POVERTY AND REEFS

VOLUME 1
A GLOBAL OVERVIEW

DFID Department for International Development

UNESCO

IMM Ltd

Emma Whittingham, Jock Campbell and Philip Townsley

IMM Ltd
Innovation Centre
Rennes Drive
Exeter University Campus
Exeter EX4 4RN
United Kingdom

http://www.ex.ac.uk/imm

DFID
Department for International Development
1 Palace Street
London SW1E 5HE
United Kingdom

http://www.dfid.gov.uk/

IOC/UNESCO
Intergovernmental Oceanographic Commission of UNESCO
1 Rue Miollis
75732 Paris Cedex 15
France

http://www.ioc.unesco.org

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Emma Whittingham

Jock Campbell

Philip Townsley

Typeset by Exe Valley Dataset Ltd, Exeter, UK
Project Management by Swales & Willis, Exeter, UK
Printed in France. Reference number: IOC/UNESCO/INF-1188, *Poverty and Reefs,* Volume 1: Global Overview, Volume 2: Case Studies. 260pp.

Citation: "Whittingham, E., Campbell, J. and Townsley, P. (2003). *Poverty and Reefs,* DFID–IMM–IOC/UNESCO, 260pp."

Printed and distributed free by:
Intergovernmental Oceanographic Commission of UNESCO
1, Rue Miollis, 75015 Paris, France.
Tel: +33 1 45 68 10 10, Fax: +33 1 45 68 58 12
Website: http://ioc.unesco.org, Email: IOCMailService@unesco.org

This document is an output from a project funded by the UK Department for International Development (DFID) for the benefit of developing countries. The views expressed are not necessarily those of DFID.

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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.

Neil MacPherson
Senior Fisheries and
Aquatic Resources Adviser
DFID

Patricio Bernal
Executive Secretary
IOC/UNESCO

ACKNOWLEDGEMENTS

The authors would like to thank DFID for commissioning this work and for providing IMM with the funds and support to implement it. Mr Neil MacPherson, DFID Senior Fisheries and Aquatic Resources Adviser and Mr Chris Price, DFID Rural Livelihoods Adviser provided guidance and advice throughout.

The authors would also like to acknowledge the late Bob Johannes, whose significant contributions and unique perspective to understanding the complex relationships of people and reefs have influenced the way many of us view, understand and work with reef communities. His contributions have been invaluable in undertaking this study, both through his prolific writings on the subject of reef communities and through the useful suggestions, ideas and contacts he provided when he reviewed the early stages of the global literature study.

Advisory Group members who provided useful insights included James Spurgeon, Dr Bob Pomeroy, Dr R.M. Ranaweera Banda, and Dr John Munro. Ole Vestergaard from IOC/UNESCO also provided useful comments and insights in the editing process of the reports.

IMM would also like to thank the collaborating partners in India (SPEECH, ANET, CARESS) and Mozambique (Kusi Lda and IDPPE) who modified their schedules to fit our deadlines and worked so hard on the case studies.

Thanks also go to Dr EV Muley of the Ministry of Environment and Forests in Delhi for advising and guiding us on the India work. Ben Cattermoul, the Regional Coordinator for the South Asia Global Coral Reef Monitoring Network provided useful suggestions and experience from Sri Lanka and the Maldives, and provided copies of numerous reports from GCRMN South Asia's extensive library. David Obura, Innocent Wanyoni and other CORDIO team members in Kenya provided valuable insights into their work which complemented the other studies. Tim McClanaham and his colleagues in Kenya also kindly gave us access to their library and provided copies of references.

Thanks and recognition also go to the many poor reef-dependent people at the case study locations, who spent much of their valuable time contributing their knowledge and experiences to the research teams.

Finally, we would like to thank Swales & Willis, our Publishing Agent, who in a short space of time converted our Word document reports into the publication presented here.

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

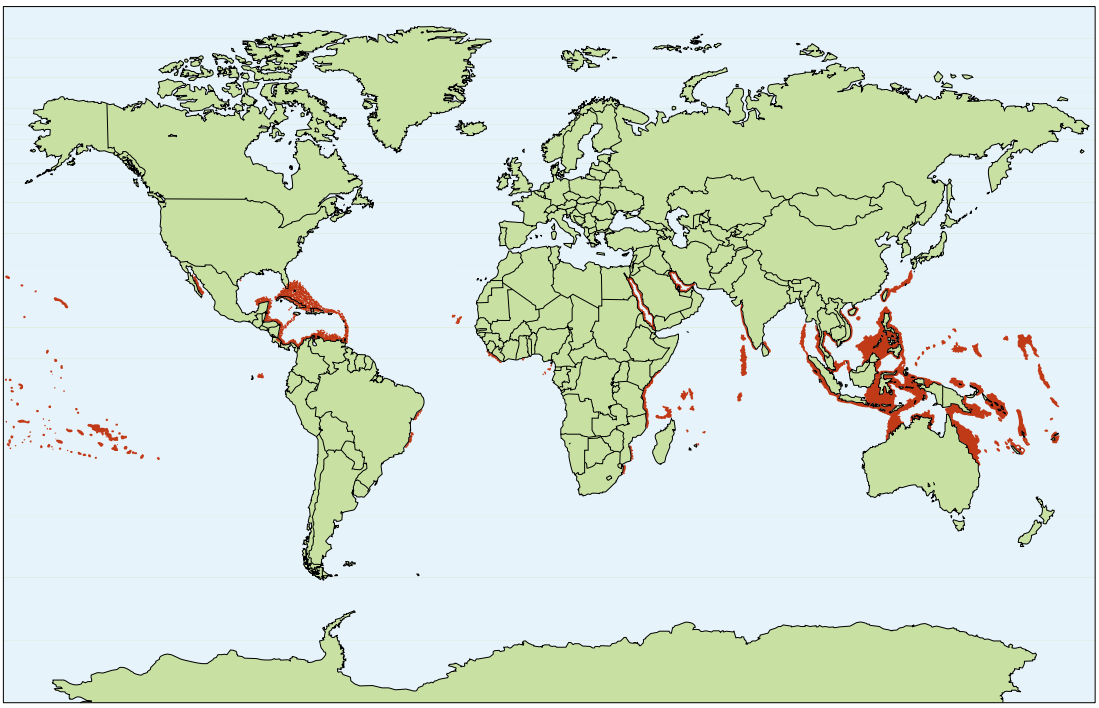
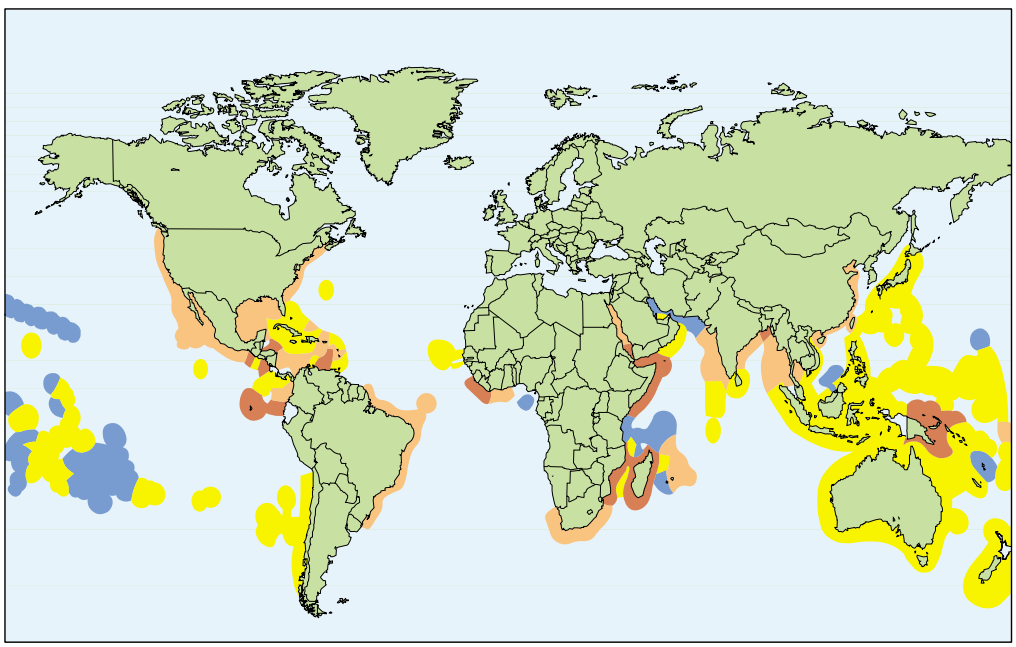


Figure 1 Global distribution of coral reefs.
Map source: http://www.reefbase.org/



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/

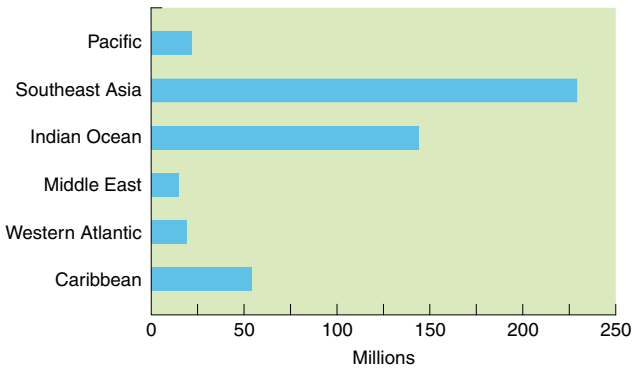


Figure 3 Number of people living within 100 km of the coast.
From: Bryant *et al.*, 1998

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.

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.

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.

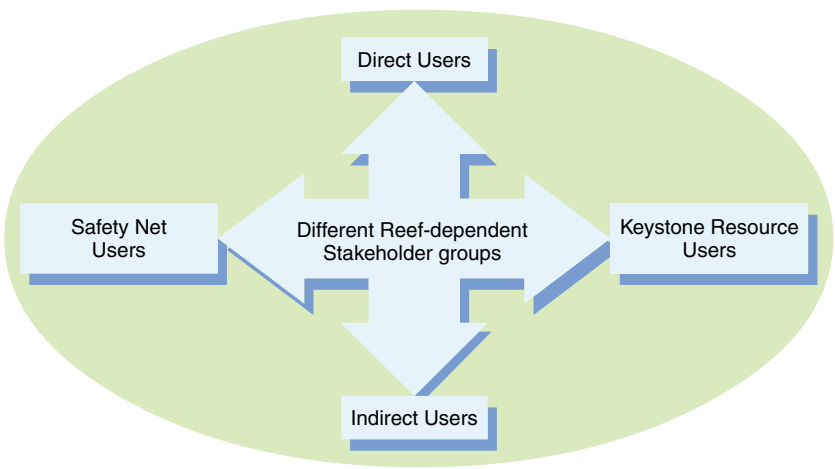


Figure 4 Key categories of reef users.

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.

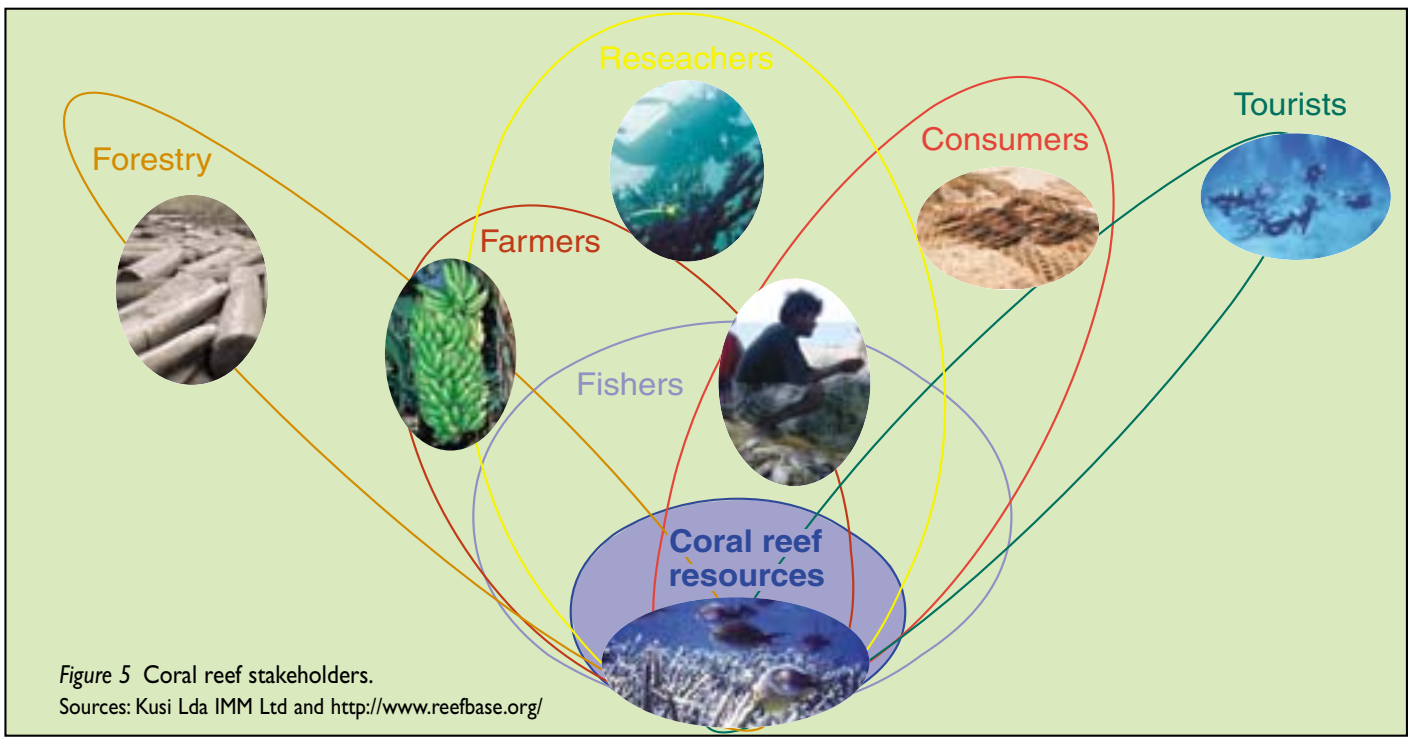


Figure 5 Coral reef stakeholders.
Sources: Kusi Lda IMM Ltd and http://www.reefbase.org/

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

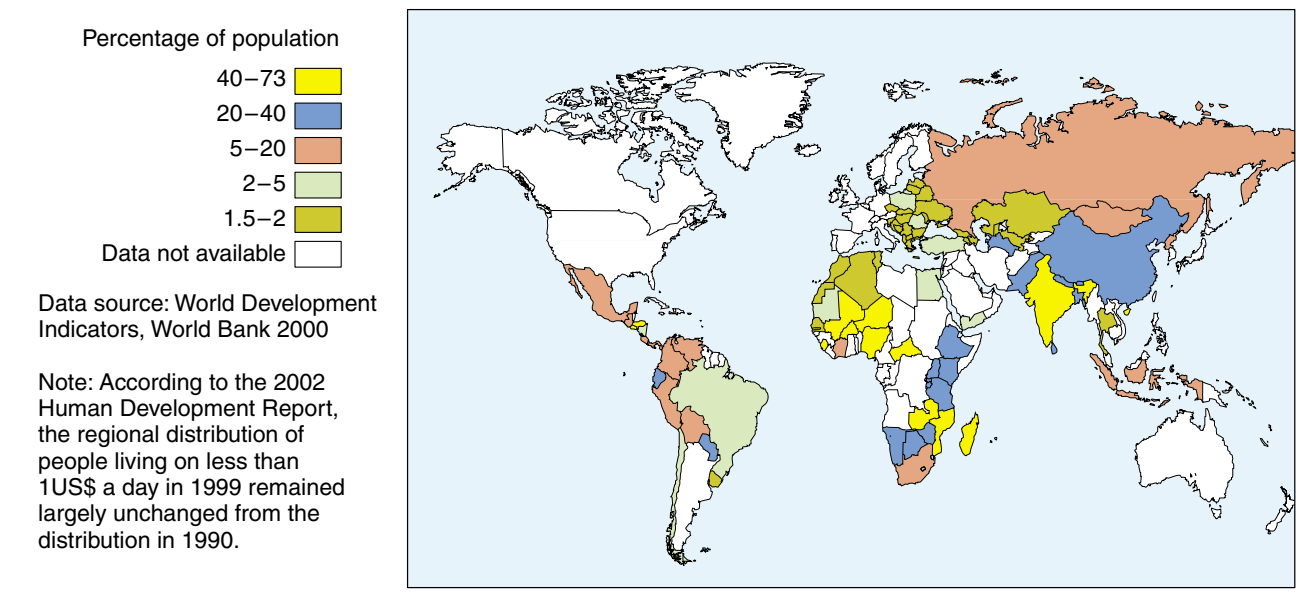


Figure 6 1990 global distribution of people living on less than 1 US$ a day.
Map source: adapted from http://www.povertymap.net/ Rozenblat (2000)

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 (km^2)*[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 (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]
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 (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]
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/km²/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)

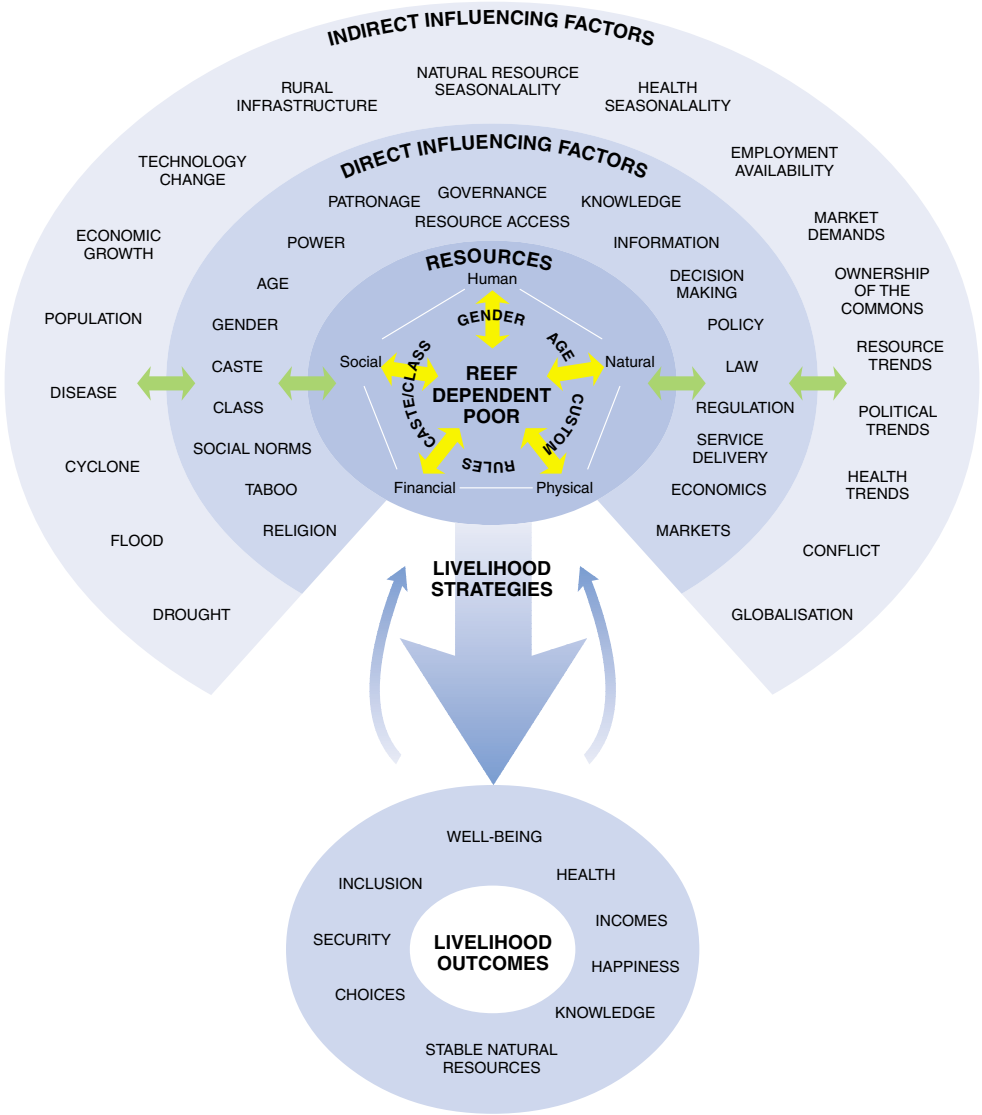


Figure 7 Reef-dependent livelihoods. The diagram is a schematic view of the livelihoods of the reef-dependent poor. It encourages us to place the poor at the centre of our interpretations and to embrace the complexity of their livelihoods. The first ellipse surrounding the poor represents the *resources* (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 coralline 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)

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)

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 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

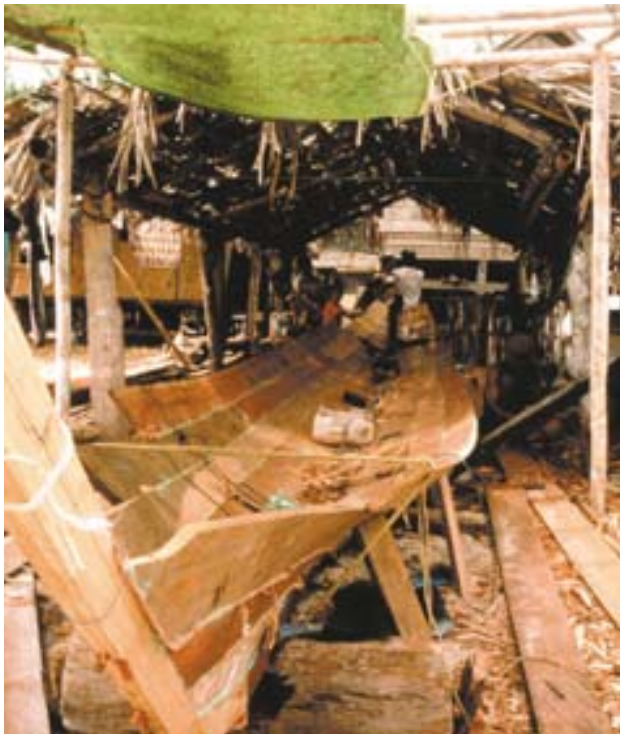


Figure 13 Local boat construction, Indonesia.
Source: James Oliver http://www.reefbase.org/

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).

