286
Puerto Rico	480	3.916	n/a	n/a	n/a	n/a	1758
Venezuela	480	23.7	Medium	18.7	31.3	5495	44 302
Haiti	450	8	Low	n/a	n/a	1464	4700
Netherlands Antilles	420	0.21	n/a	n/a	n/a	n/a	800
British Virgin Islands	330	0.02	n/a	n/a	n/a	n/a	127
Guadeloupe	250	0.426	n/a	n/a	n/a	n/a	1300
Antigua and Barbuda	240	0.066	Medium[8]	n/a	n/a	10 225	892
Martinique	240	0.415	n/a	n/a	n/a	n/a	2761
US Virgin Islands	200	0.121	n/a	n/a	n/a	n/a	370
St Kitts and Nevis	180	0.039	High[8]	n/a	n/a	11 596	343
St Lucia	160	0.156	Medium[8]	n/a	n/a	5509	1939
Grenada	150	0.089	Medium[8]	n/a	n/a	6817	2180
St Vincent and the Grenadines	140	0.115	Medium[8]	n/a	n/a	5309	2800
Barbados	<100	0.3	High	n/a	n/a	14 353	3000
Dominica	<100	0.072	High[8]	n/a	n/a	5425	2240
Trinidad and Tobago	<100	1.3	Medium	12.4	21	8176	7297
Anguilla	<50	0.012	n/a	n/a	n/a	n/a	n/a
Aruba	<50	0.07	n/a	n/a	n/a	n/a	687

Notes 1–6 as in Table 2.
Note 7 and 8 as in Table 3.

TABLE 8 SOUTH PACIFIC COUNTRY POVERTY AND REEF STATISTICS

Country	*Reef area (km²)*[1]	*Total population (millions)*[2]	*Human Development Index rank*[7]	*Population living below 1US$ a day (%)*[3]	*Population living below national poverty line (%)*[4]	*GDP per capita (US$)*[5]	*Number employed in fisheries and aquaculture*[6]
Australia	48 960	18.9	High	n/a	n/a	24 574	13 800
Papua New Guinea	13 840	4.7	Medium	n/a	21.7	2367	16 000
Fiji	10 020	0.8	Medium	n/a	25.5	4799	8985
Marshall Islands	6110	0.068	n/a	n/a	n/a	n/a	4900
French Polynesia	6000	0.249	n/a	n/a	n/a	n/a	2100
New Caledonia	5980	0.202	n/a	n/a	n/a	n/a	793
Solomon Islands	5750	0.466	Medium[8]	n/a	n/a	1975	11 000
Federated States of Micronesia	5440	0.133	n/a	n/a	39.5	n/a	1150
Vanuatu	4110	0.19	Medium[8]	n/a	n/a	3108	300
Kiribati	2940	0.092	n/a	n/a	n/a	n/a	6500
Tonga	1500	0.102	n/a	n/a	n/a	n/a	3500
Hawaii	1180	2.02	n/a	n/a	n/a	n/a	
Cook Islands	1120	0.02	n/a	n/a	n/a	n/a	215
Wallis and Futuna	940	0.015	n/a	n/a	n/a	n/a	n/a
Tuvalu	710	0.011	n/a	n/a	n/a	n/a	n/a
Samoa	490	0.2	Medium	n/a	48	4047	12 394
American Samoa	220	0.065	n/a	n/a	n/a	n/a	110
Guam	220	0.155	n/a	n/a	n/a	n/a	560
Johnston Island, USA	220	0	n/a	n/a	n/a	n/a	n/a
Niue	170	0.002	n/a	n/a	n/a	n/a	300
Pitcairn Islands	<100	0.05	n/a	n/a	n/a	n/a	n/a
Nauru	<50	0.012	n/a	n/a	n/a	n/a	325
Northern Marianas	<50	0.072	n/a	n/a	n/a	n/a	100
Palau	<50	0.019	n/a	n/a	n/a	n/a	364
Tokelau	<50	0.002	n/a	n/a	n/a	n/a	n/a

Notes 1–6 as in Table 2.
Note 7 and 8 as in Table 3.

of locally available building materials. Whilst the reefs of the Pacific are in the main in good condition, climate change poses a major threat to the livelihoods of a high percentage of the populations of many of these island states (as described in Chapter 3).

1.7 SUMMARY

Coral reefs border a large extent of the coastlines of some of the poorest countries in the world. Within those countries there are a wide diversity of stakeholders who depend upon those reef resources as a regular part of their livelihoods, as a part-time but essential component, or as a safety net in times of stress. There is also a growing dependence in wider society on reefs as a part of national heritage, as a dumping ground of waste, as a source of pleasure for tourists, or as a focus of study and research.

The number of people who depend upon reefs and their level of dependence is not well known. In the order of tens of millions rely on reefs to support part of their livelihood, providing food and income and basic subsistence needs. Many of these are very poor people, but that poverty is often hidden from sight. The poor often fall in the gaps between coastal development activities, they are often the marginalised ones that do not have legal title to coastal resources, and who are often seen as an obstacle to conservation or development. Because of this hidden nature the profile of the coastal poor is only just beginning to be understood.

This section of the report has tried to give some understanding of the distribution of the reef-dependent poor around the world and it is clear from this analysis that they are many and widely dispersed. Some are very poor (especially in Africa and South Asia), others are extremely vulnerable (such as in the Pacific). The next Chapter tries to understand how the dependence of these people on the reef manifests itself in all aspects of their livelihoods.

CHAPTER 2 AN OVERVIEW OF REEF-RELATED BENEFIT FLOWS TO THE POOR

2.1 INTRODUCTION

In the previous Chapter the widespread occurrence of reefs and the level of human interaction with the reef were outlined. Small-scale fisheries were used as one example of the benefit flows that reefs can provide. This Chapter identifies the wide diversity of benefit flows to reef-dependent communities, especially the poor. It uses a livelihoods approach and framework based on the DFID Sustainable Livelihoods Approach (SLA) to understand the wider benefits of reefs to all aspects of people lives. Some of these benefits arise because reefs can contribute directly to the resources that the poor have access to. These *resources* contribute to the building blocks of the livelihoods of the poor and ultimately to the livelihood outcomes that they aspire to. These resources can be grouped under five headings: natural, physical, financial, social and human.

In addition the reef can enhance the way the poor interact with the structures and processes that directly influence the way the poor access and use their resources. These *direct influencing structures and processes* emanate from government, the private sector and society. They in turn interact with the longer-term and periodically catastrophic background changes that affect the social, economic, environmental and policy context in which the poor exist. We refer to these as the *indirect influencing factors.*

The reef also has the potential to directly contribute to the *livelihood strategies* that the poor adopt to use the resources they can access, to respond to the structures and processes that influence them and to cope with the background context in which they operate. The services that the reef provides to the poor ultimately benefit them, by contributing to positive *livelihood outcomes.* These positive benefits are best defined and measured by the poor themselves, if they are to meaningfully represent the positive improvements in their lives.

The relationship that poor reef-dependent people have with the resources available to them, how they use these resources in the operating environment created by direct and indirect influencing factors in order to create their livelihood strategies and achieve their desired livelihood outcomes, is shown diagrammatically in Figure 7.

This section of the report focuses on the contribution of coral reefs: to the resources accessed by the poor (Section 2.2); to enhancing the interactions of the poor with direct influencing factors (Section 2.3); and to the ability of the poor to cope with the risks and vulnerabilities associated with indirect influencing factors (Section 2.4). These sections describe the many different streams of benefits to the livelihoods of the poor providing examples from around the world and from the four case studies undertaken as part of the *Reef Livelihoods Assessment* project.

2.2 CONTRIBUTION OF CORAL REEFS TO THE RESOURCES OF THE POOR

The reef contributes directly to the resources that are immediately available to the poor to use in their livelihoods. These are natural, human, social, physical and financial resources.

2.2.1 Natural resources

Coral reefs provide a wide array of benefit flows to the poor that enhance the natural resources that they have access to, these are outlined below.

2.2.1.1 High biodiversity and productivity

Coral reefs support high levels of biodiversity and biomass in tropical regions where the surrounding ocean is comparatively barren. The productivity associated with coral reefs is estimated to be higher than any other ecosystems, but varies according to the health of the reef and the reef area and region in question (Table 9).

Despite the small area coral reefs occupy on the world's surface (only 0.1%), it is believed that there are more species per unit area of coral reef than any other ecosystem (Spalding *et al.*, 2001). Globally there are an estimated 4000 coral reef fish species, which constitute at least 25% of all marine fish species (Spalding *et al.*, 2001). On many small coral islands, the biodiversity of the marine environment far outweighs that found on land and the reef represents the principal natural resource base for the local population. In the Maldives, for example, terrestrial biodiversity is insignificant compared to the rich biodiversity of the surrounding reefs, where many thousands of different species are encountered (Zuhair, 1998).

TABLE 9 FISHERIES PRODUCTIVITY ESTIMATES OF CORAL REEF ECOSYSTEMS

Reef area	*Productivity estimate ($mt/km^2/year$)*	*Source*
Philippines	18 excellent condition 13 good condition 8 fair condition	(McAllister, 1988)
Philippines	3–37	(Savina and White, 1986)
Pacific	6–20	(Dalzell and Adams, 1997)

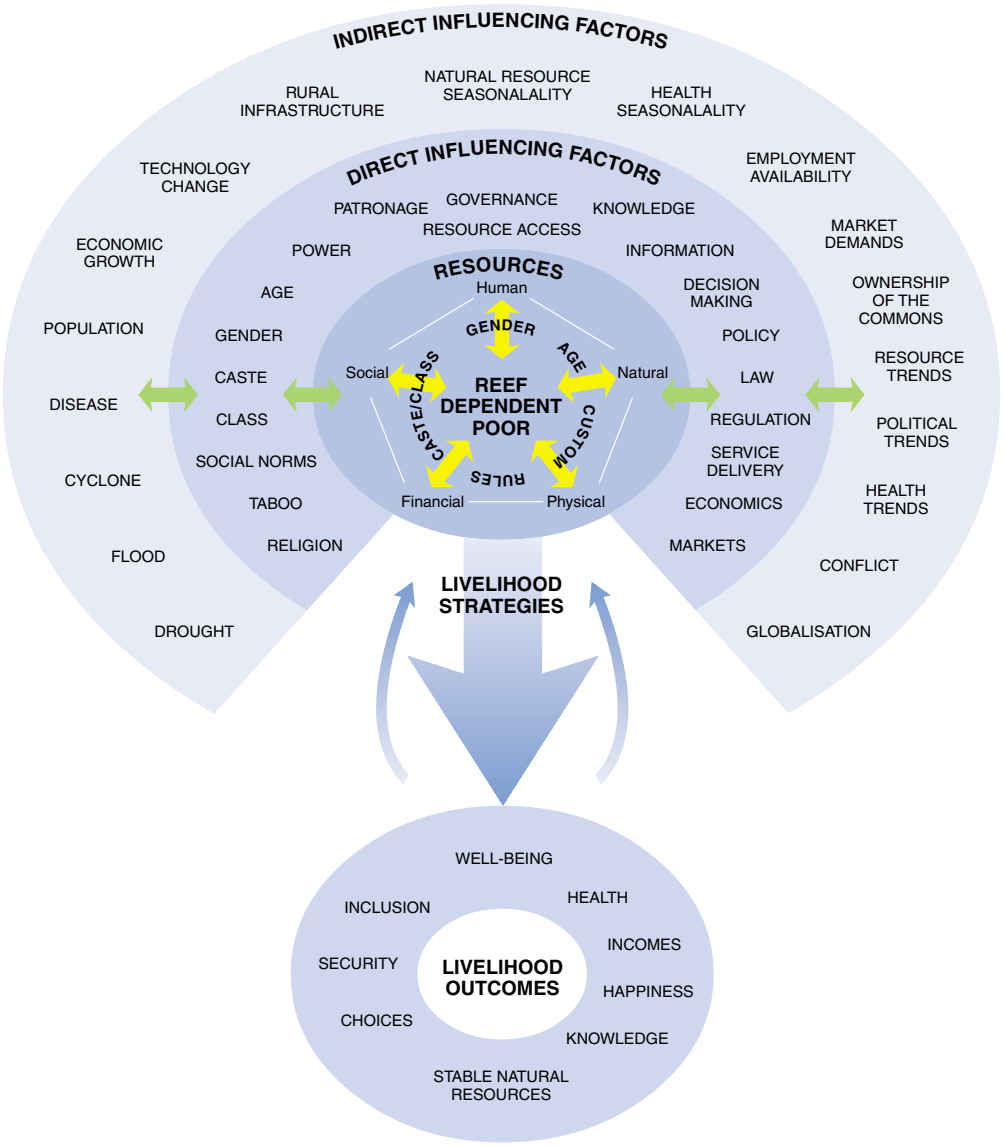


Figure 7 Reef-dependent livelihoods. The diagram is a schematic view of the livelihoods of the reef-dependent poor. It encourages us to place the poor at the centre of our interpretations and to embrace the complexity of their livelihoods. The first ellipse surrounding the poor represents the *resources* (human, natural, social, financial and physical) they have access to. Access to these resources is determined by multiple factors which influence the poor at varying levels and over which the poor have varying degrees of control. Some influencing factors may relate to characteristics of the poor themselves, such as their age, gender, class, caste or religion. Other factors may relate to aspects of the society in which they live and the political structures and processes or government and private sectors that they interact with. These factors are represented in the second ellipse surrounding the poor, as *Direct Influencing Factors*. They are factors that the poor interact with directly and over which they may have some control. Surrounding these, in the third ellipse, are the *Indirect Influencing Factors* – the seasonal, longer-term and periodically catastrophic background changes, which interact and impact upon Direct Influencing Factors and resource access, and determine the vulnerability and risks the poor are exposed to. The livelihood options available to the poor, to combine the resources they have access to and develop a *livelihood strategy* are the result of these multiple and varied influencing factors which surround the poor. Whatever livelihood strategy the poor adopt will determine the form of their *livelihood outcomes*, which is best defined by the poor themselves.

The diagram illustrated has been developed as part of the DFID-funded IMM implemented *Sustainable Coastal Livelihoods Project* and is just one way to conceptualise livelihoods. Different livelihood frameworks have been developed by other development agencies (e.g. DFID, CARE, OXFAM, UNDP). Guidance on the DFID Sustainable Livelihoods Approach (SLA) can be found at www.livelihoods.org . This site provides guidance sheets on the approach, reports and publications on its use, and an outline of many current applications through research and development activities.

BOX 4 EXAMPLES OF THE DIVERSITY OF EXPLOITED REEF SPECIES

Australia: Among the Aboriginal peoples of Australia, the sea provides 119 different kinds of fish, 42 kinds of shellfish, 5 turtles, 4 crustaceans, 2 sea mammals and squid (Worsley, 1997).

Solomon Islands: In the Marovo area of the Solomon Islands, most of the 400 reef species locally named are exploited (Ruddle *et al*., 1992).

Gulf of Mannar: 200 species are known to be commercially exploited in the Gulf of Mannar (DOD, 2001). A rapid survey of 3 coastal villages revealed 74 locally named and commonly exploited reef products, including 41 local varieties of fish, 19 local varieties of crustacean and 4 varieties of seaweed (Rengasamy *et al*., 2003).

Mozambique: Among 3 coastal communities in northern Mozambique, a rapid survey revealed that 27 different fish families, 8 mollusc species, 2 crustacean species, octopus, squid and sea cucumbers were exploited from the reef and near shore (Wilson *et al*., 2003).

High biodiversity inherently means a high diversity of potential opportunities for exploitation. Any coral reef-based fishery around the world is characterized by the large numbers of different groups of species exploited, including fish, molluscs, crustaceans and seaweed (Box 4).

2.2.1.2 A haven for small-scale fisheries

The productivity of the reef resource combined with its rich diversity play a significant role in the fisheries of many developing countries. The biological diversity and complex three-dimensional structure of coral reefs also protect against the development of large-scale commercial fisheries reliant on trawls and industrial gear (Pomeroy, 1994). Consequently, coral reefs fisheries are a haven for small-scale fishery activities and their often shallow and near-shore location allows easy access, requiring minimal technology and financial investment.

However, the predominantly small-scale and subsistence nature of the fishery means that the real benefit of the coral reef resource is often overlooked in national fishery statistics. In the South Pacific, 80% of the total coastal fisheries production is from subsistence fishing and just under half of the total annual commercial catch originates on coral reefs (Dalzell *et al*., 1995). In Indonesia, 80% of the fisheries production arises from small-scale production in inshore waters (UNEP, 1996), and in India the predominantly subsistence reef fisheries may provide 5–10% of the total marine fish production (Pet-Soede *et al*., 2000; White and Rajasuriya, 1995, respectively).

2.2.1.3 Bait fish for tuna fisheries

Reef resources also provide crucial inputs for pelagic fisheries production, through the supply of bait fish. In the Maldives, a live bait fishery has been reported from at least the fourteenth century, regularly using 20 reef-associated fish species to supply live bait to the offshore pole and line fishery (Risk and Sluka, 2000). Similarly, in Lakshadweep the pole and line tuna fishery (Figure 8) is supported by a reef-based bait fishery, which is one of the most energy- and capital-intensive fisheries associated with the reef (Hoon, 2003).

Figure 8 Pole and line tuna fishing in Lakshadweep, India
Source: http://lakshadweep.nic.in/

2.2.1.4 Interactions with adjacent coastal ecosystems

Coral reefs form an integral part of the wider coastal and ocean ecosystem interlinked by flows of nutrients, sediments and energy. Coral reefs are in many cases the basis for island creation through the accumulation of reef-generated sand and sediment behind the reef and the continual supply of sand to coastal beaches. This in turn provides a habitat for people, nesting sites for birds and turtles and lenses of fresh water for drinking and agriculture. Nowhere is this function more apparent than the coral islands and atolls of the Pacific and Indian Ocean.

Behind the shelter of reefs, lagoons, seagrass and mangrove habitats can flourish, providing extensive resources for exploitation (Box 5). The reef also provides shelter and an attractive source of food to pelagic open water fish species in a comparatively barren tropical sea. In this way, the reef acts as a 'Fish Aggregation Device', which in turn attracts fishers. For example, around the island of Tobi, one of the south west islands of Palau, fishers exploit large numbers of tuna attracted to the reef by seasonal abundances in juvenile reef fish (Johannes, 1981). In the Andaman Islands many fishing grounds for pelagic species are located on the edge of reefs or in channels between reefs (Singh and Andrews, 2003).

BOX 5 REEFS, LAGOONS AND SEAGRASS BEDS IN THE GULF OF MANNAR, INDIA

In the ***Gulf of Mannar***, coral reefs fringe a chain of 21 coral-line islands, sheltering mangroves, lagoons and a shallow 'trapped sea' with extensive seagrass beds. This mosaic of coastal ecosystems forms the basis for sea-based livelihoods among the coastal communities, including the extraction of seaweed, shells, lobsters, sea cucumbers and reef fish from the reef flats and lagoons; and the harvest of crabs, squid, fish and shells from the seagrass beds and 'trapped sea' between the islands and the mainland coast.

For the coastal people of the Gulf of Mannar coral reefs are perceived as part and parcel of the ocean, as expressed below:

- 'It is the reef from where everything sprouts and spreads throughout the entire sea'
- 'The reef is a natural nursery'
- 'It is because reefs are there and its fertility, we get different varieties of fish to catch and we have to keep different nets'

(From: Rengasamy *et al.*, 2003)

The association of coral reefs with other near-by ecosystems is often well recognized by local people (Box 5). In the south Pacific, local people perceive the reef resource as encompassing mangrove and estuarine habitats, as well as the reef itself (Hviding, 1994).

2.2.2 Physical resources

2.2.2.1 Coastal protection

Coral reefs play a critical role in providing a physical barrier against wave energy, thus reducing coastal erosion and the impact of storms. For all coastal communities living in the shelter of coral reefs, the reef barrier protects their homes, agricultural land and public infrastructure from the erosive forces of waves, currents and storms. Along the erosion-prone coasts of western and southern Sri Lanka, it has been estimated that 1 km^2 of coral reef prevents 2000 m^2 of erosion per year (Berg *et al.*, 1998). The shelter provided by reefs is widely recognised by coastal communities, in the village of Thavukadu in the Gulf of Mannar, India, where it has even been incorporated into local myth (Box 6). In locations where local communities equate their surrounding natural landscapes with their own ancestors and identities, the significance of the protection provided by coral reefs, may be even greater.

2.2.2.2 Navigation

The wave buffering effect of reefs also creates safe waters for navigation and fishing in the sheltered waters behind the reef and lagoon. Breaking waves and swells over reefs are also commonly used as guides for navigation, often in locations where no alternative navigation aids exist (Box 7). The high visibility typical of tropical waters, together with the exposure of reef flats at low tides have enabled an often intimate familiarity and mental mapping of coral heads, reefs and associated fishing grounds. In

BOX 6 THE MALE AND FEMALE SEAS OF THE GULF OF MANNAR AND PALK BAY, INDIA

In Thavukadu locals believe the ***Gulf of Mannar*** to be a male sea, due to the nature of its rough waves, which hit against the reef belt and subside in force by the time they arrive at the shore. In contrast, Palk Bay is believed to be a female sea, where like a woman the waters are calmer most of the time, but once they awake due to wind or storms the damage is heavy for there is no reef belt to control the action of the waves.

(From: Rengasamy *et al.*, 2003)

BOX 7 USING SEAMARKS OR *BETIA* FOR NAVIGATION IN KIRIBATI

The people of ***Kiribati*** relied upon seamarks or *betia* to navigate at sea. *Betia* could consist of schools of fish, flocks of birds, or the condition of waves and sky. On Tarawa Island *betia* included:

Maribo, or the waves coming over a reef;
Taribo, wave breakers on the reef
Te aiburani man, coral reefs projecting above water at low tide
Taabeneia, the mudflats and the bare reef

(From: Teiwaki, 1988)

the Pacific this is known to be so evolved so as to include names for large coral heads (Ruddle *et al.*, 1992). Elder fishermen of Montego Bay, Jamaica, are also known to have become so familiar with the sea floor that they can navigate without a compass (Bunce and Gustavson, 1998). In Sri Lanka, the topography of the sea floor is also well known by fishermen and most local reefs and submerged rocks carry names (Stirrat, 1988).

2.2.2.3 Physical boundaries

The distinctly visible characteristics of a coral reef, such as waves breaking over the reef edge, prominent coral heads or boulders and exposed reef flats have been used throughout Oceania as a means of demarcating the marine border of the traditional land and sea territories of neighbouring villages or clans (Box 8). In some cases the location of a particular feature, a reef passage or patch, influenced the positioning of a marine boundary (Schug, 1995). In the Trobriand Islands marine territories are delineated by the distinct physical boundaries of a coral patch or boulder (Young, 1979).

2.2.2.4 Source of materials

Not only are the reef inhabitants extracted, so is the foundation of the reef itself. Coral, coral sand and large gastropods are all extracted for use in local construction as building blocks and for the production of lime for cement, flooring, plastering and white wash. For many people, the use of coral in construction may be the only economically viable option and so it remains an important resource, in particular for those from isolated island communities and for the poor.

In the Maldives, coral blocks, rubble and sand are the main construction materials and as much as 20 000 m^3 is mined every year (Cesar, 1996). In Mola Village, Indonesia, coral mining

BOX 8 REEF BOUNDARIES OF *KAVEBU* TERRITORIES IN NORTHERN NEW CALEDONIA

The Nenema zone of northern ***New Caledonia***, is one of 28 linguistically distinct areas of New Caledonia, and home of the Kanak people. Within this zone the Kanak people are divided into eight independent political and social units, or *kavebu*. Land and near-shore marine areas associated with each *kavebu* are subject to ownership and are delimited. Territorial limits for each *kavebu* are established by lining up obvious landmarks, from the tops of hills on land to the reefs and reef channels at the seaward edge of the territory. These territories are subject to rules and require authorisation for one *kavebu* to fish in a territory which is not their own.

(From: Teulieres, 1992)

began relatively recently (1960s) and the coral has been used to build fences, roads, foundations of houses and to 'modernize' houses, as it is believed that coral stones make the houses stronger (Figures 9 and 10) (Elliot *et al.*, 2001). In Kiribati, coral and sand have been used for building, roadways, causeways, seawalls and for reclamation (Teiwaki, 1988). In Sri Lanka, coral has been an important source of lime for construction, agriculture and the chemical industry and it was estimated that over 18 000 tonnes of coral were mined in 1984 (Katupotha, 1995). In the past, coral stone was even used for the construction of royal tombs and monuments in Tonga (Gibbings, 1949).

CITES records account for 142 coral groups in international trade (Green and Shirley 1999). The corals' ultimate end may be in aquaria, as curios, ornaments or jewellery. Corals are also used for the production of tools and fish traps (Figure 11), although this is becoming less common with the use of synthetic alternatives. A variety of other reef species are also manufactured into tools and jewellery. In particular, reef molluscs are an important resource for ornaments and curios, their collection in many cases driven by export or tourist markets (Box 9).

2.2.3 Financial resources

2.2.3.1 Income generation

The majority of natural products extracted from a coral reef have the potential to generate income either in local markets or in export markets. Income generation is not restricted solely to the fisher, but extends through a chain of interactions to the many others involved in processing, marketing and sale (Box

Figure 9 Coral rubble and gastropod shells used in house construction in Northern Mozambique. Source: James Wilson, Kusi Lda

Figure 10 Coral harvest, Philippines. Source: Michael Ross http://www.reefbase.org/

10). In those locations where marine resources are the primary natural resource, a significant proportion of the workforce may be employed in reef-dependent activities. In the Maldives, for example, 25% of the workforce is employed in fishing, predominantly tuna fishing which depend in reefs to attract the pelagic fish and for live bait supplies (Zuhair, 1998). If reef-based tourism and travel related employment, which contribute to 56% of the national economy in the Maldives (Westmacott *et al.*, 2000), were included this figure would be greatly inflated.

Figure 11 Fish trap secured with coral pieces, Philippines
Source: John McManus http://www/reefbase.org/

In many coastal communities, fishing may be the primary or only source of cash income, particularly for poorer households. In Atulayan Bay, Philippines, a fifth of households derive all or most of their income from fishing (Pollnac, 1998). In Discovery Bay, Jamaica, some members of the fishing community have no other source of income and in Montego Bay, Jamaica, an estimated 70–95% of fishers depend on fishing as their sole source of income (Bunce and Gustavson, 1998; Woodley, 1994). In the Torres Straits of Papua New Guinea, many communities remain almost completely dependent on marine products for generating cash income and ensuring long-term economic security (Schug, 1995). In the three poor villages studied in this project in Northern Mozambique, reef products generated income for up to 90% of households (Figure 12, Wilson *et al.*, 2003).

Income generation is not just limited to fishing activities, coral mining may also play an important role. Coral miners in Sri Lanka could earn three times the alternative income of rural labour and it was estimated that in addition to the miners many thousands of people were economically dependent, directly or indirectly, on lime production (Berg *et al.*, 1998). On Mafia Island, Tanzania, coral mining ranked third as an income-generating activity, in terms of numbers of people involved (Dulvy *et al.*, 1995). In the Gulf of Mannar, fish vending offers an important opportunity for poor female-headed households, providing up to 50% of the household income (Rengasamy *et al.*, 2003).

BOX 9 EXAMPLES OF THE USE OF REEF SPECIES AS TOOLS AND ORNAMENTS

All over the world coral reef molluscs, have been harvested for shell craft, mother-of-pearl and the ornamental shell trade. Reef shells such as giant clams, green snails and *Trochus* have been harvested for the manufacture of mother-of-pearl buttons for hundreds of years. In ***Eastern Africa***, the shell trade for mother-of-pearl may date back to the 1870s, and presently shell collection for tourist curios provides an important source of income, particularly in Kenya (TRAFFIC 2001). On the ***Kei Islands of Indonesia***, where *Trochus* shells were used to manufacture mother-of pearl buttons, the leftovers were ground up and added to automobile paints to provide luster (Thorburn, 2000).

Mollusc shells and turtle shells have also been used traditionally to make fish hooks and lures and in *Palau* pieces of coral were used as a file to shape fish hooks (Johannes, 1981). On the South West Islands of Palau strings of shells were used as a rattle to attract sharks for fishing (Johannes 1981). In the ***Pacific*** Conch shells are used a horn to sound warnings and call meetings (Young, 1979).

Coral has also been used in constructing fish traps. In ***Kiribati*** coral and rock pieces are used to build large fish traps on the reef top (Teiwaki, 1988). In ***Samoa*** baskets filled with branching coral fragments were used to trap fish (Gibbings, 1949).

In other cases, reef species are the inspiration for traditional designs. Such is the case in the ***Gulf of Mannar***, where historically women used to wear a wedlock pendant designed in the shape of a reef fish, locally known as the Tonga fish or Box fish (Rengasamy *et al.*, 2003).

BOX 10 MULTIPLE FISHERIES-BASED OPPORTUNITIES IN THE GULF OF MANNAR, INDIA

'Take for example the lobster that we catch in the reef area. People associated with the production, marketing and mending of the gears and nets, fishermen, merchants, processors, people managing cold storage, export and inland distribution, it is unimaginable to comprehend all these people and their activities. Before a piece of fish is taken by a consumer, it generates a chain reaction, it creates social relations, it throws open lots of opportunities for various groups of people; a fish sacrifices itself to sustain the human life.'