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 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).

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

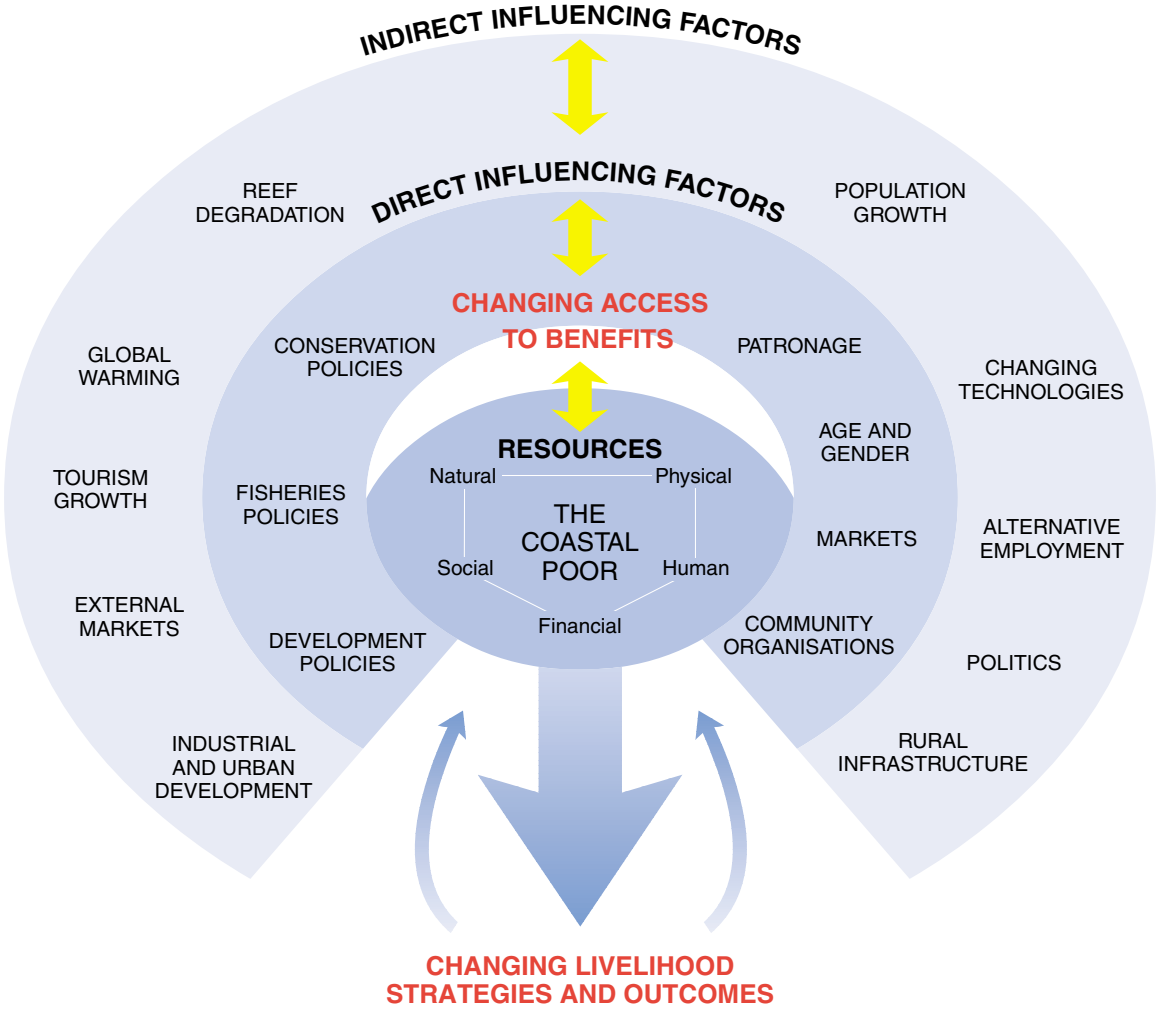


Figure 24 Factors contributing to changing access to reef benefits.

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.

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

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.

(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).

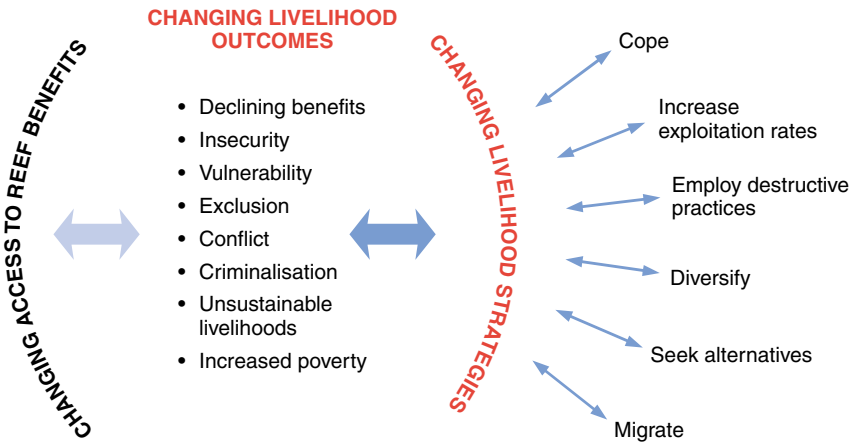


Figure 27 Impacts of changing access to reef benefits on livelihood outcomes and strategies.

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.

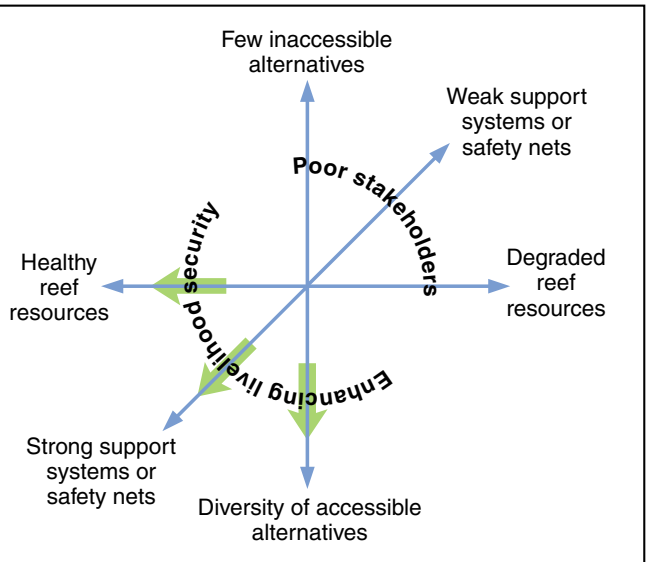


Figure 30 Components of livelihood security for poor reef stakeholders.

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

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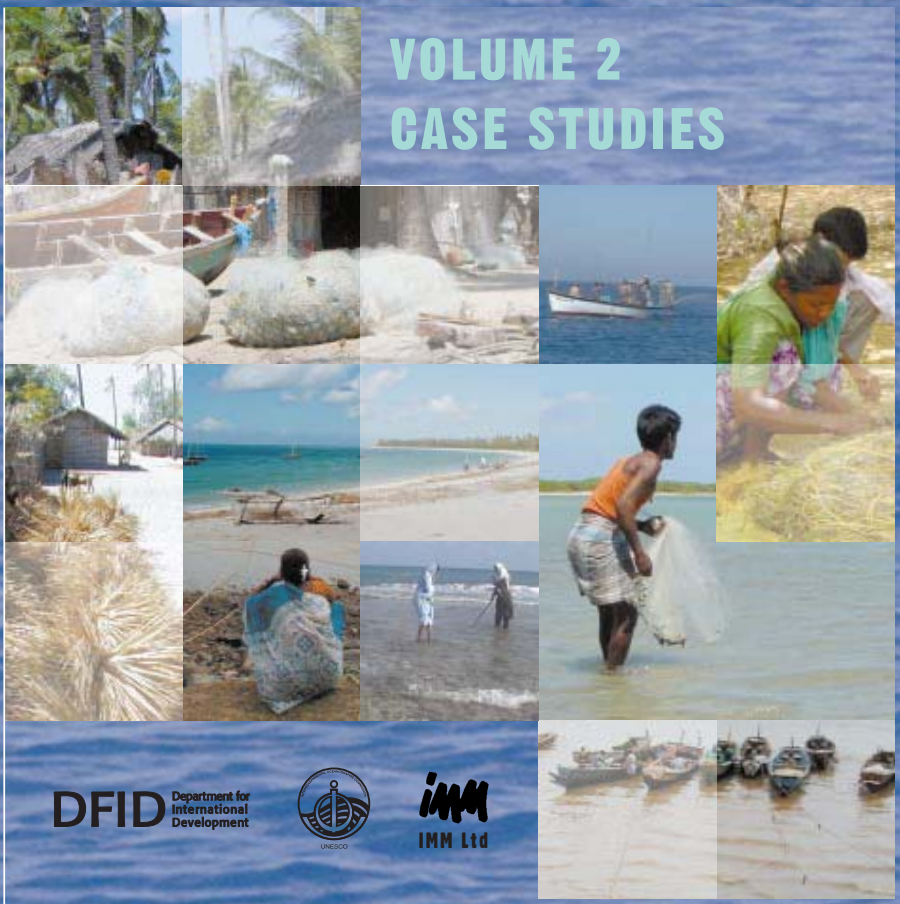
POVERTY AND REEFS

VOLUME 2
CASE STUDIES



DFID Department for International Development

UNESCO

IMM Ltd

Edited by Emma Whittingham, Jock Campbell and Philip Townsley

IMM Ltd
Innovation Centre
Rennes Drive
Exeter University Campus
Exeter EX4 4RN
United Kingdom

http://www.ex.ac.uk/imm

DFID
Department for International Development
1 Palace Street
London SW1E 5HE
United Kingdom

http://www.dfid.gov.uk/

IOC/UNESCO
Intergovernmental Oceanographic Commission of UNESCO
1 Rue Miollis
75732 Paris Cedex 15
France

http://www.ioc.unesco.org

Kusi Limitada
Rua Padre António Vieira 37
Caixa Postal 2873
Maputo
Moçambique

http://homepage.mac.com/kusimoz/kusi.html

IDPPE
Instituto Nacional de Desenvolvimento da Pesca de Pequena Escala
Av. Marginal
Parcela 141/8
Caixa Postal 2473
Maputo
Moçambique

SPEECH
The Society for People's Education and Economic Change
2/1060 Manoranjitham Street
Ezhil Nagar Madurai 625 014
India

http://www.speechtn.org/

ANET
The Andaman & Nicobar Islands Environment Team
Centre for Island Ecology
Post Bag- 1
Junglighat Post Office
Port Blair 744 103
Andaman Islands
India

CARESS
The Centre for Action Research on Environment, Science & Society
160 Sivananda Road
Gillnagar ext 2
Choolaimedu Chennai 600094
India

POVERTY AND REEFS

VOLUME 2: CASE STUDIES

Edited by

Emma Whittingham

Jock Campbell

Philip Townsley

Typeset by Exe Valley Dataset Ltd, Exeter, UK
Project Management by Swales & Willis, Exeter, UK
Printed in France. Reference number: IOC/UNESCO/INF-1188, *Poverty and Reefs,* Volume 1: Global Overview, Volume 2: Case Studies. 260pp.

Citation: "Whittingham, E., Campbell, J. and Townsley, P. (2003). *Poverty and Reefs,* DFID–IMM–IOC/UNESCO, 260pp."

Printed and distributed free by:
Intergovernmental Oceanographic Commission of UNESCO
1, Rue Miollis, 75015 Paris, France.
Tel: +33 1 45 68 10 10, Fax: +33 1 45 68 58 12
Website: http://ioc.unesco.org, Email: IOCMailService@unesco.org

This document is an output from a project funded by the UK Department for International Development (DFID) for the benefit of developing countries. The views expressed are not necessarily those of DFID.

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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.

The case studies were implemented by partner organisations as follows:

- Gulf of Mannar, India: SPEECH
- Cabo Delgado, Mozambique: Kusi Lda and IDPPE
- Andaman Islands, India: ANET
- Lakshadweep Islands, India: CARESS (desk study only)

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 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 and current Volume 2 is a compilation of the four case study reports.

BACKGROUND TO VOLUME 2: CASE STUDIES

Volume 2: Case Studies presents reports from the four case studies carried out as part of the RLA project. Each report has been edited from the original to enhance consistency of content and style.

Volume 2 is intended as a background and support document for the overview and discussion in Volume 1. Many examples from the case studies are included in Volume 1, alongside other examples from around the world taken from the literature. In the current document these examples are placed in the wider context of the study areas and communities, focusing on the different social, ecological, economic and administrative factors which affect livelihood opportunities at those locations. Each case study also outlines the local perceptions and extent of poverty and using the framework of the Sustainable Livelihoods Approach outlines the key benefit flows from the reef to the poor reef-dependent stakeholders in the study communities. Changes to reef-derived livelihoods in the study communities are also briefly reviewed.

The studies were undertaken, as described above, in response to a specific demand for information, to contribute to informing a policy decision within DFID UK. Consequently, the study locations were chosen to reflect priority areas for DFID and each study period was limited to around 6 weeks in order to meet the pressing demand for information required by the policy process. For this reason the scope of each study was limited and the depth of information and analysis was confined to an overview highlighting the key issues. It is hoped that the approach used and knowledge generated will be a stimulus for further study to evolve and expand this initial approach and understanding of poverty and reefs and the livelihoods of poor reef-dependent stakeholders.

A Case Study from Mozambique

James Wilson

Paulo Muchave

Amade Garrett

ACKNOWLEDGMENTS

James Wilson from Kusi Lda, Paulo Muchave and Amade Garrett from IDDPE undertook the fieldwork and analysis of information contained in this document and are principally responsible for the compilation of this report.

Many people assisted with the making of this study, but special thanks are due to the following without whose input and support the study would have been very much more difficult:

Simeão Lopes, Director of IDPPE,
Abel Mabunda, IDPPE representative in Pemba,
Salimo Adamuge, driver.

The contributions, patience and hard work of the populations of the villages of Maueia, Darumba and Messano are also very gratefully acknowledged. May these initiatives help to determine the road ahead. All photos in Study 1 were supplied by James Wilson, Kusi Lda.

NOMENCLATURE

ACRONYMS

GDP	Gross domestic product
IDPPE	Instituto Nacional de Desenvolvimento da Pesca de Pequena Escala (National Institute for the Development of Small Scale Fishing)
IIP	Instituto Nacional de Investigação Pesqueira (National Institute for Fisheries Research)
NGO	Non Governmental Organisation
OJM	Organização de Juventude Moçambicana (Mozambican youth organisation)
OMM	Organização de Mulheres Moçambicanas (Mozambican women's organisation)
RLA	Reef Livelihoods Assessment
UNDP	United National Development Programme
WWF	World Wide Fund for Nature

LOCAL TERMINOLOGY

Capulanas	Printed wrap
Casquinha	Small dugout canoe
Dua	Sailing vessel
Kitanda	Drag-net fishing
Machamba	Agricultural plot or field
Mashua	Sailing vessel
Mbande	Shell opercula
Nekanga	Senior figure associated with traditional cures
Ngongo	Sailing vessel
Shehe	Religious leader

BACKGROUND TO THE MOZAMBIQUE CASE STUDY

The Mozambique case study was carried out in partnership with Kusi Limitada consultants and IDPPE – the National Institute for the Development of Small Scale Fishing. Field work was carried out over a 6 week period starting in June 2002, following training in field methodology set out in IMM and SPEECH (2002). The latter was largely adhered to, but some key changes were made to the methodology to successfully secure improved data capture and reduce the duration of some of the field exercises (as outlined in Annex 1).

The following case study report provides a detailed overview of reef-based livelihoods in Mozambique's northern province of Cabo Delgado, focusing on three village communities. The first two sections of the report give a contextual overview of the study area and study communities, outlining key social, ecological, economic and administrative characteristics of the area and local livelihood systems. Section 3 discusses the features of poverty in the study communities, identifying what characteristics locally define the very poor households and estimating the extent of poverty existing in the communities. Benefits arising from the reef resources to all aspects of the livelihoods of the poorer members of the communities are described Section 4, entitled Reef Livelihoods. Section 5 outlines how reef-derived livelihoods have changed and discusses the causes of these changes and impacts on the local livelihoods. Finally, concluding remarks are made in Section 6, summarising key aspects of the benefits of reef resources to the livelihoods of the poor comunities of Northern Mozambique and how these have responded to change.

1 STUDY AREA CONTEXT

The study area chosen in Mozambique was the south of Cabo Delgado Province, the most northern of Mozambique's 11 provinces, bordering Tanzania (Figure 1). Two of the study villages, Messano and Darumba, are situated in the north of the southern zone and the third, Maueia to the south.

Mozambique has 2750 km of coastline and coastal enterprises (including fisheries) play an important role in both the national economy and coastal livelihoods. More than 90 000 people are directly involved with artisanal fishing (excluding those involved with trading and processing) operating about 11 000 vessels equipped with a wide variety of fishing gear. The catch from the artisanal sector as a whole is almost entirely destined for the domestic market and represents an important source of protein for the nation.

Figure 1 Cabo Delgado province

1.1 SOCIAL SETTING

Basic population data for the province is presented in Table 1. Nationally it is estimated that two-thirds of the population lives within 150 km of the coast, but it must be remembered that Mozambique's capital and second largest city are both within this band. In Cabo Delgado, the provincial capital is likewise situated on the coast and it would be reasonable to estimate that around 40–60% of the population of the province live within 150 km of the coast. Note from the table the low level of urbanisation and the fact that over 40% of the population is less than 14 years old. Primary data from this study indicates an average household population of 4.6, and it is difficult to see why this should be

TABLE 1 POPULATION DATA (1997)	
Population	
Total	1 287 814
Male	48%
Female	52%
Population age	
0–14 years	42%
15–64	55%
>65	3%
Population distribution	
Urban	17%
Rural	83%
Population density (ps/km^2)	15.6
per household (rural)	3.8

Source: National Population Census, 1997

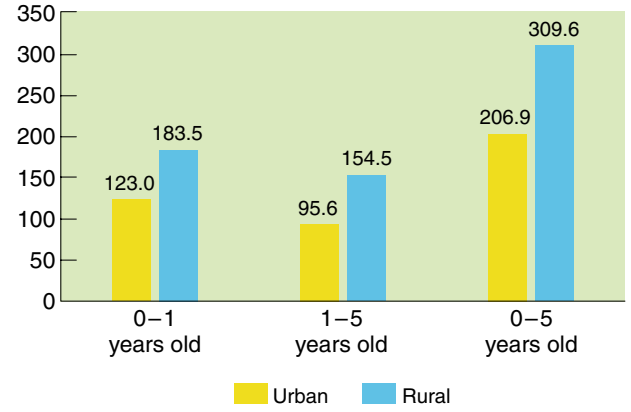

Figure 2 Infant mortality per 1000 (1997)
Source: National Population Census, 1997.