(From: Rengasamy *et al.*, 2003)

Figure 12 Small-scale fishing craft, Mozambique.
Source: James Wilson, Kusi Lda.

2.2.3.2 Low entry cost reef fisheries

The location of reefs, near shore and at relatively shallow depths, allow easy access, often by foot and without the need of boats or specialized equipment. Consequently, little investment is needed to enter a reef fishery, and thus they provide multiple opportunities for poorer households, with limited financial resources (Box 11, Figure 13).

2.2.3.3 Diversity of products and markets

The diversity of coral reef resources and exploited reef products gives access to a range of different associated markets. Certain reef products are of high value for international markets, such as: live fish for aquaria and restaurants, seaweed for agar production, or crabs for processed crab sticks, and these provide income generating opportunities to local collectors and fishers. Export demands for reef products often offer higher value options throughout the year, and may provide a more attractive market outlet compared to local markets. In the Andaman Islands, certain reef fish have become known locally as *Dollar Fish*, due to the high value they generate with export traders. Sea cucumbers are a sought after commodity from reef areas around the world (Figure 14), supplying Chinese and other Asian markets and more recently western markets, as a dietary supplement. In Eastern Africa, the arrival of Chinese settlers in

Figure 13 Local boat construction, Indonesia.
Source: James Oliver http://www.reefbase.org/

the mid 1900s coincided with the emergence of the sea cucumber industry, which has been entirely export orientated and provided a lucrative market primarily to small-scale fishers (TRAFFIC, 2001). In the Northern Mozambican village of Messano, the reef provides shelter in the near-shore shallow waters for seaweed cultivation, supplying an export market and providing an important source of income principally to women (Wilson *et al.*, 2003).

Reef products may also be used to obtain foreign currency. Such is the case in Northern Mozambique, where sea cucumbers and the opercula of large gastropods, known locally as *Mbande*, are collected and used as exchange for Tanzania shillings, helping finance trips across the border to Tanzania (Wilson *et al.*, 2003).

The diversity of reef species and markets provide stability to the fishery (Figure 15), absorbing the impact of fluctuating demand and prices, with the impact of falling demand and prices of one product, offset by continuing demand, or even rising prices of another product. Single species may also be able to access a number of different markets, both locally and for export. For example, sharks may be sold locally for their meat, teeth or jaws, and to foreign markets for their liver oil (used in cosmetics and sun cream) and skin (to process into leather) (Nichols, 1993). In the Pacific Islands, rural fishermen have accessed the Japanese market for shark fins, which provides an important income earning opportunity (Nichols, 1993). In India and Sri

BOX 11 USING SIMPLE, CHEAP AND LOCALLY AVAILABLE TECHNOLOGY TO ACCESS REEF RESOURCES

In the ***Gulf of Mannar***, shallow reef flats and lagoons can be accessed by foot and seaweed and shell collection is typically undertaken in this way, simply requiring a bag or sack to collect the harvest. Boat-based fishing activities are carried out from traditional wooden boats, of which 66% are small non-mechanised locally constructed boats with a sail and oars for rowing, known locally as *Vathai*.

(From: Rengasamy *et al.*, 2003)

On ***Agatti Island, Lakshadweep***, the practice known as *Kal moodsal* is a simple activity carried out by children and adults close to shore, at low tide, throughout the year in the shallow eastern lagoon. A simple small cast net, a leaf bag and plastic slippers are all that are required to undertake this activity, which can yield 10–12 small fish (approximately 1 kg) for household consumption. Cast nets, known as *Beesh Bala*, are not expensive and all the households in Agatti own at least one. The boats operated in the lagoon and near shore reef are small non-mechanized traditional wooden rowing boats, known as *Dhonis*, or rafts, known as *Tharappam*. These are constructed locally and have low running costs.

(From: Hoon, 2003)

In the ***Andaman Islands***, the coral reefs can be accessed by non-mechanised boats and the gear required (hand-lines) is simple and cheap and can be easily procured, unlike the alternative of nets which can often only be acquired with loans or credit. For the new immigrant household on the Andamans, with limited financial resources and limited access to loans or credit, hand-lines are an accessible option. In addition to the low investment required for gear, operating costs in terms of time and fuel, are also lower for reef-based fisheries, with many of the reef fishing grounds closer to shore, particularly those used during the rough weather season.

(From: Singh and Andrews, 2003)

Figure 14 Dried sea cucumber, Indonesia.
Source: Mark V. Erdmann http://www.reefbase.org.

Figure 15 Fish for sale at a local market, Indonesia.
Source: James Oliver http://www.reefbase.org/

Lanka, sharks are sold locally for consumption and for the curio trade, while their fins and livers are exported (Kristensen, 1990).

2.2.3.4 Reef products for exchange and barter

Reef products may not always be used to earn cash, but may be used instead as a trading commodity for barter. Shells were most likely the earliest form of currency (Box 12), and evidence for the use of shell money has been found across Africa, South Asia and China, where it dates back at least to the Shang Dynasty 1700 to 1100 BC (Risk and Sluka, 2000). Traditionally in many reef-fishing communities, reef products were not sold but shared with family, neighbours and those in need in a system of reciprocity that underpinned social and economic life. In the South Pacific, sharing reef products was a key element of social security and social status was afforded according to the extent to which a person redistributed, rather than accumulated, their resources (Johannes, 1989). Sooner or later the giver of a fish could expect to receive other goods or services in return and in some cases this was an important means of receiving otherwise unobtainable products.

With the emergence of cash economies, bartering has become less common, however, the exchange of reef products for other goods or services remains an important part of the life of coastal communities, and is particularly important for poorer members of the community, such as the elderly or female-headed households, with little or no cash savings or access to cash earning opportunities. In some cases it also continues to underpin the movement of essential goods between the coast and inland communities. In other cases, it remains an important way to maintain social customs and traditions (Box 13).

2.2.4 Human resources

2.2.4.1 Providing food security

Coral reefs and their associated fisheries are a major source of food and animal protein throughout the world, contributing to 10% of the fish consumed by humans, and providing a supply of protein for tens of millions of people (Moberg and Folke, 1999). Seafood not only provides a source of protein, it is also high in fats, vitamins and minerals. This highly nutritional food source is often the primary source of protein for coastal communities, and is of particular importance for vulnerable groups, such as the sick,

BOX 12 SHELL MONEY

The ***Maldives*** became known as the Money Islands, due to the great number of shells to be found there. Small cowries (*Cypraea moneta*) were collected from the shallow reef flats and traded for almost 4000 years, traditionally under the control of the Sultan. Direct shipments of cowries were made to Africa, Southeast Asia and Europe, and were used as one of the main forms of exchange in the slave trade. In the 1720s, at the peak of the slave trade, 500 million cowries were exported to West Africa alone (Risk and Sluka, 2000).

In ***Papua New Guinea*** several inland societies would undertake dangerous and costly trips to the coast to obtain shells for use as currency in a shell-based economy (Hogbin, 1973). With the introduction of cash economies shell currency has disappeared, although the contemporary Papua New Guinean currency, the Kina, is named after the valve of the pearl oyster, *Pinctada* species.

BOX 13 EXCHANGE AND BARTER OF REEF PRODUCTS

In the ***Andaman Islands***, reef fish are often used as a means of paying school tuition fees or gaining a favour from an official (Singh and Andrews, 2003).

In the ***Gulf of Mannar***, products from the reef and near-shore areas are widely used in systems of exchange for other products or services, which is considered as a way of life. In some instances, poorer households, particularly female-headed households, undertake activities such as net mending, in order to obtain free fish or other assistance (Rengasamy *et al*., 2003).

In ***Montego Bay, Jamaica***, the practice of sharing within a community may also ensure that vulnerable people are looked after and elderly fishermen recall sharing their catch with mothers and illegitimate children, who may not otherwise be provided for (Bunce and Gustavson, 1998).

In ***Kiribati***, there is a moral obligation to share fish catches and food with ones' elders as a mark of support and respect (Teiwaki, 1988).

In ***Papua New Guinea*** reef products were an important trading commodity with inland villages (Ruddle, 1993).

In ***Northern Mozambique***, dried fish is taken to local inland markets, where it is exchanged for other agricultural food products and clothing (Wilson *et al*., 2003).

In ***Ulithi Atoll in the Pacific***, the island of Falalap is ecologically favoured for the production of vegetables, but it lacks fishing grounds. Conversely, other islands are favoured with fishing but lack a freshwater lens essential for extensive vegetable cultivation. Consequently, the reciprocal exchange of vegetables for fish and vice versa takes place, ensuring communities obtain different foods and also forming the basis for social relations, exchange and networks between the islands (Ruddle, 1996).

In the ***Trobriand Islands***, fish products underpinned ceremonial exchanges and non-ceremonial barter linking coastal fishing communities with inland agricultural communities and allowing the redistribution of food stuffs and surpluses (Young, 1979).

Despite the erosion of reciprocal sharing with the introduction of cash economies and modernization, ***Torres Strait Islanders*** and ***Aboriginal peoples*** continue the practice of sharing marine and freshwater foods as a way of helping continue customary relationships between indigenous people and their environment and strengthening their ties of kinship (FRDC, 2001).

young, pregnant or old. In the Philippines it has been estimated that 50% of the population is reliant on fish for their primary source of protein and a large proportion of fish products originate from reef fisheries (McAllister, 1988; White and Cruz-Trinidad, 1998). Furthermore, increasing levels of child malnutrition amongst coastal communities in the Philippines, has been associated with declining fisheries production as a result of degraded reef resources (McAllister, 1988). In Sri Lanka, fish constitutes two thirds of the animal protein consumed and at least 50% of the fish species caught are directly dependent on the reef (Ohman *et al*., 1993).

In the South Pacific, people are primarily rural dwellers relying on a subsistence economy, which in turn relies predominantly on fisheries due to the scarcity of agricultural land (Adams *et al*., 1995). Coastal fisheries are vital to the nutrition of the rural people of the Pacific Islands (Table 10), with 90% of animal protein originating from fish products (Johannes, 1978), and 80% of coastal fisheries production consumed directly by the producer and their communities (Adams *et al*., 1995).

Small, damaged fish or certain parts of fish are typically a cheap food source for poor people (Figure 16), for example; the internal organs and head of sharks in Sri Lanka are mainly consumed by low income groups (Rajendran *et al*., 1992). Those reef resources, which may be accessed easily by foot and collected by hand, such as molluscs, are also often relied on as the only source of protein for the very poor. Among, coastal communities of Northern Mozambique, these resources were used heavily by women and female-headed households, often providing the only source of protein for some of the poorest and most disadvantaged members of the community (Wilson *et al*., 2003).

TABLE 10 DEPENDENCE OF PACIFIC ISLAND HOUSEHOLDS ON FISHING FOR SUBSISTENCE

Pacific Island	*% of households fishing primarily for local consumption*
Kiribati	99
Marshall Islands	87
Solomon Islands	83
Upolu	50
Vanuatu	35

Source: Bettencourt *et al*., 1995.

Figure 16 Women sorting trash fish, Indonesia.
Source: Mark V. Erdmann http://www.reefbase.org/

2.2.4.2 Medicinal contribution

Apart from their nutritional contributions to health, reef products may also provide medicinal benefits. Where communities have had long associations with the reef resources, an understanding of the medicinal properties of many of the reef species has been widely exploited (Box 14). With the emergence of modern medicines and health care, the traditional use of reef products in this way has become less common, however, for poorer households, with little access to alternatives, the medicinal properties of reef products offer ongoing benefits. In addition to local medicinal benefits, Chinese medicine has also traditionally valued the properties of reef and reef-associated products, such as sea cucumbers and sea horses, creating a sizeable (if sometimes illegal) market and income earning opportunities for local reef fishers.

2.2.4.3 A source of local knowledge

A high dependence on natural resources leads to an intimate knowledge of those resources and ways with which to extract them. People around the world who are dependent on coral reefs demonstrate a considerable understanding of the reef resource, a knowledge which reflects the diversity of the reef and encompasses species-specific information, as well as a broader understanding of ecosystem processes and linkages (Box 15). This knowledge, which is typically passed on informally and built up through experience enables poor communities, without access to sophisticated equipment or years of formal education, to successfully access and exploit the reef resource. This knowledge is also a resource which is essential for the safety and survival of fishers as they navigate and fish in a potentially dangerous environment.

2.2.4.4 A diversity of skills

The diversity of coral reef resources, together with the wealth of local knowledge of many reef users has promoted the development of a wide range of diverse fishing techniques,

BOX 14 MEDICINAL VALUES OF REEF PRODUCTS

Among the coastal communities of the ***Gulf of Mannar*** a wide range of reef and reef-associated near-shore species are known and used, when available, for their medicinal properties, including:

- Crabs – *Kan nandu* crab is useful for coughs and colds, while *Kuzhi* crab is used to reduce urea
- Fish – *Soodai* and *Mural* fish have a high iron content and are used to prevent anemia.
- Sea horses and sea lizards: are believed to help heart problems.
- Sea turtle meat: is used to treat piles.
- Dugong: the fat is believed to control digestive disorders, while the meat is thought to help muscle development.
- Shark: the meat is believed to help muscle development.
- Coralline island herb: the *Anjalai* herb is used to treat sea snakes bites.

(From: Rengasamy *et al.*, 2003)

In ***Palau***, Rabbit fish gall bladders are used for medicinal purposes, and on ***Tobi***, a South West Island of Palau, the local community use a particular Surgeon fish for the treatment of common chancre sores and fever (Johannes, 1981). On ***Hawaii*** Terebellid worms are used medicinally (Spalding *et al.*, 2001). On the ***Lakshadweep Islands***, the money cowrie, locally known as *Vallakavadi* is used in a paste as a common home remedy to treat cysts or stys in the eye (Hoon, 2003).

BOX 15 EXAMPLES OF LOCAL KNOWLEDGE OF REEF RESOURCES

In many coastal communities of the world, local knowledge has accumulated through centuries of reef dependency and is demonstrated by both the men and women who exploit the reef. An example of the level of local or indigenous knowledge is revealed in local naming systems, or folk taxa.

In the ***Solomon Islands***, 350 unique folk taxa exist for cartilaginous and bony fish, with names revealing such information as habitat, behaviour, appearance, smell, taste and interaction with fishing gear (Foale, 1998).

In ***Palau***, fishermen have names for over 300 species of fish, and in Tobi, a South West Island of Palau, 200 different fish species are differentiated with names again indicating characteristics such as species' feeding preferences, biting habits and appearance (Johannes, 1981).

In ***Atulayan Bay, Philippines*** the folk taxonomy used by local fishers distinguishes hundreds of marine vertebrates and invertebrates and is used to indicate their economic and cultural significance, as well as physical and behavioural characteristics (Pollnac ,1998).

On the ***Southern Kenya*** coast, on-going CORDIO research has so far catalogued a total of 188 local folk taxa for species exploited from the coral reefs around Diani and Chale (David Obura and Innocent Wanyoni, 2002 pers. comm.).

Local knowledge also encompasses an awareness of natural processes, such as the growth rate of important shell species or the daily and seasonal migrations of fish species and location and timing of fish spawning aggregations, as well as a knowledge of the tidal cycles and weather patterns, which affect resource availability.

In ***Palau***, fishermen exploit their knowledge of lunar spawning cycles and daily and seasonal migrations across the reef to time their fishing activities effectively and learning this information is an essential part of becoming a good fisherman (Johannes, 1981).

In ***Samoa***, local elders were able to accurately predict the biannual 'rising of the palolo', a mass spawning event, which might last only a few hours, during which locals furiously harvested the palolo worms to be consumed as a local delicacy (Gibbings, 1949).

The ***Lakshadweep islanders***, have knowledge of numerous different types of fish and where they can be found according to the tide or lunar cycle (Hoon, 2003).

For the coastal inhabitants of Chwaka Bay, on the east coast of ***Unguja Island, Zanzibar, Tanzania***, an intimate knowledge of tidal variations mapped by a detailed mental lunar calendar, and variations in wind and temperature mapped through the solar calendar, enable locals to successfully organize and schedule their fishing and agricultural activities and exploit the shallow and complex near-shore resources (Tobisson *et al*., 1998).

targeting different species and different reef habitats (Figures 17 and 18). Where coastal communities have interacted with the reef resource for many generations, their pattern of reef exploitation is typically well developed and reef users will possess a diversity of practical skills associated with the variety of fishing techniques employed. In Atulayan Bay, Philippines, 19 different fishing methods were encountered including gleaning, spear guns, hand-lines (single or multiple hooks, with or without bait), numerous types of nets, fish corral, aggregating devices, scare lines and illegal techniques such as cyanide and dynamite (Pollnac, 1998). On the Lakshadweep Islands, 16 different fishing methods were encountered on one island alone, each employing a diversity of different gears and targeting specific reef areas and species (Hoon, 2003). In Palau, a combination of knowledge and skill is demonstrated in many fishing techniques, such as the use of a nerve toxin released from the skin of sea

Figure 17 Women using a net in a shallow lagoon, Indonesia.
Source: James Oliver http://www.reefbase.org/

Figure 18 Cast netting in a shallow lagoon, Gulf of Mannar, India.
Source: Emma Whittingham, IMM Ltd.

cucumber to paralyse large edible sea anemones or octopi, or mimicking the sounds of fish underwater to attract and locate fish prey (Johannes, 1981).

Such a diversity of skills and wealth of knowledge have evolved simultaneously in order to successfully exploit the diverse reef resource. They are essential for the subsistence and survival of many isolated island communities and poor coastal communities, who have little alternative resources to exploit.

2.2.5 Social resources

2.2.5.1 Communal exploitation

The complex physical structure and often close proximity of the reef to the shore, allows and frequently requires exploitation to be undertaken as a communal or collaborative activity, sometimes with many members of the community taking part (Box 16). These activities are important in providing an opportunity for exchange and in creating and reaffirming relationships, bonds and networks within a community. Communal harvest on the reef flats by foot, also known as reef gleaning, is an activity encountered throughout the world among communities adjacent to shallow reefs. It is an activity which is often carried out by groups of women, together with children and the elderly, and as well as providing food and income benefits (discussed in Sections 2.2.3 and 2.2.4), it is also important in providing a social time between women and a chance to be together away from the house and village.

Communal activities may also be important in enhancing an individuals' sense of community through cooperation and sharing and in this way reduce conflict and assist newcomers in integrating in the community. In the Andaman Islands, opportunities for labouring on fishing boats provide the most immediate and accessible livelihood option in fishing communities and are an important way for new migrants to build up trust and relationships in the community (Singh and Andrews, 2003).

BOX 16 COMMUNAL EXPLOITATION OF REEF RESOURCES

In the ***South Pacific Islands and Palau***, group spear fishing and *roop* fishing (also known as the 'leaf sweep') is undertaken on the reef involving large numbers of men, at times the whole community. These may be important activities to provide large quantities of food for social events (Dalzell *et al*., 1995; Johannes, 1981).

In ***Papua New Guinea***, traditional use of nets, spear fishing and coral collection from the reef flats were all collaborative activities (Lokani, 1995).

In the ***Lakshadweep Islands***, a collaborative fishing operations, known as *Bala Fadal*, involving 25–30 men is carried out around three times a week during the monsoon season mainly to provide food for household consumption (Hoon, 2003).

Collaborative activities also function to reduce the risks involved in 'going it alone'. It may act as a means of sharing physical or human resources amongst the community, so helping households to overcome a lack or surplus of manpower or fishing gear. Such is the case in Sri Lanka, where two households might engage in 'partnership work', or '*havula rassava*' in situations where one household has a surplus of labour, whilst another has a shortage in relation to fishing gear (Stirrat, 1988). So typically, households with a surplus of teenage boys, may 'lend' a son to another household, where, in exchange for assisting with fishing activities, he will receive training in fishing skills, food, clothes and pocket money (Stirrat, 1988). Assistance and labour in fishing may also be exchanged at the landing site, for example, in Sri Lanka fishermen from a common landing site are expected to assist one another in dragging each other's boats ashore, an activity which could not be done otherwise, particularly during the south west monsoon when the beaches are too steep even for the smallest boat (Stirrat, 1988). In Montego Bay, Jamaica, certain fish landing sites were identified as important places for the community to exchange and network and were associated with a strong sense of community and social activity (Bunce and Gustavson, 1998).

2.2.5.2 Customs and traditions

Among traditional coastal communities, coral reef systems and the near-shore fisheries they support are often the focus of elaborate belief systems, customs and traditions (Box 17). In the

BOX 17 EXAMPLES OF BELIEFS ASSOCIATED WITH REEF AREAS

For the ***Torres Strait Islanders and Aboriginals of Australia***, the people's association with the land and sea is based on the belief that land and seascapes were created by ancestral beings, who spread social groups and their languages across the landscape in a particular way. People identify as being a member of a kin group with a particular language area associated with certain areas of land and sea and sharing responsibility for the protection and use of these areas (Innes, 1996).

In ***Papua New Guinea*** some clans believe that their home reefs were created by their ancestors, and they may also attribute spiritual powers to reefs and submerged rocks in this area (Asafu-Adjaye, 2000). Particular reef areas may be considered sacred due to the presence of ancestral spirits or monstrous creatures, or their use as burial sites or for other rituals, and this will govern the way they are used and by whom (Innes, 1996; Lokani, 1995).

In ***Kenya***, elaborate cultural beliefs and rituals of sacrifice are associated with particular sacred sites along the coast (on land and at sea), as is the practice of appeasing and requesting favours from the spirits that inhabit them. At certain times of the year, sacred sites at sea were avoided for fear of upsetting the spirits. Other sacred sites associated with unusual phenomena or danger, were avoided throughout the year (McClanahan *et al*., 1998).

Among the coastal communities of the ***Gulf of Mannar, India***, locals believe that Appa Island is the home of an island God (*Santhanamariamman*) and by pleasing this God they will be protected from evil spirits when they stay on the island. It is also believed that another god (*Muniyasamy*) resides in a coral mound just near the island and close to an area known for dangerous currents and an underwater cave. Fisherfolks are warned that in order to escape from the wrath of deities they should not approach this area (Rengasamy *et al*., 2003).

Pacific Islands, parts of Southeast Asia and the Indian Ocean, complex belief systems are prevalent and often manifest themselves in systems of customary marine tenure (CMT) or traditional management. The beliefs underpinning CMT or traditional management, consist of a complexity of spiritual associations, rituals and myths encompassing communities and their surrounding natural world on land and sea. They include beliefs and rules, which govern access to and use of reef resources and form the basis of social relationships both within a community and between communities (Ruddle *et al*., 1992). They are also a source of individual and community identity and social status, and provide a sense of well-being, bonding groups through their common beliefs and rights (Johannes *et al*., 1991; Ruddle, 1996).

Certain beliefs and rituals focus on particular reef species. In the South Pacific, totemic and other taboos may be placed on certain reef food species, restricting particular clans, families, age groups or genders from catching or eating them (Johannes, 1978; Veitayaki, 1994). Certain species may also be of ceremonial importance, for example, dried dugong skin is used in agricultural ceremonies and healing rituals in Papua New Guinea (Schug, 1995). In Tonga, lobster is a special ceremonial food item for mass feast occasions, such as weddings or birthdays (Udagawa *et al*., 1995). Other species may even be believed to be magical and the focus of worship. For example, in parts of the South Pacific shark worship was common and sharks were believed to be the embodiment of the souls of deceased ancestors, with a variety of mythology surrounding them (Nichols, 1993). In Samoa, the turtle is considered a sacred species and particular rules govern a fisherman's relationship with it (Gibbings, 1949). In India, where traditional Hindu society recognised individual species as objects of worship, the turtle occupies an important place in Hindu mythology and is considered sacred among the fishermen of Tamil Nadu (Bavinck, 2001).

The activity of fishing is also often the focus of myths and rituals, which may confer special status on an individual, and have helped perpetuate fishing knowledge and beliefs systems, which themselves are the very basis of a fishing communities' cultural identity (Raychaudhuri, 1980). The origin of particular fishing techniques are often found in local myth or legends (Box 18). In Kiribati, fishing is a feature of numerous myths and rituals and the origin of some fishing techniques and locations of good fishing grounds are derived from myth (Teiwaki, 1988). In the Lakshadweep Islands, India, there is hardly any tale or song which does not mention the traditional sailing crafts, known as *Odams*, the journeys of enterprising 'heroes' and the adventures of fishing in the sea. There are even stories of a sea ghost *baluvam*, a benevolent ghost, whose coming to shore is considered as a harbinger of prosperity for that year, bringing more coconuts, more fish and general well-being (Hoon, 2003). Elsewhere in India, the origins of certain deities are associated with fishing and the sea and rituals may be performed at every stage of fishing in an attempt to reduce hazards or to ensure a

BOX 18 A FIJIAN LEGEND

'There was once a shipwrecked rat, who when near to drowning was rescued by a kind-hearted, though wary, octopus. The rescuer made sure the rescued understood in no uncertain terms that, as land was a long way off, he would bear his passenger, only if he first received an assurance that he was "house broke" and a solemn promise that the rat remember his manners, keeping nature at bay until he was delivered safely ashore.

The promise was readily given, but alas, nature conquered, and at the moment the rat leapt ashore, the promise was broken. Like the elephant, the octopus never forgets!

Fijian mothers tell this story to their daughters, for it is by reminding the octopus of the rat who "did him wrong" that the fisherwomen are able to catch the octopus. A rat-shaped lure, made of a shell tied to a piece of reed or willow, which makes rat squeaking sounds as it's rapidly thrust in and out of holes on the reef, is used to attract the octopus.

This method of octopus fishing is recognised to be one of the few which women only are allowed to practice.'

(From: Wright, 1994)

good catch (Bavinck, 2001; Hajra, 1970; Mukherjee, 1968; Raychaudhuri, 1980). At dusk every Tuesday in the Gulf of Mannar, local fishermen will undertake a ritual called *Neeratuthal*, which involves cleaning their boats and applying *kungumam* (saffron) and sandalwood paste and lighting camphor, in order to bring good fortune to fishing (Rengasamy *et al.*, 2003).

Fishing activities and associated beliefs may give special status to individuals or groups in a community. For example, an institution of magicians has developed in India specifically to counteract poisonous bites of sea creatures (Raychaudhuri, 1980). In Papua New Guinea, certain individuals were believed to possess a mixture of magical powers and special knowledge of fish behaviours, giving them the authority to perform a traditional form of management known as *Kieching* (Lokani, 1995). Considerable prestige may be attached to the man skilled in ritual knowledge and in possession of magical powers that enable him to have success in fishing (Hogbin, 1973). In Palau, there is no higher accolade than to be called a 'real fisherman' and great pride is associated with fishing skill and knowledge (Johannes, 1981).

Fishing is often considered a way of life and an integral part of social and economic existence. In Montego Bay, Jamaica, fishers perceive their activity as an intrinsic part of the community and themselves (Bunce and Gustavson, 1998). In India and Sri Lanka, fishing is associated with particular castes and is considered a traditional occupation and way of life, which has been passed down from generation to generation. In some coastal communities (e.g. the Gulf of Mannar, India and Northern Mozambique) to be a fisherman is considered of greater status than to be a farmer, such that in Northern Mozambique regardless of the relative time spent fishing it is preferable to be labelled a fisher than a farmer (Rengasamy *et al.*, 2003; Wilson *et al.* 2003).

2.3 ENHANCING INTERACTIONS WITH DIRECT INFLUENCING FACTORS

The livelihoods of reef-dependent people not only rely on the resources that are available to them, but also to the wider environment in which they operate. In this wider environment there are a range of factors that influence the way people are able to access and use the resources available to them. Direct influencing factors include a complex range of factors resulting from history, politics, culture, religion, social relations, decision-making and negotiation. The reef ecosystems allow reef-dependent people to interact with those influencing factors in special ways that confer benefits upon them.

2.3.1 Policies

2.3.1.1 Conservation

The biodiversity of coral reefs has been a magnet for research and scientific interest and has raised the profile of coral reefs to global significance, recognized in international environmental policy and conventions (e.g. Agenda 21 of the United Nations Conference on Environment and Development (UNCED), Jakarta Mandate of the Convention on Biological Diversity (CBD) and the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA)). As a result, significant funds have been allocated specifically for coral reef conservation and management. Global Environment Facility (GEF) funds, which target biodiversity, have been used considerably by the World Bank, UNDP and UNEP for coral reef-related projects (e.g. UNDP-GEF coral reef biodiversity projects in the Maldives and in India, in the Gulf of Mannar and Andaman and Nicobar Islands). Millions of US dollars have been spent by the World Bank financing the development of a global system of marine protected areas to conserve biodiversity (Hatziolos, 1997). The International Coral Reef Action Network (ICRAN) recently received US$3 million at the World Summit on Sustainable Development (WSSD), adding to its US$5 million received in 2001 to initiate reef management and conservation activities over the next four years, and has plans to

raise a minimum of US$25 million to continue these activities over the next decade.