TABLE 2 EDUCATION AND SANITATION (1997)	
Illiteracy rate (rural)	
Male	65%
Female	92%
Population >15 years old with no schooling (rural)	
Male	83%
Female	96%
Sanitation (rural)	
Houses with latrine	34%
Houses without latrine	65%

Source: National Population Census, 1997

so different from the data of the 1997 census (household population=3.8). One explanation is possibly the influence (and different statistical treatment) of polygamy on the data.

Outline data for education and sanitation for Cabo Delgado are shown in Table 2. Rates of illiteracy and lack of schooling are extremely high, and reflect the disruption to education as a result of the civil war. The general lack of sanitation facilities is likewise dire, and may contribute to high child mortality and frequent outbreaks of associated diseases (especially cholera).

The status of primary health care in the province is probably best reflected in the infant mortality statistics – total infant mortality (up to 5 years) is 309 per 1000 in rural areas of Cabo Delgado. Data for the province are presented from the 1997 census in Figure 2, broken down between rural and urban locations. High infant mortality is considered to be directly linked to poor health infrastructure (both in terms of existence and operability), poor sanitation practices and food security. Overall life expectancy in the province is under 38 years.

1.2 ECOLOGICAL AND GEOPHYSICAL SETTING

Cabo Delgado province is in a humid (semi-arid) tropical zone. Climatic conditions are marked by distinct periods of rainfall and predictable changes in wind direction and strength throughout the year. Total annual rainfall is 900–1000 mm, 87–91% of which falls between December and March. There are two distinct seasons of the year, a hot season (coinciding with the rains) where average temperatures vary between 25–27°C, and a cooler period with temperatures of 22–25°C (May–October).

Coastal (terrestrial) topography is characterised by sandy soils often with underlying rock. In the north and centre the coastal zone is characterised by a series of parallel hills running north–south, as is the case of the hinterland behind two of the study villages, Messano and Darumba. In the south of the province the immediate coastal topography is flatter and with more productive soils

The undersea topography is characterised by a series of deep canals, running east–west, cutting into the continental shelf, such is the case of the canal immediately to the south of the island of Matemo (see Figure 7), in front of Darumba. These canals start in very deep water, cutting between islands and finish in sandy grassy regions to the west of the islands. The northern and central coast of the province is flanked by the Quirimbas Archipelago, an irregular chain of 28 coralline islands running north–south about 10 km from the coast, stretching from just south of the Tanzania border to north of Pemba.

Tidal amplitude varies from 6 m (spring tides) to 2.8 m (neap tides), with strong currents especially in deeper areas.

Along the northern coastline of Mozambique, fringing reefs are numerous away from river mouths and around offshore islands. Around the Quirimbas Archipelago, biodiversity is high,

with records of over 50 hard coral genera and over 300 species of reef fish (Spalding *et al.*, 2001).

The extent of resources in the study area has not been documented. However, a Frontier study of 1998, which covered the southern part of the Quirimbas Archipelago (from Macaloe Island to Quipaco Island) estimated mangrove resources to cover around 20 km^2 (Frontier, 1998) and include eight species. Seagrass resources are more widespread and include 10 species, covering an estimated 60 km^2. There are no data on the extent of coral resources in the same zone.

There is very little completed research on the status of marine resources, although the Frontier study compiled a detailed resource inventory. Subsequent studies indicate high coral mortality from the 1998–1999 El Niño coral bleaching event, especially on more sheltered reefs. Those more exposed to the open ocean are reported to have been less affected. Subsequent to this, the rate of recovery of affected reefs in the area is reported to be very good. Other natural threats to reefs include the Crown-of-Thorns starfish and white band disease (Governo da Província de Delgado, 2002).

1.3 POLITICAL AND ORGANISATIONAL SETTING

Mozambique gained its independence in 1975, and this was accompanied by an exodus of most Portuguese settlers and Asian traders, adoption of central planning and nationalisation of major enterprises. A civil war engulfed the country from the late 1970s to early 1990s, and resulted in a collapse in production, destruction and deterioration of infrastructure and public services, and heavy dependence on foreign aid. Only after the 1992 peace accord was Mozambique able to effectively pursue economic policies, based on privatisation of economic assets and functions, market determination of prices and exchange rates, and rationalisation of public expenditure and fiscal balance.

Today Mozambique has a democratic government system, which at the last election in 1999 restored the FRELIMO party to power for a second successive term. Although the implementation of decentralised government systems is becoming stronger, a considerable amount of economic and administrative power still remains under central control. The country is divided into 11 administrative provinces, each with a provincial governor (appointed by the centre) and each province is divided into districts, each with a district administrator (again appointed). Below the district there are localities and administrative posts. In each village, there is a village head, usually elected by the village and endorsed by local government.

Each ministry in principle has provincial directorates, the exception being Fisheries, which was only relatively recently made a ministry and still shares staff and facilities with the Ministry of Agriculture. At district level, there may be a representative of ministries which are considered key to that area.

Relevant to this study, the geographic distribution of people and villages was influenced by a national villagisation programme implemented over the early years of independence. This forced villages to come together, principally with the aim of improving the provision of social services, product and input markets and control. It was in many aspects very similar to the Ujamaa villagisation policy implemented in the same period in Tanzania. A result of this is that even today in areas where the policy was successfully implemented (such as Cabo Delgado), small villages (less than 200 households) remain very rare.

Grassroots organisations in the study area (and in Mozambique as a whole) are extremely rare, and as a result levels of community organisation and politicisation are low. The absence of such organisations can be attributed to the complete disruption of the fabric of society during the civil war, the high degree of control exerted by the command economy of the early years of independence and the total failure of the state-fostered co-operative movement of the same period.

1.4 ECONOMIC SETTING

Mozambique's economy declined rapidly during the early years of independence, primarily due to the effects of the war and the departure of many (foreign) entrepreneurs. Today GDP per capita is around $225, but with a growth rate of a little under 10%. The latter is buoyed significantly by a single major industrial investment in aluminium smelting. The domestic economy continues to be based primarily on agriculture, whilst fisheries products (mostly industrially caught shrimp), and more recently aluminium, make up the bulk of exports.

In spite of encouraging growth, the country remains very poor and Cabo Delgado province is one of the most disadvantaged. As an indicator, around 80% of households in the province have no radio, in spite of the fact that this is often one of the first purchases made with disposable income.

Principle agricultural products in Cabo Delgado are (in order of importance) cassava, maize, rice, sorghum and millet. The latter two products are mostly consumed in the south of the province, primarily in poorer households. Sweet potatoes are also important in the Quirimbas Archipelago.

The agricultural harvest period spans March to August, but poor families normally use up stocks by October. This is then followed by a period of food deficit from December to March. Average families may be able to maintain stocks through to February. In the southern coastal zone of the province there are better commercial links with the provincial capital, Pemba, as

well as better soils. Families here have higher agricultural output and normally produce 75% of food requirements. In both northern and southern coastal zones poorer families use a significant part of cash income to buy basic foodstuffs

In the northern part of Cabo Delgado there is, in general, low domestic agricultural production due to poor soils and irregularity of rainfall. Water shortages may occur in the coastal zone between September and December. (Governo de Província de Cabo Delgado and Cooperação Espanhola, 1999)

The fishery in Cabo Delgado is entirely artisanal, there being no industrial or semi-industrial vessels operating in the province. Vessels used include simple dugout canoes, outrigger canoes, and a range of planked sailing vessels (*dau, mashua and ngongo*). The 1995 census indicated that there were just under 9000[1] fishers in the province and 1900 fishing vessels, of which less than 0.5% were motorised. The most commonly used fishing gear are handlines, followed by traps, beach seines and gill nets. The fishery responds to primary subsistence needs within fishing communities and also supplies rural and urban markets as far afield as Maputo.

The use of ice or refrigeration is uncommon and most fish sent out from the coastal area is salted and sun-dried. Major markets for dried fish include Montepuez and Nampula, whilst fresh fish distribution is usually limited to nearby towns. Export products from the fishery include frozen lobster (mainly from Moçimboa da Praia), some frozen prawns, gastropod shells, opercula (known as *mbande*) and sea cucumbers.

1.5 EXTERNAL FACTORS CONTROLLING LIVELIHOOD OPPORTUNITIES

Much of the context outlined above points at external factors that influence livelihoods in the study villages.

The key issues are considered to be:

- *Location and nature of natural and physical resources.* Coastal communities have very different livelihood opportunities depending upon the coastal geography. This includes beach profile, degree of protection afforded by reefs, banks and islands, the proximity of reefs etc., all of which will influence marine livelihood opportunities. The role of agriculture is determined primarily by soil quality and water resources.
- *Lack of grassroots organisation and politicisation.* As indicated above this is can be attributed to effects of the civil war and the policies of the early years of independence.
- *Variability of agriculture.* Even in 'fishing' communities, agriculture plays an important role in almost every household. Climatic variability has great influence on agricultural production and hence livelihoods.
- *Civil war and national political stability.* This clearly has had an important influence on livelihoods and should national political stability decline again, livelihoods would be severely compromised.
- *Communications.* Road communications have an important and obvious influence on rural livelihoods, affecting access to markets and essential social services. In the study area the important tertiary and secondary roads all require periodic maintenance (to keep them passable in the rainy season), which cannot necessarily be guaranteed.
- *Monetary devaluation and inflation.* Livelihoods, especially those heavily dependent on fisheries, tend to be vulnerable to the effects of monetary devaluation and inflation. Not only does the activity depend partially on imported materials (making it vulnerable to devaluation) but also fish as a market product historically is seen as a lagging price indicator – price changes do not immediately reflect cost of production increases.
- *Reef quality.* Reef degradation due to external effects such as El Niño clearly have potential to affect livelihoods, however it should be noted that no reference was made by the three study communities at any stage during the field work to degradation of reef quality due to natural processes, such as the coral bleaching event.

2 COMMUNITY CONTEXT

This section summarises the context of each community. Details are presented both in the text of the following three subsections and, for easier comparison, in Table 6.

2.1 MAUEIA

Maueia is a village straddling the secondary road between Pemba (provincial capital) and Mecufi (district capital). By provincial standards it is a very small community of 130 houses (see Section 1.3) and, in spite of its proximity to the coast, its inhabitants are highly dependent upon benefits from land-based activities. Marine resources do, however, still make an important contribution to the community's livelihoods. It was apparent during the field work that the village is somehow forgotten, and that few organisations (governmental or non-governmental) have any links or history with the community.

2.1.1 Geographic setting

Maueia is situated on a secondary road 7 km south of Morrebwe and 22 km from Pemba. The road is unsurfaced but remains passable during the rainy season. There is daily public transport to both Pemba and Mecufi, both of which can be reached in less than an hour.

The village has neither electricity nor telephone (the nearest being in Mecufi).

The village was created immediately after independence as part of the villagisation process, bringing together populations of three nearby villages including Chicapa (visible in Figures 3 and 4).

The geography of the area is flat to undulating, with frequent small depressions caused by rivers and streams, many of which are only seasonal. Maueia is bisected not only by the road, but also the River Chicapa.

The village is about 700 m from the coast, which can only be accessed via a network of small footpaths over low scrub-covered dunes. On the coast, the sandy beach is narrow and steep, and drops down to a coralline rocky plateau which is exposed at low tide. The first 20 m of the rocky plateau are covered with mud/sand which supports a few mangroves. Beyond the rock plateau, water depth increases rapidly (see Figure 4) and is characterised by fringing reefs in parallel bands. The coastline is exposed, there being no outer islands or offshore reef.

2.1.2 Social setting

The vast majority of the population of Maueia are from a single tribal group, Macua, and there are a few families from other areas as far away as Tete (the most western of Mozambique's provinces). Newcomers are confined to an area of the village to the south of River Chicapa, with the core of the community being on the other side of the river. All of the indigenous residents are Muslims.

No specific data were collected on age structure, but the dependency ratio (total number of persons in a household divided by the number of economically active adults) was estimated as 2.6, the highest of the three villages surveyed.

The social infrastructure of Maueia is summarised in Table 3.

Figure 3 Maueia land map.

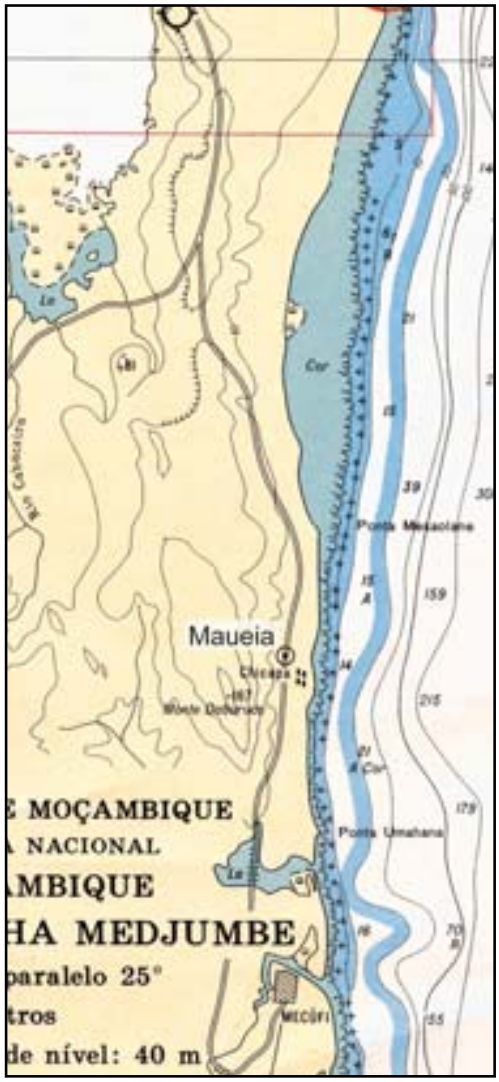

Figure 4 Maueia marine chart.

TABLE 3 MAUEIA SOCIAL INFRASTRUCTURE

Sector	*Infrastructure*	*Comment*
Education	One school (mud and thatch) with two rooms Primary education only.	Brick and mortar school exists but is at south side of village and is without a roof.
Health	No health infrastructure or personnel.	Nearest health post in Morrebwe (7 km).
Water	Three wells, only one with working pump.	Only dry in extreme conditions.
Sanitation	No latrines in the village.	
Religion	One mosque.	*Shehe* (religious leader) recently deceased.

Life in Maueia was badly disrupted by the civil war – at the time of unification of the three villages (1976) there were an estimated 970 houses in the village and by the end of the war (1992) only 74 remained. Displaced families mostly fled to Pemba or Nampula

Gender

Of the economically active persons (note that this did not include old persons or children) 46% were male, 54% were female closely mirroring the data for the rural areas of the province as a whole (see Table 1). Details of activities and responsibilities by gender are summarised in Table 6.

Culture

Apart from the Muslim faith and its attendant ceremonies, there is also widespread participation in more traditional religious practices, including initiations. Some ceremonies are focused upon a site near to the coast in the southern part of the village where a long time ago people took refuge from attacking tribes.

2.1.3 Ecological setting

Maueia is situated in a relatively dry area, and relies on rain-fed agriculture, in spite of the fact the village is bounded by two small rivers and straddles a third.

Land behind the village is wooded savannah, and was reported to be reasonably productive for agriculture. Nearer the coast, soils are very sandy and the strip between the road and the coast only supports crops in a few areas with better access to fresh water. The village has a few palms, mango trees and almost no productive cashews.

Marine resources are divided into those in the intertidal zone (molluscs, octopus) and the fish resources associated with the reef system. The most common mollusc harvested is the small gastropod *Neritidae* (Figure 5), other fisheries resources being typically diverse (see list in Annex 2). Note that the fish resources include both reef dwelling demersals, as well as large and small pelagics.

Figure 5 Commonly harvested intertidal mollusc, *Neritidae undata.*

Figure 6 Maueia beach panorama at low tide.

As with the other two communities studied, mollusc resources in the intertidal zone appear to be degraded. Fish resources were considered to be healthy though not very large. Fishing pressure was less than other communities as a result of the difficult access (lack of shelter) and the community being primarily farmers.

Intertidal resources are easily accessed from the beach on foot. Some fisheries resources can be accessed directly from the coast (swimming with spear-gun), but most require a *casquinha* – a small dugout canoe with outriggers propelled by paddle or sail (Figure 6).

2.1.4 Economic setting

Maueia has three principle economic opportunities: agriculture; charcoal production; and fishing, and participation in these is detailed in Table 6. It should be noted that Maueia's proximity to Pemba greatly increases opportunities for salaried employment. In general the livelihood strategies are less diversified than in the other study villages, with 42% of households involved in only one (or less) productive activity. It should be noted that there is a clear division between those activities which serve home consumption (agriculture, fisheries) and those which generate cash revenue (charcoal production, trade, some fishing). A summary of household productive assets is also presented in Table 6.

Commercial links

Maueia has no shop or permanent stall – the 'market' is an open area under a mango tree with no infrastructure at all. There are about six people in the village who sell basic items (cigarettes, cooking oil, kerosene) at their front door.

Proximity to Pemba means that both producers and traders will make trips to the city to sell significant excess, rather than look for buyers in the village. The development of markets in Pemba has had some impact in Maueia and fishers will even cycle to the tourist hotels to sell fish.

Finance

There is no financial infrastructure in either Maueia or Morrebwe – the nearest bank is in Pemba. Accessible credit sources are hence all informal and linked either to family, friends or traders.

2.1.5 Administrative setting

The administrative and political structure of the village is typical. There is a head (man) elected by the people, who is recognised by local, district and provincial administration. Within the national hierarchy, the head of the village answers to the head of the administrative post in Morrebwe. It was not clear if the head of the village was also the community leader (a position of more traditional authority).

Within Maueia there is a functioning village executive council comprised of various key people, each responsible for a particular sector (agriculture, fisheries, sport, women, etc.). The council also has representatives of national political organisations such as OMM (Mozambican Women's Organisation), OJM (Mozambican Youth Organisation), the latter being particularly active in the organisation of sport and culture (dance).

2.1.6 Vulnerabilities and risks faced by the community

The principle vulnerabilities and risks faced by the community in Maueia are:

Drought	Particularly vulnerable due to high dependence on agriculture.
Animal diseases	Newcastle's disease means that all chickens are slaughtered in the dry season.
War	Life in Maueia was completely disrupted by the civil war.
Health risks	There are no immediately accessible health resources. In addition, sanitation is extremely poor, and cholera-type disease risk is high.

Bad weather	The coast is exposed and bad weather will quickly reduce fishing activities.
Seasonal food shortages	There are few, seldom sufficient, stocks and savings to last the whole year. February – March is always a difficult time.
Cyclone	Maueia is in cyclone latitudes. The last one (1969) brought total destruction.
Economic turmoil	Maueia was affected by national economic problems during the early 1980s, when there was money but nothing to buy. People even resorted to tree bark clothing.
Declining resources	Poorer households have higher dependence on intertidal gastropod resources which are reported to be progressively declining.

2.2 DARUMBA

Darumba is a small community in front of the southern part of the Quirimbas Archipelago, whose inhabitants are primarily fishers. The village was established in 1987 by families fleeing attacks by guerrilla forces on Mipande, some 4 km further upstream on the same river where Darumba stands today. In Mipande livelihoods are more focused on agriculture, but the community fished the river and reef areas prior to the resettlement. Livelihoods in Darumba are more dependent upon fisheries resources, including bivalves, marine and riverine fin fish and shrimp. In spite of the remote location and difficult access, the village is not as isolated as it might seem.

2.2.1 Geographic setting

Darumba is situated on a small rise on a low lying peninsular in front of the island of Matemo in the Southern Quirimbas. The southern edge of the peninsular is bounded by River Quiria Makoma and the eastern edge by the sea. Darumba is some 20 km from the local administrative post in Mucojo (reached by sandy narrow track). From Mucojo the district capital (Macomia) is a further 45 km to the west (reached by unsurfaced road), and Pemba some 180 km to the south of Macomia (reached by tarred road). This route is the only viable means of land access – the coastal route to the south (via Mipande) shown in Figure 7 is not passable. There is public transport to Macomia via Mucojo about twice per week, and from there transport to Pemba passes daily. In the absence of public transport the only way to reach Mucojo is on foot.

There is no phone or electricity in either Darumba or Mucojo – the nearest phone is at Macomia.

Figure 7 Messano and Darumba land map.

The village is subdivided by a low lying sandy flat which floods at high spring tide. The main part of village has most of the houses and infrastructute, whilst the minor part (to the south east) has a working cold store and a few houses.

The coast immedately in front of the village is covered with low density mangrove, protected by an offshore bank running north towards Olumbua, the southern extremety of which is coralline and is known as Nvú.

2.2.2 Social setting

Most of the population of Darumba is from the Mwani tribal group, with some Macuas. There appeared to be few 'outsiders' in the village, but people were encountered from as far away as Beira (Sofala province).