The international attention and support focused on coral reefs is also reflected in the national policies and funding of coral reef nations. In India, for example, the Ministry of Environment and Forests has established the Indian Coral Reef Monitoring Network (ICRMN), and over the last three years has allocated and distributed funds for monitoring activities in each of the four major coral reef areas.

Such attention has the potential to bring benefits to local communities, where conservation efforts embrace concepts such as sustainable and equitable livelihoods and coastal community development.

2.3.1.2 Indigenous rights

Coral reefs have also been the focus of attention on indigenous rights, through the recognition of traditional and indigenous reef-dependent communities and the importance and value of their rights and knowledge. The adoption of international standards of human rights has led to specific policies and legislation registering and protecting the rights of indigenous peoples. This has had significant relevance to those communities with customary or traditional associations with the land and sea, which define their rights over and use of reef resources (Box 19).

Recognition of the rights of indigenous peoples may confer greater participation in government-led policy planning and implementation. In the Great Barrier Reef (GBR) World Heritage Area increasing acknowledgement of indigenous rights and interests has led to greater involvement and participation of Aboriginal and Torres Strait islander communities in planning, policy formulation, assessment and management of the GBR marine resources. For example, Aboriginal and Torres Strait islanders have been involved in the co-operative management of dugong and turtles, and increasing numbers are being recruited as staff for the GBR Marine Park Authority (Benzaken *et al.*, 1997). Similarly, in the Surin Islands, Thailand, participation of local indigenous people in the management of the national park has been promoted in response to the International Decade of the World's Indigenous People (UNESCO, 2001).

The recognition of the value of indigenous traditions and knowledge has also led to the introduction of formal courses on this subject in local schools. In Tokelau, elders teach traditional knowledge in primary and secondary schools (Ruddle, 1993).

BOX 19 THE RECOGNITION OF INDIGENOUS COMMUNITIES IN TORRES STRAIT

The 1976 **Torres Strait** Treaty reflects a concern for the rights of indigenous people in its recognition of 'the importance of protecting the traditional way of life and livelihood' of Torres Strait indigenous people and its requirement that people preserve the traditional customary rights of access to and use of land and marine resources. The formal recognition of systems of customary marine tenure strengthen and empower these systems and bring a range of associated benefits to indigenous communities. However, the interpretation of formal treaties and legislation in distributing rights may often be the cause of conflict among communities. For example, in interpreting the 1976 Torres Strait Treaty preference has been given to the interests of coastal villages, ignoring inland groups who also claim a relationship with the marine resource of the Torres Strait.

(From: Schug, 1995)

2.3.1.3 Trade and fisheries development

Coral reef diversity and productivity offer opportunities for implementation of fisheries development policies, particularly those focused on expanding export markets, which in turn provide opportunities to small-scale reef fishers. A diversity of reef products attract the attention of lucrative export markets, and represent an important source of income to coastal communities, as well as export revenue for national economies (Section 2.2.3.3). In the Indian state of Tamil Nadu, fishery policy in the sixth 5-year plan supports the promotion of fish-based industries with specific reference to reef-based products, such as pearls and the sacred chank (Drewes, 1982).

The small-scale nature of coral reef fisheries also benefit from policies targeting the development of local artisanal fisheries, supporting trade diversity, or protecting and developing local production. In the Marshall Islands, for example, the second 5-year development plan promotes the development of existing small-scale fisheries in the outer islands, with the objective of increasing the supply of fish to urban areas on central islands and providing opportunities of increased cash earnings on outer islands (MIMRA, 1995). In certain Pacific Islands, import duty on imported fish and meat has been imposed as a means of reducing trade deficits and increasing support for local fisheries, where imported canned fish has frequently replaced the market for local fresh fish (Johannes, 1981). Thus, in the Solomon Islands, an import duty of 37.5% was imposed on imported canned fish, while in Western Samoa a 34% import duty was imposed (Johannes, 1981). In the Philippines and Thailand, implementation of the FAO 'Action Programme on the Promotion of Fisheries in the Alleviation of Malnutrition' led to fisheries development policies aimed at increasing the use of

local fisheries products for the alleviation of malnutrition (Heel, 1986).

Coral reefs also provide habitats for stock enhancement programmes, which may be a part of fisheries and trade development policies aimed at increasing stocks of valuable reef products and promoting commercial extraction and associated financial benefits for local communities. Such programmes are common throughout the South Pacific, for example, in Tonga a Japanese-funded Aquaculture Research and Development Project aims to enhance stocks of giant clams, relying on local villagers to manage nursery stocks on their local reefs (Sone and Lotoahea 1995).

2.3.1.4 Structural adjustment

Coral reefs also play a role in supporting people as they cope and adapt to changing policies in other sectors. The impact of structural adjustment policies resulting in the displacement of people from their original livelihoods, may be absorbed by the coral reef fishery. For example, on the island of Niue, cut backs in government sector jobs resulted in a corresponding increase in fishing pressure on reef flats and slopes, as laid off government workers turned to the reef fishery to meet their income and other needs (Pasisi, 1995). Similarly, the impact of policies of land privatisation, which typically have disproportionate effects on disadvantaged groups by reducing their access to land resources, may again be assimilated by the multiple and accessible options offered by the coral reef resource. Local fisheries resources may even be the target of structural adjustment policies. In the 1950s in Sri Lanka, for example, government policy encouraged the creation of 'fishing colonies', which resulted in the movement of large numbers of people from the south to resource rich areas along the north-west coast (Stirrat, 1988).

2.3.2 Institutions

2.3.2.1 Markets and private enterprise

The diversity of coral reef products attract a diversity of market outlets, which are composed of an often complex system of traders and private entrepreneurs linking the fisher to the consumer (Figures 19 and 20). These trading institutions are vital for the livelihoods of many poor coastal communities, providing vital infrastructure support required to process, handle, transport and market reef products. For the small-scale reef fishers, private traders often provide access to high value export markets and are the only accessible source of credit available for poorer households. While such credit provision is frequently inequitable, indebting and bonding poor households to traders, for many it is critical for survival: providing access to fishing gear; absorbing short-term losses; and supporting households in times of crisis. In the Sri Lankan village of Ambakandawila, the local credit system provided a third of all credit and allowed local villagers to meet basic daily expenditures, as well as major expenditures for fishing gear, regardless of the availability of immediate income (Stirrat, 1988). For poor households in coastal villages of the Gulf of Mannar, private traders provide the only easily accessible from of credit, which becomes a safety net at times of crisis or during festival periods, when expenditure is high (Rengasamy *et al.*, 2003).

Traders may also provide opportunities for fishers to access seasonal migratory fishing opportunities and thereby overcome

Figure 19 A widow and trader sorting the crab catch, Gulf of Mannar, India.

Source: Emma Whittingham, IMM Ltd.

Figure 20 Fisherman with sea urchin catch, Philippines.

Source: James Oliver http://www.reefbase.org/

seasonal lows in local fishing or activities in other sectors. During the south west monsoon, in Sri Lanka, traders arrange credit to cover basic accommodation and food requirements at temporary fishing camps on the north east coast and guarantee to purchase fish and transport to distant markets (Stirrat, 1988). On South Andaman Island, India, fish traders support the seasonal migration of 60–70 West Bengali fishers to the coastal community of Guptapara, to access the lucrative reef fishery for export markets (Singh and Andrews, 2003).

2.3.2.2 Government institutions

Coral reef and associated resources and the near-shore, small-scale fisheries they support, are the focus of various government institutions, concerned either with the conservation of the reef resource (environment departments and agencies), the management of the local fishery (fisheries departments and agencies), or for the development and welfare of the local fishing communities (development and social welfare departments and agencies).

Where such institutions' objectives and activities reflect the needs and aspirations of the local coastal communities and the poor, they may bring a stream of different benefits. For example, in the Gulf of Mannar, the Fisheries Department, through local extension offices, has recently begun targeting women's groups to improve their livelihood status, through the provision of training to introduce new activities or enhance existing ones (e.g. training in hygienic handling and processing of fisheries products). In the same place, the Revenue Department, has provided important benefits, through the provision of pensions and relief to widows of fishermen, on which some elderly widows are completely dependent to support themselves (Rengasamy *et al.*, 2003).

Decentralised local government structures may also play a role in supporting local level management of resources. In Tamil Nadu, India, while small-scale fishing is typically open access, local associations or *panchayats* will regulate how people exploit the adjacent inshore area, through a system of rules relating to types and application of fishing gear. Rules apply equally to outsiders and local fishers, giving anyone the right to fish in a particular area as long as they abide by the local rules (Bavinck, 2001). Village *panchayats* also function to settle disputes over fishing activities within or between villages and provide a means of legitimising local level decisions relating to matters of common interest (Bavinck, 2001; Mukherjee, 1968).

However, despite the obvious scope for providing benefits to local communities, the actual benefits arising from relevant government institutions is highly variable, depending on their financial and human resources and objectives. These benefits are frequently low in many developing countries amongst the poorer members of the community, who typically lack access to formal structures and processes. For example, in Northern Mozambique, the infrastructure of relevant government institutions at a local village level is extremely weak and in most cases non-existent (Wilson *et al.*, 2003).

2.3.2.3 Traditional management systems

In many communities of the world, complex and deep-rooted associations between the communities and their natural environment have manifested in a diversity of beliefs and traditions (Section 2.2.5.2), which are widely encountered in systems of traditional management. Where coral reefs form part of the local environment, they are an integral part of these traditional management systems, which define ownership, access and use of near-shore coral reef resources through systems of beliefs, rules and social norms. In this way, traditional management forms the framework for social relations and negotiation, and defines the form and extent of access to local resources (Box 20). For those communities or family groups possessing the access rights or tenure over a reef area, traditional management may provide numerous benefits: promoting equity, sharing, and local monitoring and management of resources.

The control of traditional management extends beyond the activities of a single community, it also governs interactions with neighbouring communities and outsiders. Provided the relevant rules of conduct are followed, access may be permitted to exploit the resources of a neighbour. Throughout Oceania, it was common for permission to fish in a neighbours fishing ground to be granted in exchange for a portion of the catch. This was an important way to obtain reef products absent in your own fishing ground or unavailable due to bad weather (Johannes, 1978). It also defined social relationships and boundaries between neighbours. In the Solomon Islands, coastal rights-holding groups exchanged access to their marine resources with inland forest or 'bush' right-holding groups, enabling each group to exploit important resources outside their traditional territory (Ruddle *et al.*, 1992).

Traditional management systems, through direct intent or simply as the byproduct of another purpose, are often associated with sustainable livelihoods. On some Pacific Islands, management measures intending to conserve the resource and ensure future sustainability were clearly the outcome of an awareness of the limited nature of the resource and the isolation of the population (Ruddle *et al.*, 1992). The Nenema people of northern New Caledonia, for example, condemned wastage and thus avoided catching in excess of what could be consumed (Teulieres, 1992). Other traditional management measures included a variety of

BOX 20 TRADITIONAL MANAGEMENT SYSTEMS

In ***Vanuatu***, rights to access and use of areas of near-shore reef are held by individual clans, or, where previously independent and isolated clans have moved into proximity and coalesced, marine tenure has been amalgamated into 'community' tenure of a group of clans. Within marine territories fishery activities are governed by rules which dictate how, where, when and by whom resources may be harvested. In some cases, rules may ban the use of a specific fishing gear, at other times they may enact a temporary closure on a certain area of reef or reef species. Closures are often associated with cultural events or ceremonies, for example; to honour the death of a chief, the waters in which the body was washed would be closed. In other cases, while it might be explicitly stated that the purpose of a closure was for conservation to promote tourism, there may also be significant implicit reasons for closure, such as strengthening claims to adjacent land or making a political statement to the wider community.

(From: MRAG, 1999)

In ***Kiribati***, under the traditional sea tenure, which declined under colonial administration, customary practices involved an intricate system of mutual sharing and obligation, and there was no apparent evidence of deprivation or lack of access to the sea and its resources. Each island had its own rules about fishing, including when to fish, how to fish and where to fish, and what should be done before, during and after each fishing expedition. It was regarded as sinful to exploit a reef not belonging to one's family without first requesting permission and there was a moral obligation to allow reciprocal access to both maternal and paternal relatives. Compliance with these rules ensured maximum productivity and equitable sharing in the community.

(From: Teiwaki, 1988)

Along the ***Kenya*** coastline, small-scale fishery activities have traditionally been regulated through taboos and omens controlled by community elders. These beliefs and rules govern where and when to fish as well as how one should fish, and act to maintain social control and access to common pool resources.

(From: Glaesel, 2000)

restrictions on fishing practices, e.g. areas were declared as taboo, forbidding fishing for ritual reasons and to ensure a large catch for a feast or celebration, or because the area had been over-fished (Johannes, 1978). In Indonesia, the traditional practice of 'Sasi' functioned to ensure reef species were allowed to reproduce, grow and accumulate and that heavily exploited areas of reef were allowed to regenerate (Thorburn, 2001). In Tamil Nadu, India, local village gear restrictions are motivated by a desire to minimize harm to the community in three ways: harm to the fish stock; harm to the majority style fishing (or potential gear conflict); and harm to the social cohesion of the community (Bavinck, 2001).

In contemporary times, where traditional management is recognized and supported by government and legislation, it may be the basis for negotiating with outsiders over access rights in return for fees or royalties and in this way act as a means of income generation. In the Solomon Islands and in Fiji license fees, royalties or 'goodwill' payments are made by commercial bait fishers to the traditional owner of a fishing ground in order to access the right to fish for bait (Rawlinson, 1995). In Maluku, Indonesia, families have pledged traditional ownership rights over reef areas as collateral for loans from entrepreneurs, who then gain access to exploit commercially valuable fin and shell fish resources (Ruddle, 1993). In the village of Thavukadu in the Gulf of Mannar, a fee is imposed on outsiders to operate shore nets adjacent to the village or use the village fish landing site. These fees are kept as a common fund and spent on village festivals or common expenses (Rengasamy *et al.*, 2003).

Recognition of traditional management by local governments has also empowered local level involvement in policy formation and implementation, extending beyond the physical boundaries of the reef resource. In Oceania, active traditional management systems have facilitated the involvement of local communities in steering the course of externally initiated activities, such as industrial bait fishing, the cultivation of seaweed, pearl oysters and giant clam, diving-based tourism, as well as inland logging and mining developments (Hviding, 1994). For example, in the Solomon Islands, coastal rights-holding groups have resisted inland logging and mining developments in forest rights-holding territories over concern for damage to reef resources through river-borne sedimentation (Ruddle *et al.*, 1992). In Vanuatu, the Fisheries Department both recognises and encourages the traditional management practices of local villages, which has enabled the development of a co-operative approach to the management of the Trochus

resource, and resulted in a positive relationship between the government and community (Jimmy, 1995). But the potential for applying and combining the significant and valuable indigenous ecological knowledge and traditional management systems with formal scientific approaches to management and development is vast and as yet mostly untapped (Johannes, 1994).

2.3.3 Organisations

In the same way that the biodiversity of coral reefs has attracted recognition in international policy, it is also the target of a multitude of initiatives and NGOs at international (e.g. International Coral Reef Initiative (ICRI), World Conservation Union (IUCN)), regional (e.g. UNEP Regional Seas Programmes), national and local levels. These organisations may have powerful voices in decision-making, and where this coincides with the needs and aspirations of local resource users, this may bring positive impacts.

In South Asia, the Global Coral Reef Monitoring Network (GCRMN) works together with government institutions, universities, NGOs and local reef stakeholders to co-ordinate and build capacity to inform management for the sustainable use of coral reef resources. This has led to increasing participation of local communities in monitoring and an increasing recognition amongst institutional stakeholders of the wide range of reef stakeholders and their diverse needs, aspirations and priorities.

The reef fishery is also the focus of local organisations, such as fisheries co-operative societies and unions, which may provide a voice to local small-scale fishers and promote their interests, both with regards to the reef resource and other issues of welfare and equity (Box 21). In many instances, fishing co-operatives were set up to manage the marketing of fish products on behalf of the fishers, in order to reduce the control of independent traders and to allow fishers to receive better returns for their catch. For example, in India the Gujarat Fisheries Central Co-operative Association provided credit and loans, supplied low cost equipment, assisted with fish processing and marketing, provided knowledge on new technology in fishing, and looked after the welfare of its members (Hajra, 1970).

2.3.4 Social relations

2.3.4.1 Gender and age

Reef flats and shallow reef lagoons are accessible on foot, without the need of a boat and so provide an opportunity for women, children and the elderly to access the reef and directly engage in harvesting activities, or reef gleaning (Box 22, Figure 21). This is a significant factor distinguishing reef-based fisheries from other near-shore fisheries, which are typically recognised as being an adult male domain, with women and children restricted mainly

BOX 21 THE FISHERIES UNION OF THE GULF OF MANNAR, INDIA

For the small-scale fisherfolk of the **Gulf of Mannar**, the most important organisation at the village level is the Fisheries Union, with 80% of small-scale fishers (men and women) being active members. The union provides the only common channel through which problems and issues can be voiced at higher levels by local fisherfolk. Participation and reliance on unions has strengthened in recent years in response to degrading reef resources, increasing conflicts with commercial fishing operations and the restrictions imposed by the Gulf of Mannar Marine Biosphere Reserve (GOMMBR). Local participation in the Fisheries Union has empowered the small-scale fishers, and brought about a number of successful local management measures, including:

- The restriction of commercial trawling activities within the 'trapped sea' between the islands and the mainland coast, thereby safeguarding the resource for the local small-scale fishers and reducing overall conflict in the fishing industry.
- A locally agreed ban on dynamite fishing and coral mining (reinforcing the official government ban), and a ban on the use of a metal tool for seaweed harvest. These were in recognition of the danger and damage caused by these activities, an awareness which was the product in part of efforts associated with the GOMMBR, as well as individuals' personal observations of the impacts of destructive practices.

(From: Rengasamy *et al.*, 2003)

Figure 21 Women reef gleaning, Fiji.
Source: James Oliver, http://www.reefbase.org/

BOX 22 REEF GLEANING

Exploitation of the reef flat on foot and by hand, or reef gleaning, is commonly the domain of women and children. On a daily basis reef gleaning in many communities provides a regular supply of protein and may significantly enhance the nutritional status of households (Gina-Whewell, 1992). In certain seasons when weather limits access to more exposed parts of the reef, it may also be the only source of food or income.

On the ***islands of the Indo-Pacific***, the extent of women's contribution to marine foods ranges from 11% in Kiribati, to 17% in Western Samoa and 25–50% in Papua New Guinea (Tuara, 1995).

In the coastal communities of ***Northern Mozambique***, reef harvesting activities are particularly important to women, providing food and cash security for those lacking in other resources or those households lacking a main provider. Women from over two-thirds of households in the study communities were involved in intertidal mollusc collection, providing a key source of daily protein, as well as an opportunity for women to generate cash from excess mollusc harvest, giving them some level control (although not guaranteed) over the household's income. (Wilson *et al.*, 2003).

On the ***Lakshadweep Islands, India***, not only does reef gleaning provide a supplementary source of income, which the women can control, it is also the source of a wealth of knowledge about the reef resource, which women accumulate from a young age. For elderly and households lacking formal education, who cannot access jobs in the government sector, and live by subsistence means alone, reef gleaning forms an important share of household income. While for others, although the financial dependence on reef gleaning has diminished, its importance for women as a recreation, a break from household duties and a chance to chat together away from the men, is still of great value (Hoon, 2003).

to shore-based activities and often excluded from food collection and commercial harvesting activities, in particular where this involves the use of boats (Bavinck, 2001). Consequently, women may be some of the most marginalised groups in a fishing community (Campbell and Beardmore, 2001). However, in a coral reef fishery the diversity of options for exploitation and the physical accessibility of the reef opens up opportunities for direct participation by women and consequently increases their independence and the importance of their role in the community. It also provides a place for children to play and learn important skills and knowledge for fishing activities later in life (Figure 22). This is the custom in the South West Island of Tobi, Palau, where for 3–4 years young boys will use simple hand lines with a loop and bait at the end to learn the art of fishing and the behaviour of different fish species on the reef flats (Johannes, 1981). Similarly, in the Surin Islands, Thailand, young Moken boys spend much of their time playing, swimming and diving in shallow reef lagoons and in doing so build crucial skills for their future daily subsistence (UNESCO, 2001).

Women are not only involved in reef gleaning, they also undertake coral mining activities, make and mend fishing gear, and are frequently involved in fish processing and marketing. In Wakatobi National Park, Sulawesi, women typically dominate coral mining activities for which there are few alternative income-generating opportunities available, in particular for widows (Elliot *et al.*, 2001). In Papua New Guinea, island women process lime from corals (Lokani, 1995), and despite it being illegal women in Sri Lanka often extract coral for lime production, due to its accessibility and the pressure to generate additional income (Ekaratne *et al.*, 1998). Women also participate in making and mending fishing gear (in India, Hajra, 1970 and Mukherjee, 1968; in the South Pacific, Tuara, 1995).

Fish processing and marketing are activities often dominated by women and offer an important survival strategy for households with access to few other physical assets (such as boats and gear), for elderly women, widows or wives of infirm men. Small-scale reef fisheries support the involvement of local women traders and their involvement can give them greater control over the household income and in negotiating for loans or credit. Their role is not only important in providing income

Figure 22 Children reef gleaning, Philippines.
Source: John McManus, http://www.reefbase.org/

Figure 23 Women cleaning crab nets, Gulf of Mannar, India.
Source: Emma Whittingham, IMM Ltd.

for their families, it also underpins the local village economy (Heel, 1986).

In certain fishing communities on South Andaman Island, India, up to 70% of women were involved in fish vending, which represented an important opportunity for the recently migrated households, with limited financial and physical resources (Singh and Andrews, 2003). In the Gulf of Mannar, India, the role of women in the small-scale fisheries is a key factor in providing them with independence to control income and spending and support the household (Figure 23). Women's involvement is also frequently expressed as being pivotal in the local fishery and the importance of their involvement is demonstrated through women's active participation in the Fisheries Union and local NGO activities (Rengasamy *et al.*, 2003).

Systems of traditional management often play a role in defining the division of labour between men and women, confining women to access those foods harvested by hand (Teulieres, 1992). On Ulithi Atoll women have a distinct role and rights in the distribution of fish catches. This is because the canoe hulls, made from mahogany logs from Yap Island are obtained through the exchange of cloth made by the women of Ulithi (Ruddle, 1996).

2.3.4.2 Caste and class

Customary laws and traditional management systems associated with reef resources may also have an impact on caste and class distinctions. In the Kei Islands, Indonesia, indigenous property law divides Kei society into three classes or castes based on ancestry and heritable rights to land, marine and other resources (Thorburn, 2000). In Palau, the activity of reef fishing negates boundaries of class and clan to the extent that while fishing even a chief possesses no special authority and receives no special treatment (Johannes, 1981). In India, fishermen castes are among the lowest in the Hindu caste hierarchy and among the weakest politically and economically (Heel, 1986). However, in fish marketing, the various types of middleman or intermediary are considered non-caste occupations and therefore provide valuable opportunities as long as they do not disrupt the caste hierarchy (Raychaudhuri, 1980). In the Gulf of Mannar, it was observed that the women of the coastal Mooper caste, were considerably more independent and outgoing compared to their inland counterparts, which was attributed in part to the greater opportunities for women to participate in reef fisheries (Rengasamy *et al.*, 2003). Fisheries may also provide opportunities to low caste inland villagers, who may be employed to participate during seasonal peaks in fishing activities (Bavinck, 2001).

2.4 THE ABILITY TO COPE WITH INDIRECT INFLUENCING FACTORS

The way in which people use their resources will be dependent on the risk and vulnerability associated with indirect influencing factors, which make up the background context in which they live. These are external variables over which people have little or no control, and include gradual and predictable trends, sudden and unpredictable shocks and seasonality. Coral reefs provide a number of benefits to people in coping with or adapting to indirect influencing factors.

2.4.1 Seasonality

Poor people with little access to land, labour and financial resources are particularly reliant on exploiting natural resources and consequently they are vulnerable to seasonal changes in availability and markets for those resources. In this way, fisheries, and the fishers dependent on them, are subject to seasonal changes in access to, and availability of, marine resources due to seasonal weather patterns, or patterns of species abundance.

The diversity of coral reef fisheries, combined with their physical and economic accessibility and the protection they provide against inclement weather, create a relative stability as compared with other fisheries or indeed land-based agricultural production. Within the coral reef fishery there is a capacity to buffer the effects of local depletions, seasonal unavailability or seasonal lows in market demand of a single species, due to the multitude of alternative options (species or reef habitats) available. Furthermore, with access to sheltered areas of reefs open

throughout the year, the reef can also buffer the affect of seasonal lows or inaccessibility in offshore fisheries, exposed to weather variations.

In many places the reef may even act as a resource bank, used as a means of saving food for future times of need. In Manus, Papua New Guinea, giant clams are collected and held in walled enclosures on the reef until they are needed in periods of rough weather (Johannes, 1982). Similarly, the *hohobulu*, a species of giant clam, in New Georgia, Solomon Islands, is gathered on nearby reefs and kept as a 'clam farm' until needed (Gina-Whewell, 1992). In Palau, giant clams and sea cucumbers are seldom eaten during good weather in an effort to conserve their populations for months during which rough weather prohibits good fishing (Johannes, 1981).

Coral reef resources also offer an alternative to seasonal lows in other sectors, particularly agriculture, providing stability to households when agricultural production is low. In coastal communities in Northern Mozambique, near-shore and intertidal harvests provide key sources of food and cash when agriculture production is low, with the peak in fisheries production coinciding with the period of lowest agricultural stocks (Wilson *et al.*, 2003). In Indonesia, hundreds of thousands of subsistence fishers rely on coral reefs as a source of food security in times of agricultural hardship (Cesar, 1996). In Papua New Guinea, while agriculture is the primary means of food production, a large proportion of the coastal population engage in sporadic subsistence fishing (Opnai and Aitsi 1995). At these times, even low market value reef products may hold particular importance to poor people with limited alternative choices.

In this way, the coral reef provides significant benefits to poor households in coping with hard times. In many cases the reef is a *keystone resource*, offering a vital alternative source of subsistence and cushioning the impact of seasonal vulnerabilities. Often it is the shallow reef flat and lagoon, sheltered from bad weather, that are most utilised as *keystone resources* (Box 23).

2.4.2 Shocks

The coastal zone is vulnerable to the impact of sudden sea-borne storms and cyclones, as well as disturbances such as earthquakes and flooding originating on land. Coral reefs play a crucial role in sheltering the coast from the full impact of storms and protecting coastal infrastructure and agricultural lands, as well as other near-by ecosystems (seagrass beds and mangroves). In the Gulf of Mannar, India, elderly villagers remember the 1964 cyclone, which washed away Dhaniskodi, the eastern-most village in the Gulf of Mannar, and recall how those villages close to the reef and islands were protected from extreme weather (Rengasamy *et al.*, 2003).

Coral reefs may also provide a means of coping with the devastating effects of a climatic event in other sectors. During the 1990s in Vanuatu, cyclones damaged much of the copra and cocoa crops important for income earning in local communities. In response, coastal communities turned to the inshore reef resources in order to earn the quick cash needed to re-build their homes (Jimmy, 1995). There are also many examples of reef resources cushioning the impact of drought and famine. In the drought-prone lands bordering the Gulf of Mannar, India, coastal communities and landless agricultural labourers had to 'eat fish or starve' during the severe droughts of 1966 and 1973–1974 (Rengasamy *et al.*, 2003). Similarly, in Northern Mozambique, reef resources provide a safety net during the periodic impact of drought on agricultural production, providing critical food resources, as well as sources of income to buy other basic food stuffs (Wilson *et al.*, 2003). In addition, the reef resources provide critical alternatives when agricultural crops are destroyed by animals (Box 24).

BOX 23 SEASONAL STABILITY OF REEFS DURING ROUGH WEATHER

During low fishing periods in ***Atulayan Bay, Philippines***, reef gleaning is an important resource, ensuring a supply of protein to local communities (Pollnac, 1998).

Similarly, in times of inclement weather in ***Kiribati***, molluscs from the lagoon provide an important supplementary source of protein (Teiwaki, 1988).

On the ***Lakshadweep Islands, India***, the shallow reefs and lagoons provide a constant and stable food and income source all year around, even during bad weather, and provide the only protein source for the poorest households, who are unable to stock up with food prior to the monsoon (Hoon, 2003).

On the ***Andaman Islands, India*** during the rough weather season months, from June to October, distant fishing grounds and off-shore areas are inaccessible. However, nearby reefs can still be reached and assure a source of income, and protein, throughout the year, providing an important alternative to vegetable protein sources which increase in price during the rough weather season (Singh and Andrews, 2003).

BOX 24 REEF RESOURCES AS AN ALTERNATIVE TO AGRICULTURE IN DARUMBA, NORTHERN MOZAMBIQUE

'Our fertile land is on the other side of the river, but we have to share the harvest there each year with monkeys, elephants and warthogs. We have tried to chase them away using fire, drumming, anything, but fail. Our only alternative is to depend more on fishing and shell collecting for food and money to buy food. After collecting oysters we will dry the meat on sticks and sell them in Macomia, returning with cassava, flour, sugar or soap.'