All of the village residents are Muslims, but with varying degrees of adherance.

The dependency ratio for households was estimated as 1.9, the lowest of the three villages surveyed. It is also noteworthy that no houses were encountered without a productive person in the household (i.e. totally dependent on outside support).

Figure 8 Messano and Darumba marine chart.

The social infrastructure of Darumba is summarised in Table 4.

The civil war affected Darumba, and was one of the causes behind its foundation in 1987. During the war the number of houses rose to about 290 households (boosted by families seeking protection). This number has now dropped to its present level of 186 as families returned over the years after the peace accord.

TABLE 4 DARUMBA SOCIAL INFRASTRUCTURE

Sector	*Infrastructure*	*Comment*
Education	One school with roof, but only posts for walls. Primary education only.	Brick and mortar school exists, but is at south side of village and is without a roof.
Health	No health infrastructure or personnel.	Nearest health post in Mucojo (20 km).
Water	One well with pump, three traditional wells with poor water quality.	
Sanitation	No latrines in the village.	
Religion	One mosque.	

Gender

Of the economically active people (note that this did not include old persons or children) 52% were male, 48% were female, somewhat different from the data for the rural areas of the province as a whole (see Table 1). Details of activities and responsibilities by gender are presented in Table 6.

Culture

Apart from the Muslim faith and its attendant ceremonies, there is also widespread participation in more traditional religious practices, including initiation and particular ceremonies to assure good results from productive activities. Details were not divulged but key persons, such as the *Nekanga*, (a senior female figure associated with traditional cures) and the community leader (a male figure of traditional authority) were clearly held in high esteem.

2.2.3 Ecological setting

Land immediately surrounding Darumba is very sandy and poor which, together with large populations of warthogs and monkeys, makes it unsuitable for reliable agricultural production.

All agriculture is undertaken in the area immediately across the river from the village, where although the soils are better, animal invasion is still a threat. Land here has better access to water, there being several small tributaries feeding into the river exclusively from the south side. The village has a few palms, mango trees and productive cashews.

Marine resources are divided into those in the intertidal zone (molluscs, octopus) and the fish resources associated with the reef system. The most common molluscs harvested are the bivalves *Pteriidae* and *Arcidae* (Figures 9 and 10). The other fisheries resources being typically diverse (see list in Annex 2). The river makes an important contribution to catches and yields shrimp (*Penaens indicus, P. monodon*), mangrove crabs and a wide variety of salt and brackish water fish.

As with the other two study communities, mollusc resources in the intertidal zone appear to be degraded. Resources in the river were reported as healthy but with shrimp under increasing pressure following local market developments. No information was available or gathered on the status of immediate coral based resources, but those at Matemo were described in 1998 as in good condition (Frontier, 1998).

Some of the intertidal resources are easily accessed from the beach on foot, whereas others, including Nvú (the focus of much collection and marine fishing effort), can only be accessed by vessel.

Figure 9 Commonly harvested intertidal mollusc, *Pteriidae*.

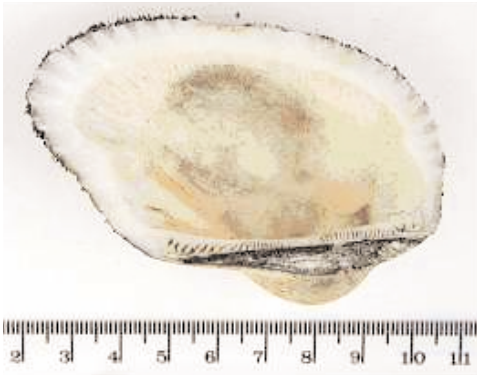

Figure 10 Commonly harvested intertidal mollusc, *Arcidae*.

2.2.4 Economic setting

Darumba has three principle economic opportunities: fishing; agriculture; and trading, and participation in these is detailed in Table 6. The general strategy is more diversified than in Maueia, with 29% of households involved in only one (or less) productive activity. A summary of household productive assets is also presented in Table 6.

Commercial links

Darumba has no shop, but has stalls at a village market under a mango tree. A few people also sell basic items (cigarettes, cooking oil, kerosene) at their front door.

The principal primary markets for products from Darumba are the cold store in the village (higher value fish products) and Macomia (dried fish). Some traders, particularly those returning with food or clothing to sell, also take products to inland markets, including Montepuez. There are also longstanding commercial links with Tanzania through traders coming south or going north.

Finance

There is no financial infrastructure in either Darumba, Mucojo or Macomia – the nearest bank is again in Pemba (at least a day's travel). Credit sources include an NGO (Amoder, with a small programme for micro credit in coastal communities), as well as other informal sources including family, friends or traders.

2.2.5 Administrative setting

The administrative and political structure of the village is similar to that of Maueia. There is a head (man) elected by the people, who is recognised by local, district and provincial administration. The head man answers to the head of the administrative post in Mucojo. As indicated above, a community leader was identified who clearly had more traditional authority.

No reference was made to the village executive council, though it is most unlikely that the village did not have one. There are representatives of the national political organisations OMM (women) and OJM (youth).

Darumba had a more confused party political setting, with elements of the community clearly aligned to different political parties, resulting in competition, exclusion and some low level tension.

2.2.6 Vulnerabilities and risks faced by the community

The principle vulnerabilities and risks faced by the community in Darumba are:

Rainfall	Both excessive and lack of rain. In the former case the water table rises and floods houses in the lower areas of the village.
Health risks	There have been no less than six health epidemics since 1987 (including scabies, malaria, meningitis, cholera, tuberculosis).
Seasonal food shortages	There are few, seldom sufficient, stocks and savings to last the whole year. February–March is always a difficult time, but eased by the seasonal peak in fisheries.
Declining resources	Poorer households have higher dependence on intertidal bivalve resources which are reported to be progressively declining.
Road access	The roads between Darumba and Mucojo, and between Mucojo and Macomia are prone to degradation. The latter requires periodic major reconstruction.
Animals eating crops	Elephants, warthogs, monkeys devastate both planting and harvest.

2.3 MESSANO

Messano is the largest of the three study villages and is situated about 20 km north of Darumba, due east of Mucojo. Like Maueia, the village is quite new (established in 1969) and was previously situated a kilometre or more inland. The old village is visible in Figure 7 (written as *Massano*). Livelihoods in Messano are extremely dependent on marine resources, which are both relatively abundant and accessible. Agriculture in the area is described as poor, primarily due to unproductive sandy soils. In addition, trading is important, both between the community and the hinterland, as well as with the islands in the southern Quirimbas Archipelago.

2.3.1 Geographic setting

The geographic setting of Messano is shown in Figures 7 and 8. The village is situated right on the coast, on the south side of a flat sandy area which floods at high tide (not shown on map (Figure 7), or chart (Figure 8)). A sandy track connects the village to Mucojo (administrative post) about 3 km distant. From Mucojo the district capital (Macomia) is a further 45 km to the west (reached by unsurfaced road), and Pemba some 180 km to the south of Macomia (reached by tarred road). In addition, tracks connect Mucojo to the neighbouring village of Nambo (visible in Figure 7) and Pangani (to the north, just outside of both Figures 7 and 8)

There is occasional transport to reach public transport at Mucojo and Macomia, and from there transport to Pemba passes daily. In the absence of transport the only way to reach Mucojo is on foot.

There is no phone or electricity in either Messano or Mucojo – the nearest phone is at Macomia.

The beach in front of Messano is sandy with a very flat profile, the water retreating about 700 m at low spring tide. The beach is protected from the south east (from where the strongest winds blow) by Ponta Pabula and Baixo Zala. The area is, however, more exposed to north-westerly winds.

2.3.2 Social setting

Almost all of the population of Messano are from the Mwani tribal group, with very few 'outsiders' in the village. All of the village residents are Muslims.

The dependency ratio for households was estimated as 2.4, similar to Maueia. A surprising 23% of households are estimated to be female-headed (without a resident male), but these data may have been complicated by polygamy. Six percent of houses (the highest of all the three study villages) were found to have people with no economic activity (i.e. totally dependent on outside support).

The social infrastructure of Messano is summarised in Table 5.

Messano was surprisingly unaffected (directly) by the civil war, although some families left for the security of Pemba and Maputo, and others arrived from more vulnerable nearby communities. The village was never attacked.

Gender

Of the economically active persons (note that this did not include old persons or children) 48% were male, 52% were female, similar to data for the rural areas of the province as a whole (Table 1). Details of activities and responsibilities by gender are summarised in Table 6.

Culture

Apart from the Muslim faith and its attendant ceremonies, there is also widespread participation in more traditional religious practices, including initiation and particular ceremonies to assure good results from productive activities. Details were not divulged but key people, such as the community leader (a male figure of traditional authority) were clearly held in high esteem.

2.3.3 Ecological setting

Land immediately surrounding Messano is very sandy, making it unsuitable for reliable agricultural production.

All agriculture is undertaken in the area behind the village, towards Mucojo and the previous location of *Massano*. Immediately to the south of Messano there is a coconut plantation (apparently not commercially used), the village also has many coconut palms amongst the houses.

TABLE 5 MESSANO SOCIAL INFRASTRUCTURE

Sector	*Infrastructure*	*Comment*
Education	One school of brick and mortar construction, recently built and in good condition Primary and half of secondary curriculum taught.	Operational, with teachers.
Health	No health infrastructure or personnel.	Nearest health post in Mucojo (only 3 km).
Water	One well with pump, two traditional wells of which one has poor water quality.	
Sanitation	No latrines in the village except at the school.	
Religion	Two mosques.	

Figure 11 A pile of discarded mollusc shells outside a house in Messano.

Marine resources are divided into those in the intertidal zone (bivalves, octopus) and the fish resources associated with the reef system. The most common molluscs harvested are the bivalve *Pteriidae* (Figure 9) and the gastropods *P. trapezium* and *C. ramosus* (Figure 12). The other fisheries resources being typically diverse (see list in Annex 3). Fishing grounds extend beyond the immediate littoral zone to the islands of Quifula and Mogudula, as well as the Zala reef. Unique amongst the study villages, Messano has rapidly expanding seaweed production, made possible by the protected and shallow nature of the beach.

As with the other two community studies, mollusc resources in the intertidal zone appear to be degraded, and it was also reported that both *C. ramosus* and sea cucumbers were becoming more difficult to find and are 'probably over-exploited' (Frontier, 1998). Coral resources at the island of Mogundula were described in 1998 as in good condition (Frontier, 1998). The area falls within the forthcoming Quirimbas National Park, whose baseline documents maintain that the current status of resources is actually critical: 'At the moment, the fisheries in the coastal area of the PNQ (fisheries in the coastal areas, being these accessible to artisanal fisheries) are on the edge of collapse'. The situation is attributed to excessive pressure due to the over-exploitation of fish stocks in Nampula and Tanzania, and subsequent migrations of fishers (Governo da Província de Cabo Delgado, 2002).

The intertidal resources are easily accessed from the beach on foot, including areas where oysters are sought and seaweed

Figure 12 Commonly harvested molluscs, *P. trapezium* and *C. ramosus*.

Figure 13 Fresh and dried seaweed.

cultivated (Figure 13). All the capture fisheries resources (except *kitanda*, drag-net fishing) and the intertidal resources on the nearly islands require a boat and a journey of up to 10 – 15 km.

2.3.4 Economic setting

Messano has three principle economic opportunities: fishing; agriculture; and trading, and participation in these is detailed in Table 6. The general strategy is more diversified than in any of the other study villages, with only 9% of households involved in only one (or less) productive activity. The high participation in seaweed culture should be noted. A summary of household productive assets is also presented in Table 6.

Commercial links

Messano has signs of very strong commercial links in the past, including large shops built by Indian traders prior to independence. Currently only one of these operates (basic food commodities only), but two (better stocked) shops are found at Nambo a few hundred metres to the north.

The primary markets for fish products from Messano are the working shop (which has an ice box and works as a buying post for the same company which owns the cold store in Darumba) and Macomia (dried fish). Some traders also take products to inland markets including Montepuez, particularly those returning with food or clothing to sell. There are also longstanding commercial links with Tanzania through traders coming south or going north.

Finance

There is no financial infrastructure in either Messano, Mucojo or Macomia – the nearest bank is again in Pemba (at least a day's travel). Credit sources are therefore focused upon other informal sources including family, friends or (more often) traders.

2.3.5 Political setting

The administrative and political structure of the village is similar to that of Maueia and Darumba. There is a head (man) elected by the people, who is recognised by local, district and provincial

administration. The head man answers to the head of the administrative post in Mucojo.

No reference was made to the village executive council, though it is most unlikely that the village did not have one. There are representatives of the national political organisations OMM (women), OJM (youth) and internal security.

2.3.6 Vulnerabilities and risks faced by the community

The principle vulnerabilities and risks faced by the community in Messano are:

Drought Agricultural land is poor and drought can wipe out crops.

Health risks There have been five health epidemics since 1975 (including scabies, malaria, cholera and tuberculosis).

Poor agriculture Agriculture is seldom capable of supplying basic household consumption needs, and viable livelihoods therefore must include other productive activities.

Crop disease Coconut productivity is on the decline, attributed to lethal yellowing disease.

Declining resources Poor households have higher dependence on intertidal bivalve resources, which are reported to be progressively declining.

Animals eating crops Animals (monkeys) eat crops at planting and harvest (not nearly as acute as Darumba).

Animal encroachment Hyenas have been known to enter the village and attack (and kill).

Single seaweed market There is only one seaweed buyer, and the dependence on the company is getting progressively stronger (important in the light of poor agriculture).

Figure 14 Messano beach panorama – 180° panorama, looking from the water's edge at low tide back towards the village.

2.4 SUMMARY

TABLE 6 STUDY VILLAGE COMPARISON TABLE

	Maueia		*Darumba*		*Messano*	
Natural resource access	*Aquatic resources*: Exposed rock/coralline based resources, intertidal molluscs *Land*: Reasonable accessible land for cultivation		*Aquatic resources*: Sheltered sand coralline banks, intertidal resources, river *Land*: Poor local land		*Aquatic resources*: Sheltered sand coralline banks, intertidal resources, zone suitable for seaweed culture *Land*: Poor local land	
Community social composition	Ethnic group Religion	Macua Islam	Ethnic group Religion	Mwani Islam	Ethnic group Religion	Mwani Islam
Livelihood opportunities (% figures show households with this as primary activity)	Agriculture Charcoal Fish Employment (external) None (dependant) Artisan Trader	65% 14% 9% 5% 3% 3% 1%	Fishing Agriculture Trading Transport Employee (in village) Shell collector None (dependant)	59% 24% 10% 2% 2% 2% 2%	Fishing Agriculture Trader Artisan None (dependant) Seaweed culture	47% 28% 17% 4% 2% 2%

TABLE 6 (CONTINUED)

	Maueia		*Darumba*		*Messano*	
Livelihood strategies (% figures show households with these primary and secondary activities)	Agriculture		Fishing		Fishing	
	+Charcoal	13%	+Agriculture	20%	+Agriculture	40%
	+Employment (external)	8%	+Shell collection	14%	+Seaweed culture	4%
	+Fishing	5%	+Trading	10%	+Trading	2%
	+Artisan	3%	+No secondary activity	16%	Agriculture	
	+Trading	2%	Agriculture		+Fishing	9%
	+No secondary activity	33%	+Fishing	14%	+Seaweed culture	9%
	Charcoal		+Trading	4%	+No secondary activity	6%
	+Agriculture	8%	+No secondary activity	6%	+Octopus collection	2%
	+Fishing	6%	Trading		Trading	
	Fish		+Agriculture	2%	+Agriculture	15%
	+Agriculture	8%	+Fishing	4%	+Fishing	2%
	+Charcoal	2%	+No secondary activity	4%	Artisan	
	External Employment		Transport		+Agriculture	2%
	+Agriculture	3%	+Trading	2%	+Seaweed culture	2%
	+No secondary activity	3%	None	2%	None (dependant)	2%
	None	3%	Shell collector		Seaweed culture	
	Artisan		+Agriculture	2%	+Agriculture	2%
	+Agriculture	1%	Employee (in village)			
	+No secondary activity	2%	+No secondary activity	2%		
	Trader					
	+No secondary activity	1%				
					Note: 68% of households involved with seaweed culture (as primary, secondary or lesser activity)	

Gender roles	***Principle occupation***	***M***	***F***	***Principle occupation***	***M***	***F***	***Principle occupation***	***M***	***F***
Key:	Fishing	✓	✗	Fishing	✓	✗	Fishing (vessel)	✓	✗
M/F Male/Female	Agriculture	❍	✓	Agriculture	❍	✓	Fishing (dragnet)	❍	✓
✓ Common	Charcoal	✓	✗	Trade	✓	❍	Agriculture	❍	✓
❍ Rare	Firewood cutting	✓	❍	Transport	✓	✗	Trade	✓	❍
✗ Never	External employment	✓	✗	Mollusc collection	❍	✓	Artisan	✓	✗
	Artisan	✓	✗	Employee	✓	✗	Mollusc collection	❍	✓
	Trade	✓	✗	Thatch cutting	❍	✓	Employee	✓	✗
	Mollusc collection	❍	✓				Thatch cutting	❍	✓
							Seaweed culture	❍	✓
	Principle decisions	***M***	***F***	***Principle decisions***	***M***	***F***	***Principle decisions***	***M***	***F***
	What to plant	✗	✗	What to plant	✓	❍	What to plant	✗	✓
	When to plant[1]	✓	✓	Use of stored product	✓	✗	Selling of agricultural product	✓	✗
	Size of plot	✓	✗	How *any* cash spent	✓	❍	Giving away of stocks (to family)	✓	❍
	Other agricultural issues	✗	✓	Other agricultural issues	✓	✓	Children's schooling	✓	✗
	Giving away of stocks (to family)	✓	❍	Children's schooling	✓	✓	Schooling materials	✓	✗
	Selling of agricultural produce	✓	✓	Schooling materials	✓	✓	Repairs to house	✓	✓
	Schooling materials	✗	✓	Repairs to house	✓	✓			
	Repairs to house	✓	✓	Animal husbandry	✓	✗			
				Children's schooling	✓	✗			

Demography[2,3]						
Population	est. 624 (837)	Population	510 (437)	Population	est. 903 (1154)
No. households	130 (213)	No. households	186 (126)	No. households	210 (370)
No. households with fishers	32 (53)	No. part-time fishers	54	No. part-time fishers	n/a
		No. full-time fishers	124	No. full-time fishers	63

TABLE 6 (CONTINUED)

	Maueia		*Darumba*		*Messano*	
Household human assets	Average household	4.8	Average household	4.6	Average household	4.3
	Dependency ratio	2.6	Dependency Ratio	1.9	Dependency Ratio	2.4
	% Houses with no economically active person	2%	% Houses with no economically active person	0%	% Houses with no economically active person	6%
	Female[4] (no male)	18%	Female[4] (no male)	6%	Female[4] (no male)	23%
	Male (no female)	5%	Male (no female)	10%	Male (no female)	11%
Household productive assets	Canoes	9%	Canoes	49%	Canoes	0%
	Sail canoes	1%	Sail canoes	8%	Sail canoes	28%
	Nets	5%	Nets	18%	Large sail boat	13%
	Hooks	3%	Hooks	25%	Nets	30%
	Traps	9%	Spear	4%	Hooks	34%
	Cycle	2%	Traps	10%	Spear	0%
	Agricultural tools[5]	77%	Mask/fins	18%	Traps	6%
			Cycle	10%	Mask/fins	0%
			Agricultural tools[5]	49%	Cycle	13%
					Agricultural tools	91%
Vulnerabilities and risks	War		War		Animal incursion in village	
	Drought		Animal incursion in agricultural plots		Health	
	Over-exploitation of intertidal resources		Health		Outsiders	
			Major market is a single fish buyer		Weather	
					Export dependence (seaweed), with single buyer	
					'Lethal yellowing' of coconut plants	

1 Described as 'a community decision'.
2 1997 census data in parenthesis, other data are primarily from this study.
3 Fisher data from IDPPE survey 9/01 (did not cover Maueia). Maueia data have been estimated by this study.
4 Data severely compromised by polygamy. Some households appear female-headed, when they are in reality supported by a man. Others appear to have a male head when the man is in reality split between 2–4 households.
5 Considered to be an underestimate. In the absence of latrines it would be very unusual to find a household without a simple agricultural 'enxada' (hand hoe used to bury faeces).

3 POOR STAKEHOLDERS

3.1 OVERVIEW OF POVERTY

According to the UNDP Human Development Report (2002), Mozambique ranks near the bottom of the Low Human Development countries as the sixth poorest county in the world. The Human Poverty Index for Cabo Delgado province (1997) was 67.8 and the composite standard of living deprivation 75.5% – in both cases the province with the worst indicators in the country.

The real GDP per capita for the whole of Cabo Delgado province was estimated as $143 per year in 1998 (UNDP, 1999) putting the province as a whole under the widely accepted poverty line of $360 per capita per year.

In the absence of any further data, it is considered reasonable to assume that these indicators are generally applicable to the study area in question. In other words, the study villages are all in the poorest province in one of the poorest countries of the world. The communities as a whole are all poor by global standards, and a 'poor stakeholder' is considered to be any stakeholder in the community.

It is, however, valid to observe that in the community there are households that are considered better and worse off than others, and this was investigated during the field work, following the ranking methodology set out in the guidelines (IMM and SPEECH, 2002).

3.2 MAUEIA

Contributors to local poverty (used as factors by the community in ranking households) are set out in Table 7. Much emphasis was placed during the ranking process on willingness and ability to work as an important poverty criteria. It is of interest to note that no issues are directly related to fisheries, although they are clearly implied through the preference for diversified livelihoods.

TABLE 7 POVERTY CRITERIA, MAUEIA

Issues considered to contribute towards household poverty	*Issues considered to alleviate household poverty*
• Laziness, especially if there are opportunities for productive work	• Hardworking
• Many persons in the household	• Ability to clear a large plot for cultivation
• Illness/injury (inability to work)	• Diversification of productive activities
• Dependence on others	• External employment
• Disorganised household	
• No man in the household	
• Polygamous household	
• Old age	

The classification of all households is set out in Table 8, cross tabulated against primary household activity. 53% of the households surveyed in Maueia fall into the two most disadvantaged groups, although, as indicated above, all households in the community are poor and disadvantaged by global standards.

The data show clearly that those involved in charcoal production are considered as having better livelihoods than those not. Neither fishing nor agriculture guarantee freedom from poverty – both disadvantaged and less disadvantaged households can be involved with these activities.

Table 8 also shows the asset ownership by 'poverty' classification. It is interesting to note that ownership of nets is considered a contributor to a better livelihood, and that there appears to be no clear correlation between the classification and vessel ownership.

TABLE 8 CROSS-TABULATIONS OF POVERTY RANK, MAUEIA

Primary activity	*A*[1]	*B*	*C*	*Assets*	*A*	*B*	*C*
Agriculture	24%	14%	27%	Paddle canoe	4%	3%	3%
Artisan	3%	0%	0%	Sail canoe	0%	1%	0%
Charcoal	10%	2%	3%	Nets	3%	2%	1%
External employment	5%	0%	0%	Hook and line	2%	1%	1%
Fishing	3%	3%	3%	Spear gun	0%	0%	0%
None (dependent)	0%	0%	3%	Traps	6%	1%	3%
Trader	1%	0%	0%	Large sailboat	0%	0%	0%
Grand total	47%	19%	34%	Mask and Fins	0%	0%	0%

1 classification: A, above reasonable livelihood; B, reasonable livelihood; C, below reasonable livelihood.

3.3 DARUMBA

The criteria used in the ranking of households in Darumba are shown in Table 9. The corollary of the fact that dependence on agriculture is considered to contribute to poverty was clearly that dependence on fishing (the principal activity in the village) is considered to be beneficial. As with Maueia, ability to work (good health) was considered fundamental.

TABLE 9 POVERTY CRITERIA, DARUMBA

Issues considered to contribute towards household poverty	*Issues considered to alleviate household poverty*
• High dependence on agriculture • Ill health	• Youth • Good health • Ownership of fishing gear • Employment in a beach seine group

TABLE 10 CROSS-TABULATIONS OF POVERTY RANK, DARUMBA

Primary activity	*A*[1]	*B*	*C*	*Assets*	*A*	*B*	*C*
Agriculture	4%	4%	16%	Paddle canoe	18%	14%	18%
Employee (cold-store)	2%	0%	0%	Sail canoe	6%	2%	0%
Fish	31%	20%	8%	Nets	4%	4%	0%
None (dependent)	2%	0%	0%	Hook and Line	6%	8%	12%
Shell collector	2%	0%	0%	Spear gun	4%	0%	0%
Trader	4%	2%	4%	Traps	2%	4%	4%
Transport	2%	0%	0%	Large sailboat	0%	0%	0%
				Mask and Fins	10%	4%	4%
Grand total	47%	25%	27%				

1 classification: A, above reasonable livelihood; B, reasonable livelihood; C, below reasonable livelihood.

Table 10 shows the classification of all village households surveyed by primary activity and also against asset ownership. Here agriculture is clearly associated with poverty, while fisheries are associated with improved livelihoods. The ownership of a sailing canoe and nets is likewise associated with better livelihoods, as is mask and fins (used for sea cucumber and *mbande* (shell opercula) collection). The use of hook and line (usually used over reef resources) is clearly associated with poverty.

3.4 MESSANO

The criteria used in Messano for classification of households are shown in Table 11. Although external remittances has the smallest contribution to household benefit of the three villages (see Table 14), it was only in Messano that it was specifically mentioned as a positive livelihood criteria. Fishing was clearly seen as an important part of a reasonable livelihood.

Table 12 shows the classification of all households surveyed by activity and against asset ownership. 76% of households fall into groups b and c, in spite of the fact that Messano was clearly the least poor of the three study villages. As with Darumba, agriculture is seen as a poor livelihood, and trading is perceived as a positive contribution. It is surprising that the ownership of nets appears to be positively correlated with poverty.

TABLE 11 POVERTY CRITERIA, MESSANO

Issues considered to contribute towards household poverty	*Issues considered to alleviate household poverty*
• No man in household • Polygamous household • Small agricultural plot • No involvement in fishing	• Ownership of larger sailing sailing vessel (*dau/mashua/ngongo*) • Involvement in trading • Remittances from external family

TABLE 12 CROSS-TABULATIONS OF POVERTY RANK, MESSANO

Primary activity	*A*[1]	*B*	*C*	*Assets*	*A*	*B*	*C*
Agriculture	2%	4%	21%	Paddle canoe	0%	0%	0%
Fish	13%	19%	15%	Sail canoe	6%	17%	4%
None	0%	0%	2%	Nets	6%	11%	13%
Seaweed	0%	0%	2%	Hook and Line	6%	21%	6%
Artisan	2%	2%	0%	Spear gun	0%	0%	0%
Trader	6%	11%	0%	Traps	2%	0%	4%
				Large sailboat	11%	0%	2%
Grand total	23%	36%	40%	Mask and Fins	0%	0%	0%

1 classification: A, above reasonable livelihood; B, reasonable livelihood; C, below reasonable livelihood.

4 REEF LIVELIHOODS

Coral reefs have the potential to provide a stream of benefits to the three coastal communities studied in Cabo Delgado. Some of these benefits arise because reefs can contribute to the *resources* that the communities have access to. These reef-related resources contribute to the building blocks of the livelihoods of the communities 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 communities interact with the structures and processes that directly influence the way they 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 communities 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 communities ultimately benefits them, by contributing to positive changes in the *outcomes* of their livelihoods. These outcome changes are best defined and measured by the communities themselves if they are to meaningfully represent positive improvements in their lives.

It should be noted that throughout this analysis it has been difficult to separate the benefit that is gained from fisheries and marine-related activities that are reef-related from those which are not (or are very much less) reef-related. Open sea and riverine fisheries fall into the latter category, and both of these are practised in the study villages (especially Darumba and Messano). The benefit accruing from these fisheries is not easily separated from that accruing from reef-based fisheries.

The following sections describe the many different streams of benefits to the livelihoods of three study communities, focusing on reef benefits to household resources (Section 4.1); to enhancing interactions with direct influencing factors (Section 4.2); and to coping with the risks and vulnerabilities associated with indirect influencing factors (Section 4.3). Where appropriate throughout the following sections story boxes have been included to illustrate points of view expressed by groups or individuals in the study communities.

4.1 RESOURCES

The contribution from the reef to natural, physical, financial, human and social resources is summarised in Table 13 and described in more detail in the following sections (4.1.1–4.1.5)

4.1.1 Natural resources

The main fishing areas accessible to the three communities are over reef areas. Collection also takes place in intertidal areas, on the nearby protected reef flats in Darumba and Messano, and on the coralline rock plateau at Maueia (Figure 15). The coral reef ecosystem is characterised by high biodiversity and productivity, which provide a wide range of options for exploitation. All three communities exploit a diversity of demersal fish species from the reef, as well as octopus, lobsters and molluscs from intertidal areas. Sea cucumber and larger gastropods are also extracted from deeper water areas in Darumba and Messano. The greatest diversity of species is exploited at Messano, followed by Darumba and finally Maueia, where dependency on fishing and reef resources is low (see Annex 2).

The majority of households in all three communities engage in some exploitation of the accessible intertidal resources, ranging from 95% of households in Maueia and Darumba to an estimated 70% of households in Messano. For a small number of households (2%) in Darumba, shell collection was identified as the primary activity. Involvement in fishing is more varied, with 59, 47 and 9% of households engaged in fishing as their primary occupation in Darumba, Messano and Maueia respectively, with additional households also involved as secondary activities (18, 11 and 10% in Darumba, Messano and Maueia respectively).

The perceived contribution of fisheries resources to overall household benefit varied from 58% in Messano, to 57% in Darumba and 25% in Maueia (Table 14). These benefits are largely associated with the reef resource, with the exception of Darumba, where part of the fish catch (~40%) and the shrimp catch is from the river. In Messano, this figure also includes seaweed, cultivated in the shallow sandy intertidal areas.

4.1.2 Physical resources

Offshore coral reefs are important barriers against wave action and erosion on the coastline, protecting agricultural land and property. All three communities received some degree of physical protection in this way, although at Maueia protection was largely afforded by the coralline rock plateau, possibly an ancient reef.

TABLE 13 A SUMMARY OF REEF BENEFITS TO HOUSEHOLD RESOURCES

Resources	*Benefits from the reef*	*Village(s)*[1]
Natural	*Diverse resource*	
	Diversity of demersal fish on reef habitat	All
	Small gastropods	Ma
	Larger gastropods and sea cucumbers	Ms, D
	Intertidal resources, accessible to and used by most households	All
Physical	*Protection of coast*	
	Reef affords varying degrees of protection against wave action	All
	Protection results in sand flats suitable for seaweed cultivation	Ms
	Source for lime	
	Coral burnt for lime production (not frequent)	All
	Building material	
	Large gastropod shells used for house construction	Ms, D
	Coral used for house construction	Ms
	Navigation	
	Reef provides key reference for position and fishing grounds	All
Financial	*Cash sales from fish*	
	Fishing contributes 34–38% of cash income (Ms, D), and 10% in Ma	All
	Cash sale from molluscs	
	Cash from sale of molluscs controlled partially by women (infrequent commercial use in other study villages)	D, (Ms)
	Cash sale from seaweed	
	Cash from sale of seaweed making significant contribution, controlled partially by women	Ms
	Source of 'foreign exchange'	
	Sea cucumber and opercula of large gastropod used as convertible currency for travellers and migrants to Tanzania	Ms, D
	Exchange	
	Dried fish exchanged at inland markets for food products and clothing	Ms. D
Human	*Protein from fish*	
	Fish supplies 19–24% of internally consumed household benefit	All
	Protein from intertidal mollusc resources	
	Important protein resource for those with no access to fish or animal proteins (female-headed households, etc.)	All
	Knowledge	
	Fishing valued as skill and knowledge	All
Social	*Traditional practices*	
	Some items originating from reef used in traditional cures	D (possibly others)
	Collaborative extraction	
	Women go to harvest intertidal resources together	All
	Women go to harvest seaweed together	Ms
	Status	
	Fishing considered a status activity, especially asset ownership	All
	Fishing provides a sense of identity	All

1 Ma, Maueia; D, Darumba; Ms, Messano.

Figure 15 Intertidal collection in Maueia.

TABLE 14 PERCEIVED CONTRIBUTION TO OVERALL HOUSEHOLD WELL-BEING

Contribution to overall household well-being (%)[2]	*Maueia*	*Darumba*	*Messano*
Fish	15	30[1]	30
Shells and octopus	10	14	9
Sea cucumber and deep water shells	0	3	3
Seaweed	0	0	16
Shrimp	0	10	0
Agriculture	39	26	26
Charcoal	13	0	0
Trading	2	0	8
Extended family	13	10	1
Artisan	8	0	6
Thatch cutting	0	8	4
Livestock	0	0	3

1 ~40% of fish catch in Darumba from river.
2 Refer to Annex 1 for explanation.

At Messano, protection provided by the reefs and offshore islands has resulted in shallow sand flats adjacent to the village, which are exploited for seaweed cultivation. Seaweed cultivation began only recently, established in 1999, and has currently produced a total of 78 tons of dry seaweed for export. This offers an important opportunity for the livelihoods of the Messano community, with 68% of all households engaged in seaweed cultivation and 17% of households considering it their primary or secondary activity.

The reef is also used as a source of lime for whitewash, made from gastropod shells (in Darumba and Messano) and from quarried coral rock (Maueia). This use is now infrequent with less than 5% of houses whitewashed with lime in Darumba and Maueia, and less than 10% of houses in Messano. Large gastropod shells (Darumba, Messano: 50% of households) and coral rubble (Messano: 65% of households) are also used as a building material for house construction (Figure 16).

Figure 16 Gastropod shells and coral rubble in house construction in Messano.

Finally, in all communities, the reef and sand bars provide key reference points in navigating and in locating fishing grounds. Apart from landmarks on shore, there is no alternative navigating aid but the reef and sand bars, thus all fishers depend on this benefit.

4.1.3 Financial resources

The reef and associated resources are important sources of cash income in all three communities (Table 15). In Maueia 10% of households derive their cash income from the sale of fish. For households not involved in charcoal-making (the main source of cash in Maueia), the contribution of fisheries products as a source of cash income is greater. In Darumba, an estimated 93% of households derive cash income from the sale of reef products. Dependence is particularly high for agricultural households, who face high risks associated with animal damage to crops. Similarly, in Messano an estimated 92% of households derive cash income from reef-based sources, with agricultural households heavily dependent due to low soil productivity. Fishing activities are also a source of cash used to pay for seasonal agricultural labour.

In Darumba and Messano, sea cucumbers and gastropod opercula (locally known as *Mbande*) are used as a source of convertible currency when travelling to Tanzania (Box 1). Although the number of households involved in this activity is few, their dependence on the benefit is high. Formerly a network of rural buying and processing posts existed for the export of sea cucumber. However, overexploitation of this resource led to its collapse in the mid 1990s.

Also in Darumba and Messano, dried fish is taken to local inland markets at Montepuez, where they are exchanged for other agricultural food products and clothing. In Messano, specialised traders undertake this exchange, rather than it being common to individual household strategies.

TABLE 15 ESTIMATED CONTRIBUTIONS TO HOUSEHOLD INCOME

Contribution to household income (%)	*Maueia*	*Darumba*	*Messano*
Fish	10	38[1]	34
Shells and octopus	6	7	6
Sea cucumber and deep water shells	0	6	4
Seaweed	0	0	25
Shrimp	0	18	0
Agriculture	18	0	0
Charcoal	29	0	0
Trading	5	0	12
Extended family	14	15	1
Artisan	19	0	9
Thatch cutting	0	16	6
Livestock	0	0	4

1 ~40% of fish catch in Darumba from river.

BOX 1 REEF RESOURCES AS A SOURCE OF FOREIGN EXCHANGE

'Here it can be difficult to get (Tanzanian) shillings and persons travelling to Tanzania often collect *Mbande* over a period before their journey. Little by little. When they have enough, maybe a carrier bag full or two, they take a *dau* or *ngongo* north and on arriving in *Msimbati*[1] there are people there who buy the Mbande for good money and you use the cash to pay for the the rest of your journey. Some say the price in Masasi is even higher.' **Messano**

1 A common port of desembarkation in Tanzania for trade and travellers from Mozambique, situated between the Rovuma River and Mtwara.

4.1.4 Human resources

Reef and intertidal resources provide an important source of food and protein in the diet of all three communities (Table 16). In Maueia, where the use of the marine resources is comparatively less, households expressed that fish and shells were needed 'to make a meal'. Here, mollusc collection guarantees some animal protein, even in the poorest of households and dependence on mollusc resources increases in those households without a fisher, i.e. female-headed households (18% of households) and poorer households with no main secondary activity apart from agriculture (36% of households). Likewise in the communities of Darumba and Messano, dependence on mollusc resources for protein increased in female-headed

TABLE 16 ESTIMATED CONTRIBUTION TO INTERNALLY CONSUMED BENEFIT

Contribution to internally consumed benefit (%)	*Maueia*	*Darumba*	*Messano*
Fish	19	24[1]	22
Shells and octopus	14	20	16
Sea cucumber and deep water shells	0	0	1
Shrimp	0	2	0
Agriculture	56	50	58
Extended family	11	5	1
Livestock	0	0	2

1 ~40% of fish catch in Darumba from river.

households (6% and 23% of households, respectively). In Messano, the primary use of fish is for food and only the excess is sold, providing an important source of cash to obtain other food stuffs during the low season for agriculture.

For those involved in fisheries activities, the associated skills in fishing and knowledge of fish species is a significant and valued human resource in all three communities. In Messano, seaweed cultivation has also become a source of knowledge and skills, particularly amongst the women, who are principally involved in this activity.

4.1.5 Social resources

Intertidal activities, including the collection of molluscs and seaweed cultivation, are typically undertaken collaboratively and mainly by women. These activities represent one of the few opportunities for women to engage in conversation with other women away from their houses and in the absence of men. Women from almost all households in Maueia and up to 70% of households in Darumba and Messano engage in mollusc collection, while 68% of households in Messano undertake seaweed cultivation.

Fishing activities are generally considered as a status activity for those households involved in all communities, with added status in Darumba and Messano if a household owns a fishing vessel (57 and 41% of households, respectively). In all communities, fishing activities were strongly associated with sense of identity amongst fishers. Even in Maueia where fishing may not be a primary 'earning' activity in a household, the fisher will participate more frequently in fishing than any of the other household activities. Thus fishing may be considered as the primary household activity and the household head will consider himself a fisher, rather than a farmer or charcoal burner, which in reality contribute more income (Box 2).

In all three study communities little evidence was encountered that the reef plays a role in traditional ceremonial practices, although there was some evidence that special ceremonies are undertaken to assure good results from fisheries activities. In Darumba, reef-related resources, such as sand and shells were used in traditional cures. This may have also been the case in other villages, although it was not divulged due to a lack of willingness to expose information on traditional practices outside the Muslim faith.

BOX 2 FISHERIES AS A SENSE OF IDENTITY

'The greatest contributor to my house is charcoal, although between us we spend more time on agriculture than any other activity. But I go fishing every day of the year weather permitting, even just for an hour or less to check my traps. I might be back home by 6 a.m., ready to go to the *machamba* or to cut wood for charcoal. You ask who I am? I am a fisherman, not a farmer or charcoal burner.' **Maueia**

4.2 DIRECT INFLUENCING FACTORS

Coral reef and associated coastal and marine resources are the focus of fisheries and environment-related policies, institutions, organisations and social relations. Directly and indirectly, therefore, the reef and associated resources give rise to structures and processes that can positively influence the lives of poor reef-dependent people. These positive influences are summarised in Table 17 and discussed in more detail in the following sections (4.2.1–4.2.4).

4.2.1 Policies

It is difficult to say that the reef makes a contribution to beneficial policy, except that reefs and reef resources are the focus of national and international attention and hence stimulate policy development. In general it is the reef and reef users who are the intended beneficiaries of such policies.

Thus, near-shore reef resources have been the focus of fisheries policies implemented through marine fisheries regulations, which have focused on safeguarding near-shore resources for the small-scale sector and ensuring sustainability of the fisheries. Regulations have included the protection of near-shore fisheries resources (up to 1 mile from the coast) for the artisanal fishers, thereby ensuring the reef resource is safeguarded from larger-scale commercial exploitation. Regulations also control minimum mesh sizes and prohibit coral mining in an attempt to prevent damage and ensure sustainability of the reef and fisheries resources. While the existence of a reasonable legislative framework for reef resources management clearly exists, with the limited representation of provincial institutions, implementation is difficult and thus the potential benefits derived are minimal.