(From: Wilson *et al.*, 2003)

Coral reefs resources are also vital safety nets for the sudden loss of physical or human resources. In the Andaman Islands, India, for example, loss of fishing nets is a common occurrence amongst fisherfolk, an event which can completely alter the livelihood status of a family, with lost opportunities for income and food production. In these situations, however, hand-line fishing on the reef offers a critical safety net and coping mechanism, providing a source of income and food until a new net can be purchased (Singh and Andrews, 2003). For widows or female-headed households, who have lost their husbands and principal support, near-shore reef resources are vital for sustaining the household's livelihood, and in many cases prevent abject poverty. In the Gulf of Mannar, India, the accessible shallow reef resources provide a vital coping strategy for female-headed households (Box 25).

BOX 25 CORAL REEFS AS A SAFETY NET FOR FEMALE-HEADED HOUSEHOLDS IN THE GULF OF MANNAR, INDIA

The husband of a local woman was a fisherman. He was forced to give up fishing because of abdominal cancer of which he died. Since then all the four children in the household had to depend upon the sole income of their mother. When her husband was active and alive, there was no need for her to go to the sea. When her husband was diagnosed as a cancer patient, for a month she could not do anything. She thought of committing suicide. But the mother sea consoled her by saying 'Come, I am here to take care of your family'. She decided to work in the sea. She harvests seaweed and shells from the reef flats, she is knowledgeable about the various types of species and which can be exploited for income.

(From: Rengasamy *et al.*, 2003)

2.4.3 Trends

2.4.3.1 Market trends

Throughout the world subsistence economies have been shifting towards monetary-based systems and increasing commercialisation. For coastal communities dependent on coral reef resources, the diversity of products available has supported multiple opportunities for commercial extraction for local and foreign markets. Some reef products attract high demand and high prices (see Section 2.2.3.3), offering good income earning opportunities for small-scale fishers.

As mentioned earlier, the physical nature of a coral reef, its complex three-dimensional structure and coral outcrops, prevents the use of modern industrial gear and thus the development of large-scale fisheries (Pomeroy, 1994). In this way, the coral reef offers a haven for the small-scale, low tech and often poor fishers, reducing conflict and displacement by wealthier high tech industrial fisheries, which is a common occurrence in other near-shore fisheries. However, when demand and prices are sufficiently high (e.g. for live fish for foreign aquaria or restaurants), then this can lead to changing patterns of exploitation, with the emergence of intensive and often destructive techniques, maximizing the short-term profits available, to the detriment of the future health and sustainability of production (see following Chapter 3).

Coral reef resources may also buffer the impacts of market trends in other sectors. In Indonesia, for example, booming prices of cloves in the 1970s encouraged communities to develop clove gardens, often to the extent that they abandoned their traditional harvest of marine commodities. However, when the price of cloves fell, alternative sources of income were sought from the reef and sea (Thorburn, 2000).

2.4.3.2 Population trends

Coastal populations around the world are on the increase, both due to local population growth and as a result of migrants, displaced by conflict or pressures of livelihoods, who are attracted to the coast in search of new opportunities. The diversity and productivity of coral reef resources, afford a sink for such migrants, providing a range of livelihood opportunities that are both physically and economically accessible. In Mozambique, for example, many rural farmers fled to the coast for protection during the war (Campbell and Beardmore, 2001). Similarly, in Sri Lanka the south and west coasts have been the sink for large numbers of displaced people as a result of the ongoing conflict in the north and east. Barriers for outsiders to enter a coral reef fishery are minimal, offering opportunities for those with limited if any physical or financial resources. In the Andaman and Nicobar Islands, the rich coral reef resource has

BOX 26 REEF RESOURCES AS A SINK FOR MIGRANTS IN THE ANDAMAN AND NICOBAR ISLANDS, INDIA

Early settlement in the ***Andaman and Nicobar Islands*** was associated with the forestry industry. As the population grew, farmers were settled to provide food. Many of the settlers undertook fishing on the coral reefs for subsistence needs, but it was not until the 1960s that settlers were brought over by the administration to develop the fishery industry.

In the last three decades there has been a flood of immigration, with fisherfolk migrating from various parts of India, including Andhra Pradesh, Kerala, West Bengal and Tamil Nadu, and Bangladesh. It is now estimated that fisherfolk currently constitute approximately 6% of the total settler population of 356 265, almost double the number in 1995.

Many immigrants are escaping hardships and are attracted by the possibility of improving their livelihood, with land easily encroached from forest areas and a good potential for fishing. The productive coral reef resources provide many opportunities for new migrants, particularly as labourers on boats, requiring only hand-lines which are cheap and locally available.

However, opportunities for further immigration has now been curtailed through a Supreme Court Order enacted in an effort to ensure the sustainability of development on the islands.

(From: Singh and Andrews, 2003)

attracted thousands of migrants from mainland India, often escaping drought, famine or conflicts (Box 26).

Coral reefs also offer important opportunities for seasonal migrants, enabling them to cope with seasonal lows in availability. In Sri Lanka, fishers seasonally migrate from west to east coasts and vice versa in association with the changing monsoon seasons and in order to access sheltered resources, and continue to fish and generate income (Stirrat, 1988). Similarly, Tanzanian fishers migrate temporarily south to access reef resources in Northern Mozambique, although in this case their stimulus is the degradation of their local resources (Wilson *et al.*, 2003). Such temporary migrations are often the focus of conflicts between local and outside fishers. However, in some cases they may also be important sources of employment for local non-fishing communities, engaging in on-shore boat maintenance and repairs (Hajra, 1970).

2.4.3.3 Tourism development

Tourism is frequently promoted as a highly profitable industry. Coastal areas and coral reefs are magnets for tourism development and in many cases the industry is promoted as a means to provide alternatives to fishery-based livelihoods and ensure the sustainability of local coral reef resources. Coral reef areas around the world have experienced a huge increase in tourism development, with many millions of tourists visiting reef areas annually. In the Caribbean alone, 20 million people visit coastal areas, where coral reefs attract 60% of the world's scuba-diving tours (ICRI, 2002a).

The development of coral reef tourism has the potential to bring valuable benefits to local communities. In many coral reef areas, tourism is one of the main industries bringing employment and income-generating opportunities to coastal areas. The development of infrastructure (roads, communications, etc.) associated with the expansion of tourism may also bring benefits to local communities. However, the ability of the poorer members of the community to access the benefits of tourism is far from guaranteed and requires a sensitivity of development guided by social, cultural and environmental principles. Such an approach is encompassed in small-scale eco-tourism activities, which have attracted growing recognition for their role in sustainable development (Box 27).

While there are clearly potential benefits of tourism development to local communities, in many cases the absence of proper planning and recognition of local needs and priorities, has marginalized local communities and led to conflict between tourism and local small-scale fishers (see Chapter 3, Section 3.3.3).

2.5 SUMMARY

For the casual observer, the reef provides a limited number of benefits to regular users linked into resource extraction, mainly fisheries. In reality the benefit flows are much more complex and affect different groups of people in many different ways. Not only do they provide a range of benefits in terms of the resources that reef-dependent people use directly in their livelihoods, the reef can also affect the interaction between reef-dependent people, their resources and the factors that control how they access and use those resources. In addition, reefs help people cope with, and adapt to, the wider changes that affect their lives whether they be regular seasonal changes, longer-term trends, or periodic shocks and stresses.

These benefit flows help reef-dependent people develop a range of livelihood strategies, and the diversity of those strategies reflects the diversity of type and form of the benefits that flow from the reef ecosystem. Some people are able to

BOX 27 EXAMPLES OF SUCCESSFUL CORAL REEF ECO-TOURISM

In the ***Solomon Islands***, the 'Solomon Island Village Stays' were developed in order to let the traveller experience the true feeling of the Solomon Islands. There is a network of over 20 village home stays located throughout the Solomon Islands. A family of the village operates each home stay. This gives the local villagers an opportunity to earn cash without selling their land to developers or loggers.

The ***Belize*** Eco-tourism Association, was created on Earth Day in 1993. As part of its Code of Ethics, it recognises the need to support economic and social sustainability by encouraging small-scale tourist developments, providing employment of local people, purchasing products made locally from sustainable resources and providing guidance to all guests to be environmentally and culturally responsible.

In the last few years, the ***Western Samoa*** Visitor's Bureau has established a National Eco-tourism Programme. The programme promotes a variety of types of sustainable tourism, which are designed to directly benefit rural villagers, contributing a proportion of tour fees directly to the villagers.

(From: The United Nations Department of Social and Economic Affairs, Division for Sustainable Development, Small Island Developing States Unit 'Eco-tourism Success Stories' SIDS website http://www.sidsnet.org/eco-tourism/index.html)

develop strategies that make full-time regular use of the reef or its resources, others can use the reef as a crucial safety net in difficult times. Others use the reef as a *keystone resource* that they tap into at certain times of the year when other resources are not available to them. The diversity of stakeholders, outlined in Chapter 1, Section 1.3, also affects the diversity of reef-related livelihood strategies. Their use of the benefit flows are not just for subsistence, income or food security; the reef provides a much stronger platform for social and cultural development which is not always considered in economic analyses of the reef.

In some situations the reef provides the very means to keep many people out of poverty and so it often appears that reef-dependent communities are not as badly off as some of their neighbours, whose strategies are mainly land-based. In the Pacific, for instance, many reef-dependent communities seem idyllic but there is a growing level of vulnerability amongst these communities that threatens to undo much of the work that has been achieved through the wider development process. In almost all reef-dependent communities the benefit flows that the reefs provide are under threat and the livelihoods of some of the poorest people are being seriously undermined. In the near future many of those who have been helped above the poverty line will start to slip back below it unless there are radical changes in the way reefs and reef-dependent communities are viewed and worked with.

The changes affecting reefs and reef-dependent communities, and their consequences, are discussed in the next Chapter.

CHAPTER 3 CHANGING BENEFIT FLOWS AND INCREASING VULNERABILITY

3.1 INTRODUCTION

For many millions of poor coastal people, coral reefs provide a diversity of benefits on which they may depend throughout the year, during particular seasons or intermittently during their lives. Many poor people rely on these benefits as a keystone resource or critical safety net in times of hardship. In this way, the benefits provided by the reef enable the poor to cope with vulnerabilities, keeping many people out of extreme poverty and providing them with livelihood stability. As described in the previous Chapter, these benefits are accessible to some of the most disadvantaged groups, such as female-headed households and the elderly.

However, the ability of coral reefs to continue to provide benefits to the poor is changing. Throughout the world, the capacity of coral reefs to offer a buffer against adversity and provide livelihood stability is being eroded as a result of a wide range of factors that influence the poor's access to, and use of, reef resources. Consequently, many of the poor dependent on reefs are becoming increasingly vulnerable.

3.2 CAUSES OF CHANGE

Livelihood systems are constantly changing and nowhere is this more apparent than the dynamic coastal environment, at the interface between land and sea and at the convergence of a diversity of sectors. Changes to coastal livelihoods are driven by a complex web of interacting factors, acting indirectly or directly, over which the coastal poor have varying degrees of control. These factors influence access to resources and ultimately determine the livelihood strategies adopted and so contribute to the livelihood outcomes of the poor (Figure 24).

The changing access to coral reef benefits can be viewed as a product of four major interacting factors, namely: population growth, market and technology changes, reef degradation and reef conservation.

3.2.1 Population growth

Coastal population growth is the result both of natural growth as well as migration to coastal areas. Globally 2.2 billion people or 39% of the world's population live within 100 km of the coast. Among coral reef countries, the proportion of people is even greater, with on average 78% of the population living within 100 km of the coast,[2] and almost half a billion people living within 100 km of a coral reef (Bryant *et al.*, 1998).

As coastal populations continue to increase, so does the number of dependents on coral reef resources. And as the benefits of coral reefs become distributed among increasing numbers of people, so the competition for access increases, ultimately leading to a decline in the quality, quantity and diversity of benefits for each stakeholder.

In addition, the growing number of coastal people means that land-based activities are also becoming threatened. In many areas, agricultural land area per person is declining, land is being degraded through over-use, and the demand for agriculture labour is falling. This reduces opportunities for many coastal people and forces them to depend even more heavily on the coral reefs. Furthermore, improved health and social services in many areas have increased survival rates of coastal people to the point where they are living longer. This has led to larger numbers of vulnerable older people depending on the resources.

3.2.2 Market and technology changes

The shallow and complex physical structure of coral reefs, together with their high biodiversity, has resisted the large-scale commercialisation and industrialisation of production, which has been common in other coastal ecosystems. As a result, coral reef fisheries have remained small-scale and accessible to the poor. However, at the same time with the movement from subsistence to cash economies, growth in transport and globalisation of markets, coral reef fisheries have experienced a shift away from predominantly subsistence-oriented production, towards commercial production increasingly orientated to export markets.

In many cases, lucrative external or export markets have created a high demand for certain reef products, leading to an intensification of production, controlled by players and forces outside the local environment. Frequently, this has attracted outsiders to the reef fishery and has also led to the introduction of new technologies to increase production efficiency, such as scuba or the use of cyanide, which have serious impacts on the reef and sustainability of the fishery. In many cases, it has led to reef degradation with over-exploitation of the target product and the local collapse of the fishery (Box 28).

3.2.3 Reef degradation

Coral reefs are fragile ecosystems, slow growing and sensitive to changes in the narrow range of temperature, light and acidity in

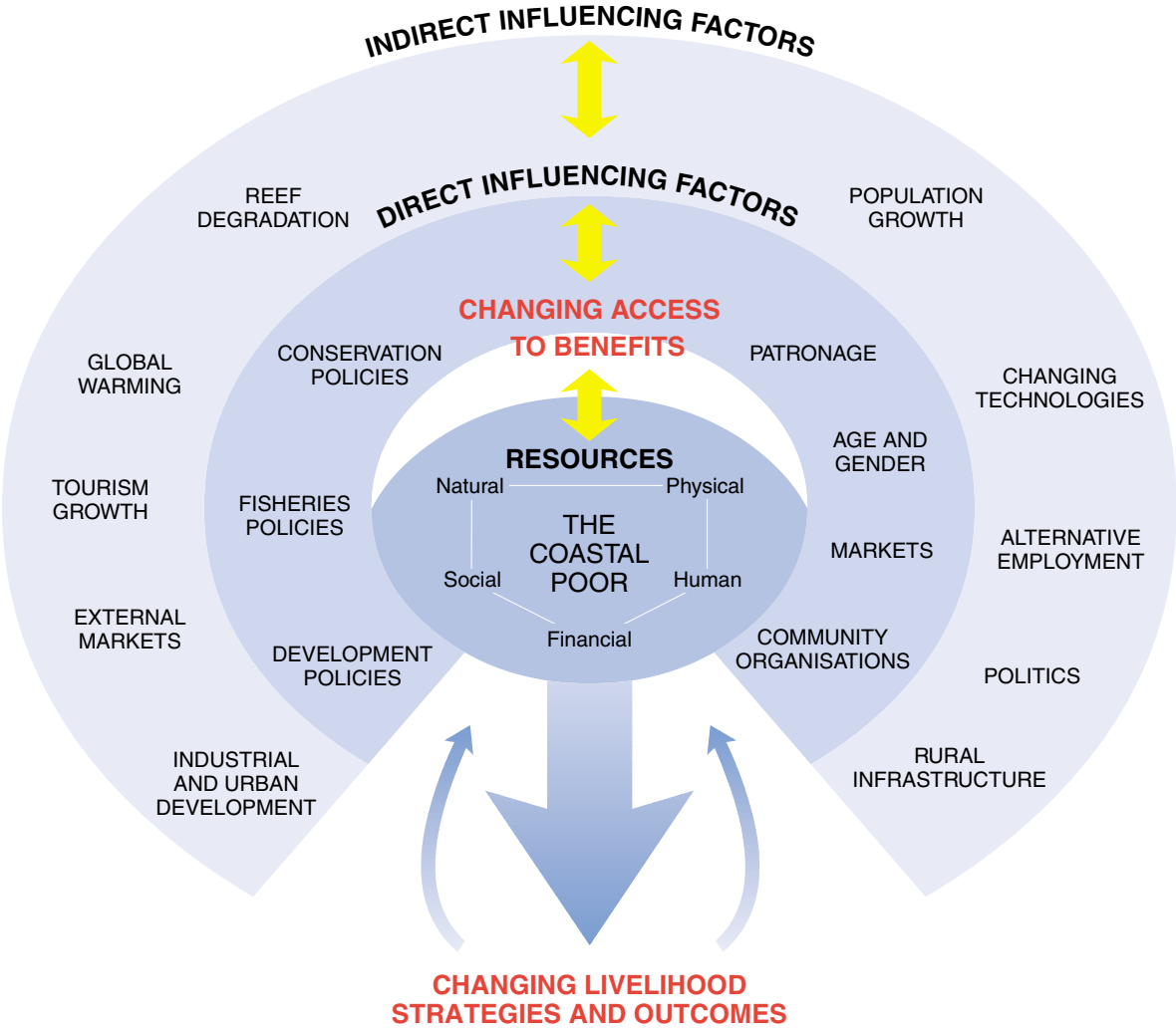


Figure 24 Factors contributing to changing access to reef benefits.

which they exist. Sources of disturbance to coral reef ecosystems are multiple and synergistic and of natural as well as anthropogenic origin. Living in shallow coastal waters, where the externalities of human activities, both nearby on the coast and far away upstream, frequently concentrate, coral reefs are extremely vulnerable to human disturbance, such as: sedimentation (from coastal development or upstream forestry and agriculture); nutrient waste (from coastal populations and agriculture); and chemical and oil pollution (from agriculture, industry and shipping).

Coral reefs are also degraded through the direct removal of reefs, e.g. for land reclamation or coastal construction, or the over-exploitation of reef products. As mentioned above, local coral reef fisheries are a major source of reef degradation, resulting in increasing often unsustainable pressures on the resource, both through a growth in the numbers of users and scale of extraction, as well as the intensification of extraction and the emergence of destructive technologies.

As well as human disturbances, natural impacts also take their toll on reef resources. Outbreaks and plagues of reef predators, such as the Crown-of-Thorns starfish, cause widespread reef mortality, while cyclones and hurricanes leave large areas of reef damage in their wake. But of all the natural impacts, global warming is one of the most threatening disturbances on a large scale. Coral reefs and coastal fisheries are highly vulnerable to climate change, with coral reefs at risk of undergoing significant and often irreversible damage (IPCC, 2001). Large-scale episodes of elevated sea surface temperatures are principal factors linked to mass bleaching and coral mortality events throughout the world (Box 29). Research suggests that mass bleaching events are likely to increase in frequency and severity within 20 years (Hoegh-Guldberg, 1999). Recent

BOX 28 EXTERNALLY DRIVEN CORAL REEF FISHERIES

Sea cucumber trade in Eastern Africa

In Eastern Africa the sea cucumber fishery is almost entirely for export to Asian markets and offers a lucrative opportunity for small-scale fishers. Physical and financial resources required to enter the fishery are low, with intertidal areas and shallow waters gleaned on foot at night with the aid of a lantern. However, as the resources in many intertidal areas have become fully exploited, skin diving in deeper waters involving teams of divers operating from boats has become more common. More recently the use of scuba equipment has allowed divers to exploit greater depths and for longer periods. In recent years reports from Kenya, Tanzania and Mozambique indicate that the sea cucumber resources particularly in shallow waters have declined due to over-fishing and high demands and prices.

(From: TRAFFIC, 2001)

Live food fish trade in Southeast Asia

Keeping fish alive until just before they are cooked has been a popular Chinese custom for centuries. With increasing wealth in Hong Kong, local fisheries could no longer meet the growing demand for live fish and the demand spread to other fisheries. High prices and demand for live food fish generate considerable profit which have encouraged the use of new technologies and have attracted 'foreign' private companies and fishers to exploit near-shore reef areas. During the early 1970s fishers in the Philippines began using cyanide to capture live food fish for export to Hong Kong. The use of cyanide is simple, it is relatively inexpensive and easy to obtain, and so cyanide fishing has become a prevalent method, which has spread throughout Southeast Asia and beyond (Figure 25). However, it is also a destructive technology, often killing the fish before they reach the market and causing damage to the surrounding reef and reef species. Furthermore, the species targeted, such as groupers, are slow-growing and long-lived and vulnerable to over-fishing.

By the late 1980s the live fish trade was in decline in the Philippines and moved to Indonesia. The introduction of the trade followed similar progressions, led initially by external companies operating from large boats with teams of divers from other parts of Indonesia. For example, in the Kei Islands in the south-east of the Indonesian province of Maluku, the live fish trade appeared in 1991 led by a number of different private companies from outside, in a trade which was hugely profitable and expanded rapidly. The emergence of the trade brought conflicts between the local fishers and communities and the outside operations, due to the damage caused by the cyanide use, but primarily due to the absence of respect for local rights of access to the near-shore fishery resources. After 5 years the profitability of the large operations declined with falling yields and the fishery was replaced by smaller low cost operations with more local involvement. Cyanide use continued and the focus of conflict shifted from local fishers against outsiders to village against village and between different groups within communities.

Figure 25 Live fish cages, Indonesia.
Source: James Oliver http://www.reefbase.org/

(From: Thorburn, 2001)

studies predict that probabilities of repeat episodes of mass bleaching in central sites within the Indian Ocean will increase to a 10% chance of recurrence for all months or a 50% chance of recurrence for the warmest months after only 25–35 years (Sheppard, 2002). Low lying coralline islands have already begun to suffer the effects of that sea-level rise. Reports indicate that two islands in Kiribati have already been engulfed by rising seas and the South Pacific Regional Environment Programme (SPREP) warn that many other islands are at risk from increasing coastal erosion and severe flooding associated with storms and high tides.[3] An IPCC report indicates that developing countries are likely to suffer most in terms of loss of life and the negative economic effects of climate change (IPCC, 2001).

An analysis of risks facing reefs around the world estimates that 60% of reefs are under threat (Bryant *et al.*, 1998). Out of four categories of risk considered, coastal development; over-exploitation and destructive fishing; inland pollution and

Figure 26 Bleached coral (*Acropora* sp.), Sri Lanka.
Source: Arjan Rajasuriya http://www.reefbase.org/

BOX 29 MASS CORAL BLEACHING AND GLOBAL WARMING IMPACTS ON CORAL REEFS

Since 1979 six major episodes of mass coral bleaching have occurred throughout the world causing entire reef systems to lose all living coral (Hoegh-Guldberg, 1999). The most severe episode of coral bleaching occurred in 1998, affecting every geographical coral reef area in the world and causing mortality of an estimated 16% of the world's reef-building corals (Wilkinson, 2000).

Evidence indicates that elevated temperature is the principle cause of mass bleaching events. For those corals that survive bleaching, productivity and growth are reduced and increasing temperature effects will reduce their reproductive capacity (Hoegh-Guldberg, 1999). In addition, changes to the chemical properties of oceans predicted to accompany climate change are likely to result in slower growth of corals and a reduced capacity to 'keep up' with bio-erosion rates and rising sea-levels (Boesch *et al.*, 2000; Hoegh-Guldberg, 1999). Increasing temperatures are also associated with the emergence of coral diseases, which are likely to become more prevalent with global warming (Rosenberg and Ben-Haim, 2002). Consequently, the impacts of coral bleaching combined with other global warming effects, will result in declines in coral abundance, diversity and health, compromising the ability of coral reefs to respond to other disturbances and with potentially major impacts on the entire reef ecosystem and reef fisheries (Hoegh-Guldberg, 1999).

Current understanding suggests that corals will be unable to acclimatise or adapt fast enough to keep pace with climate change and they may be the 'single largest casualty' of global warming (Hoegh-Guldberg, 1999).

erosion; and marine pollution, coastal development and over-exploitation were considered to pose the greatest potential threat to reefs (Bryant *et al.*, 1998). Coral reefs in Southeast Asia are the most threatened in the world, with 88% of reefs at risk from human activities and 50% of these facing 'high' or 'very high' levels of threat (Burke *et al.*, 2002). With many reefs already degraded and a large proportion of others threatened, the reef benefits available to coastal communities and the poor are in decline and in many cases lost or changed irreversibly.

3.2.4 Reef conservation

International and national recognition of declining reef resources has resulted in increasing efforts to protect and conserve reef biodiversity for the future. These efforts have focused on protecting coral reef areas and species from negative impacts through the prevention or better management of sources of impact. Coral reef fisheries are recognised as having major negative impacts on coral reef biodiversity, health and function. Consequently, many efforts have targeted reef fishery activities, frequently using legislation banning the harvest of particular species, or restricting fisheries activities through systems of marine protected areas, as discussed in the following Chapter, Section 4.3.

In this way, coral reef fishers and communities dependent on the reef are commonly perceived as a source of problems and negative impacts, particularly associated with their role in reef fisheries. Thus, efforts of reef conservation, in their well-meaning attempt to reduce this impact can have the effect of keeping fishers away and reducing their access to reef resources.

3.3 IMPACTS OF CHANGE

Changing access to reef benefits has had wide ranging impacts on poor reef-dependent communities, varying in extent and form from one place to the next. The impact of this change can viewed within a livelihood's context as changes to livelihood outcomes and changes to livelihood strategies, as illustrated in Figure 27. The following sections describe some of these changes, which are common to many different circumstances.

3.3.1 Changing livelihood outcomes

3.3.1.1 Declining benefits

Increasing numbers of reef dependents and degrading reef resources are commonly resulting in a reduction in reef benefits per capita. With little or no access to alternative resources, poor reef users must expend greater and greater efforts to maintain the flow of benefits from the reef, so pressure on reef resources increases and the availability of benefits decline further. As the resources decline, not only do the quality and quantity of products decline, so does the diversity of products available (Box 30).

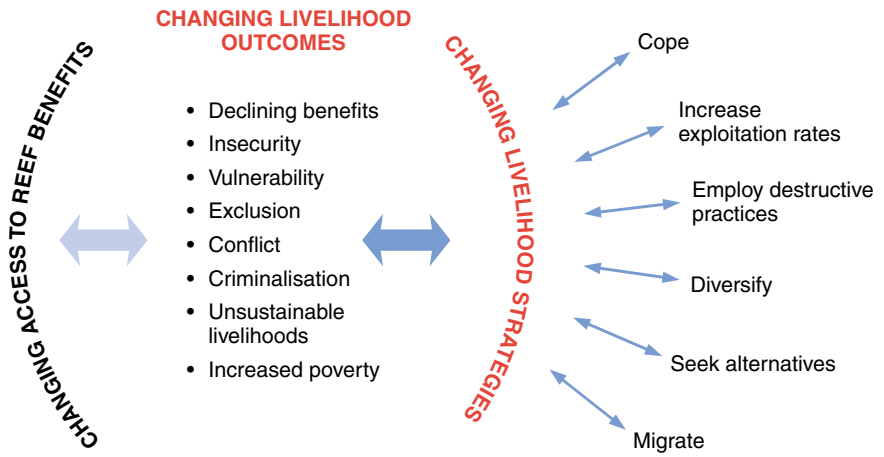


Figure 27 Impacts of changing access to reef benefits on livelihood outcomes and strategies.

As reef resources become depleted, so food security is becoming threatened in many communities. Whilst alternative protein sources are often available, more and more of these are commercially produced and require to be purchased rather than be harvested from the wild. This puts the poor consumers in an increasingly difficult position (Box 31).

The diversity of reef products is an important factor in the ability of the reef to provide livelihood stability (as outlined in Chapter 2). Thus, not only do declining benefits reduce food and income security of the poor, they also reduce livelihood stability, brought by both the diversity of reef products available and the productivity of the reef, and in this way they increase vulnerability amongst the poor.

BOX 30 DECLINING REEF BENEFITS IN THE GULF OF MANNAR, INDIA

The general consensus amongst local fisherfolk in the three study villages was that fish catches had declined over the last two decades, both in terms of the size of fish and their variety. This was attributed to the increasing fishing effort of the expanding coastal population, combined with fishing practices, which have promoted over-exploitation (the use of nets with small mesh sizes) and caused damage to the resource base (dynamite fishing). With near-shore resources forming the basis of most people's livelihoods, their decline has had a considerable impact. As resources have become more scarce the effort expended on fishing activities has increased, demanding greater involvement of the household, particularly female members. Ultimately, this has lead to further pressure on the existing resources and while the financial impact of declining catch has been buffered to an extent by the growth of high value markets, the human impact has been the loss of household food security.

(From: Rengasamy *et al.*, 2003)

3.3.1.2 Exclusion

Changing resource access will often have opposing impacts on different reef stakeholders. For some, the change may be positive leading to new or improved opportunities, while for others the change may exclude them from benefits and access to new opportunities. Typically, many of the changes in reef access have led to a shift in benefits away from local communities adjacent to the reef resource and from the most vulnerable, to outside and more powerful interests.

The emergence of lucrative foreign markets, as described above (Section 2.4.3.1), has led to the emergence of foreign traders displacing local mediators and often weakening local market systems. Consequently, the benefits of reef harvests are increasingly maximised in external market systems, with comparatively minimal returns to local producers. Similarly, the growth in well-meaning reef conservation efforts restricting local exploitation of reef resources, has often resulted in the shift of benefits away from local reef-dependent communities to wider society benefits of maintaining biodiversity. In this way, restrictions on trade of globally endangered reef species have often legally excluded many reef stakeholders from sources of livelihood. Where these restrictions target shallow reef resources, such as reef molluscs, this has particularly affected women reef gleaners, who often rely heavily on this resource as one of the few accessible sources of food and income. In other cases, reef conservation has displaced the benefits from local reef users to foreign tourists, with local fishers denied access to marine protected areas (Box 32).