A diversity of reef products offers opportunities for local communities to access high value export-orientated markets. These opportunities have been supported by policies promoting market development. For example, a variety of fish products, including reef fish and lobsters, have been the target of Africa Commercial, who run the cold store in Darumba and the icebox in Messano. This relatively recent development, has been supported indirectly by policies promoting high value fisheries products from the artisanal sector, and provides local secure high value markets for fish products. Similarly, the government through its provision of a monopoly licence to the seaweed buyer GENU

TABLE 17 A SUMMARY OF REEF BENEFITS TO DIRECT INFLUENCING FACTORS

Influencing factors	*Benefits from the reef*	*Village(s)*[1]
Policies	*Artisanal fisheries exclusive zone*	
	1 mile from coast reserved for artisanal fisheries. *Protects* artisanal fisheries (and reef resources)	All
	Habitat protection and recognition of national and global value	
	Quirimbas National Park in early stages of implementation	Ms, D
	Coral mining prohibited by law	All
	Minimum mesh sizes limited by law	All
	Policy to support higher value fishery products	
	Improving market development for higher value products	D, Ms
	Exclusive seaweed buyer	
	Government granted exclusive (monopoly) licence to GENU	Ms
	Community management	
	Increasing formal recognition of communities' role in resource management (not directly reef-related, but all coastal resources)	All
Institutions	*Marketing*	
	Local and hinterland markets for dried/roast fish	All
	Access to urban market for higher value products	Ma
	Access to tourism market for fish	Ma
	Local buyer of high value products (shrimp, lobster, fish)	Ms, D
	Major international buyer of seaweed with agent in village providing guaranteed market	Ms
	Credit	
	Credit from traders on basis of future production secures fishers livelihood	Ms, D
	Commercial circuits	
	Important commercial circuit: fish from coast to the inland, crops/clothing from inland to the coast	Ms, D
Organisations	*Village organisation*	
	Key person on village council responsible for all fisheries issues (not just reef-based)	Ma
	NGOs	
	Local NGO with very limited micro credit programme	D
Social relations	*Access*	
	Open and easy access to intertidal resources provides opportunities for all, especially important for women, but at the cost of over-exploitation	All

1 Ma, Maueia; D, Darumba; Ms, Messano.

BOX 3 QUIRIMBAS NATIONAL PARK

'We don't have any problem with the (Quirimbas) park. Some people came here to talk about it and from what we understand it will not affect us directly. They spoke of areas outside of our normal fishing grounds. If what they promise is true, the park will make things better for us. Lets see.' **Darumba**

'What park? We were not consulted here . . . You say they will try to reduce incoming migrants, that might be a good idea, but how will they manage?' **Messano**

has promoted a guaranteed market and price for seaweed. At Messano, the shallow intertidal waters sheltered by the reef, have permitted seaweed cultivation, which has brought considerable benefits to seaweed producers.

Reef diversity is also the focus of international and national concerns for reef conservation, which have driven policies promoting habitat protection, recently resulting in the establishment of the Quirimbas National Park with support from the World Wide Fund for Nature (WWF). Among the nearby communities of Darumba and Messano, there are currently mixed opinions of the value of the national park (Box 3). The aims of the national park are to promote rational usage and exclusion zones. Benefits to local communities will depend on their participation in decision-making and will likely be mixed with some costs associated with the closure of fishing grounds. However, with the increasing recognition of communities' role in fisheries resource and coastal management there is greater potential for the incorporation of local needs and aspirations in future management.

4.2.2 Institutions

In general there appears to be an almost total absence of effective provincial institutions at the village level and even at a provincial level there are few institutions with any impact on reef resources. However, the reef and near-shore resources and the small-scale fisheries they support are the source of a range of different markets which are key local institutions, providing, as described above (Section 4.1.3), sources of cash income or mechanisms for exchange with inland communities. All three study communities market dried or roasted fish locally or in the hinterland and in Darumba and Messano the exchange of dried fish with inland communities is an important commercial circuit moving fish inland and agricultural crops and clothing to the coast. In Maueia, high value fish products can access nearby market outlets in the urban centre of Pemba and tourist hotels, which locals can access by cycle or via traders. As mentioned in the previous section (Section 4.2.1), high value fish products and seaweed also support the presence of Africa Commercial in Darumba and Messano, and GENU in Messano, which offer fixed prices ($0.42/kg of first grade fish and $0.13/kg of dried seaweed) and provide an important source of cash sales. In Messano and Darumba local fish traders are also a source of credit, providing access to fishing gear and subsistence during low fishing periods in return for tied production. This arrangement is most prevalent amongst fishers who own gear (i.e. 41% of households in Darumba and 62% of households in Messano) and dependence is likely to be more significant amongst poorer fishers.

4.2.3 Organisation

Like village-level institutions, there is an almost total absence of village organisations, however, the reef and near-shore resources and associated fisheries were found to be the focus of two local organisations, concerned firstly, with local management of the fishery, and secondly with the welfare of the local fishers.

The first, in Maueia, comprises the key person or 'head fisher' on the village council, who is responsible for all fisheries issues, including: ordering and collecting fishing gear from Pemba, and identifying and informing others of fishing zones. An estimated 20% of fishers rely on the 'head fisher' in Maueia to assist in obtaining fishing gear. The second relevant organisation was in Darumba and comprised the local NGO Amoder, who supports the local fishing community through a limited micro credit scheme, which began in 1997.

4.2.4 Social relations

The accessibility of the intertidal resources provides opportunities for all members of the community to participate in harvest, including women, the young and elderly. As described in earlier sections, mollusc and octopus resources can be collected directly on foot from the intertidal reef flat and sand bars (Darumba and Messano) and the coralline rock plateau (Maueia). In Messano, the shallow sand bars protected by the reefs are also accessible for seaweed cultivation. These activities are particularly important to women, as well as other disadvantaged groups, providing food and cash security for those lacking in other resources or those lacking a main provider. Women from over 65% of households in all three study communities are involved in intertidal mollusc collection and in Messano in seaweed cultivation (Figure 17). Excess mollusc harvest and seaweed harvest provide opportunities for women to generate cash, giving them some level control over the household's income, although this is not guaranteed as some women hand over cash revenues to their husbands.

Figure 17 Women harvesting seaweed at Messano.

4.3 INDIRECT INFLUENCING FACTORS

The contribution of the reef and reef resources to the communities' ability to cope with the risks or opportunities associated with the background factors of seasonality, shocks and trends is summarised in Table 18 below and described in the following sections (4.3.1–4.3.3).

4.3.1 Seasonality

In general, the three study villages are characterised by high seasonality of contributions to livelihoods, influenced by the seasonality of fishing, as well as other livelihood activities, particularly agriculture and also charcoal burning in Maueia. However, this seasonality is partly overcome through the complementarity of some contributions and the stability of others.

In all three villages fishing and intertidal collection provide key sources of food and cash when agriculture production is low and when charcoal production is low in Maueia. Critically, the peak in fisheries production coincides with the period of lowest agricultural stocks, enabling purchase of shortfalls. In Messano,

TABLE 18 A SUMMARY OF REEF BENEFITS TOWARDS COPING WITH INDIRECT INFLUENCING FACTORS

Influencing factors	*Benefits from the reef*	*Village(s)*[1]
Seasonality	*Complementarity with other activities*	
	Both fishing and intertidal collection important activities when agriculture is low	All
	High fish production coincides with period of lowest agricultural stocks	All
	Also complementary with low in charcoal production	Ma
	Agriculture and fisheries as complementary activities, undertaken in parallel or sequentially in a single day	D, Ma
	Constancy	
	Both capture fisheries, and mollusc collection support livelihoods all year round (with variability, but less so with molluscs)	All
	Seaweed culture possible all year round with little variability	Ms
Shocks	*Ability to cushion shocks*	
	Intertidal resources important fallback for female-headed or decapitalised households	All
	Seaweed culture also important fallback for female headed or decapitalised households	Ms
	Fisheries, gastropod, cephalopod and seaweed production not drastically affected by drought (major common vulnerability)	All
	Fallback position when agriculture decimated by wild animals	D
Trends	*Opportunities for cash income*	
	Fish serves as a source of cash to support primary needs	All
	Local markets for higher value products improving, responding (partially) to reef resources	All
	Ability to absorb changes in other markets	
	Contraction of sea cucumber market compensated for by increased fishing pressure and seaweed culture (Ms only)	Ms, D

1 Ma, Maueia; D, Darumba; Ms, Messano.

it was also noticed that more than 90% of households involved in fisheries, seaweed cultivation or trading benefited from trading activities which followed and compensated fishery and agricultural cycles, satisfying household deficiencies for food (pre-agricultural harvest) and clothing (post-agricultural harvest). On a daily cycle in Darumba and Messano, there is also complementarity between agricultural and fisheries activities, allowing them to be undertaken in parallel or sequentially throughout the day without conflict of time or resources.

Despite a certain seasonality, fishing activities can be carried out throughout the year, with intertidal collection providing a crucial fallback when fisheries are low. In Messano, periodic declines in fishery production, due to weather patterns, is also offset by seaweed cultivation activities, which provide a constant supply of cash throughout the year. Thus, as a whole the relative constancy of near-shore marine resources provide stability to livelihoods, offsetting the extreme variability in agriculture production.

4.3.2 Shocks

The constancy of near-shore marine resources, combined with their accessibility provide key safety nets cushioning shocks to people's livelihoods. In this way intertidal resources, including seaweed culture are vital to the livelihoods of widows, decapitalised households, including female-headed households, and households lacking labour for agriculture. They also support those families abandoned by migration, who become effectively temporarily female-headed and depend on the intertidal resources for protein consumption.

The periodically serious impact of drought on agricultural production is also cushioned by local marine resources. Fisheries, mollusc, octopus and seaweed culture resources are unaffected by drought and so provide a critical food supply and sources of income to buy other basic food stuffs. This safety net has been exploited twice in the last 27 years in Messano and three times in the last 26 years in Maueia.

In Darumba, there is also a high threat of invasion of elephants, warthogs and monkeys which can decimate crops to 5% of the normal level. Almost all the households in Darumba have some involvement in agriculture, thus the safety net provided by the fisheries resources is extensive, as well as crucial, in overcoming this loss and providing an alternative source of food and income (Box 4).

4.3.3 Trends

Reef and near-shore resources are the principal source of cash income in nearly all households in Messano and Darumba and in 10% of households in Maueia. In their role in generating income, therefore, reef resources have been important in providing opportunities for increasing commercialisation of livelihoods.

The productivity and diversity of the reef resource also provides opportunities for market diversification and significantly options of high value products. This has enabled reef users to benefit both from existing local markets and from the trend in development of markets for higher value products, and has been apparent in all three study villages to varying extents. This diversity also provides stability with different market outlets offsetting price fluctuations in any single market. Thus, with the decline of markets, such as the sea cucumber market in the mid-1990s, the diversity and productivity of the reef resource compensated the loss, by allowing fishers to shift to other options.

In Messano, the diversified livelihoods and markets are highly interrelated and dependent, with cash from fisheries and seaweed used to purchase basic goods and pay for agricultural labour. Indeed, in Messano, the role of seaweed culture in cash earning is becoming progressively more important, which not only represents an apparently secure and constant source of income, but also the cash earned is partially controlled by women (Box 5).

BOX 4 REEF RESOURCES AS AN ALTERNATIVE TO AGRICULTURE

'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'. **Darumba**

BOX 5 OPPORTUNITIES OF SEAWEED CULTIVATION

'Before the seaweed company came, our husbands paid for everything at home. Sometimes they gave us some *capulanas* or other clothing, but these days, through seaweed culture, we have some money of our own and we contribute to the household, especially when it comes to paying for the cost of education and medicines. Although some women are allowed by their husbands to keep all the money from seaweed selling, and others hand all of it over (to their husbands)'. **Messano**

5 CHANGE, CAUSES AND CONSEQUENCES

Livelihoods are dynamic and are constantly changing in response to direct and indirect influencing factors, which impact upon the strategies households are able to adopt and the ultimate outcomes of those strategies. The most significant changes, causes and consequences that have affected livelihoods in the study villages are summarised in Table 19. In the absence of any other indication, the information is common to all study villages.

Major changes to reef-based livelihoods amongst the study communities fall into three main categories: natural resource status; fisheries; and conservation.

5.1 STATUS OF NATURAL RESOURCES

Changes in the status of natural resources have been characterised by the decline and degradation of resources. Together with natural impacts (e.g. El Niño, Crown-of-Thorns starfish), open access, increasing local fishing pressure and, in the case of the declining sea cucumber resource, high market demand and availability of SCUBA technology, have led to declines in intertidal mollusc and reef resources. As resources have become more scarce efforts to exploit them or alternative resources have increased, leading to further pressure on the existing resources and deteriorating household food security. Where viable alternatives exist, such as the seaweed cultivation at Messano, dependence on the declining intertidal mollusc resources has dropped as households have shifted to seaweed and improved their financial and food security. Migration out of the communities in response to changes in natural resource status is a possibility, although evidence suggested that participation was low, with greater 'in-migration' to the Quirimbas area from distant communities, possibly motivated by resource depletion at distant sites.

It should be noted here, that despite the generally perceived depletion of near-shore intertidal and sea cucumber resources in all three villages, reef fisheries are perceived locally to be in good condition and have only been documented otherwise in reports.

5.2 FISHERIES

Changes in the fisheries have been associated with the development of markets, as well as deteriorating access to fishing gear. Market development, as mentioned in earlier sections, has targeted high value fish, for export and local tourism markets. With expanding commercialisation financial security of households has increased, and fish is sold fresh rather than dried (Darumba, Messano). However, this may be at the cost of reduced food security, with cash being spent on non-food expenditures. Food and income security are also threatened by the deteriorating access to fishing gear, brought about by rising local prices and consequent worsening terms of trade between fish and fishing gear, as well as the lack of availability of fishing gear locally. This has resulted in increased use of locally made gear and increased pressure on sea cucumber or intertidal resource collection, with consequences for resource status as mentioned above.

5.3 CONSERVATION

In recognition of a perceived decline in pelagic and demersal resources (not encountered as a local perception amongst study communities), as well as the potential for ecotourism focused on coral reefs and coastal resources, there has been an emergence of efforts to conserve and manage the marine resource, manifested in the establishment of the Quirimbas National Park (approved by Parliament in 2002). While implementation of the national park has yet to take place, the potential impact for local communities is largely anticipated as a positive one, through improved community participation in resource management and improved resource status. Potential costs to local communities include possible restrictions on fishery activities and so livelihoods, however, if well planned these could be avoided or compensated for.

It is worth noting how much international issues and forces have started to influence livelihoods in the study area, in spite of its apparent remoteness. Almost all of the positive market developments are attributable to growing international linkages, even seaweed culture which is a direct result of the creation of a local market by an international seaweed processor. The Quirimbas National Park has had international support and aims to benefit from foreign investment and tourism. Changes in the terms of trade between fish and fishing gear is linked to the performance of the Mozambican economy as a whole relative to foreign markets.

TABLE 19 A SUMMARY OF KEY CHANGES IN REEF-DERIVED LIVELIHOODS, CONTRIBUTING FACTORS AND IMPACTS IN NORTHERN MOZAMBIQUE

Changes in reef-derived livelihood [1,2]	*Contributing factors*	*Impacts on strategies and outcomes*
Decline in intertidal mollusc resources	• Open access • Easy equitable access • Variability of agriculture (especially D), variability of rains, poor soils (Ms).	• More labour invested in collection • Adoption of alternatives, especially seaweed culture (Ms) • Deterioration in household food security
Decline in sea cucumber resources (Ms, D)	• Open access • Strong local market (destined for export) • Use of higher technology (SCUBA)	• More labour invested in collection • Targeting of alternative resources • Possible migration in search of other resources
Contraction of local sea cucumber market (Ms, D)	• Improved control of foreign investors • Declining resource	• Re-adoption of 'traditional' sea cucumber market (via Tanzania) • Targeting of alternative resources and increased fishing pressure
Development of local higher value fish market	• Growing accessible tourist market (Ma) • Improved links with international markets (Ms, D) • Devaluation and inflation has improved terms of trade of export business (Ms, D)	• Change of marketing strategy, taking fish to higher market personally (Ma), selling fresh rather than dried (Ms, D) • Increased financial (and indirectly food) security • Possibly reduced food security (cash spend on non-food expenditure)
Degradation of reef resources[3] (Ms, D)	• Increasing local fishing pressure (more fishers) • In-migrants • El Niño • Crown-of-Thorns starfish	• Reduced food security • Reduced financial security • Increased migration possible
Development of seaweed culture and market (Ms)	• Coastal physical geography and climate • Policy environment	• Improved financial (and indirectly food) security • Reduced dependence on collected intertidal resources
Decline in use of reef-derived limestone whitewash	• Unknown, possibly legislation, possibly changes in disposable income and priorities	• Unknown
Deteriorating terms of trade between fish and fishing gear, also non-availability locally of gear	• Devaluation and inflation has resulted in rising local prices	• More emphasis on fishing with locally made gear (traps), sea cucumber or collection of the intertidal resources • Worsening food and financial security
Implementation of Quirimbas National Park (Ms, D)	• Perceived decline in pelagic and demersal resources • Opportunities in tourism which may be harnessed through the park for the benefit of resources (and those dependent on them), individual investors and local communities	• As yet unknown as implementation has not yet started. Anticipated impact: – Improved resources and improved financial and food security for most fishers – Restricted fisheries (and livelihoods) for some fishers – Reduced in-migration – More local community involvement in resource management

1 Note: Where no reference to location is made, issue applies to all study villages.
2 Ma, Maueia; Ms, Messano; D, Darumba
3 Reported in texts, not reported by study villages.

6 SUMMARY AND CONCLUSIONS

Mozambique possesses the third largest extent of coral reefs in Eastern Africa and according to the UNDP Human Development Report (2002) is the sixth poorest country in the world. A large proportion of its coral reefs are found fringing the coast and offshore coralline islands in the northern province of Cabo Delgado, which was the focus of this study. Cabo Delgado, on the border of Tanzania, is one of the poorest provinces in Mozambique and one of the more isolated. The population of the province is relatively small and population density is low, with around 40–60% living within 150 km of the coast. The impacts of the civil war and associated social and economic turmoil disrupted services for many years, and infrastructure and service delivery remain poorly developed. Standards of health and education are severely low, with the lack of sanitation contributing to frequent outbreaks of disease. Government support is also weak, with an almost total lack of government institutions at the village level. Similarly, community organisation and politicisation are low and organisations operating at the village level are extremely rare.

For the people of the coastal villages studied in Cabo Delgado, livelihoods are entirely based on the surrounding natural resources. Livelihood diversification is extremely high, both within households and within communities, and are greatest amongst communities with poor agricultural resources. This diversity represents the principal mechanism to cope and survive, reducing risks through multiple options for choice and as safety nets in times of hardship. Agriculture in many places is poor, prone to drought, cyclones, disease and the risk of animal invasions, which can totally decimate crops.

For all communities the reef and near-shore resources play a fundamental role in livelihoods, sheltering homes and property and in some areas providing a protected environment for seaweed cultivation. These resources provide a source of food, income and materials for construction or lime for white washing. The diversity of reef resources is a source of considerable knowledge and skills in methods of extraction. Near-shore fishing is in most communities considered a status activity and is an important source of identity, something which was observed even in communities where fishing was not the primary livelihood option, and in households where fishing was not the primary source of income. The 'ever presence' of the intertidal reef and near-shore resources provides an important sense of security and peace of mind for coastal communities. The open access nature of intertidal resources is easily accessed by all groups, requiring no entry investment or status, and so particularly benefits disadvantaged households. For women or female-headed households this accessibility provides an opportunity to access the reef by foot and harvest shallow mollusc resources, which contribute significantly to household food security.

Within the diverse livelihood systems of the coastal communities, the reef and near-shore fisheries provide keystone resources during lows in agriculture, and vital safety nets in the face of extreme hardships, such as drought, or animal invasion. For households who have lost their main provider, such as female-headed households, and for those without sufficient capital to enter into fishing, or without sufficient labour to meet subsistence needs through agriculture, the accessible shallow intertidal reef resources provide a crucial role in securing livelihoods. The dependency on shallow intertidal resources was observed even in the predominantly agricultural community of Maueia, where the overall contribution of fisheries to livelihoods was significantly lower, but where intertidal resources (small gastropods) play an important seasonal role in household consumption.

The high dependence on the intertidal resources is, however, at the cost of uncontrolled exploitation and degradation of resources. Indeed, with easy access to intertidal resources, even the low technology and largely subsistence mollusc collection has resulted in depletion of the local resource. The lucrative demands of export markets for reef species have also taken their toll on the resources, with heavy exploitation of sea cucumber, for example, leading to the collapse of this fishery. Reefs have also been impacted by the coral bleaching event in 1998 (associated with global warming and increases in sea surface temperatures), as well as outbreaks of Crown-of-Thorns starfish. However, in general there are relatively few externalities impacting the reefs and near-shore resources in Northern Mozambique, especially when compared to other more industrialised coastal areas of the world. And even despite the existing impacts, local communities generally perceive the reef fishery to be in good condition.

Nevertheless, when current changes are viewed in the context of population growth and global warming, the impacts on the near-shore resource base and in particular the intertidal resource has potentially significant implications for the future livelihoods of the coastal communities. Opportunities in seaweed cultivation have provided an important alternative and reduced some pressure from the intertidal resources, as well as bringing increased income security to many households. However, this may not necessarily

translate into increased food security and may increase risk through specialisation in the longer term. The establishment of the nearby Quirimbas National Park also holds potential to diversify livelihoods through eco-tourism, and provides opportunities to increase local participation in resource management. However, it may also potentially increase costs to local communities through possible restrictions on fisheries activities, though with proper planning and collaboration with local communities this can be avoided or compensated for.

In an area of such high poverty, it is important to understand reef related issues in the wider livelihood framework. In other words, to understand the isolation of these communities from policy implementation, the absence of local organisations, the poor infrastructure and education, and the extreme vulnerabilities which people face, associated with health and agriculture prone to drought, disease and animal invasion. Without addressing this wider context, there is the real risk that the communities may be incapable of responding to the opportunities and incentives emerging through other intervention or development processes specifically targeting a single sector or concern such as the coral reefs.

7 REFERENCES AND NOTES

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NOTES

1 The survey covered 136 fishing centres with no extrapolation for centres not included.

ANNEX 1 VARIATIONS TO FIELD METHODOLOGIES

The field methodology specified in the guidelines for the study (IMM and SPEECH, 2002) was followed as closely as was appropriate and possible within time and human constraints. On some occasions variations were made to the field methodology in an attempt to improve data capture or modify the methodology to suit local conditions. This annex outlines the major differences in applied methodology.

1 VILLAGE SELECTION

Village selection was made by the study team with the assistance of provincial officers from the IDPPE whilst in Pemba prior to the start of the field work. The key selection criteria proved to be village size, in an attempt to follow the specified guidelines – small villages of 50–70 households are extremely rare (as a result of villagisation policies), and it is very much more common to find villages of 1000 or more households. Note that community leaders were not part of the selection exercise. As the idea of the exercise was to illustrate coastal livelihoods rather than make a structured sample, this shortcut was considered to be acceptable.

2 HOUSEHOLD SURVEY/MAPPING

The village mapping exercise was facilitated by the use of pre-made household cards (Figure 18), one being filled out for each household mapped. Data covered population, house type, activities (primary and secondary were recorded) and productive and animal assets. It should be noted that the recording of more than just the primary activity made the overlapping livelihood activity unnecessary as these data had already been collected in the mapping exercise.

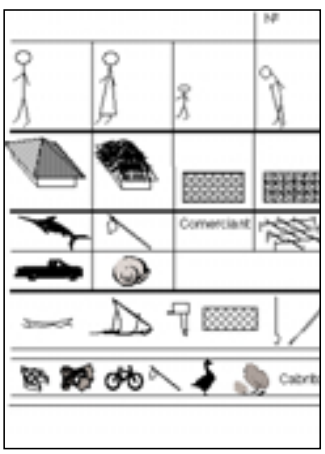

Figure 18 Pre-made household cards.

In the first village (Maueia) all households were included on the village mapping, but with over 100 households this proved to be very time consuming. In Darumba and Messano only a sample of houses was mapped. The sample size in these villages was restricted to 50–60 houses (approximating to the sample size specified in the guidelines), and houses chosen by taking the total number of houses in the village (information supplied by village head), dividing this by 60 and using the result as a sampling interval (calculated as three for Darumba and four for Messano). The whole village was then walked with the local team member (physically passing in front of every house) and a card filled in for each third (Darumba) or fourth (Messano) house. This proved to be a very successful sampling technique.

Village data, if not presented in percentage form in this report, has been scaled up on the basis of information obtained from the sampled houses.

3 INDIVIDUAL HOUSEHOLD INTERVIEWS AND BENEFIT

Interviews with individual households were not focused around semi-structured interviews as suggested in the guidelines, but instead a 'semi-quantitative' exercise was developed. Around this exercise conversations often developed, but it was found to be a quick and effective way to obtain a great deal of key information.

The exercise had two parts, one looking at household 'benefit' and the other at 'expenditure'. Both used similar principles. The interviewee(s) was asked what activities *contributed to household well-being* and each activity mentioned was represented pictorially on a small square of paper placed on the ground. On completion of the list (usually between three and six sources of benefit were mentioned) the interviewee was given a pile of 50 or so matches and asked to distribute the matches between the paper squares in keeping with the contribution that each activity made to the household – the greater the contribution, the more matches. Often not all the matches were distributed and sometimes more matches were requested.

On completion of the distribution the matches placed on each activity were counted and percentages calculated of total contribution to benefit. Note that whether the interviewee chose to distribute 100 or 25 matches made no difference to the result – what was important was the relative importance of each activity (Figure 19).

Figure 19 Benefit and expenditure data collection.

It was important to realise (revealed through on-going conversations about why matches had been distributed in a particular way) that the contribution valuation contained more than just food and cash benefits – interviewees put more emphasis on those activities that were dependable and could be relied upon to sustain the family no matter what may.

Estimates of cash and non-cash benefit (presented in Tables 15 and 16) were made on the basis of the 'total' benefit data, divided using either commonsense (clearly bucket-making brings cash rather than food benefits, whilst agriculture can bring both) or on the basis of conversations with interviewees.

At the start of the second part of the exercise the interviewee was asked *what are the principle expenses in the household* and again each was represented on a paper square. Again matches were distributed in keeping with the significance of each expense item. In the end, the expenses data set was little used in the writing of this report.

The analysis of data from both the above exercises and the household mapping was greatly facilitated by the use of a small database, linked to spreadsheet pivot tables. Data were entered daily into the database and could be checked immediately and data verified before leaving the village.

4 VENN DIAGRAM

The Venn diagram exercise was not successfully carried out in any of the villages, attributed to the extremely low level of local organisation. Participants simply had little or nothing to express. In the end it was abandoned and replaced by a semi-structured interview with the village headman.

5 STUDY TEAM COMPOSITION

The field team was made up of only four people, namely

James Wilson, (economist, team leader); Paulo Muchave, (sociologist); Amade Garrett, (officer, IDPPE Pemba); Salimo Adamuge, (driver and logistics).

Only the first three people participated in the field exercise, but the driver/logistics was an essential practical support to successful day-to-day operation. In each village one person from that community was integrated into the team to assist with introductions, language, clarifications, etc. It was apparent that such a small team has the advantage of being less conspicuous, but at times data coverage was limited by time and the fact that the team was not easily subdivided. An additional disadvantage was that all members of the team were under constant pressure.

ANNEX 2 DIVERSITY OF NATURAL RESOURCES EXPLOITED FROM REEF AND NEAR-SHORE COASTAL ECOSYSTEMS

	Maueia	*Darumba*	*Messano*
Fish	*Lutjanidae* *Lethrinidae* *Carangidae* *Balistidae* *Scombridae* *Serranidae* *Scaridae* *Mullidae* *Caesionidae* *Sharks*	*Belonidae* *Hemiramphidae* *Acanthuridae* *Leiognathidae* *Mullidae* *Scaridae* *Lutjanidae* *Caesionidae* *Balistidae* *Sphyraenidae* *Lethrinidae*	*Lutjanidae* *Carangidae* *Sharks* *Serranidae* *Siganidae* *Scombridae (Scomber)* *Lethrinidae* *Scaridae* *Mullidae* *Acanthuridae* *Scorpaenidae* *Zeidae* *Muraenidae* *Dasyatidae* *Pomacanthidae* *Chaetodontidae* *Sphyraenidae* *Scombridae (Thunnus)* *Haemulidae* *Gerreidae* *Labridae*
Molluscs	*Gastropods:* *Neritidae (undata, textilis)*	*Bivalves:* *Sand Oysters (Pteriidae)* *Arcidae (Barbatia decussata, Anadara)* *Gastropods:* *Muricidae (C. ramosus)* *Fasciolaridae (P. trapezium)*	*Bivalves:* *Pteriidae (Pinctada)* *Arcidae (Barbatia decussata, Anadara)* *Gastropods:* *Muricidae (C. ramosus)* *Fasciolaridae (P. trapezium)*
Cephalopods	*Octopus*	*Octopus* *Squid*	*Octopus*
Crustaceans	*Lobsters*	*Lobsters:* *Palinuridae (P. ornatus, P. versicolor)*	*Lobsters:* *Palinuridae (P. ornatus, P. versicolor)*
Echinoderms		*Sea Cucumbers:* *Holothuriidae*	*Sea Cucumbers:* *Holothuriidae*
Macroalgae			*Seaweed:* *Euchema Spinosa*

A Case Study from the Gulf of Mannar

S. Rengasamy

John Devavaram

Rajendra Prasad

Erskine Arunodaya

ACKNOWLEDGMENTS

Thanks are due to all the staff at SPEECH and their counterpart, TRRM, in the coastal villages of Gulf of Mannar, who facilitated fieldwork and enriched our knowledge through their depth of experience in the field and understanding of the local perspective.

Local participants in all three villages spent much of their valuable time in contributing to the information contained in this study. We thank them and hope that the discussions and knowledge they shared will benefit their work with TRRM and potential future work with programmes concerned for the coral reefs and sustainable development of the Gulf of Mannar region.

All photos in Study 2 were supplied by Emma Whittingham, IMM Ltd.

NOMENCLATURE

ACRONYMS

GoEF	Department of Environment and Forests, Government of India
GOMMBR	Gulf of Mannar Marine Biosphere Reserve
GCRMN	Global Coral Reef Monitoring Network
ICRMN	Indian Coral Reef Monitoring Network
IUCN	International Union for the Conservation of Nature
NGO	Non-Governmental Organisation
SPEECH	Society for People's Education and Economic Change
WWF	World Wide Fund for Nature

LOCAL TERMINOLOGY

Rs Indian Rupee (exchange rate ~47Rs: 1US$)

Types of houses

Pucca	Concrete house – roof and walls
Tiled	Brick walls, tiled roof
Thatched	Mud walls, coconut/palm leaf roof

Types of boats

Country boats	Mechanised and non-mechanised local wooden boats used in small-scale fishery
Vathai	Small wooden non-mechanised country boats with sail and oars for rowing. Used by 2–3 people
Vallam	Small wooden mechanised country boats with outboard diesel engine and often larger than *Vathai*. Used by 6–10 people
Karavalai Thoni	Small wooden canoe, used for short distances and with shore net
Launches	Large commercial trawlers

Types of fishing gear	*Description*	*Notes*
Crab net	Specific for crab Used between islands and shore over seagrass Operated from country boats (mechanised and non-mechanised)	On loan from traders with sale agreement for catch Up to ~10 nets may be deployed from one boat ~3 people operate from non-mechanised country boat ~10 people operate from mechanised country boat
Disco net	Varying mesh size Unspecific Often made up of old pieces of net	Owned by local low income vulnerable families. Sale of catch not tied to trader but at choice of fisher
Cast net	Hand operated net Used in shallow water around islands and from shore Thrown over schools of fish	Owned by local low income vulnerable families. Opportunistic use Sale of catch not tied to trader but at choice of fisher
Squid hook and line	Line with specific squid hook Operated from any boat in area between island and shore	Owned by individuals Low expense Often used in conjunction with crab nets Sale of catch linked to trader
Shore net	Larger mesh on sides Small mesh at end Unspecific Operated from shore over deep water	Owned by individual in community Operated by ~40 or more Labour on shore waged Owner and assistants in boat share catch Excess small fish distributed
Seaweed scraping tool	Metal hoe type tool Used to scrape seaweed from reef	Owned by individual users Local regulation to stop its use and return to hand picking seaweed.

BACKGROUND TO THE GULF OF MANNAR CASE STUDY

The Gulf of Mannar case study was carried out in partnership with SPEECH, following consultation with the Indian Coral Reef Monitoring Network (ICRMN). This was the first RLA case study and focused on developing and piloting participatory assessment methods for application in other case study locations. The methodology designed is outlined in brief in Annex 1 and in more detail in IMM and SPEECH (2002). The main work was undertaken over a period of 6 weeks beginning in March 2002. A half-day validation workshop was held by SPEECH in mid-April 2002 with local village participants and representatives from relevant local government departments (Fisheries and Forests) and research institutions.

The following case study report provides an overview of reef-based livelihoods in the Gulf of Mannar, focusing on three village communities in the Ramanathapuram district on the eastern side of the Gulf. The first two sections of the report give a contextual overview of the study area and study communities, outlining key social, ecological, economic and administrative characteristics of the area and local livelihood systems. Section 3 discusses the features of poverty in the study communities, identifying what characteristics locally define poor households and estimating the extent of poverty existing in the communities. Benefits arising from the reef resources to all aspects of the livelihoods of the poorer members of the communities are described in Section 4, entitled Reef Livelihoods. Section 5 outlines how reef-derived livelihoods have changed and discusses the causes of these changes and impacts on poor people's livelihoods. Finally, concluding remarks are made in Section 6, summarising the key aspects of the benefits of reef resources to the livelihoods of poor households and how these have responded to change.

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1 STUDY AREA CONTEXT

The area considered for study was the eastern region of the Gulf of Mannar located on the south east border of Tamil Nadu, India's southern most maritime state (Figure 1). The three study villages: Indiranagar; Idinthakalpudur; and Thavukadu, are located on the eastern shores of the Gulf of Mannar in the district of Ramanathapuram (Figure 2, page 123).

1.1 SOCIAL SETTING

According to the 2001 census, Tamil Nadu ranks as the sixth largest state in India, with a population of over 62 million and a population density 48% greater than the national average. 4.4% of the state's population live in the coastal districts of Ramanathapuram and Toothukkudi bordering the Gulf of

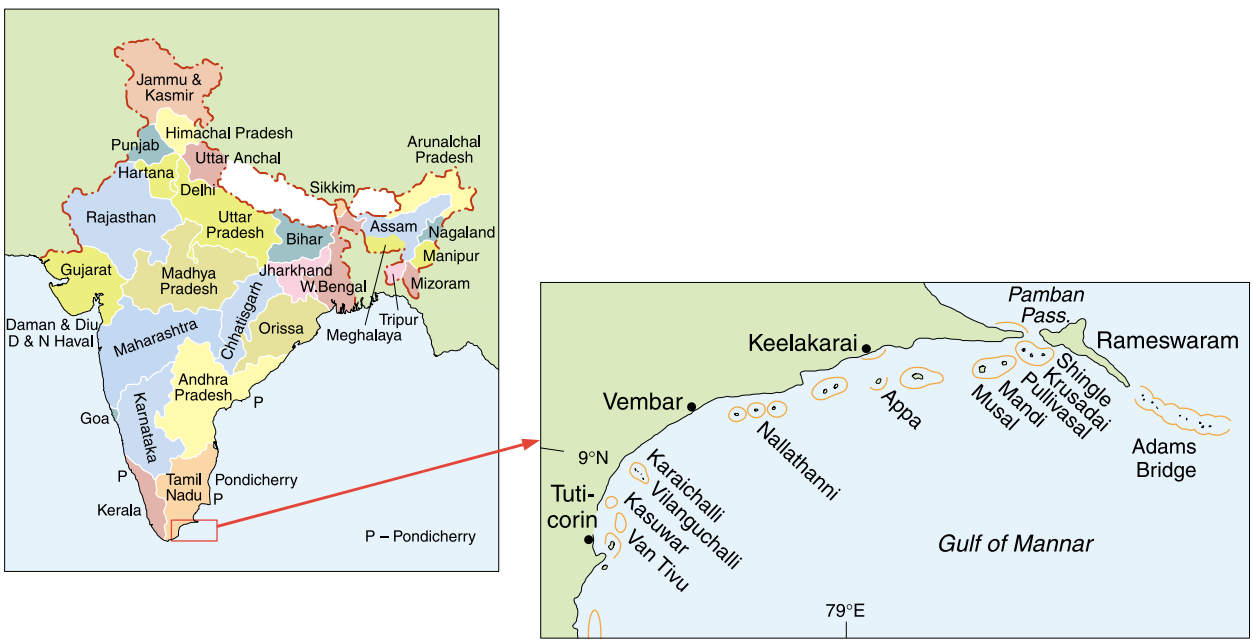

Figure 1 Location of study area.

Source: India map: National Informatics Centre, Government of Tamil Nadu website: http://tnmaps.tn.nic.in/
Gulf of Mannar map: ICRMN website http://envfor.nic.in/icrmn/icrmn.html

Mannar, where population densities are respectively 11% less and 4.6% greater than the national average (Table 1).

The literacy rate for Tamil Nadu and the two coastal districts is generally high and above the national average. As a whole the state's literacy rate has increased by 11% since the last census in 1991. This may be attributed to an increase in the number of primary and secondary educational establishments and students in the state. Government school education is also free and poor students are eligible to get free uniforms, books and a free lunch.

Life expectancy at birth for Tamil Nadu is slightly greater than the national average, while the infant mortality rate for the state remains the same as the 1991 census (Table 2), with a higher rate of 59 in rural areas compared with 40 in urban areas. Medical facilities are available in 37.5 and 41.8% of villages in Ramanathapuram and Toothukkudi districts, respectively.

The Tamil Nadu population is made up predominantly of Hindus, who comprise 89% of the population, followed by small proportions of Muslims and Christians (5 and 6%, respectively) and even smaller numbers of Jains and Sikhs. Among the coastal districts of the Gulf of Mannar the picture is only slightly changed, with 79% Hindus, followed by 12% Christians and 9% Muslims. Caste groupings within the districts are as described in Table 3.

TABLE 1 DEMOGRAPHIC STATISTICS FOR INDIA, TAMIL NADU AND COASTAL DISTRICTS

Statistic	*India*	*Tamil Nadu*	*Ramanathapuram*	*Toothukkudi*
Population[1]	1 027 015 247	62 110 839	1 183 321	1 565 743
Male	531 277 078	31 268 654	582 068	764 087
Female	495 738 169	30 842 185	601 253	801 656
Decadal growth rate[1] (1991–2001)	21.34	11.19	5.73	7.54
Population age[1]				
0–6years	157 863 145	6 817 669	141 809	173 580
Population distribution[1]				
Urban	285 354 954	27 241 553	299 813	661 932
Rural	741 660 293	34 869 286	883 508	903 811
Population density[1] (ps/km^2)	324	478	287	339
Per household[2]			4.69	4.35
Total dependency ratio	0.79[3]	0.62[3]	0.76[2]	0.75[2]

1 Census of India, 2001
2 (NCAER, 2001) Toothukkudi value combined with neighbouring district of Tirunelveli
3 Census of India, 1991

TABLE 2 SOCIAL DEVELOPMENT STATISTICS FOR INDIA, TAMIL NADU AND COASTAL DISTRICTS

Statistic	*India*	*Tamil Nadu*	*Ramanathapuram*	*Toothukkudi*
Literacy rate[1]	65.38	73.47	73.05	81.96
Male	75.96	82.33	82.96	88.66
Female	54.28	64.55	63.55	75.64
Sanitation (% households)[2]				
Houses with safe drinking	62.3	67.4		
Houses with toilet	23.7	23.1		
Life expectancy[3]				
Male	62.80	64.85		
Female	64.20	65.20		
Infant mortality rate[4]	72	53		

1 Census of India, 2001
2 Census of India, 1991
3 Director of Census Operations, Chennai (1996–2001)
4 Department of Public Heath and Preventative Medicine, Chennai (1998)

TABLE 3 CASTE GROUPINGS IN COASTAL DISTRICTS BORDERING THE GULF OF MANNAR

Caste	*Proportion of population (%)*	
	Ramanathapuram	*Toothukkudi*
Scheduled castes	19	14
Pallans	12	7
Parayans	4	3
Mukkulathors	16	9
Idaiyans	6	In some strength
Yadavs	6	In some strength
Nadars	6	20
Vellalas	6	8
Muthurajas	In some strength	No record
Naidus	In some strength	In some strength
Brahmins	No record	In some strength

Source: National Informatics Centre, Government of Tamil Nadu website: http://tnmaps.tn.nic.in/

The Gulf of Mannar occupies a prominent place in the cultural heritage and history of India. The famous pilgrim centre of Rameswaram depicted in the Ramayana scriptures is situated on Pamban Island at the eastern end of the Gulf. Rameswaram is also known as *Sethu* from the expression, 'from the Himalayas to *Sethu*', which speaks of the oneness of India's past. The coastline and mainland of Ramanathapuram district (named after the God Rama) are also associated with places and events mentioned in the Ramayana (e.g. Tirupullani, Devipatnam, Darbasayanam). Thousands of pilgrims are attracted to Ramanathapuram district and Rameswaram every day from all over India.