BOX 31 DECLINING FOOD SECURITY IN THE DOMINICAN REPUBLIC

During dry periods and droughts people along the coast develop an increased dependency on fish. Consequences of increasing drought will impact many different groups of coastal people, but in particular food producers (farmers and fishers) and the urban poor, who are marginal wage earners.

In the village of ***Buen Hombre in the Dominican Republic***, the impact of a drought in 1987–1991 meant that the normal diversity of animal protein available (goats, dogs and chickens) was lacking. Fish was practically the only accessible source of animal protein. Farmers became dependent on fish protein for their families, and fishers were pressurised to provide fish to farming relatives, while at the same time needed to sell some fishing to order to have cash to purchase water needed to make their own family dinner.

(From: Stoffle, 2001)

BOX 32 THE EXCLUSION OF LOCAL REEF FISHERS FROM MARINE PROTECTED AREAS

Marine protected areas in India focus on biodiversity, conservation and tourism values placing the coral reefs within them 'off limits' for local fishery activities. In the ***Gulf of Mannar Marine Biosphere Reserve*** (GOMMBR), access and exploitation of shallow reef and seagrass areas surrounding the 21 coralline islands in the Gulf is prohibited and the Wildlife Protection Act (1972) prohibits the collection of many reef species. For the majority of poor reef stakeholders living along the coast of the Gulf of Mannar, these restrictions place severe and impossible restraints on their livelihoods. With no viable alternatives, poor reef stakeholders are reported to continue to access prohibited reef resources at great risk and increasing transaction costs.

(From: Rengasamy *et al.*, 2003)

Wakatobi National Park, in Eastern Indonesia was designated as a park in an effort to protect coral reefs with high biodiversity and to halt the use of destructive fishing techniques. Conventional approaches to management of the park (through rules and regulations) has not involved or considered the livelihoods of the local community. Restrictions imposed by park officials are disapproved of by locals as they interfere with their livelihoods, and many continue to carry out activities illegally, for example; the extraction of certain rare target species for the live fish trade and favourite food species. Discontent among the local Mola community was widespread and comments from fishers such as the following are reported to be common: 'This park makes our life difficult. All coral that provides for us is already closed and we are restricted from fishing there. For the Mola community, we get everything from the sea, all our daily needs; we only buy wood and drinking water and rice, so when the sea is restricted we cannot live'.

(From: Elliot *et al.*, 2001)

Elsewhere, local reef stakeholders have been displaced from accessing resources in tourist areas, purely for aesthetic reasons. For example, on the Zanzibar island of Unguje, although legally locals cannot be excluded from using beach and tidal flats outside hotels, high-class tourism developments on the southeast coast have resulted in the displacement of women from accessing near-shore areas for seaweed cultivation and reef gleaning, which was thought to spoil the area for tourists (Wallevik and Jiddawi, 1999).

The poor are particularly vulnerable to the impacts of shifting benefits, as they are often not involved or considered in decision-making processes that brought about the change. Furthermore, they lack the necessary resources to access alternative opportunities that may accompany such changes, e.g. they generally lack the required skills to enter the tourist industry.

Thus the outcome of shifting reef benefits is frequently a loss of food and income-generating opportunities for local reef-dependent communities and the poor, as well as a loss of ownership and disenfranchisement from control of local resources.

3.3.1.3 Increasing conflict

With increasing numbers of reef dependents competing for declining reef resources it is not surprising that there is also increasing conflict amongst reef stakeholders. Where changes have brought about the displacement of reef benefits to outside interests or stakeholders, these 'outsiders' frequently become the focus of conflicts and disputes (e.g. local fishing communities and 'foreign' cyanide fishing operations, Box 28). In the same way, conflicts between local fishers and those responsible for marine

BOX 33 CONFLICTS IN KENYA OVER THE DIANI MARINE RESERVE

In **Kenya**, the Diani Marine Reserve south of Mombasa was gazetted in 1995. The Kenyan Wildlife Service is responsible for the development and management of the reserve in which traditional non-destructive fishing activities are permitted.

Controversy and conflict have surrounded the history of the Diani Marine Reserve from its conception to its establishment. The original motivation for establishing the reserve came in 1990 from expatriate residents and hotel owners primarily concerned with protecting beach areas from increasing security problems, but also concerned over the poor condition of Diani's reefs. Beach traders opposed the reserve, which threatened to close their access to tourists on the beach and so severely restrict their livelihoods. Fishers distrusted the motives of the reserve and feared that early proposals for a marine park, which would totally exclude their activities, would be resurrected and potentially include the entire coast. Their distrust and opposition to the reserve and the Kenyan Wildlife Service was amplified by the realisation, from evidence elsewhere in Kenya, that the success of the reserve in eliminating destructive techniques, such as beach seining, and so preventing further resource decline, was not guaranteed. These negative perceptions were reinforced further by political influences.

(From: Rubens, 1996)

protected areas, which have excluded fishers in initial stages or throughout implementation, are commonly encountered (Box 33). Expanding coastal and reef tourism may also bring conflicts beyond those over access to reef benefits, in particular when local cultural sensitivities are not respected. As reef benefits decline and competition and conflicts increase many of the reef stakeholders excluded and disadvantaged by the changes become increasingly disenchanted with their livelihood system. In Kenya, for example, declines in fish catches and increasing conflicts with immigrant fishers, tourism and protected areas, have challenged young fishers' faith in the ability of their elders to interact with the spirit world to ensure the health of and control access to community waters (Glaesel, 2000). This has led to intergenerational conflicts and in some cases the total abandonment of traditional spirit appeasing ceremonies (Glaesel, 2000; McClanahan *et al.*, 1998).

3.3.1.4 Illegal livelihoods

For many poor reef stakeholders faced with restrictions over reef access resulting from reef conservation efforts, there is no option but to continue accessing reef benefits illegally. With no other viable alternative to turn to, poor stakeholders typically lack the choice to alter their livelihoods in favour of conservation. Furthermore, the risk of punishment for breaking the law in many cases is not a sufficient disincentive to stop exploiting a prohibited reef area or reef species. Lack of resources for enforcement and corruption in enforcement systems often reinforces this situation (Johannes, 1999). The corruption in enforcement systems is also a widespread source of increased transaction costs for the poor.

3.3.1.5 Unsustainable livelihoods

Where external markets drive high demands and lucrative prices for reef products, patterns of resource use often become unsustainable, often relying on destructive fishing practices. In such situations, the longer-term consequences of declining resource productivity are discounted against the economic gains in the short term. This is frequently perpetuated through systems of political or social patronage, even in cases where the destructive extraction techniques are illegal (Figure 28).

While many poor reef stakeholders may have no choice but to continue illegal and often unsustainable resource exploitation, for others choosing lucrative short-term gains over longer-term sustainability is often seen as a means to escape the inevitability of future resource declines. In Sri Lanka a local dynamite fisher justified his choice of short-term profits as a means to provide better education to his children and therefore an opportunity for them to escape the declining fishery (Robert Cordover, 2002, pers. comm.).

Figure 28 Dynamite fishing, Philippines.
Source: Thomas Heeger http://www.reefbase.org/

Figure 29 Seaweed farming in Northern Mozambique.
Source: James Wilson, Kusi Lda.

In other cases, external market forces encourage poor stakeholders to specialise in high value products so reducing livelihood diversity and increasing risk to livelihood sustainability in the longer term. Export markets for seaweed have led to large-scale seaweed cultivation in shallow intertidal waters sheltered by coral reefs in many parts of Eastern Africa (Figure 29). Seaweed cultivation is commonly undertaken by women and offers a relatively constant source of income, encouraging many women to concentrate on this activity and consequently spend less time farming. Specialisation in this way on a single production system subject to external influences beyond local control has increased the vulnerability of local livelihoods and threatens their sustainability (Wilson *et al.*, 2003; Wallevik and Jiddawi, 1999).

3.4 CHANGING LIVELIHOOD STRATEGIES

In response to changing access to reef benefits and consequent changes in livelihood outcomes, poor reef-dependent communities adopt a variety of different livelihood strategies, ranging from persisting with existing strategies and simply coping, to the modification of existing strategies or the adoption of altogether new strategies. In each case the strategy adopted will impact the ultimate livelihood outcome, which in turn will impact the choice of livelihood strategy in a series of change and response (Figure 27). For example, where strategies have been modified, such as through increased exploitation or destructive exploitation, this will have a negative feedback on the long-term sustainability of livelihood outcomes, which may in turn result in people seeking entirely new alternatives, either close to home or at a distant location that require them to migrate.

The changes in livelihood strategies, or the way people use their resources, is likely to affect different people in different ways. Those people with access to alternative resources, or support systems, such as family networks or public service support, will be the quickest to adapt and may often profit from change. However, the poorer members of a community are often those with little choice or access to alternatives and whose support systems are weak. So the poor are often slow to adapt to change and can easily be marginalized by change. DFID-funded research in the post-harvest fisheries sector has revealed that while many changes have brought improvements to people's lives, often changes are taking place so quickly that the poor are unable to adapt (Box 34).

3.5 VULNERABILITY TO FUTURE CHANGE

Given the projections of continued global population growth, continued urbanisation and industrialisation and the escalating impacts of global warming, pressures on coral reef ecosystems will inevitably continue to increase. As coral reef resources decline their capacity to support the coastal poor, providing livelihood stability and reducing vulnerability, will erode. This has clearly already been the case in many parts of the world, where poor reef stakeholders have suffered a loss of livelihood security and increasing risks and conflicts, which have commonly resulted in unsustainable and often illegal livelihoods. In many cases this situation has been worsened by external market forces and conservation efforts, which have resulted in the exclusion of poor reef stakeholders.

Agricultural activities, which are often combined with reef-related activities in poor households are also threatened. Global warming predictions suggest that yields of some crops in tropical locations will decrease even with minimal increases in temperature, because such crops are near their maximum temperature tolerance (IPCC, 2001). This trend is thus likely to further exacerbate future vulnerability to change (Box 35).

BOX 34 CHANGES IN FISH UTILISATION AND IMPACTS ON THE POOR IN INDIA

Changing Fish Utilisation and its Impact on Poverty in India – DFID's Post-Harvest Fisheries Research Programme – has looked at the ways in which fish utilisation in India has changed over time and the impacts that these changes have had on the livelihoods of the poor. The research has revealed that poor people involved in the utilisation of fish are caught up in a complex set of interacting changes. Changes in fisheries resources and the ways in which they are exploited have led to shifts in the types and quantities of fish available and different relationships between those involved in fish catch and those who buy, transport, process and sell fish on the land. Increasing pressure on declining fisheries resources means that fish catches are increasingly landed at urban ports and sold to larger-scale fish buyers, often excluding the small-scale traders, processors and middlemen who used to handle catches at rural landing sites.

Once fish is landed, changes in the patterns of demand have also influenced the ways in which benefits flow from fisheries. Increasingly, fish catches are destined for urban, and even international, markets which require higher-quality, iced fish. The demand for dried, salted and smoked fish that supported a significant number of small-scale fish processors, often among the poorer sections of coastal communities, has reduced dramatically. These changes have also created new opportunities in the processing of fish for export and fresh fish handling but, inevitably, the poor have often found themselves unable to take advantage of these changes and opportunities.

As a result of these changes, the equilibria within coastal communities have also shifted. Many traditional skills and trades associated with fish utilisation, such as fish processing or the artisanal manufacture of containers for transporting fish have declined or disappeared, forcing groups involved to shift into new occupations, with varying degrees of success. The increasing population in coastal areas has meant that competition for all livelihood opportunities has increased and, wherever one option disappears, it is inevitably difficult for the poorer and more vulnerable groups to find alternatives. Once fish moves from fish landings into the trading network, changes have often been even more dramatic. The expansion of the transportation network has made the movement of fish far quicker and easier, opening up new market opportunities but also changing the relationships between different actors in the market, as well as the actors themselves. Cash and access to capital plays an increasingly important role in market relationships, replacing older patterns of exchange and patronage between different levels of the marketing chain. In some cases this may have made the system more open and "competitive", but this has also meant greater risk, a factor that particularly affects the ability of poorer groups to participate. Women, who previously played an important role in fish marketing, seem to be increasingly marginalized, while the market is more and more dominated by large- and medium-scale operators. Domestic and international demand for fish is increasing steadily, driving the overall value of fish upwards and making it more and more inaccessible for poor consumers.

Many of the changes that have affected patterns of fish utilisation in India are not necessarily negative and have created significant improvements in the ways in which fish is used and patterns of wastage. But these changes are occurring with increasing rapidity, making significant demands on the innovativeness and capacity for adaptation among the people involved. Often it is the poorest who are least able to quickly adapt to these changes.

For many of the poor, alternative options to diversify or change their livelihoods in response to these changes are inaccessible. The poor typically lack the resources and support to change. Existing opportunities are frequently too risky, they may conflict with cultural or social norms and they are often unsustainable in the longer term. So with the erosion of reef benefits, future declines in agriculture, and few viable alternatives or support, the future for the many millions of poor people dependent on coral reefs is severely threatened.

Just as the coral reefs have frequently been referred to by scientists and politicians as the 'miner's canary' of global warming, so they may also be referred to as a 'miner's canary' of increasing vulnerability of the livelihoods of the poor.

3.6 SUMMARY

Whilst the reef provides a wide range of benefits to many people, especially to the poor, those benefit flows are changing as a result of factors that are impacting upon the reef. Some of these

BOX 35 CLIMATE CHANGE AND COASTAL LIVELIHOODS

The working group of the Intergovernmental Panel on Climate Change (IPCC) has identified a series of probable impacts and vulnerabilities of climate change in relation to coral reefs. Reefs are identified as natural systems that are sensitive to, and under threat from, climate change. Coastal areas more generally are expected to become progressively inundated and many small islands are predicted to become submerged. These coastal areas will also be subjected to increased cyclonic weather patterns and increased variability and unpredictability of general weather patterns.

Linked to the direct effects of climate change are the likely changes in coastal agricultural activities adjacent to reefs. It is projected that these will exhibit a general reduction in crop yields, compounded by declining water availability and a widespread risk of flooding (from both changing precipitation and sea-level rise). These will lead to greater dependence on reef resources in the short term.

The ability of human systems to adapt to these changes is highly variable and those with the least resources have the least capacity to adapt and are the most vulnerable. Thus, impacts are expected to fall disproportionately on the poor.

(From: IPCC, 2001)

impacts are caused by the very people who depend upon the reef. Many more are caused by changes outside the control of reef-dependent communities. Some of these changes are occurring at the moment, others are predicted to occur in the future as a result of climate change and other trends.

The impact of these changes varies between different stakeholder groups, but in general the poor are finding that their livelihoods are being stressed more than most and they are the least able to respond. The changes are likely to result in the decline of a wide array of benefit flows, to greater exclusion of the poor, increasing conflict, criminalisation of the poor, declining food security and more unstable livelihoods. As mentioned in previous sections, many groups of people who are currently above the poverty line are likely to fall below it as a result of these changes.

CHAPTER 4 INTERVENTIONS

4.1 INTRODUCTION

In response to changes in reef benefits, international, national and local institutions and organisations have tried a variety of strategies to deal with the problems. These include: integrated processes that unite sector agencies, protected areas, participatory approaches that involve communities, generating alternative livelihoods, and a diversity of tools for better understanding reefs and informing policies. In the main, the approaches have been implemented by agencies that start from a biophysical perspective and mainly operate with biophysical skills. The aim of many of the interventions has been primarily towards the sustainability of the reef with less emphasis on the livelihoods of reef-dependent communities and this should be borne in mind when reading this Chapter.

4.2 RESPONDING TO CHANGING LIVELIHOODS

Livelihood security of the poor and vulnerable dependent on reefs can be split into three component parts: (1) the diversity of alternative livelihood opportunities the poor have access to; (2) the strength of livelihood support systems, such as government welfare or health, which provide a safety net in times of hardship or crisis; and (3) the health of the reef system that the poor are dependent upon. Each of these three components exist as a continuum as shown in Figure 30. The poor are frequently faced with a situation where there are few alternative livelihood opportunities available to them, support systems or safety nets are weak and the reef benefits on which they depend are eroding. The effectiveness (in terms of poverty reduction) of the intervention approaches discussed below need to be viewed in terms of the changing circumstances of the poor. As the livelihoods of poor reef stakeholders become increasingly vulnerable, interventions to address poverty and reef-related issues need to consider each of these three components of livelihood security in order to make a meaningful and sustainable impact.

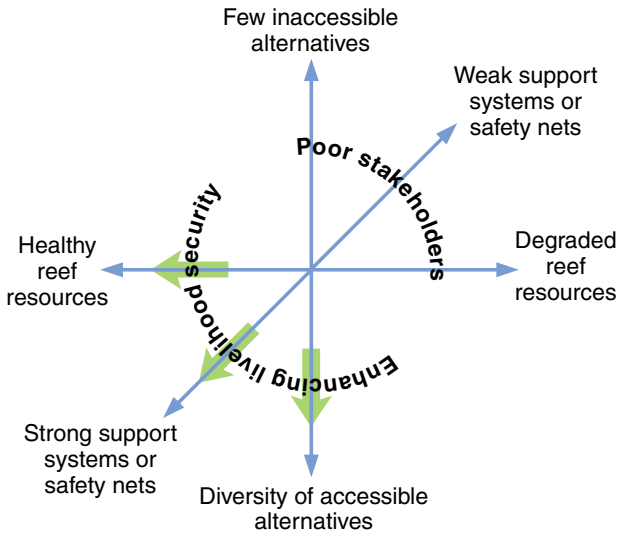


Figure 30 Components of livelihood security for poor reef stakeholders.

The following sections examine current reef-related interventions and discusses how successfully they have addressed the causes of increasing vulnerability and enhanced the livelihood security of poor reef stakeholders.

4.3 PREVENTING REEF DECLINE

Considerable effort has focused on preventing reef decline and conserving reef resources. The following sections describe a range of different interventions commonly encountered in attempts to prevent reef decline and discusses their relative success and failure in dealing with poverty-related reef issues.

4.3.1 Reefs incorporated into Integrated Coastal Zone Management systems

Integrated Coastal Zone Management (ICZM) has been widely applied in coral reef areas in an attempt to try to manage development and solve the complexity of issues in coastal areas in a more cross-sectoral and holistic way. As a theoretical concept it aims to integrate environmental, social, cultural and economic concerns through an iterative process of planning, action and evaluation, involving stakeholder participation at all levels and at all stages. However, in the inevitable prioritisation of the vast range of issues to be addressed in the coastal zone, certain concerns take precedence. In a review of coastal projects in Eastern Africa, Moffat *et al.* (1998) suggest that a large majority of ICZM efforts remain focused on biodiversity conservation, often to the neglect of local development. Given the close linkages between poverty and environmental degradation, this imbalance compromises both the ability of ICZM to contribute to improving the lives of poor stakeholders, as well as its ability to achieve its explicit objective of conservation. It was also noted that many ICZM efforts in Eastern Africa were implemented by external donors or NGOs through short-term projects, when the management interventions themselves required long-term inputs to achieve and sustain change and to respond to the dynamic nature of lives on the coast (Moffat *et al.*, 1998).

White and Deguit (2000) suggest that after many years of working with ICZM approaches in the Philippines, new directions for coastal management are required. This involves, amongst other things, much greater levels of participation than has been used in the past. In reviewing progress on the management of coral reefs in Eastern Africa, Wells (2000) notes that the priority ingredients for success are:

- Involving local communities in decision-making and management;
- Ensuring appropriate livelihoods for those immediately dependent on reefs for their income;
- Developing integrated coastal management frameworks for coral reef management;
- Involving the tourism and dive industries;
- Identifying mechanisms for sustainable financing;
- Promoting training and capacity building;
- Establishing long-term monitoring programmes.

She also points out that coral reef management is becoming seen much more 'as a way of life' rather than a series of short-term projects. Collaborative approaches to reef management are discussed more below.

4.3.2 Collaborative or cooperative management approaches to reefs

Collaborative and cooperative management approaches to coral reef management, as part of wider ICZM initiatives, or as distinct strategies of their own, have emerged from the recognition that an absence of community involvement in, and ownership of, interventions has played a significant part in the failure of many coral reef management efforts. Many existing approaches have tended to ignore local knowledge and capacity, marginalizing local users and failing to respond to their needs. Collaborative or co-management places the local reef stakeholders at the centre of any intervention, involving them in decision-making and management and addressing their needs and aspirations in collaboration with local government, NGO and private institutions (Box 36). Through this collaboration, human resources, expertise and funding are spread across a range of groups, which can ensure a higher possibility of success in developing countries where any single institution is unlikely to have the capacity to support long-term management interventions.

In a review of a selection of community-based coral reef management interventions from around the world, White (1994) notes that despite the overall success of greater involvement of communities in management such interventions must recognise:

- *No model exists for collaborative or co-management* and the nature and balance of roles, responsibilities and stakeholders involved will depend on local circumstances. Clearly defining these roles in an equitable way is an essential part of the process. For some collaborators their roles and responsibilities may well be different from established behaviours and will require support to accommodate change. For example, local community organisations may be weak or non-existent and will require strengthening over time to fully engage in a meaningful way.
- *The wider socio-economic and political context* is the source of important influencing forces, which may constrain the ability

BOX 36 COMMUNITY-BASED MANAGEMENT IN PORTLAND BIGHT, JAMAICA

The management of the ***Portland Bight*** area on ***Jamaica's south coast*** has been delegated to the Caribbean Coastal Area Management (CCAM) Foundation. About 20 000 people are living in the area, mostly below the poverty line and in recognition of their presence CCAM proposes the area be considered as a 'Socio Biosphere Reserve'. This is the first conservation effort in Jamaica led by a social scientist and the approach is focused on participation through co-management. CCAM's objective is sustainable development and the intention is to manage through a series of stakeholder councils, including: government, resource user, and private sector representatives.

The first stakeholder management council, the Portland Bight Fisheries Management Council (PBFMC), was launched in 1995 and was comprised of local artisanal fishers, representatives from the fishers co-ops, from recreational fishing clubs and from government departments, and CCAM. Their first task has been the development of fisheries regulations. This has been a fully participatory process and resulted in both the fishers and government perceiving ownership over the regulations. In addition, 50 fisherfolk have been appointed as 'honorary game wardens' or 'fisheries inspectors' and provided with training, giving them powers of search and arrest. Close supervision has only encountered one abuse of authority or false arrest since 1996.

(From: Espeut, 1999, 2002)

of the community to respond to problems. For example, controlling the impact of external market forces or resource users from outside the community, will require strong community organisation and co-ordination with external stakeholders, it may also be benefited by legitimising local ownership over resources.

- *Existing traditional management systems* offer opportunities and constraints to collaborative or co-management, which need to be fully understood to maximise effectiveness. For example, controls over resource access and use commonly encountered in traditional management systems can be used as effective fisheries management tools and are much the same as many contemporary fisheries controls. However, the rationale and values behind the use of such controls in their traditional context may be quite different and even at odds with contemporary goals and so must be fully understood within their context to affect the desired outcome.
- *The role of donor agencies* needs to accommodate a flexible and process-orientated approach, recognising the diversity of needs, values and opportunities of local stakeholders and the considerable time and commitment required to support innovative and small-scale community-orientated initiatives and to ensure sustainability.

4.3.3 Marine protected areas

One focused instrument often used in ICZM is the Marine Protected Area (MPA). There are over 1600 MPAs scattered throughout the world's oceans[4], covering 1% of the marine environment, of which 660 incorporate coral reefs (Spalding *et al.*, 2001). MPAs, known variously as marine parks, reserves, or sanctuaries are increasingly being used as tools in ICZM and collaborative or cooperative management initiatives, for protecting and restoring marine biodiversity, ensuring sustainable fisheries management and in association with tourism developments. According to the World Wide Fund for Nature,[5] the purpose of MPAs is to:

- Help protect vulnerable habitats and threatened species;
- Increase fishery productivity by protecting critical breeding, nursery, and feeding habitats such as estuaries, mangroves, seagrass beds, and coral reefs;
- Protect breeding populations which can help restock and restore overexploited areas;
- Reduce the impact of tourism and other direct human activities;
- Provide local communities with alternative livelihoods, such as well-managed tourism.

Depending on local circumstances, MPAs vary greatly in the extent to which they meet these multiple objectives. In some cases MPAs may be established principally as a tool for biodiversity protection, fisheries management or tourism and in other cases multiple use strategies, including a number of the above may be employed.

There is evidence that MPAs can be used effectively to meet these objectives, in particular in enhancing fish stocks. However, only a decade ago it was noted that only a small percentage of the world's MPAs were effectively managed (White, 1994). Kenchington (2000) notes that '. . . the concept of a protected area that can be managed in effective isolation from activities in surrounding areas is not ecologically tenable'. Likewise, the success of MPAs in terms of sustaining reef benefits to poor stakeholders depends largely on the extent to which locals have participated in negotiating the objectives of the area and in subsequent management and monitoring (Box 37).

BOX 37 THE SUCCESS OF MPAS IN SUSTAINING REEF BENEFITS FOR THE POOR

Sumilon Marine Reserve was set up in 1974 on ***Sumilon Island, Philippines***, to protect 25% of the reef and increase local fish yields on the instigation of biologists at Silliman University and the local municipal council. By the late 1970s, early 1980s local fishers indeed perceived that fish yields had increased. However, following a change in local administration in 1980 the reserve lost local support by both politicians and the community, who perceived the reserve as an externally driven initiative. This support is still lacking and has resulted in management failure and over fishing in the reserve.

Apo Marine Reserve, Philippines, was established in 1985 following education and conservation activities in the area since 1979, which worked with locals to identify their needs and management problems. The community have been actively involved in the reserve since its inception and remain involved in its implementation. Small tourist facilities have been set up bringing benefits to the local economy and a community education centre has been built from visitor fees and donations. The success of Apo Marine Reserve is largely attributed to the involvement of the local community at all stages.

(From: Talbot and Wilkinson, 2001)

4.3.4 Participatory approaches to reef management

A key element of any co-management process is participation, and participatory approaches to reef management are becoming increasingly important. However, participation can take many forms from a very extractive process to one of mutual collaboration. Campbell and Salagrama (2001) highlight varying degrees of involvement of both the community and outside professionals (Table 11), which vary according to: the balance of control between the community and outsiders; the stage at which interactions occur; the quality of those interactions; the perceived benefits derived by each side; and the level of empowerment developed within the community as a result.

The degree of participation applied in any intervention depends on local circumstances and the objectives of the intervention. In some cases, participation will evolve from initially being professional-led, into a community-led collaboration as capacity within the community develops (Box 38). Evidence suggests that participation early on in the process and significantly

TABLE 11 DIFFERENT DEGREES OF PARTICIPATION

Type: A	Professional exclusive	Only involvement of professional participants
Type: B	Professional-led Contract	Professionals 'buy-in' the skills and equipment of the coastal people
Type: C	Professional-led Consultative	Professionals utilise the indigenous knowledge of the coastal people for their own purposes
Type: D	Professional-led Collaborative	Professionals allow the involvement of coastal people in the activities under conditions prescribed by the professional
Type: E	Collegial	Professional and community members work equally together to generate knowledge and develop interventions on an issue of mutual importance
Type: F	Community-led Collaborative	Coastal communities allow the involvement of outsiders in the activities under conditions prescribed by the community
Type: G	Community-led Consultative	Coastal communities utilise the knowledge base of the professional researchers for their own purposes
Type: H	Community-led Contract	Coastal communities 'buy-in' professional support from outside to address their needs
Type: I	Community exclusive	Only involvement of community members

Adapted from Campbell and Salagrama, 2001

BOX 38 LOCAL PARTICIPATION IN FISHERIES MONITORING IN EAST AFRICA

At several locations in Kenya and Tanzania, local fishers are participating in fisheries-monitoring programmes together with local government institutions, scientists and NGOs. Standard methods for monitoring have been adapted to suit local fishers, including the use of local taxonomic names and local measures of size. Multiple training activities over a prolonged period and involving a reciprocal learning process between fishers and scientists has been necessary to develop skills and understanding, and overcome the constraints of low literacy and difficulties in correlating local and scientific taxa. Collaboration between local communities, scientists, government officers and NGOs at all stages, from data collection to analysis and dissemination, has encouraged the sharing of information and ideas.

The process has taken considerable time to build acceptance and to develop reliable monitoring systems. It has also required external funds to compensate for local fishers' time, potentially constraining its long-term sustainability. However, this has been rewarded by increased levels of awareness and understanding of the need for and impact of management interventions and improved management and community empowerment. At the two sites in Kenya (Diani and Kiunga) the process has been a stimulus for fishers to organise into community, or 'self-help', groups, which are variously involved in discussions with government authorities, and are functioning much like the fishing co-operatives, which had previously collapsed due to political and financial problems. While empowerment was not the initial motivation of the participatory fisheries monitoring activities it is considered an important outcome, which is likely to contribute to the longer term success of the programmes.

(From: Obura *et al.*, 2002)

in negotiating the objectives of any intervention is critical to ensure its longer-term success. It is also important that participation is maintained throughout the process to ensure sustainability in the longer term.

Despite the many advantages of participation it is not a panacea to ensuring interventions succeed in preventing reef decline and assuring sustainable reef benefits for poor stakeholders. The success of participation will depend on when participation takes place in the process and how it is sustained. It will depend on the equitability of the participation process and how well the poorer and often hidden members of the community are included. It will also depend on the extent to which local systems of patronage are accommodated in the process. A DFID-funded study of participation in ICZM in the Puttalam district of Sri Lanka, highlighted the significance of patronage relations in influencing the outcomes of any intervention and stressed the need to understand and develop mechanisms to convert potentially negative impacts of patronage into a positive and dynamic force (Foell *et al.*, 1999).

4.3.5 Sustainable coastal livelihoods

Whilst many efforts in ICZM, co-management and MPAs now incorporate participation they tend to do so to better achieve the functional aim of improved resource management. The DFID-funded, policy research project *Sustainable Coastal Livelihoods* (SCL), based in India, Sri Lanka and Bangladesh, has taken a people-centred approach to the coastal ecosystem. It explores the relationship between policy and poverty in the coast, identifies key problem areas and provides guidance on improved approaches. The SCL project uses the Sustainable Livelihoods Approach (SLA) as a means of understanding and addressing the complexity of coastal livelihoods and many of the lessons learnt from that project have informed and influenced the approach adopted during the fieldwork of the current *Reef Livelihoods Assessment* project. The SCL project identified the following key points for improved policy formulation and implementation in support of the coastal poor:

- Adopting a vertically and horizontally integrated approach to policy formulation, planning and policy implementation that involves the full participation of the coastal poor.
- The need for policy-informing research to fully engage with the poor and to develop much more collaborative approaches to the research process.
- Using information effectively and systematically in informing and influencing the multitude of different stakeholders involved in coastal development to achieve appropriate behaviour change in line with agreed objectives.
- Reorganising and building capacity in extension services to specifically target the poor.
- Recognising the specific importance that common pool resources have for the poor and accommodating that into policies and plans.
- Recognising the diversity and the value of community-based systems for control, coordination and communication and to incorporate these into policy-implementation measures.
- Recognising and responding to the inability of the poor to take up most development opportunities that are provided before they are taken up by more advantaged members of society.
- Approaching the issue of alternative livelihoods in systematic ways that build on a detailed understanding of the livelihoods of the poor and how those livelihoods fit into wider development processes.
- Recognising the importance of mobility, migration and displacement in the livelihoods of the poor and catering for this.
- Recognising the specific needs of the poor in disaster situations and to cater for those needs.

In addition to the broader approaches to coasts and reefs discussed above, there are a variety of much more specific policy instruments, as outlined in the following sections.

4.3.6 Information exchange

The communication and exchange of different forms of information between a wide range of different stakeholders is a major component of any intervention. It may take the form of monitoring and evaluating project impacts or change, in order to assist better management, or it may focus on awareness raising, to disseminate and exchange information amongst stakeholders.

4.3.6.1 Monitoring and evaluation

Coral reef-related monitoring programmes have been developed as part of wider international initiatives, such as the Global Coral Reef Monitoring Network (GCRMN) and Reef Check, and also as part of local level coral reef interventions.

At global levels the focus of monitoring programmes has been on collecting information to better understand regional and global trends and to raise awareness of these changes amongst policy-makers within governments and donor agencies, in order to promote support for interventions to address these changes. At local levels monitoring and evaluating is an integral part of any management process, providing critical information to understand the associated impacts and effectiveness of an

intervention and to allow the process to adapt and grow. In the GCRMN South Asia node, linkages between the global and local levels of monitoring have been strengthened, where local partners have adopted an 'Inform globally, act locally' approach to their work. This has resulted in greater local ownership of the GCRMN process in the South Asia region.[6]

In order to fully understand change and the impacts of management interventions, monitoring must consider environmental, social, cultural, economic and political factors relating to both coral reefs and coral reef stakeholders. However, in line with the predisposition of many programmes towards coral reef conservation, monitoring and evaluation is often focused towards understanding the status of the coral reef resource and the impact of natural changes and human activities on the reef. Attention to the impacts of interventions on the livelihoods and well-being of local poor stakeholders has so far been less pronounced.

However, socio-economic monitoring of reef stakeholders is increasingly recognised as an important and critical component of our understanding and ability to effectively manage coral reef resources and ensure sustainable benefits to stakeholders. Indeed, socio-economic monitoring and the identification of suitable indicators to measure change, has been the focus of considerable debate and resulted in the production of a manual specifically targeting socio-economic assessments for coral reef management (Bunce *et al.*, 2000). In East Africa a programme is currently underway to develop socio-economic monitoring in partnership with ongoing coral reef management projects (Box 39).

4.3.6.2 Awareness raising

Awareness raising is a major component of most interventions associated with preventing reef decline and is an important part of developing a better understanding of issues amongst stakeholders and as a means of creating a willingness to change attitudes and behaviours.

In the same way as monitoring has concentrated on the objectives of coral reef conservation, awareness raising is often focused on informing stakeholders of the negative impact of their actions on the health of the reef. It is also often used as a means of informing locals of the objectives of an intervention in order to gain their support. While these efforts may be successful

BOX 39 EAST AFRICA SOCIO-ECONOMIC MONITORING

Supported by the CORDIO programme, an initiative is underway in ***East Africa*** to build a partnership programme for socio-economic assessments and monitoring, in recognition of the critical need for socio-economic information to support effective management and sustainable use.

The initial focus for the socio-economic monitoring programme is coral reefs and mainland East Africa (Mozambique, Tanzania, Kenya), though this is likely to be broadened in the future. The aim is to develop a monitoring process and associated information management system at the project/local level and regional level by providing services such as training, reviews and identification of suitable indicators. The process is being developed in partnership with ongoing coastal and marine resource management and research projects in Eastern Africa. Monitoring protocols are being designed to be applied by members of the resource-use community, or in partnership with them. Indicators for monitoring have been developed together with partner projects according to the project's needs, practicability, suitability to comprehension and use by resource users, and comparability across the region. At the early stages of development, following consultation with a variety of projects, three areas were identified as appropriate for potential indicators:

(1) Resource use patterns
(2) Attitudes and perceptions (to management regimes or other users)
(3) Well-being (economic status/food security).

Currently there are several projects involved in the programme, including the CORDIO Participatory Fisheries Monitoring Programme in Diani, Kenya (which is in the first field testing phase), the CARE Misali Island Conservation Project in Pemba, Tanzania, and the Participatory Fisheries Monitoring Programme in Kiunga, Kenya (which are both in preliminary discussion phases).

Although still at its early development stages, the programme represents a concerted and focused effort to address the lacuna of socio-economic monitoring information on the impact and effectiveness of management for local people and resource users. Information which will be critical to ensure the longer-term success and sustainability of coral reef management interventions.

(For more information on this programme contact David Obura, CORDIO East Africa
email: dobura@africaonline.co.ke)

BOX 40 CORAL REEF FORUM IN SOUTH ASIA

The ***GCRMN South Asia*** programme has recently help set up coral reef forums in Sri Lanka and the Maldives. Each forum includes a wide range of stakeholders concerned with the sustainable use and management of coral reefs, from government departments, to NGOs, user groups, researchers and projects. The fora provide important opportunities to exchange information, ideas and best practice and will help to ensure a co-ordinated approach and response amongst a diversity of stakeholders faced with a complexity of issues and problems. Applying a systematic informing and influencing strategy developed by the *Sustainable Coastal Livelihoods* (SCL) project, the fora have already begun a process of understanding how to better influence change towards sustainable use amongst a wide range of coral reef stakeholders.

(See: http://www.ioc.unesco.org/gcrmn/workshop%20report.doc)

BOX 41 THE MARINE AQUARIUM COUNCIL

The Marine Aquarium Council (MAC) is an international organisation established in 1998 with the aim of conserving coral reefs and other marine ecosystems by creating standards and certification for those engaged in the collection and care of ornamental marine life from reef to aquarium. To achieve this aim, MAC has developed standards and launched a best practice certification scheme for those involved in each stage of the harvest and trade of marine ornamental species. This includes certification schemes for collection areas, collector associations, exporters, importers and retailers. Through partnerships with local organisations and governments, support is being provided to build the local capacity of collectors to comply with MAC standards and help ensure the sustainability of harvest.

(From: Marine Aquarium Council website www.aquariumcouncil.org/)

in achieving what they set out to do they are likely to be less successful in eliciting behavioural change if they do not recognise and balance the diversity of needs of different stakeholders.

There is a growing recognition of the importance of adopting a more systematic approach to informing and influencing that responds to the diversity of stakeholders and their wide ranging needs and aspirations (Box 40).

4.3.7 Legislation

Another specific policy instrument is reef legislation. The use of legal instruments as a means of implementing fisheries management, MPAs, ICZM or collaborative management interventions is widespread. Many of the controls for managing fisheries, such as restrictions on gear, catch or controls over access to particular areas or species, are not new to coral reefs and are common amongst many traditional community-based management systems. However, whilst in the past the objectives of such measures may have had little to do with conservation or sustainable use, these are the primary goals of current legislation. In many cases, such legislation is now in the hands of local or national government and is often led by international initiatives promoting controls over trade in endangered species (e.g. CITES) or encouraging sustainable trade (Box 41).

The success of legal controls is largely determined by the strength of local support and is often compromised by the cost of enforcement and corruption. In some situations, changes in the law that do not also address reef-dependent livelihoods are in danger of criminalising the livelihoods of the poor with additional adverse consequences. Where the poor have no alternative but to continue with their existing, now illegal, livelihood the management objectives are unlikely to be achieved. Where legislation has been more effective local resource-users have been included in the development, communication and monitoring of regulations (Box 42). Such an approach increases local ownership of controls, however, it requires sufficient resources and support to implement at a local level and still remains open to corruption.

4.3.8 Economic valuations

Economic valuations of coral reef resources are increasingly undertaken as a means to influence national level policy-making. Calculating the economic value of coral reef resources to wider society and the national economy, enables planning and decision-making to incorporate ecosystem values in cost–benefit analyses for development (Box 43). In this way, the total value of coral reefs from tourism, fisheries and coastal protection has been compared against the cost of destructive fishing, coral mining, or against the benefits and costs of forestry activities (see Cesar, 2000, for examples). Economic valuation techniques have also been widely used in assessing the costs and benefits of establishing marine protected areas (see Cesar, 2000, for examples). In all cases, these models have provided strong economic justification for coral reef conservation and have highlighted the role of coral reefs in national economic development planning.

BOX 42 LOCAL INVOLVEMENT IN CORAL REEF LEGISLATION

In 1978 the ***Philippines*** government passed a number of measures that would enable local government and communities to share in the responsibility of fisheries regulations enforcement. Local fishery law enforcement teams have been established in many areas. These are known as *Bantay Dagat* or 'guardians of the sea' and are comprised of deputised fish wardens from local villages, members of the local police force and occasionally representatives from the Philippine National Police Maritime Command and the Coast Guard or Navy. *Bantay Dagats* provide good opportunities for the community to work together. However, their organisation is dependent on the motivations of the local political leadership, which changes every 3 years, and which jeopardises adherence to fisheries law enforcement as well as efforts to maintain well-trained wardens. Enforcement can also be a dangerous activity and compensation for the high risk faced by the local wardens is limited. Despite these problems, in well-organised and cohesive communities improved law enforcement has been achieved.

(From: Sievert and Diamante-Fabunan, 1999)

In the ***Southern Tanzanian*** district of Mtwara, the local communities are strongly committed to stopping dynamite fishing and have taken charge of controlling dynamite activities relieving the Tanzania People's Defence Forces (TPDF). A collaboration of district leaders, the Rural Integrated Project Support (RIPS) initiative and a local association SHIRIKISHO, initiated an extensive community education and awareness campaign of the harmful effects of dynamite fishing. The campaign, using participatory approaches, empowered local communities with a sense of ownership and successfully reinforced the earlier TPDF crackdown on dynamite fishing.

(From: Luhikula, 1999)

BOX 43 EXAMPLES OF ECONOMIC VALUATIONS OF CORAL REEFS

In a World Bank study on the economic value of coral reefs in ***Indonesia***, Cesar (1996) analysed the net benefit to individuals and costs to society as a result of five different threats to coral reefs (poison fishing, blast fishing, coral mining, sedimentation and pollution, and over-fishing). This clearly showed, that for none of the threats do the short term benefits even approach the long-term costs (under the assumptions of a 10% discount rate and 25 year horizon). For example, coral mining is estimated to yield net benefits to individuals of US$121 000 per km^2 of reef, while causing net losses to society of US$93 600 in fisheries value, US$12 000–260 000 in coastal protection value, US$2900–481 900 in tourism value, US$67 000 in forest damage, and unknown costs due to lost food security and biodiversity.

(From: Cesar, 1996)

In a review of the values of ***Philippine's*** coastal resources, White and Cruz-Trinidad (1998) have estimated that the combined value of coral reefs, mangroves, fisheries and aquaculture contribute at least US$3.5 billion every year to the Philippine national economy. Of this, the total area of coral reef was estimated to contribute an annual economic benefit of at least US$1.35 billion to the national economy, from the combined values of fisheries, tourism and coastal protection.

(From: White and Cruz-Trinidad, 1998)

While at a national level this information has made considerable contributions towards the level of importance attributed to coral reefs by policy-makers, it is unable to expose the full value of reefs to people at a local level and in particular to the poor. As revealed in previous sections, a large part of the poor's dependency on reefs is associated with subsistence and is linked to the role of the reef in their wider livelihood strategies. It is not surprising, therefore, that the value of reefs to the poor do not feature significantly in national level statistics and are difficult if not meaningless to define in terms of monetary values.

It is of importance, however, that the full benefits of reefs to the poor are more widely acknowledged at national levels in order that planning and decision-making can adequately address the needs of the poor in development. Without this acknowledgement there is the risk that economic values of reefs at national levels will eclipse the benefits of reefs to the poor in influencing policy-making and planning, and consequently resultant interventions are likely not to adequately address the needs of the poor.

4.3.9 Property rights

Attempts to limit the negative impacts of increasing coastal populations on poor reef stakeholders has focused largely on recognising and legitimising their rights to access reef benefits. This reflects a trend throughout fisheries management to address access rights in an attempt to overcome the increasing conflicts over scarce fisheries resources and the inability of many existing

controls to sustainably manage open access fishery resources (FAO, 2000c). For poor small-scale fishers, the definition and enforcement of their rights to access reef resources is an important mechanism to control exploitation by outsiders and ensure reef benefits are sustained for the local community. However, as highlighted in the FAO State of World Fisheries and Aquaculture Report (2000c), problems are likely to arise with property rights systems in fisheries management relating to:

- How the rights are defined – in other words, who has the right to use the resources of a fishery, which portion of the fishery may be used, and how and when it may be used;
- How the rights are conferred and upheld;
- How the rights create incentives for those involved – by virtue of the fact that they, to lesser or greater degrees, allocate potential benefits, which may or may not reinforce management objectives.

In addition, there is a need to cater for the livelihood aspirations of those excluded from the fishery and to date few systematic approaches have been used to address this issue.

Throughout the Pacific, access rights to reef resources are defined and controlled within the traditional customary marine tenure systems. However their application to contemporary coastal resources management is not necessarily a straightforward exercise and depends on their compatibility with government policy, in particular fisheries development policy; the clarity of definition and robustness of rights, in particular the determination of traditional boundaries and rights-holders; and their contribution to sustainable fisheries, which depends largely on the values and objectives of traditional systems of control (Ruddle, 1998).

4.3.10 Eco-tourism

In an effort to control the adverse effects of large-scale coastal tourism developments and to provide accessible alternative livelihood opportunities to local communities, sustainable tourism and eco-tourism are frequently promoted. These are often undertaken as part of collaborative management or ICZM initiatives, promoting small-scale, low impact activities which provide direct benefits to the locals involved. However, the extent to which the poorer members of a community may benefit from eco-tourism is unclear. Often such initiatives require those involved to have a certain level of language skills, or to be the owners of particular physical resources (boats or extra rooms). This may require extra support or skills training for poorer households, it may also not be a socially or culturally acceptable alternative for some households, e.g. female-headed households.

4.3.11 Environmental impact assessment

Environmental Impact Assessment (EIA) is a tool used to identify the ecological, social and economic impacts of a project prior to decision-making. It aims to predict impacts at an early stage in project planning and design, find ways and means to reduce adverse impacts, shape projects to suit the local environment and present the predictions and options to decision-makers. However, the extent to which EIA addresses the specific impact of a development on the poor is questionable, as is the extent to which decision-makers alter development designs in the general rush to capitalise on globalisation.

4.3.12 Reducing habitat destruction and enhancing habitat rehabilitation

Recognising the already significant populations and high levels of industrialisation and urbanisation in and upstream of coastal areas, the focus of many interventions is to attempt to mitigate the unavoidable negative impacts on coral reefs. In some cases, this has involved attempts to control sources of pollution, such as controlling sediment run-off by improving land use practices, or controlling nutrient and pesticide pollutants by promoting sustainable agricultural practices (Box 44).

BOX 44 THE BETTER BANANA PROJECT: CONTROLLING EROSION AND POLLUTION FROM BANANA PLANTATIONS

The coral reefs of many countries in the ***Caribbean and Latin America*** have suffered high levels of degradation associated with sedimentation and pollution from fertilizers and pesticides originating from banana cultivation. The Better Banana Programme (BBP) involving many countries in Latin America and the Caribbean began in 1991 in an attempt to halt deforestation by banana companies and promote environmental and social standards in the banana industry.

The objectives of the BBP are to minimize the environmental impacts of banana farms, including erosion problems and pollution from chemicals, while maximizing the benefits to workers and communities. This has been achieved through the use of market incentives and eco-labelling. Standards for responsible production were first negotiated in Costa Rica through discussions with banana producers, environmentalists, scientists, community leaders and government agencies. More than 150 farms have so far been certified in Ecuador, Colombia, Panama and Costa Rica (including large companies and in Ecuador a co-operative of 35 small farms), and others in Guatemala and Honduras are enrolled in the programme.

(From: ICRI's Best Practices for the Protection and Management of Coral Reefs http://www.environnement.gouv.fr/icri/)

In other cases, mitigating impacts on coral reefs have involved attempts to restore the environment. This may focus either on restoration of the reef habitat itself, or on specific reef species through stock enhancement programmes. In either case, considerable time, expertise and resources may be necessary, which will limit the scale of restoration. In many cases, restoration attempts are still at early and experimental stages and the longer-term success is uncertain. Where the negative impact of resource use or externalities, such as pollution, is high the success of reef habitat restoration will be constrained, without first reducing or eliminating these threats.

4.4 DIVERSIFYING AND ENHANCING LIVELIHOOD OPPORTUNITIES

The poor are continually seeking alternative income-generating opportunities both to supplement current diminishing sources, and to provide opportunities for occupational migration. Whilst income activity diversification and occupational migration are often adopted to reduce risk, they can actually increase risk in the short to medium term. This occurs often enough to dissuade the poor from this course of action until they are in very desperate situations. An increasingly important role of development agencies is to take part of that risk and support the uptake of viable and sustainable income alternatives or to enhance existing livelihood opportunities.

In light of the declining availability of and access to reef resources, many reef-focused interventions are beginning to search for alternatives to substitute the incomes and livelihoods lost for those dependent on the reef, or to replace unsustainable or destructive reef exploitation patterns. In the past this has often proved rather difficult because the alternatives suggested have rarely been well linked into the resources of the poor or to the requirements of local markets (Box 45). In some cases they have not acknowledged the seasonality context in which the poor operate or the shocks and changes that they confront. Or they have ignored the wider influences that society places on the poor. In many cases, the success of alternatives is limited to the lifespan of the programme initiating the change, with alternatives unable to exist without external support or to adapt to the dynamic nature of livelihoods.

There is now a growing recognition that a more systematic approach, which looks holistically at livelihoods and develops solutions in partnership with people, after careful consideration of the opportunities and threats, is likely to generate more acceptable and sustainable results. Solutions may not simply require the development of an alternative income-generating opportunity to replace an illegal or declining option. They may also involve enhancing or diversifying existing activities through direct changes to the activities themselves or the wider context in which they operate. Experience suggests that for successful interventions to be developed and sustained a greater understanding of local livelihoods is required. More emphasis on a process of dialogue, understanding, planning, development and evaluation is needed as opposed to the rush of many

BOX 45 PROVIDING ALTERNATIVE LIVELIHOODS TO CORAL MINERS IN SRI LANKA

In an attempt to stop illegal coral mining activities, the Coast Conservation Department in ***Sri Lanka*** has implemented a number of programmes to provide alternative livelihood opportunities to coral miners. In the late 1980s these programmes focused on providing agricultural employment as an alternative to illegal coral mining, which was identified as an option in line with the education levels of coastal communities.

In some sites this involved the relocation of families from the coast and the provision of one acre of coconut or rubber tree plantation, or one acre of bare land. At other sites, families were offered opportunities to engage in poultry farming. In all locations a large number of people joined the programmes, motivated mainly through a fear of a crackdown on coral mining activities, but also encouraged by the increased income opportunities offered by the programmes. However, despite these incentives, the programmes have largely failed, with many people returning to coral mining activities. The main reason for failure was the lack of relevant experience and skills in the different farming activities, which led to low productivity and declining incomes. For the relocated families there was also a lack of basic facilities, such as transport, health services and schools, which placed major constraints on livelihoods. In those instances that the programme succeeded, it was generally with those people who were able to diversify into other non-coral mining options, in addition to farming.

The experience demonstrates that while higher incomes and fear of punishment may be an incentive to change they are insufficient to sustain change. For alternative livelihood interventions to be long lasting a better understanding of local skills and experiences are needed and support is required to build local capacity to adapt. It is also crucial to understand the wider constraints and opportunities on local livelihoods in order to develop alternatives that are viable in the longer term.

(From: Perea, 2002)

BOX 46 SUSTAINABLE LIVELIHOODS ENHANCEMENT AND DIVERSIFICATION

As part of the *Sustainable Coastal Livelihoods* (SCL) project it was realised that, whilst promoting alternative livelihoods for reef-dependent communities is considered a major policy instrument in reef conservation, most attempts to address the livelihoods of the poor were unsystematic and not based on a sound understanding of the strengths and weaknesses of existing or potential livelihoods. As a consequence the success rate of such measures is limited. In response the SCL project has developed a framework not only for systematically identifying diversified livelihoods, but also for identifying ways to enhance existing livelihoods to make them more sustainable.

(See: www.ex.ac.uk/imm/scl.htm)

interventions to apply a shopping list of potential alternatives in order to meet project timescales and objectives (Box 46).

4.5 STRENGTHENING LIVELIHOOD SUPPORT SYSTEMS

The capacity of basic services and support systems and their accessibility to poor reef stakeholders is critical in determining the poor's ability to respond and cope with change. Poor health and education weaken the potential of the poor to adapt and change. An absence of support mechanisms in times of crisis burden the poor with high levels of risk, a burden which in some cases is increasing with the decline of reef benefits, which formerly provided safety nets and keystone resources in times of hardship.

On the remote Lakshadweep Islands and the Andaman and Nicobar Islands of India, high levels of government support and subsidies have developed local infrastructure and services, such that local communities have access to higher standards of support, in terms of education, health and sanitation, than in many other areas of India. On the Lakshadweep Islands, government sector jobs offer an important alternative to reef-based livelihoods and provide a major source of income and prosperity to the islands. Many households have benefited from these opportunities and overall the average household income has increased. However, frequently the elderly, the poorly educated, or traditionally skilled have been by-passed by this development, left behind to pursue reef-related activities as opposed to steady salaried government employment options. This has rapidly contributed to polarity and income disparity within the island populations and has resulted in an increasing incidence of poor households (Hoon, 2003).

Clearly while strengthening the underlying support from government for basic services is critical, it will only create positive changes for the poor if its development is targeted at the poor. The very nature of poverty often excludes the poor from the benefits of development. Therefore, to better target development a more detailed understanding of the poor is required, which goes beyond standard measures, embracing the diversity of poor stakeholders and incorporating local aspects of poverty.

4.6 SUMMARY

There are a wide diversity of approaches that have been used in association with reefs and reef-dependent livelihoods. In the main these have been used to address biophysical aims and so evidence for their effectiveness in addressing livelihoods issues is less obvious. There is, however, a growing recognition that greater levels of involvement of reef-dependent communities in identifying and solving problems is the way forwards. However, these approaches in the main still view participation as a functional approach and few initiatives are addressing reef-related issues with a people, let alone, a poverty focus.

For participation to increase success in terms of poverty reduction it must engage reef-dependent people in an equitable way – it must understand that the community is not homogenous and that the poor are often difficult to 'see' and engage in the development process – it must also consider the powerful influences of patronage and external market forces and attempt to engage with these creatively to transform them into positive influences.

A key part in future changes will be more systematic approaches to understanding the complexity of people's lives and to responding to the challenges they face. Halting reef decline in an equitable and participatory fashion is not sufficient to change people's behaviours and enhance livelihood security. Support must be given to help people change themselves and reduce the risks associated with changing. Solutions must be developed together, be locally acceptable, build on strengths and opportunities, while recognising threats and be dynamic in the longer term. Support must also come from government services to enhance safety nets which need to be better targeted to the poor.

CHAPTER 5 DISCUSSION AND FUTURE DIRECTIONS

5.1 OVERVIEW OF THE CURRENT SITUATION

5.1.1 The global distribution of reefs and reef stakeholders

Coral reefs are found in shallow waters throughout the tropical world and dominate the coastlines of many countries in the South Pacific, Southeast Asia and the Indian Ocean, including some of the poorest countries in the world. It has been estimated that over half a billion people live within 100 km of a coral reef, with over 200 million living near reefs in Southeast Asia and nearly 100 million living near reefs in the Indian Ocean (Bryant *et al.*, 1998). While these figures are often quoted in the literature, the actual number of people who depend upon reefs, and their level of dependence, are not well known. We do know, however, that there is a wide diversity of stakeholders who depend upon reef resources. Some reef stakeholders depend upon reef resources as a regular part of their livelihood, some are part-time users who only occasionally depend on the reef, but that dependence is absolute, others use the reef as a safety net. There is also a growing dependence in wider society on reefs as part of national heritage, as a dumping ground for waste, as a source of pleasure for tourists, or as a focus of study and research.

Among those people dependent on coral reefs the numbers living in poverty is significant. Two-thirds of all reef areas are found in developing countries, one quarter of which occur in least developed countries (UNDP, 2002). Thus many reef stakeholders are very poor people, but that poverty is often hidden from sight. The poor often fall in the gaps between coastal development activities, they are often the marginalized ones that do not have legal title to coastal resources, and who are often seen as an obstacle to conservation or development. Because of this hidden nature the profile of the coastal poor is only just beginning to be understood. However, it is clear that dispersed around the world there are considerable numbers of poor people dependent on reefs. Some are very poor (especially in Africa and South Asia), while others are extremely vulnerable (such as in the Pacific). For all of these people, coral reefs offer a physically and economically accessible, diverse and highly productive resource, which provides a complex range of benefits affecting different groups of people in many different ways.

5.1.2 The benefits of reefs to the livelihoods of the poor

Reef resources provide a multitude of different benefits to the poor, including seasonally stable sources of food, building materials, a medium of exchange, medicines and a source of income and status. It is the reef that often gives rise to islands that provide habitats for people and lenses of fresh water for drinking and agriculture. The reef also protects coastal villages from storms and wave action and provides shelter to lagoons and other productive areas, such as seagrasses and mangroves, which in turn provide a reserve of food in all weather conditions. The physical structure of the reef dictates that many activities are done communally and the traditional linkages between reefs and fish and the spirit world mean that reefs can be socially and spiritually unifying.

The diversity of reef products support multiple opportunities for direct exploitation for people with many different skills and access a wide range of different markets, including high value export outlets. The structural and species diversity of the reef prohibits large-scale industrial production and favours small-scale production, preserving opportunities for those with few financial or physical resources. The common pool nature of many reef resources allows easy entry for those who are displaced from other sectors, especially in times of emergency, but the high degree of skill required to understand the reef fully means that barriers to entry still limit the uptake of more complex harvesting strategies.

Unlike many fisheries, where women are excluded from production, coral reefs offer opportunities for women to collect from the reef by foot, this has significant benefits in empowering women in the household, and different reef-based strategies between men and women spread household risk. For poor coastal households, particularly female-headed households and vulnerable groups such as the elderly, shallow coral reef resources are often the principal source of food and income security.

Not only do reefs provide a range of benefits in terms of the resources that reef-dependent people use directly in their livelihoods, the reef can also affect the interaction between reef-dependent people, their resources and the factors that control how they access and use those resources. In this way, the presence of reefs may benefit people in their interaction with the politics, culture or social relations which affect their lives. For example, throughout the world the diversity of reef species has provided opportunities for implementation of fisheries development policies focused on high value export markets, which in turn provide opportunities for small-scale reef fishers. Reef resources also help people cope with, and adapt to, wider changes that affect their lives whether they are regular seasonal changes, longer-term trends, or periodic shocks and stresses. These benefit flows help

reef-dependent people develop a range of livelihood strategies, and the diversity of those strategies reflects the diversity of type and form of the benefits that flow from the reef ecosystem. Some people are able to develop strategies that make full-time regular use of the reef or its resources, others can use the reef as a crucial *safety net* in difficult times. Others use the reef as a *keystone resource* that they tap into at certain times of the year when other resources are not available to them. The use of the benefit flows are not just for subsistence, income or food security; the reef provides a much stronger platform for social and cultural development, which is not always considered in economic analyses of the reef.

In some situations, the reef provides the very means to keep many people out of poverty and so it often appears that reef-dependent communities are not as badly off as some of their neighbours, whose strategies are mainly land-based. In the Pacific, for instance, many reef-dependent communities seem idyllic, but there is a growing level of vulnerability amongst these communities that threatens to undo much of the work that has been achieved through the wider development process.

5.1.3 Changing reef benefits and future vulnerability

The ability of coral reefs to continue to provide benefits to the poor is changing. Throughout the world the capacity of coral reefs to buffer risks and vulnerabilities and provide livelihood stability is eroding as a result of changing access to and availability of reef resources. These changes are being driven by a complex web of interacting factors, acting indirectly or directly, over which the coastal poor have varying degrees of control. One of the principal factors responsible for declining reef benefits is reef degradation, which has arisen as a result of increasing pressures from population, development, market forces and climate change.

Coral reef ecosystems are extremely sensitive to change and easily suffer from disturbance. As coastal areas become ever more populated, increasing numbers of reef stakeholders have begun to compete for access to reef benefits, a situation that has led to increasing pressure on the reef resource typically resulting in overharvesting and reef decline. Lucrative markets for reef species often drive unsustainable and destructive extraction regimes, which further damage the reef. The reefs are also degraded by coastal and inland developments and the pollution they produce, as well as the natural impacts of storms and predator outbreaks. But in the longer term the threat of climate change is perhaps one of the most significant large-scale causes of reef decline, which threatens to damage large areas of reef worldwide.

For the poor reef stakeholders, these changes have resulted in an increasing reliance on reef benefits as large coastal populations, widespread development and increasing global market forces, overwhelm and degrade alternative resources. Increasingly dependent on a declining resource, the livelihoods of the poor reef stakeholders are vulnerable, and as the stability provided by the reef is eroded, so is their income and food security. In many instances, poor reef stakeholders have become marginalised from access to reef benefits, where coastal tourism developments, external markets and well-meaning efforts to halt reef decline have excluded the poor. In these cases, livelihoods have often become criminalized by regulations, adding increasing burdens of risk and transaction costs on the poor who typically have few other alternatives.

In the face of current population and development trends and predictions of global warming this situation will worsen, no more so than in the low lying coralline islands scattered throughout the Indo-Pacific. These changes threaten the benefit flows that the reefs provide to almost all reef-dependent communities and seriously undermine the livelihoods of some of the poorest people. In the near future many of those who have been helped above the poverty line will start to slip back below it, unless there are radical changes in the way reefs and reef-dependent communities are viewed and worked with.

5.1.4 Attempts to address poverty and reef-related issues

On international, regional and national levels, declining coral reef resources have become a significant focus for concern and the target for numerous interventions. These interventions have tended to be motivated by a prevailing international priority for biodiversity conservation and consequently their focus is on preventing reef decline and protecting reefs from sources of degradation. This predisposition has dictated the priorities, approaches and outcomes of interventions and has inadvertently resulted in a lack of attention to, and often exclusion of, poor reef stakeholders.

However, there is a growing consensus that in the absence of meaningful consideration of local needs many interventions have failed. In recognition of this failure and the priority for poverty alleviation of many donors and govenments, issues of poverty, food security and livelihoods are increasingly emerging in coral reef fora. Furthermore, many interventions are evolving towards increasingly participatory and collaborative approaches, with increasing examples of success. However, despite this shift there remains a lack of acknowledgement that global priorities of reef conservation and biodiversity protection are not necessarily shared with poor stakeholders trying to survive from day to day. This is compounded by a lack of understanding of poor reef-dependent people: who they are, what their priorities are, what problems they face, and how to best support them in coping with declining reef benefits.

Future interventions require a shift in balance towards people-focused coastal development supporting the sustainable livelihoods of the coastal poor. This shift must be accompanied

by a greater consideration of the full context of the livelihoods of the poor, including interventions which systematically deal with enhancing livelihood security of the poor, through diversification and enhancement of livelihoods, and interventions which focus on strengthening support services for the poor. Currently these aspects are often overlooked or tagged on to programmes aimed at preventing reef decline. These deserve considerably more attention if the impacts of current interventions are to succeed in sustaining reef benefits and the livelihoods of poor reef stakeholders in the longer term.

5.2 PRINCIPLES FOR ADDRESSING POVERTY-RELATED REEF ISSUES

Based on our current understanding of poverty and coral reefs it is clear that for future interventions to effectively address poverty among reef stakeholders the current approaches to poverty-related reef issues need to change. The various interventions targeting reefs, coastal communities and poverty reduction suggest some important ways in which this change can occur. The current *Reef Livelihoods Assessment* project has furthered that understanding considerably. From this a set of principles of good practice begin to emerge. This is outlined below:

5.2.1 Enhancing the understanding of reef and poverty-related issues

- Recognising the dependence of the poor and vulnerable on reef resources and the need to understand and address their specific needs and aspirations.
- Recognising that the nature of poverty often means that the poor are hidden or excluded from interventions and may co-exist in coastal areas with apparent wealth.
- Recognising that the poor are not a single homogenous group and an understanding of the different types of poor stakeholder is essential to effectively target the poor.
- Recognising that the lives of poor stakeholders are diverse and complex and a holistic understanding of this complexity is needed in order to develop viable responses.
- Recognising the wealth of existing knowledge, both formal and informal, concerning reefs and people and the need to more effectively share and apply this knowledge.
- Recognising the importance and value of informal, indigenous or local knowledge systems and the need to enhance their integration with formal, scientific knowledge systems.
- Recognising the diversity of stakeholders and the need to introduce systematic informing and influencing strategies to create opportunities for sharing information in forms that are accessible to, and targeted at, different types of stakeholders.

5.2.2 Promoting a balanced and integrated approach to reef and poverty-related issues

- Recognising that there are multiple stakeholders involved in reef issues, from those at the local ground level to those at an international level, who have multiple and varying objectives ranging from conservation and protection, to sustainable use, exploitation or development.
- Recognising the need to raise awareness and change attitudes in order to harmonise these multiple objectives and actively promote the priorities, needs and aspirations of the coastal poor in approaches to policy development and interventions.
- Promoting a broader consideration of coastal community development, which incorporates social, economic, environmental, governance and vulnerability issues and overcomes the difficulty of looking beyond natural resource management, symptomatic of ICZM approaches.
- Encouraging an integrated multi-disciplinary approach, which combines local participation with national level support across multiple sectors relevant to the livelihoods of local communities (i.e. health, education etc. as well as natural resources).
- Developing partnerships between different agencies and groups to enhance knowledge and skill sharing and involvement in the policy and development process.
- Promoting participation, which targets poor stakeholders, and facilitates their involvement in agreeing common entry points and throughout the subsequent research or development process.
- Acknowledging the role and importance of political and patronage systems and the need to incorporate and work with them to ensure positive change.
- Promoting a flexible and process-orientated approach that recognises the dynamic and complex nature of livelihoods, which can accommodate change and which avoids mechanistic approaches and preconceived solutions.
- Initiating a process which starts small, based on an understanding of threats, weaknesses and opportunities, and builds on the strengths of experience, best practice and success.

5.2.3 Enhancing the livelihood security of the poor and vulnerable dependent on reefs

- Promoting a systematic approach, which builds on existing strengths and recognises weaknesses and threats, to develop viable, sustainable and dynamic livelihood opportunities, which enhance or diversify existing options for the poor and vulnerable.
- Strengthening existing mechanisms, which support livelihoods and complement reef access in times of hardship or crisis and enhancing access to these support mechanisms by the poor and vulnerable.
- Recognising the need to secure rights of access to reef

resources for the poor and vulnerable through prioritising their needs in policy development and where appropriate incorporating existing traditional or local rights.

- Promoting co-management in fisheries and coastal development and the need to ensure sustainability at all levels: environmental, economic, social and governance.
- Promoting a precautionary principle to management interventions, development and exploitation of reef ecosystems grounded in sound environmental, social and economic impact assessments.
- Enhancing or maintaining the carrying capacity of the environment by reducing the adverse effects of externalities from other sectors through greater inter-sector and international cooperation at the policy-making and policy implementation stages.
- Undertaking, where feasible, efforts to rehabilitate habitats and mitigate the impacts of development on the poor and vulnerable.
- Supporting efforts to understand, address and combat impacts of global climate change.
- Recognising the potential loss of physical protection from the reef in the future and the need to enhance disaster planning and responses which target the poor and vulnerable.

5.3 POLICY CONSIDERATIONS

The policy formulation and implementation environment surrounding reef-dependent people is only partially focused on those people, the main emphasis is on reef conservation. Many of the key international institutions and initiatives concerned with coral reefs are those whose primary objective is nature conservation. There is a considerable short-fall in the required skills, awareness, attitudes and institutional orientation required to respond effectively to reef-related poverty. However, there is a growing awareness of this deficiency and recognition that coral reef conservation cannot meet its desired objectives without better consideration of poverty issues and the sustainable livelihoods of reef-dependent poor people. This change in thinking has also been encouraged by the shifting priorities of international donor agencies and governments towards poverty alleviation. However, in many circles the awareness of poverty-related reef issues is still in its infancy. For many others, despite growing realisation of past and current deficiencies in dealing with poverty and reefs, there remains insufficient capacity to understand and respond more effectively.

There is an urgent need for guidance and support amongst coral reef practitioners, agencies and initiatives to assist the changes needed to address poverty-related reef issues more effectively. Unless this is achieved in the near future many poor people will confront greater levels of hardship than they have faced before and many coastal communities above the poverty line will start to fall into poverty. **The implications for international development targets are serious in terms of both people moving back into poverty, and an increasing trend in the loss of reef-based environmental resources**.

There is a need for a major drive to re-orient the current approaches to reefs and reef-dependent people. To bring about this level of change requires a series of initiatives at the macro, meso and micro levels.

At the **macro-level** there is a need for a change in the global policy framework that shifts the focus from reef conservation to the sustainable and equitable use of reef ecosystems where poverty reduction is a central theme rather than a means towards an end. This requires a large degree of awareness raising, consensus building, policy reform and the uptake of a new array of policy instruments. These need to be based on a much better understanding of the issues facing the reef-dependent poor. There is a growing willingness to accept this kind of reform, but a lack of coordinated understanding about how to achieve it. Support at the macro-level is also required to reflect the interconnected nature of reef problems and to deal with the interstitial and dispersed nature of reef-dependent poverty.

At the **meso-level** there is a need for substantial capacity building in coastal community development and poverty reduction approaches. This applies not only to governments in countries where reef dependence is an issue, but also to regional intergovernmental and NGO agencies concerned with these issues. Many of the approaches that need to be applied have still to be developed, some are currently being developed and others exist, but need to be brought together and applied to reef issues.

At the **micro-level** there is much to be done in understanding the nature of reef-dependent poverty. This study has shown that there is already a large amount of information out there, but this has rarely been brought together to provide a cohesive body of knowledge that can inform policy. The poor have even more to teach us about the way they live with, use and manage their reefs. From this, new approaches to sustainable livelihoods, livelihood enhancement, poverty reduction and reef management can begin to be developed.

5.4 SUMMARY

There is a need for a major shift in policy, approaches and policy instruments in relation to reefs if major equity and sustainability problems are to be avoided in the future. This requires a significant level of support to help to re-orientate interventions directed at the poor. This role has the potential to place pro-poor development on to a very high profile agenda in the resource conservation field that offers the opportunity for widespread attitude change, practical uptake and policy influence.

ANNEX 1 COUNTRY OUTLINES OF POVERTY AND REEFS

The following annex provides an outline of national level statistics relating to reefs and poverty for the four regions identified as poverty-reef hotspots, namely: Eastern Africa, South Asia, Southeast Asia and the Western Caribbean.

EASTERN AFRICA

Comoros

Comoros ranks as one of the third poorest of the Medium Human Development countries (UNDP, 2002) with the highest levels of poverty occurring on Anjouan Island (WB, 1994a). The volcanic islands are densely populated and are surrounded by fringing coral reefs. Fisheries are largely small-scale and traditional and predominantly target the near-shore coral reef resources (Spalding *et al.*, 2001). There are over 4500 registered small-scale traditional fishers in the Comoros (Spalding *et al.*, 2001).

Kenya

Kenya is one of the lowest ranking Medium Human Development countries (UNDP, 2002) with greatest poverty occurring in rural areas (WB, 1995). Coastal areas are densely populated and coral reefs border much of the coastline and surround offshore islands and barrier islands in the north (Spalding *et al.*, 2001). A large small-scale marine fishery operates along the coast associated with the coral reef and near-shore resources. Although it contributes only minimally to total national fisheries production, this small-scale fishery is of crucial importance to local communities as a source of subsistence and livelihood (FAO, 2001a).

Madagascar

Madagascar also ranks as one of the world's Low Human Development countries (UNDP, 2002), with poverty predominant in rural areas and particularly high in the southwest region of Toliary (WB, 1996). Coral reefs are widespread in the north and off the southwest coast, and support fishery activities, which are mainly focused on reef formations and reef-associated species, accounting for 43% of the total production and involving approximately 50 000 people living in 1250 villages (Gabrie *et al.*, 2000).

Mauritius

According to the UNDP Human Development Report (2002), Mauritius is a high ranking Medium Human Development country. The main island of Mauritius is comparatively well developed compared with the smaller island of Rodriguez, which remains relatively undeveloped. Both Mauritius and Rodriguez islands are surrounded by fringing reefs and Mauritius also holds jurisdiction over a string of reef-fringed islands to the north (Spalding *et al.*, 2001). Inshore lagoons, reefs and offshore banks are the focus of fisheries, which forms the basis of the economy, along with coastal and reef tourism and the sugar cane industry associated with the main island of Mauritius (Naim *et al.*, 2000).

Mozambique

According to the UNDP Human Development Index (2002), Mozambique ranks as the sixth poorest country in the world. A large proportion of the population live in coastal areas, with large numbers associated with Mozambique's capital and second largest city, both located on the coast. Coral reefs dominate the northern coast of Cabo Delgado, one of the poorest provinces in the country, and the northern Nampula province. Reefs are also found scattered along the southern coast.

Marine fisheries account for more than 90% of total fish production and play an important role in the national economy and the livelihoods of coastal people. Fishery activities are predominantly small-scale and recent estimates suggest that as many as 90 000 people are involved in small-scale fisheries (excluding those involved in trading and processing), a considerable increase from FAO estimates (Table 3) (Wilson *et al.*, 2003). In areas where the coastline is bordered by coral reefs, such as the northern province of Cabo Delgado, the entirely small-scale and non-mechanised fishery is largely focused on the coral reef and associated near-shore resources and forms an integral part of the livelihood systems of coastal people.

Reunion and Mayotte

Reunion and Mayotte are French territories, whose development has relied heavily on financial assistance from France, the European Union and in recent years on Reunion, investment from private industry. However, despite the apparent wealth, on Reunion, minority groups still suffer poverty and unemployment (CIA, 2002). Both islands are home to relatively small populations and on the larger island of Reunion, the majority of people live close to the coast, which is bordered along the western shores by a limited area of fringing coral reef. Coral reefs also surround the island of Mayotte, with a wide lagoon separating fringing reefs from a barrier reef 3–15 km

offshore (Spalding *et al.*, 2001). On Reunion, near-shore fishing is small-scale and coral reefs have been estimated to contribute to approximately 10% of the total coastal production (Naim *et al.*, 2000). Reefs are also frequently accessed by part-time non-professional fishers, who reach the shallow reef by foot (Naim *et al.*, 2000). Near-shore fisheries are similarly small-scale on Mayotte and employ an estimated 3600 fishers (Spalding *et al.*, 2001). Coastal and reef-based tourism is growing in importance on both islands.

Seychelles

The Seychelles is a well-developed archipelagic nation, which although not included in the most recent human development ranking, is estimated to rank among the highest of the Medium Human Development countries (UNDP, 2002). However, despite the countries high level of development, its high GDP per capita compared to other Eastern African countries and its small population, an estimated 16% of the population remain below national poverty lines and distribution of income is highly unequal (WB, 1994c, see Table 3). An extensive coral reef system surrounds the high islands in the north and is the foundation of the coralline islands and atolls in the south of the archipelago (Spalding *et al.*, 2001). Reefs and lagoons are the focus of the small-scale fishery and supply a large proportion of the fish consumed nationally (Jennings *et al.*, 2000; Spalding *et al.*, 2001). Coastal and reef-based tourism is also an important industry and one of the main sources of employment (Spalding *et al.*, 2001).

Somalia

Although statistical information on poverty in Somalia is limited, Somalia is recognised to be one of the least developed countries in the world. Political instability and civil war have severely affected the country for over a decade and currently serious food shortages are affecting a large proportion of the population. Coral reefs are known to border much of the southern coastline. Fisheries are nearly entirely small-scale with a long tradition and provide an essential component to the livelihoods of a large portion of the coastal population (Pilcher and Krupp, 2000).

Tanzania

Tanzania ranks as one of the world's Low Human Development countries (UNDP, 2002) with poverty overwhelming associated with rural areas (NBS, 2002). The coastline is inhabited by a large and rapidly growing coastal population and is bordered by the largest area of shallow coral reef in Eastern Africa, which is found along most of the coast and surrounding offshore islands (Spalding *et al.*, 2001). Livelihoods are still based predominantly on agriculture and fishing, with estimates of the numbers of full-time marine fishers ranging from 10 000 to 15 000, who predominantly operate from small non-mechanised craft (FAO, 2001c). Coral reefs form an important source of subsistence and income for the coastal population and more than 30% of marine fish landings are estimated to have been harvested on or adjacent to coral reefs (Muhando, 1999).

SOUTH ASIA

Bangladesh

Bangladesh is one of the poorest countries in South Asia and ranks as a Low Human Development country (UNDP, 2002), with a third of the population living on less than 1 US$ a day (Table 4). However, despite the large coastal population and significant number of people employed in fisheries and aquaculture, the numbers associated with coral reef areas and fisheries is small, with coral reefs limited to a small area surrounding the coast of St Martin's Island.

India

India is one of the lower ranking Medium Human Development countries, with over a third of its population living on less than 1 US$ a day (Table 4). Coastal areas are heavily populated, but coral reefs are limited to two main areas off the mainland coast: the Gulf of Mannar, in the south; and the Gulf of Kutch, in the northwest, with the remaining reefs associated with the remote islands of Lakshadweep off the west coast and the Andaman and Nicobar Islands off the east coast. Reef fisheries have been estimated to contribute to 5–10% of the total marine landings (Pet-Soede *et al.*, 2000; White and Rajasuriya, 1995, respectively), and contribute significantly to the subsistence and income of coastal fishing communities in the four reef areas. Estimates of the numbers of small-scale fishers, amount to 21 000 in the Gulf of Mannar and 20 000 in the Andaman and Nicobar Islands (Rengasamy *et al.*, 2003; Singh and Andrews, 2003). On Lakshadweep where the reefs form the foundation of the low-lying coralline islands and home to 60 595 people, tuna fishing relying on bait fish from the reef constitutes a major part of the local economy and reef harvest is the main source of subsistence for poor households (Hoon, 2003).

Maldives

The Maldives has the highest ranking Human Development Index of all South Asian coastal nations. It is also the country with the greatest expanse of coral reef, associated with a chain of 22 coral atolls running 800 km from north to south and including 1200 low coralline islands, of which 199 are inhabited. Coral reefs are the foundation of life on the Maldives,

providing land area, construction materials, the source of bait fish for a large tuna fishery, and supporting smaller reef fisheries for limited local consumption and growing exports. Island and reef-based tourism also represents a significant industry.

Pakistan

Pakistan is again one of the poorer countries in South Asia and ranks as a Low Human Development country (UNDP, 2002). Little is known of the coral reefs in Pakistan, however, similar to Bangladesh, the area is believed to be small and the full extent of their support to fisheries and coastal communities is also unknown.

Sri Lanka

Sri Lanka represents a middle ranking Medium Human Development country (UNDP, 2002) with a densely populated coastline, particularly in the west and south. Fringing coral reefs are estimated to occur along approximately 2% of the coastline mainly in the northwest and east (Spalding *et al.*, 2001), patchy reefs also occur in the southwest and in deeper waters off the west coast. Near-shore fisheries have been estimated to contribute to 60% of total landings in 2000 (NARA, 2001), of which 15 to 50% are estimated to be reef-associated species (Berg *et al.*, 1998, Spalding *et al.*, 2001, respectively). According to the 1999 census of marine fisheries, there was a total of 115 014 active fishers distributed among 1437 villages around the coast of Sri Lanka, predominantly operating small-scale craft (59% of fishing craft are small-scale and traditional) (NARA, 2001).

SOUTHEAST ASIA

Cambodia

According to the UNDP Human Development report (2002), Cambodia is officially one of the least developed countries in Southeast Asia, ranking as a low Medium Human Development country. Poverty remains concentrated in rural areas, where an estimated 90% of poor people live (ADB, 2002). Little is known of the coral reefs off the coast of Cambodia's relatively short coastline, but coral reefs are known to occur off the mainland coast and surround the offshore islands (Spalding *et al.*, 2001). The marine fishery is mainly coastal and near-shore arising almost entirely from small-scale and subsistence activities, which are estimated to provide the principle livelihood for 10% of households and a part time livelihood for a further 34% of households (FAO, 1999a).

China

China is a middle-ranking Medium Human Development country (UNDP, 2002), with an estimated 213 million people, or 23% of the rural population, still living on less than 1US$ a day (ADB, 2002). Coral reefs are limited along China's South China Sea coastline, with some reefs found around Hainan Island in the mouth of the Gulf of Tonkin and reefs off the coastline of Hong Kong and Taiwan and its offshore islands (Spalding *et al.*, 2001). Little information is available on the fisheries interactions with these coral reefs areas, although over-fishing is cited as a source of coral reef degradation in these areas (Spalding *et al.*, 2001).

Indonesia

Indonesia is a lower ranking Medium Human Development country (UNDP, 2002), with more than 56 million people living on less than 1 US$ a day. The majority of the population live on the coast, which stretches over 95 000 km encompassing over 17 000 islands (including sandbanks and rocks), of which 6000 are inhabited. Shallow coastal waters are home to 18% of the world's coral reefs, the largest extent associated with any single nation (Spalding *et al.*, 2001). 80% of Indonesia's fisheries production has been estimated to originate from small-scale production in near-shore waters (UNEP, 1996). It has been estimated that the coral reefs, which dominate the near-shore, form the foundation of livelihoods and food security for hundreds of thousands of subsistence fishers (Cesar, 1996).

Malaysia

Malaysia is an upper ranking Medium Development country (UNDP, 2002), with a large proportion of its population living in coastal areas. Coral reefs are mainly found in Eastern Malaysia around off-shore islands, with the most extensive reefs located around the coast of Sabah (Spalding *et al.*, 2001). Small-scale fishers dominate the Malaysian fishing industry, but their overall dependence on coral reef resources is limited to those operations in the vicinity of coral reef areas.

Mayanmar

Myanmar does not rank particularly high in socio-economic development when compared to its Southeast Asia neighbours. According to the Asian Development Bank (2000), estimates suggest that as many as one in four households could be considered poor, and a more recent report suggests that the last official figure of poverty incidence (Table 5), is likely to be an underestimation (ADB, 2002). Half the population live in coastal areas and while little information exists on the coral reefs, they are known to be extensive around offshore islands in the north and south, and around the Mergui Archipelago (a group of 800 forested and reef fringed islands) and the offshore Burma banks (Spalding *et al.*, 2001). Marine fisheries constitute more

than 75% of the total annual fish production and are considered one of the most important components in Myanmar's economy, with fish providing a major source of protein and the fishery providing employment and livelihoods for a large portion of the population (FAO, 2001b).

Philippines

The Philippine Archipelago is an upper ranking Medium Human Development country (UNDP, 2002), where poverty is largely associated with rural areas and natural resource based livelihoods.[7] Most of the population lives in coastal areas, which are bordered by the third largest expanse of coral reef associated with a single nation (Spalding *et al.*, 2001). Reef fisheries constitute 10% of the total fish production in the Philippines and as much as 70% of the total harvest on some small islands (Cesar, 1996; White and Cruz-Trinidad, 1998, respectively). It has been estimated that more than one million small-scale fishers depend directly on reef fisheries for their livelihood and coral reefs contribute significantly to protein supplies, in a country where more than 50% of animal protein is derived from marine fisheries and aquaculture (White and Cruz-Trinidad, 1998).

Singapore and Brunei

Both Singapore and Brunei rank among the High Human Development countries of the world (UNDP, 2002). Both are relatively small and well-developed countries, where the interaction of poverty and reefs is likely to be minimal.

Thailand

Thailand ranks as an upper-ranking Medium Development country, falling in between Malaysia and Philippines in terms of human development indices (UNDP, 2002). Coral reef areas are encountered on all coasts and are particularly extensive around the offshore islands on the west coast in the Andaman Sea. Marine fishery activities play an important socio-economic role in Thailand, contributing to 79% of the total fisheries production in 1996 and providing the primary accessible source of protein for most people (FAO, 2000b). Coral reefs located in rural areas are the focus for small-scale fisheries and provide important sources of income and food. In some areas, coastal and reef-based tourism activities are replacing small-scale fisheries (Sudara and Yeemin, 1997).

Vietnam

Vietnam ranks alongside Indonesia as a lower-ranking Medium Human Development country (UNDP, 2002), with a third of the population living on less than 1 US$ a day. A large proportion of the population live in coastal areas and coral reefs are reported to surround most of the offshore islands, with some fringing reefs off the east mainland coast and offshore in the Gulf of Tonkin and Ha Long Bay (Spalding *et al.*, 2001). Marine fisheries are predominantly small-scale and are estimated to provide the primary source of household income for 8 million people and contribute to part of the income and subsistence of a further 12 million people (FAO, 1999b).

WESTERN CARIBBEAN

Belize

According to the UNDP Human Development Indices (2002), Belize ranks just below Mexico as an upper Medium Human Development country. About 33% of the population, primarily in the southern rural districts of Toledo and Cayo, remain below the poverty line (WB, 2002c). One of the longest barrier reef systems in the Caribbean is found bordering Belize's shallow shelf and three large coral atolls are located further offshore (Spalding *et al.*, 2001). Reef products, such as lobsters and Queen Conch are a major component of the marine fisheries, which in 1998 were estimated to involve nearly 2000 fishers (Spalding *et al.*, 2001).

Cayman Islands

The Cayman Islands are overseas territories of the UK and an offshore financial centre, where the interaction of poverty and reefs is likely to be minimal if existent.

Colombia

Colombia ranks as an upper Medium Human Development country (UNDP, 2002), with an estimated 8 million Colombians with incomes below a nutritionally defined subsistence level, and the majority of these people living in rural areas (WB, 2002a). A third of the population of Colombia lives in coastal areas. Coral reefs are found bordering approximately 9% of the mainland coast, predominantly on the Caribbean coast, and are also located offshore on the banks and atolls of the Nicaraguan Rise (Spalding *et al.*, 2001). These include the large densely populated island of San Andres, home to 80 000 people, where subsistence fishing on the surrounding reefs provide an important source of food (Spalding *et al.*, 2001).

Costa Rica

Although Costa Rica is among one of the High Human Development countries (UNDP, 2002), nearly 7% of the population remains below the poverty line (Table 6), with most of the poor living in rural areas (WB, 1997). Most of the coral reefs in Costa Rica are found on its Pacific coast, with only

limited reef areas off the Caribbean coast (Spalding *et al.*, 2001). Small-scale fisheries dominate the Costa Rican marine fisheries, engaging an estimated 750 fishers along the Caribbean coast and a further 6700 fishers on the Pacific coast, where small-scale fisheries represents one of the principle economic activities, frequently undertaken in combination with agriculture (FAO, 1996a).

Cuba

Although insufficient information exists on the level of poverty in Cuba, it is estimated that Cuba ranks as one of the upper Medium Human Development countries (UNDP, 2002), however, the average Cuban's standard of living remains at a low level compared with 1990 (CIA, 2002). Cuba is the second largest area of coral reef in the Wider Caribbean, with reefs bordering most of the Cuban shelf (Spalding *et al.*, 2001). Reef fisheries play an important role in the Cuban economy and as a source of protein.

Honduras

In 1998 Honduras ranked among the lowest-income countries in the western hemisphere (WB, 1999a) and is currently among the lower ranking Medium Human Development countries in the world (UNDP, 2002). Most of the poor live in rural areas and are engaged in agricultural activities or in agriculture-related services (WB, 1994b). Nearly 70% of the population lives in coastal areas, where coral reefs are found surrounding the offshore Bay Islands, Cayos Cochinos, Mosquitia Cays and Banks and the remote Swan Islands. A high percentage of men and women on the coast depend on fishing as a source of household income and as the main source of protein. Small-scale fishers are found all along the Caribbean coast and in 1998 numbered 2000 in the Mosquitia area alone (FAO, 2002a).

Jamaica

Jamaica represents a middle-ranking Medium Human Development country (UNDP, 2002), where the poorest households typically comprise around 25% of the rural population and 10–35% of the urban population (ODN, 2000). Coral reefs surround much of the coastline and are also found on the nine offshore banks, notably at the Pedro and Morant Cays (Spalding *et al.*, 2001). Natural resources provide the main economic opportunities to rural households (ODN, 2000) and near-shore resources and offshore cays were estimated in 1990 to support the livelihoods of 18 739 small-scale fishers.[8]

Mexico

Mexico ranks as an upper Medium Human Development country (UNDP, 2002), with an estimated 45 million Mexicans living on less than $2 per day, and 10 million living less than $1 per day, without a reliable supply of basic foodstuffs or clean water (WB, 2002b). Nearly one-third of Mexico's population live in coastal areas, which are home to the third largest extent of coral reefs among countries in the Wider Caribbean. Coral reefs are found on both the Caribbean and Pacific coasts, with the most extensive reef development occurring around the Yucatan peninsula on the Caribbean coast (Spalding *et al.*, 2001). Marine fisheries are predominantly small-scale (97% of registered fishing boats are small boats (FAO, 2000a)), and are reported to have heavily exploited reef resources, particularly in areas in the Gulf of Mexico (Spalding *et al.*, 2001).

Nicaragua

Ranking close to Honduras in terms of Human Development (Table 6), Nicaragua remains among the poorest countries in the western hemisphere, with approximately 50% of the population, or about 2 million people, living in poverty and 19% living in extreme poverty (WB, 1999b). Coral reefs are found along the entire coastline and are well developed around offshore islands and cays (Spalding *et al.*, 2001). Small-scale fishing in near-shore waters is associated with both the Pacific and Caribbean coasts and is important economically, socially and nutritionally for coastal people, frequently being mixed with agricultural activities on the Caribbean coast (FAO, 1996b).

Panama

Panama ranks alongside Mexico as a upper ranking Medium Human Development country (UNDP, 2002), however, despite its relatively high income per capita, over one million people (37% of the population) live below the poverty line and over half a million (19% of the population) live in extreme poverty, particularly in rural and indigenous areas (Lindert, 1999). Coral reefs are found both on the Pacific and Caribbean coasts, with extensive areas on the eastern coast associated with the San Blas Archipelago, which stretches to the Colombian border (Spalding *et al.*, 2001). Small-scale fisheries targeting near-shore resources are found on both coasts, with a large majority of activities (95%) occurring on the Pacific coast, where 80% of the country's population is located (FAO, 2002b). Small-scale fisheries constitute about half of the total fishery activities in the country and provide an important source of fish for the national market (FAO, 2002b).

NOTES

1 The term 'reef' is used throughout the document in the context of coral reefs and is not to be confused with any other reef formations.
2 Data from the World Resources Institute (WRI), calculated from 1995 United Nations Population Division totals for each coral reef country
3 BBC news 'Islands disappear under rising seas' Monday 14 June 1999
4 World Resources Institute (WRI), 1999
5 WWF – World Wide Fund for Nature http://www.panda.org
6 For more information on the GCRMN South Asia node activities see the website: http://ioc.unesco.org/gcrmn/index.html
7 From World Bank country information http://www.worldbank.org/
8 Information from Fisheries Division, Ministry of Agriculture, Jamaica website: http://caricom-fisheries.com/jamaica-fisheries/main.html

REFERENCES

Adams TJH, Richards A, Dalzell P, Bell L. 1995 Research on fisheries in the Pacific Islands region. South Pacific Commission and Forum Fisheries Agency Workshop on the Management of South Pacific Inshore Fisheries 2: 87–166.

ADB. 2000. Asian Development Outlook, 2000. Oxford University Press, New York.

—— 2002. Asian Development Outlook, 2002. Oxford University Press, New York.

Asafu-Adjaye J. 2000. Customary marine tenure systems and sustainable fisheries management in Papua New Guinea. International Journal of Social Economics 27: 917–926.

Bavinck M. 2001. Marine resource management. Conflict and regulation in the fisheries of the Coromandel coast. Sage Publications India Pvt Ltd, New Delhi, India (394).

Benzaken D, Smith G, Williams R. 1997. A long way together: the recognition of indigenous interests in the management of the Great Barrier Reef World Heritage Area. State of the Great Barrier Reef World Heritage Area Workshop, 471–495.

Berg H, Ohman MC, Troeng S, Linden O. 1998. Environmental economics of coral reef destruction in Sri Lanka. Ambio 27: 627–634.

Bettencourt S, Talati C, Johannes RE. 1995. Sustainable development of coastal fisheries in the Pacific Islands region. South Pacific Commission and Forum Fisheries Agency Workshop on the Management of South Pacific Inshore Fisheries 2: 373–384.

Boesch DF, Field JC, Scavia D. 2000. The Potential Consequences of Climate Variability and Change on Coastal Areas and Marine Resources: Report of the Coastal Areas and Marine Resources Sector Team, US National Assessment of the Potential Consequences of Climate Variability and Change, US Global Change Research Program. Decision Analysis Series Number 21. NOAA's Coastal Oceans Program, Silver Spring, MD (163).

Bryant D, Burke L, McManus J, Spalding MD. 1998. Reefs at risk. World Resources Institute, International Center for Living Aquatic Resources Management, World Conservation Monitoring Centre, United Nations Environment Programme (56).

Bunce LL, Gustavson KR. 1998. Coral reef valuation: a rapid socioeconomic assessment of fishing, watersports, and hotel operations in the Montego Bay Marine Park, Jamaica and an analysis of reef management implications. World Bank.

Bunce LL, Townsley P, Pomeroy RS, Pollnac RB. 2000. Socio-economic manual for coral reef management. Australian Institute of Marine Science (251).

Burke L, Selig E, Spalding MD. 2002. Reefs at risk in Southeast Asia. World Resources Institute (72).

Campbell J, Beardmore JA. 2001. Poverty and aquatic biodiversity. In: Saunders J (ed.) Living off biodiversity: exploring livelihoods and biodiversity issues in natural resources management. International Institute for Environment and Development, London, 191–229.

Campbell J, Salagrama V. 2001. New Approaches to Participation in Fisheries Research. FAO Fisheries Circular no. 965: 56.

Cesar H. 1996. Economic analysis of Indonesian coral reefs. World Bank (95).

—— 2000. Collected Essays on the Economics of Coral Reefs. CORDIO, Kalmar, Sweden (244).

CIA. 2002. The World Factbook 2002. Central Intelligence Agency, USA.

Dalzell P, Adams TJH. 1997. Sustainability and management of reef fisheries in the Pacific Islands. Proceedings of the 8th International Coral Reef Symposium 2: 2027–2032.

Dalzell P, Adams TJH, Polunin NVC. 1995. Coastal fisheries of the South Pacific Islands. South Pacific Commission and Forum Fisheries Agency Workshop on the Management of South Pacific Inshore Fisheries 2: 19.

DOD. 2001. Resources Informations Systems for Gulf of Mannar (India). Integrated Coastal and Marine Area Management Project, Chennai (87).

Drewes E. 1982. Three fishing villages in Tamil Nadu. A socio-economic study with special reference to the role and status of women. Bay of Bengal Programme (65).

Dulvy NK, Stanwell-Smith D, Darwall WRT, Horrill CJ. 1995. Coral mining at Mafia Island, Tanzania: a management dilemma. Ambio 24: 358–365.

Ekaratne SUK, Davenport J, Lee D, Walgama RS. 1998. Communities protecting coastal resources: Rekawa Lagoon, Sri Lanka. In: Taneja B (ed.) Communities and conservation: natural resource management in South and Central Asia. Sage Publications Pvt Ltd, New Delhi, India, 481–491.

Elliot G, Mitchell B, Wiltshire B, Manan A, Wismer S. 2001. Community participation in marine protected area management: Wakatobi National Park, Sulawesi, Indonesia. Coastal Management 29: 295–316.

Espeut P. 1999. The Jamaica Coral Reef Action Plan and the Portland Bight Sustainable Development Area. InterCoast Network: International Newsletter of Coastal Management 34: 14–15.

—— 2002. Community policing in the Portland Bight Protected Area, Jamaica. SPC Traditional Marine Resource Management and Knowledge Information Bulletin 14: 34–35.

FAO. 1996a. Fisheries country profile – Costa Rica. Food and Agricultural Organisation of the United Nations, Rome (11).

—— 1996b. Fishery country profile – Nicaragua. Food and Agriculture Organisation of the United Nations, Rome (10).

—— 1999a. Fishery country profile – Cambodia. Food and Agriculture Organisation of the United Nations, Rome (9).

—— 1999b. Fishery country profile – Viet Nam. Food and Agriculture Organisation of the United Nations, Rome (9).

—— 1999c. Number of Fishers 1970–1996 – Revision 1. Fishery Information Data and Statistics Unit, Food and Agriculture Organization of the United Nations, Rome.

—— 2000a. Fishery country profile – Mexico. Food and Agriculture Organisation of the United Nations, Rome (9).

—— 2000b. Fishery country profile – Thailand. Food and Agricultural Organisation of the United Nations, Rome (8).

—— 2000c. The state of world fisheries and aquaculture 2000. Food and Agriculture Organization of the United Nations, Rome, Italy.

—— 2001a. Fishery country profile – Kenya. Food and Agriculture Organisation of the United Nations, Rome (16).

—— 2001b. Fishery country profile – Myanmar. Food and Agricultural Organisation of the United Nations, Rome (12).

—— 2001c. Fishery country profile – Tanzania. Food and Agricultural Organisation of the United Nations, Rome (12).

—— 2002a. Fishery country profile – Honduras. Food and Agriculture Organisation of the United Nations, Rome (15).
—— 2002b. Fishery country profile – Panama. Food and Agriculture Organisation of the United Nations, Rome (12).
Foale S. 1998. What's in a name? An analysis of the West Nggela (Solomon Islands) fish taxonomy. SPC Traditional Marine Resource Management and Knowledge Information Bulletin 9: 3–6.
Foell J, Harrison E, Stirrat RL. 1999. Participatory approaches to natural resource management – The case of coastal zone management in the Puttalam District, Sri Lanka. DFID and the University of Sussex.
FRDC. 2001. Australia's Fishing Industry: traditional sector. Fisheries Research and Development Cooperation.
Gabrie C, Vasseur P, Randriamiarana H, Maharavo J, Mara E. 2000. The coral reefs of Madagascar. In: Obura DO (ed.) Coral Reefs of the Indian Ocean: Their Ecology and Conservation. Oxford University Press, Oxford, 411–444.
Gibbings R. 1949. Over the reefs. Readers Union with JM Dent and Sons, London, UK (240).
Gina-Whewell L. 1992. Roviana women in traditional fishing. SPC Traditional Marine Resource Management and Knowledge Information Bulletin 1: 12–13.
Glaesel H. 2000. Community-level marine resource management and the spirit realm in coastal Kenya. Women in Natural Resources 21: 35–42.
Green EP, Shirley F. 1999. The global trade in coral. World Conservation Monitoring Centre, World Conservation Press, Cambridge, UK (70).
Hajra D. 1970. Marine fisherfolk of Gujarat: a preliminary exploration. In: Sinha SC (ed.) Research programmes on cultural anthropology and allied disciplines. Anthropological Survey of India, Calcutta, India, 55–73.
Hatziolos M. 1997. Coral reefs and the world bank. People and the Planet 6: 30–31.
Heel CV. 1986. Nutrition and small-scale fisheries in India. Food and Agriculture Organization, Rome (64).
Hoegh-Guldberg O. 1999. Climate change, coral bleacing and the future of the world's coral reefs. Marine Freshwater Research 50: 839-866
Hogbin I. 1973. Anthropology in Papua New Guinea. Melbourne University Press (243).
Hoon V. 2003. A case study from Lakshadweep. In: Whittingham E, Campbell J, Townsley P (eds) Poverty and Reefs: Volume 2 Case Studies. For DFID, IMM and IOC-UNESCO by UNESCO, Paris, 187–226
Hviding E. 1994. Community-based management of coral reef resource systems: South Pacific experiences. The management of coral reef resource systems: 82–84.
ICRAN. 2002. People and Reefs: a partnership for prosperity. International Coral Reef Action Network (4).
ICRI. 2002a. The Cancun Declaration. The ICRI Regional Workshop for the Tropical Americas: Improving reef condition through strategic partnership 12–14 June 2002, 3.
—— 2002b. Deciding on priorities to protect and manage the world's coral reefs. International Coral Reef Initiative (9).
Innes J. 1996. Developing the linkages. Indigenous involvement in the management of the Great Barrier Reef World Heritage Area. Reef Research 6: 1–4.
IPCC. 2001. Summary for policymakers. Climate change 2001: impacts, adaptation and vulnerability. A report of Working Group II of the Intergovernmental Panel on Climate Change (17).
Jazairy I, Alamgir M, Panuccio T. 1992. The state of world rural poverty: an inquiry into its causes and consequences. International Fund for Agricultural Development, Rome, Italy (514).
Jennings S, Marshall SS, Cuet P, Naim O. 2000. The Seychelles. In: Obura DO (ed.) Coral Reefs of the Indian Ocean. Oxford University Press, Oxford, 383–410.
Jimmy RA. 1995. Case study: the application of traditional management on Trochus fishery in Vanuatu. South Pacific Commission and Forum Fisheries Agency Workshop on the Management of South Pacific Inshore Fisheries 2: 221–224.
Johannes RE. 1978. Traditional marine conservation methods in Oceania and their demise. Annual Review of Ecological Systems 9: 349–364.
—— 1981. Words of the lagoon. Fishing and marine lore in the Palau district of Micronesia. University of California Press, London, England (207).
—— 1982. Implications of traditional marine resource use for coastal fisheries development in Papua New Guinea. Institute of Applied Social Economic Research 16: 239–249.
—— 1989. Managing small-scale fisheries in Oceania: unusual constraints and opportunities. Economics of fishery management in the Pacific Island region, 85–93.
—— 1994. The science of Pacific Island peoples and marine resource management. Proceedings of the Conference on the Science of the Pacific Island Peoples.
—— 1999. Breaking environmental laws. SPC Live Reef Fish Information Bulletin 6: 1–2.
Johannes RE, Ruddle K, Hviding E. 1991. The value today of traditional management and knowledge of coastal marine resources in Oceania. South Pacific Commission's Twenty-third Regional Technical Meeting on Fisheries.
Katupotha J. 1995. Public awareness: key to conservation of mangrove and coral reef ecosystems in Sri Lanka. Sri Lanka Journal of Geography 1: 15–28.
Kenchington R. 2000. Fisheries Management and Marine Protected Areas – A 2000 Perspective. InterCoast Network: International Newsletter of Coastal Management 37: 4–5.
Kristensen JD. 1990. Utilisation of shark in Tamil Nadu, India and Sri Lanka. Bay of Bengal Programme (10).
Lindert K. 1999. Panama Poverty Report 1999. World Bank Group (48).
Lokani P. 1995. An oral account of overfishing and habitat destruction at Pororan Island, Papua New Guinea. South Pacific Commission and Forum Fisheries Agency Workshop on the Management of South Pacific Inshore Fisheries 1: 251–263.
Luhikula G. 1999. Community participatory approach pays dividends in fight against dynamite fishing. InterCoast Network: International Newsletter of Coastal Management 34: 10–11.
McAllister DE. 1988. Environmental, economic and social costs of coral reef destruction in the Philippines. Galaxea 7: 161–178.
McClanahan TR, Glaesel H, Rubens J, Kiambo R. 1998. The effects of traditional fisheries management on fisheries yield and the coral reef ecosystem of southern Kenya. Oceanographic Literature Review 45: 561–562.
McGoodwin JR. 2001. Understanding the cultures of fishing communities: a key to fisheries management and food security. FAO Fisheries Technical Paper No. 401: 287.
MIMRA. 1995. Country statement – Marshall Islands. South Pacific Commission and Forum Fisheries Agency Workshop on the Management of South Pacific Inshore Fisheries 1: 127–129.
Moberg F, Folke C. 1999. Ecological goods and services of coral reef ecosystems. Ecological Economics 29: 215–233.

Moffat DM, Ngoile MN, Linden O, Francis J. 1998. The reality of the stomach: coastal management at the local level in Eastern Africa. Ambio 27: 590–598.

MRAG. 1999. Vanuatu – country report. The Performance of Customary Marine Tenure in the Managament of Community Fishery Resources in Melanesia, 2a: 64.

Muhando C. 1999. Assessment of the extent of damage, socio-economic effects, mitigation and recovery in Tanzania. In: Sporrong N (ed). Status report and project presentations 1999. CORDIO, SAREC Marine Science Program, Department of Zoology, Stockholm, Sweden.

Mukherjee B. 1968. The Noliya of Puri and their sea-fishing organisation. Bulletin of the Anthropological Survey of India XVII: 301–315.

Naim O, Cuet P, Mangar V. 2000. The Mascarene Islands. In: Obura DO (ed.) Coral Reefs of the Indian Ocean. Oxford University Press, Oxford, 353–381.

NARA. 2001. Sri Lanka Fisheries Year Book 2000. Socio-economic and Market Research Division, National Aquatic Resources Research & Development Agency, Colombo.

NBS. 2002. Household Budget Survey 2000/01. National Bureau of Statistics, Dar es Salaam, Tanzania (218).

Nichols PV. 1993. Sharks. In: Hill L (ed.) Nearshore marine resources of the South Pacific. IPS, Suva, 285–327.

Obura DO, Wells S, Church J, Horrill CJ. 2002. Monitoring of fish and fish catches by local fishermen in Kenya and Tanzania. Marine Freshwater Research 53: 215–222.

ODN. 2000. Consultations with the poor – country report, Jamaica. Oneworld Development Network, Sussex, UK (89).

Ohman MC, Rajasuriya A, Linden O. 1993. Human disturbances on coral reefs in Sri Lanka: a case study. Ambio 22: 474–480.

Opnai LJ, Aitsi L. 1995. Summary of coastal fisheries development and management problems in Papua New Guinea and priorities for action. South Pacific Commission and Forum Fisheries Agency Workshop on the Management of South Pacific Inshore Fisheries 1: 135–145.

Pasisi B. 1995. Country statement – Niue Island. South Pacific Commission and Forum Fisheries Agency Workshop on the Management of South Pacific Inshore Fisheries 1: 117–121.

Perea N. 2002. Alternative Livelihood through Income Diversification: as management options for sustainable coral reef and associated ecosystem management in Sri Lanka. South Asia Co-operative Environment Programme (58).

Pet-Soede L, Venkataraman K, Rajan PT. 2000. Case 1: An assessment of the socio-economic importance of reef fisheries in India. In: RA (ed.) Assessment of the socio-economic impacts of the 1998 coral reef bleaching in the Indian Ocean. Resource Analysis, Institute for Environmental Studies, The Netherlands, 67–78.

Pilcher N, Krupp F. 2000. The status of coral reefs in Somalia. In: Wilkinson C (ed.). Australian Institute of Marine Science, Townsville, Australia.

Pollnac RB. 1998. Rapid assessment of management parameters for coral reefs. Coastal Resources Center, University of Rhode Island (199).

Pomeroy RS. 1994. Management options for small scale fisheries. The management of coral reef resource systems 78–81.

Rajendran I, Nambiar K, Shridar R. 1992. Marine fish marketing in Tamil Nadu. Bay of Bengal Programme (47).

Rawlinson N. 1995. Customary ownership of sea areas and resources with respect to the management fo baitfisheries in Solomon Islands and Fiji. South Pacific Commission and Forum Fisheries Agency Workshop on the Management of South Pacific Inshore Fisheries 2: 653–657.

Raychaudhuri B. 1980. The moon and net: study of a transient community of fishermen at Jambudwip. Anthroplogical Survey of India, Calcutta, India (274).

Rengasamy S, Devavaram J, Prasad R, Arunodaya E. 2003. A Case study from the Gulf of Mannar. In: Whittingham E, Campbell J, Townsley P (eds) Poverty and Reefs: Volume 2 Case Studies. For DFID, IMM and IOC-UNESCO by UNESCO, Paris, 113–146.

Risk MJ, Sluka R. 2000. The Maldives: A nation of atolls. In: Obura DO (ed.) Coral Reefs of the Indian Ocean. Oxford University Press, Oxford, 325–351.

Rosenberg E, Ben-Haim Y. 2002. Microbial diseases of coral and global warming. Environmental Microbiology 4: 318–326.

Rubens J. 1996. An analysis of the benefits and costs of marine reserve regulations at Diani, Kenya. Department of Marine Science and Coastal Management. University of Newcastle, Newcastle Upon Tyne, UK (156).

Ruddle K. 1993. External forces and change in traditional community-based fishery management systems in the Asia-Pacific region. Maritime Anthrological Studies 6: 1–37.

—— 1996. Back to first 'design principles': the issue of clearly defined boundaries. SPC Traditional Marine Resource Management and Knowledge Information Bulletin 6: 4–12.

—— 1998. The context of policy design for existing community-based fisheries management systems in the Pacific Islands. Ocean and Coastal Management 40: 105–126.

Ruddle K, Hviding E, Johannes RE. 1992. Marine resources management in the context of customary tenure. Marine Resource Economics 7: 249–273.

Savina GC, White AT. 1986. Reef fish yields and nonreef catch of Pamilacan Island, Bohol, Philippines. The First Asia Fisheries Forum 497–500.

Schug DM. 1995. The marine realm and the Papua New Guinean inhabitants of the Torres Strait. SPC Traditional Marine Resource Management and Knowledge Information Bulletin 5: 16–23.

Sheppard CRC. 2002. Probabilities of repeat episodes of the 1998 mortality in the Indian Ocean. Reef Conservation UK Annual Meeting December 2002, Abstract.

Sievert RF, Diamante-Fabunan DAD. 1999. Local participation in fisheries law enforcement. InterCoast Network: International Newsletter of Coastal Management 34: 16–17.

Singh A, Andrews HV. 2003. A case study from South Andaman Island. In: Whittingham E, Campbell J, Townsley P (eds) Poverty and Reefs: Volume 2 Case Studies. For DFID, IMM and IOC-UNESCO by UNESCO, Paris, 147–186.

Sone S, Lotoahea T. 1995. Ocean culture of giant clams in Tonga. South Pacific Commission and Forum Fisheries Agency Workshop on the Management of South Pacific Inshore Fisheries 1.

Spalding MD, Ravilious C, Green EP. 2001. World atlas of coral reefs. UNEP World Conservation Monitoring Centre, University of California Press, Berkeley, USA (424).

Stirrat RL. 1988. On the beach. Fishermen, fishwives and fishtraders in post-colonial Lanka. Hindustan Publishing Corporation, Delhi, India (170).

Stoffle RW. 2001. When fish is water: food security and fish in a coastal community in the Dominican Republic. In: McGoodwin JR (ed.) Understanding the Cultures of Fishing Communities: A Key to Fisheries Management and Food Security. Food and Agriculture Organization of the United Nations, Rome, 219–245.

Sudara S, Yeemin T. 1997. Status of Coral Reefs in Thailand. In: Birkeland C (ed.) Status of Coral Reefs in the Pacific. Sea Grant College Program, School of Ocean and Earth Science and Technology, University of Hawaii, 135–144.

Talbot F, Wilkinson C. 2001. Coral reefs, mangroves and seagrasses: a sourcebook for managers. Australian Institute of Marine Science, Townsville, Australia (193).

Teiwaki R. 1988. Management of marine resources in Kiribati. University of the South Pacific (239).

Teulieres MH. 1992. Traditional marine resource management in the north of New Caledonia. SPC Traditional Marine Resource Management and Knowledge Information Bulletin 1: 8–11.

Thorburn CC. 2000. Changing customary marine resource management practice and institutions: the case of Sasi Lola in the Kei Islands, Indonesia. World Development 28: 1461–1479.

—— 2001. The house that poison built: customary marine property rights and the live food fish trade in the Kei Islands, Southeast Maluku. Development and Change 32: 151–180.

Tobisson E, Andersson J, Ngazi Z, Rydberg L, Cederlof U. 1998. Tides, monsoons and seabed: local knowledge and practice in Chawaka Bay, Zanzibar. Ambio 27: 677–685.

TRAFFIC. 2001. Stormy seas for marine invertebrates – trade in sea cucumbers, seashells, and lobsters in Kenya, Tanzania and Mozambique. TRAFFIC East/Southern Africa, Nairobi, Kenya (70).

Tuara PN. 1995. The role of women in the management of Pacific Island inshore fisheries. South Pacific Commission and Forum Fisheries Agency Workshop on the Management of South Pacific Inshore Fisheries 2: 227–232.

Udagawa K, Kava V, Fa'Anunu U. 1995. Lobster fishery in the Tongatapu Island group, Tonga: its biology and the effect of new fishery regulation. South Pacific Commission and Forum Fisheries Agency Workshop on the Management of South Pacific Inshore Fisheries 1: 323–334.

UNDP. 2002. Human Development Report 2002. United Nations Development Programme (292).

UNEP. 1996. Report on the workshop on the application of methodologies for valuation of environmental and natural resources with particular reference to oceans and coastal areas. United Nations Environment Programme, Denpasar, Bali, Indonesia (66).

UNESCO. 2001. Indigenous people and parks. The Surin Islands Project. UNESCO, Paris (63).

Veitayaki J. 1994. The contemporary applicability of traditional fisheries management in the South Pacific. SPC Traditional Marine Resource Management and Knowledge Information Bulletin 3: 14–17.

Wallevik HB, Jiddawi N. 1999. Impacts of tourism on the activities of the women of the southeast coast of Unguja, Zanzibar. Proceedings of the 20th Anniversary Conference on Advances in Marine Science in Tanzania, 535–550.

WB. 1994a. Comoros – Poverty and growth in a traditional small island society. World Bank Poverty Net Library.

—— 1994b. Honduras Country Economic Memorandum/Poverty Assessment. Latin American and the Caribbean Region, World Bank (215).

—— 1994c. Seychelles – Poverty in paradise. World Bank PovertyNet Library (2).

—— 1995. Kenya poverty assessment. Eastern Africa Department, World Bank (194).

—— 1996. Madagascar Poverty Assessment. Central Africa and Indian Ocena Deparment, World Bank (58).

—— 1997. Costa rica – Identifying the social needs of the poor: an update. World Bank Poverty Net Library.

—— 1999a. Country brief – Honduras. World Bank Group.

—— 1999b. Country profile – Nicaragua. World Bank Group.

—— 2002a. Country brief – Colombia.

—— 2002b. Country brief – Mexico. The World Bank Group.

—— 2002c. Country Profile – Belize. World Bank Group.

Wells S. 2000. Emerging Trends in Reef Management: Eastern Africa. InterCoast Network: International Newsletter of Coastal Management 37: 8–9 and 30.

Westmacott S, Cesar H, Pet-Soede L, Linden O. 2000. Coral bleaching in the Indian Ocean: socio-economic assessment of effects. In: Cesar H (ed.) Collected Essays on the Economics of Coral Reefs. CORDIO, Kalmar, Sweden, 94–106.

White AT. 1994. Collaborative and community-based management of coral reefs: lessons from experience. Kumarian Press, Inc., Conneticut, USA (129).

White AT, Cruz-Trinidad A. 1998. The Values of Philippines Coastal Resources: Why Protection and Management are Critical. Coastal Resource Management Project, Cebu City, Philippines (96).

White AT, Deguit E. 2000. Philippine Community-Based Coastal Management: Evolution and Challenge. InterCoast Network: International Newsletter of Coastal Management 37: 6–7 and 31.

White AT, Rajasuriya A. 1995. South Asian regional report on the issues and activities associated with coral reefs and related ecosystems. SACEP (34).

Wilkinson C (ed.). 2000. Status of Coral Reefs of the World: 2000. Global Coral Reef Monitoring Network, Australian Institute of Marine Science, Townsville, Australia.

Wilson J, Muchave P, Garrett A. 2003. A Case study from the Mozambique. In: Whittingham E, Campbell J, Townsley P (eds) Poverty and Reefs: Volume 2 Case Studies. For DFID, IMM and IOC-UNESCO by UNESCO, Paris, 73–111.

Woodley JD. 1994. Facilitating change in artisanal fishery practice at Discovery Bay, Jamaica. The management of coral reef resource systems: 75–78.

Worsley P. 1997. Knowledges. What different peoples make of the world. Profile Books, London, England (407).

Wright HO. 1994. Octopus fishing is women's work. SPC Traditional Marine Resource Management and Knowledge Information Bulletin 3: 20.

Young MW. 1979. The ethnography of Malinowski. The Trobriand Islands 1915–18. Routledge and Kegan Paul, London, Boston and Henley (254).

Zuhair M. 1998. Conservation by local communities in the Maldives. In: Taneja B (ed.) Communities and conservation: natural resource management in South and Central Asia. Sage Publications Pvt Ltd, New Delhi, India, 102–116.