1.2 ECOLOGICAL AND GEOPHYSICAL SETTING

Bordering the Bay of Bengal, with a 1000 km coastline and a continental shelf of 41 400 km^2, Tamil Nadu accounts for 13 and 9% of India's coastline and continental shelf, respectively. More than 55% of the continental shelf is no deeper than 50 m. The Gulf of Mannar covers an area of approximately 10 500 km^2 along 8°35′–9°25′ north latitude and 78°08′–79°30′ east longitude.

The climate in the Gulf of Mannar is marked by the monsoon seasons, with heavier rainfall during the north east monsoon from October to December. The average annual rainfall varies from 762 mm to 1270 mm and average monthly temperatures range from a maximum of 31°C in May to a minimum of 25°C in January. The south west monsoon season, from June to September, contributes little towards the annual rainfall, but periods of rough seas are reported around August.

Tidal amplitude is only 0.5 m, increasing to a maximum of 0.81 m during springs tides and falling to 0.2 m during neap tides.

Within the Gulf of Mannar 21 uninhabited islands covering a total area of 6.2 km^2 are scattered close to the coastline, stretching 140 km from Tuticorin in the south west to Rameswaram in the north east. As shown in Table 4, the islands range in size from 0.003 km^2 (Poovarasanpatti Island) to 1.29 km^2 (Hare Island) and are found at varying distances from coast from a maximum of 15 km to only 3 km.

The Gulf of Mannar is home to three major ecosystem types, which are found on and surrounding the 21 islands, namely coral reefs, seagrasses and mangroves. The extent and composition of these ecosystems has been the subject of much research in recent years[1] and the area is recognised for its biodiversity, including 128 species of coral, 12 species of seagrass, nine species of mangroves and thousands more species of associated flora and fauna (DOD, 2001). Amongst this biodiversity there is evidence of 200 species being commercially exploited and 123 species which are believed to be vulnerable or endangered (DOD, 2001). The extent of coral reef and seagrass immediately surrounding the 21 islands has been estimated from satellite imagery to cover an area of 99 and 86 km^2, respectively (DOD, 2001).

Much of the research surrounding the marine ecosystems of the Gulf of Mannar has also indicated serious degradation of the natural resources. Activities of the coastal population are widely viewed as having deleterious impacts on the marine ecosystems,

TABLE 4 CHARACTERISTICS OF THE 21 ISLANDS OF THE GULF OF MANNAR

Island group	*Island*	*Area (km^2)*	*Nearest coastal town*	*Distance to nearest coastal town (km)*
Tuticorin	Van Tivu	0.16	Tuticorin	6
	Kasuwar	0.20		7
	Karaichalli	0.16		15
	Vilanguchalli	0.01		15
Vembar	Upputhanni	0.30	Vembar	8
	Pulvinichalli	0.06		8
	Nallathanni	1.10		10
Keelakkarai	Anaipar	0.11	Keelakari	9
	Valimunai	0.07		9
	Appa	0.29		8
	Poovarasanpatti	<0.01		8
	Thalairi	0.75		9
	Valai	0.10		9
	Mulli	0.10		10
Mandapam	Hare (Musal)	1.29	Mandapam camp	7
	Manoli	0.26		5
	Manoliputti	0.02		5
	Poomarichan	0.17		3
	Pullivasal	0.30		3
	Krusadai	0.66	Pamban	3.5
	Shingle	0.13		4

causes of degradation include coral mining, destructive fishing practices, such as dynamite fishing and trawling, over-harvesting of vulnerable or endangered species and land-based pollution. In addition, the 1998 El Niño event and associated high surface water temperatures resulted in extensive coral bleaching and mortality throughout the Gulf of Mannar (Kumaraguru, 1998).

In response to these factors and in recognition of the high level of biodiversity, the islands and surrounding marine ecosystems of the Gulf of Mannar were declared firstly as a national park and subsequently as a marine biosphere reserve (Box 1).

1.3 ECONOMIC SETTING

Fisheries is the predominant industry in the coastal belt of the Gulf of Mannar. In Tamil Nadu marine fisheries account for 82% of all active fishermen, who are responsible for 76% of the total fish production in the state and 8% of the total marine catch for India. Tamil Nadu's fishing fleet numbers 64 126 vessels of which 84% are traditional crafts (known locally as *Vallams* and *Vathai*) contributing 47% of the total fish landings. There are an estimated 316 422 people earning their livelihoods from marine fishing in the state, distributed among 591 fishing villages.[2] According to a Tamil Nadu marine fisherfolk census undertaken during 2000, 98 of these villages are located along the Gulf of Mannar coast with an estimated population of 72 766, of whom it is estimated 21 000 are active fishermen.

Historically the Gulf of Mannar coastline has been a significant region in maritime trade, including the trading of pearls with the Greek and Roman empires from the days prior to Augustus Caesar (63 BC–14 AD), as documented by the historian Pliny from the second century AD. The Gulf is famous for its chank (*Xanchous pyrum*) and pearl fisheries, both of which have been a government monopoly. Chanks are a particularly valuable cultural resource, with the sinistral or right-handed whorled chank considered sacred and used in worship in Hindu temples. While the pearl fishery has not been open since 1961 due to the absence of sufficient oyster populations, the chank fishery has continued on an annual basis until it was officially banned in recent years.

Of the two coastal districts bordering the gulf, Ramanathapuram contributed 23% to the overall marine fish production in the state during 1998–1999, the largest production of any district in Tamil Nadu, while Toothukkudi contributed 13%.[3] Traditional crafts were responsible for 39 and 38% of the overall production for Ramanathapuram, and Toothukkudi districts, respectively.

Traditional or small-scale fishing is carried out predominantly in the 'trapped sea' between the islands and the mainland coast and in the shallow waters and reef areas surrounding the islands. Fishing takes place throughout the year, but changes in nature according to local availabilities of different species. Wind patterns generally restrict the use of small-scale crafts between the months of August and October, and during this period many fishermen simply switch to labouring on larger mechanised boats.

In addition to fisheries-related occupations along the coast, there are opportunities for employment in salt extraction, particularly in the western side of the Gulf near Tuticorin, and also in Palmyrah (toddy) tapping and agricultural labour. Skilled work is also undertaken, with mat weaving common in Ramanathapuram district. Moving inland from the coast toddy tapping and agriculture are the predominant occupations with small business-related opportunities prevalent near Rameswaram in connection with the tourism in this area (SSFRD, 1998).

BOX 1 THE GULF OF MANNAR MARINE BIOSPHERE RESERVE (GOMMBR)

GOMMBR was the first marine biosphere reserve not only in India but also in South and Southeast Asia. The IUCN Commission on National Parks and WWF identified the reserve as being an area of 'particular concern' given its diversity and special multiple use management status. As the first marine biosphere reserve declared in India, this area has long been a national priority.

The GOMMBR was declared on 18 February 1989 by the Government of India and the State of Tamil Nadu. The intention of declaring the 21 islands and surrounding sea, including 6.4 m depth on the bay-side to 9.1 m depth on the seaward side, as a marine biosphere reserve is for the purpose of protecting marine wild life and its environment. The main objectives of the GOMMBR are:

- Conservation and management of representative marine ecosystems
- Protection of endangered and important marine living resources
- Provision of long-term conservation of genetic diversity
- Promotion of basic and applied research work and its monitoring
- Dissemination of information through education and training.

(Source: DOD, 2001)

1.4 ADMINISTRATIVE SETTING

Administrative systems operate at varying levels within the state. The first level of decentralisation is the district, followed by taluks, blocks and town and village panchayats. As mentioned above, there are two coastal districts bordering the Gulf of Mannar (Ramanathapuram and Toothukkudi, also known as Tuticorin), the administrative divisions within these districts are described in Table 5 below.

A total of 98 villages are found bordering the Gulf of Mannar; 91 in Ramanathapuram district and seven in Toothukkudi district. As well as the panchayat administrative systems associated with these villages, smaller community organisations are invariably present, these include caste-based organisation, fishermen's *sanghams* and women's self-help groups. Village level fishermen *sanghams* are groups of small-scale fishermen, these are represented at a district level through a Fisheries Union. Various local and national NGOs are also active in the Gulf of Mannar all of whom are associated in one way or another with the local communities of small-scale fishermen, some with a focus towards welfare and empowerment, while others focus on the marine environment, public awareness and the development of alternative livelihood strategies.

Historically the Gulf of Mannar and its islands were ruled as a kingdom by the Raja of Ramnad. During medieval times, the Raja of Ramnad, known as *Sethupathi*, is believed to have parted ownership of some of the islands, either as gifts or in trade. Thus, some of the islands, such as Hare (Musal) and Nallathanni, were either fully or partly owned by individuals, while the remaining islands were known as *poramboke* land or 'nobody's' land. All the islands were eventually ceded to the government (or purchased in the case of the privately owned islands) and they are now notified as reserve lands, protected along with surrounding waters as part of the GOMMBR. Management of the GOMMBR is the responsibility of the Department of Environment and Forests (DoEF), the remaining marine resources are managed through the Department of Fisheries, both departments are represented in the Gulf of Mannar through extension offices.

TABLE 5 ADMINISTRATIVE UNITS OF THE COASTAL DISTRICTS OF THE GULF OF MANNAR

Administrative unit	*Ramanathapuram*	*Thoothukkudi*
Taluks	7 (3)	8 (3)
Blocks	11 (4)	12 (3)
Town panchayats	9	20
Village panchayats	443 (91)	408 (7)

Note: Figures in brackets indicate the number of administrative units bordering the Gulf of Mannar.

1.5 EXTERNAL FACTORS CONTROLLING LIVELIHOOD OPPORTUNITIES

For the coastal communities of the Gulf of Mannar there are combinations of factors that determine their livelihood opportunities, these include:

Natural resources: This represents a fundamental factor underpinning the fisheries occupations which dominate the livelihood opportunities of the coastal communities. The accessibility of the islands and surrounding resources, as well as the availability of resources (their quality and quantity) are key factors influencing the success and form of the natural resource-based livelihood system. In the Gulf of Mannar access to natural resources is determined not only by the varying distance between the islands and the coastal communities, but also by controls placed on the system by the GOMMBR and other laws and regulations. Availability of resources is determined largely by the resource status, which in the Gulf of Mannar is widely considered to be degrading.

*Culture: A*ttitudes and responsibilities towards sustainable resource exploitation are influenced strongly by culture. The traditional fishermen along the Gulf of Mannar are *Moopers* who are culturally known for subsistence living and attitudes of responsibility towards the health of the natural resources. At the same time, however, the caste system ties the coastal fisherfolk to fishery-based occupations and limits the possibilities for livelihood diversification or the uptake of alternative livelihood options.

*Market system: W*ith the commercialisation of fisheries, markets and associated traders and middlemen play a pivotal role in determining the form and success of fisheries livelihoods, providing infrastructure for the timely purchase of perishable items, providing credit, soft loans, equipment (on loan or hire) and supporting families through periods of crisis. In the Gulf of Mannar, the relationship between market traders and fishers is known as the *Sattambi* system, guaranteeing trade for the small harvests of the traditional small-scale fishermen.

2 COMMUNITY CONTEXT

The following section provides a summary of the context of each of the study villages. A direct comparison of the three study villages is given in Table 6.

The study was conducted in three villages located in Ramanathapuram, the eastern district of the Gulf of Mannar, namely Idinthakalpudur, Indiranagar (located in Ramanathapuram taluk) and Thavukadu (located in Rameswaram taluk on Pemba Island) (Figure 2).

2.1 GEOGRAPHICAL, ECOLOGICAL, SOCIAL AND ECONOMIC SETTING

2.1.1 Idinthakalpudur

Idinthakalpudur is located 3 km south of Keelakari town, which is accessible via a dirt road (Figure 2). The houses are located along the shore only a few metres away from the sea and are predominantly thatched (62% of households). There are 48 households in Idinthakalpudur with an average size of 4.2. The

TABLE 6 STUDY VILLAGE COMPARISON TABLE

	Indiranagar	*Idinthakalpudur*	*Thavukadu*
Natural resource access	*Marine resources:* seagrass bed, reef-based resources surrounding islands. Nearest island is Valai Island 15 km away. *Terrestrial resources:* coconut farms, and few acres of agriculture lands earlier owned by the Rajas (kings) now used by the fishing families	*Marine resources:* seagrass bed, reef-based resources surrounding islands. Nearest island is Appa Island 10 km away. *Terrestrial resources:* coconut farms, and few acres of agriculture lands earlier owned by the Rajas (kings) now used by the fishing families	*Marine resources:* sand bottom near-shore suitable for shore net. Near-shore seagrass and reef-based resources. Nearest island is Shingle Island 15 km away. *Terrestrial resources:* Forests adjacent to village, owned by Forest Dept
Social composition	Single caste 100% Hindu	Single caste 100% Hindu	Single caste 100% Hindu
Demography	Population 238 Males 129 Females 109 No. households 48 No. families 64	Population 190 Males 92 Females 98 No. households 48	Population 191 Males 93 Females 98 No. households 45
Livelihood opportunities (% households with primary option)	Own boat fishing 41% Boat labour 39% Seaweed collection 13% Land-based 8% Sea-based options 93% Land-based options 8%	Own boat fishing 39% Boat labour 30% Seaweed collection 23% Land-based 9% Sea-based options 92% Land-based options 9%	Own boat fishing 52% Shorenet labour 27% Land-based 13% Boat labour 4% Family abroad 4% Sea-based options 83% Land-based options 17%
Livelihood strategies	54% with no secondary activity 46% with secondary activity, including: Own boat fishing 5% Boat labourers 34% Land-based 7% 31% families involved in seaweed collection 33% households have family working abroad	65% with no secondary activity 35% with secondary activities, including: Own boat fishing 3% Seaweed collection 13% Boat labour 12% Land-based 7% No households have family working abroad	55% with no secondary activity 45% with secondary activities, including: Boat labour 9% Shorenet labour 33% Land-based 3%
Gender roles Key: M/F Male/Female ✓ Common ❍ Rare ✗ Never	***Principle occupation*** ***M*** ***F*** Own boat fishing ✓ ✗ Boat labour ✓ ✗ Seaweed collection ❍ ✓ Land-based ❍ ✓	***Principle occupation*** ***M*** ***F*** Own boat fishing ✓ ✗ Boat labour ✓ ✗ Seaweed collection ❍ ✓ Land-based ✓ ❍	***Principle occupation*** ***M*** ***F*** Own boat fishing ✓ ✗ Boat labour ✓ ✗ Shorenet labour ✓ ✓ Land-based ✓ ✓

TABLE 6 (CONTINUED)

Household (hh) human assets	Average hh size 5.0 Female-headed hh 8% Hh with no male 2%	Average hh size 4.2 Female-headed hh 19% Hh with no male 9%	Average hh size 4.0 Female-headed hh 11% Hh with no male 4%
Household productive assets	Mechanised boat 19% Country boat 33% Crab nets 29%	Mechanised boat 22% Country boat 24% Crab nets 36%	Mechanised boat 10% Country boat 42% Shore-net 4% Crab nets Nil
Vulnerabilities and risks	• Seasonal monsoon impacts • Resource degradation • Restrictions associated with GOMMBR • Net damage by commercial pair trawlers • Net theft	• Seasonal monsoon impacts • Resource degradation • Restrictions associated with GOMMBR • Net damage by commercial pair trawlers • Net theft	• Seasonal monsoon impacts • Resource degradation • Restrictions associated with GOMMBR • Net damage by commercial pair trawlers • Net theft • Coast Guard, customs interference due to proximity to Sri Lanka
Local institutions (distance away)			
Forest Department	Keelakari 18 km	Keelakari 3 km	Rameswaram 11 km
Fisheries Department	Periapattanam 3 km	Keelakari 3 km	Rameswaram 11 km
Taluk Office	Ramnad 15 km	Ramnad 20 km	Rameswaram 11 km
Panchayat Union Office	Thiruppulani 10 km	Thiruppulani 13 km	Mandapam 23 km
Fisheries Union	Ramnad 15 km	Sivakami 3 km	Pamban 18 km
Market traders	Muthupettai 3 km	Keelakaria 3 km	Rameswaram 11 km
Self-help groups and TRRM NGO	Rameswaram 18 km	Sivakamipuram 3 km	Pamban 18 km

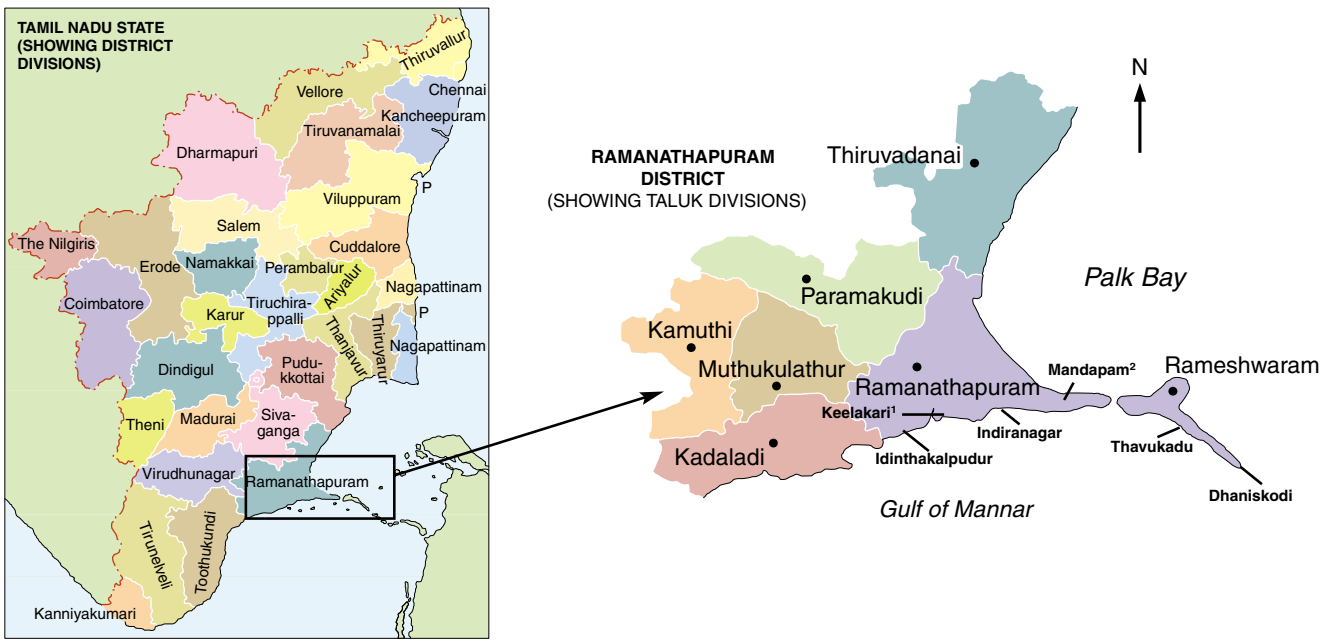

Figure 2 Location of study villages.

Source: National Informatics Centre, Government of Tamil Nadu website: http://tnmaps.tn.nic.in/

1 Keelakari town population size: 3,170

2 Mandapam town population size 11,000

total population of the village is 190 (92 males and 98 females), all of whom are Hindu and from a single caste group. Electricity is supplied to the village, but no sanitation facilities are present and all other services are located a walkable distance away in Keelakari town (Table 7).

The nearest island to Idinthakalpudur is Appa Island approximately 10 km from the village. The coral reefs surrounding Appa and neighbouring islands are used extensively by the village for harvesting seaweed, shells and lobsters. Fishing activities also take place around the reefs and in the 'trapped sea' area between the islands and the mainland coast, associated with the seagrass habitat and crab and fish resources. The majority of seaweed and shell collection is undertaken by women, who travel in groups to the islands onboard fishing boats.

Coconut and Palmyrah (toddy) palms provide a source of land-based labour opportunities. Goat rearing, mat weaving and construction labour are also undertaken as land-based activities with women only taking an occasional part. But the majority of households in Idinthakalpudur are involved in sea-based occupations, with only 9% undertaking land-based options. Households also tend to be associated with a single livelihood option, with only 35% of households undertaking secondary activities.

2.1.2 Indiranagar

Indiranagar is located 18 km north east of Keelakari and 0.6 km away from the sea (Figure 2). There are 48 households in the village with an average size of 5.0 and predominantly constructed of thatch (60% of households). The population numbers 238 (129 males and 109 females) all of whom are Hindu and from a single caste group. Piped water and electricity are available in the village, but there are no other sanitation facilities and all other services are located in the nearby towns of Muthupettai and Periapattanam, 1 and 3 km away, respectively (Table 8).

TABLE 7 IDINTHAKLPUDUR SOCIAL INFRASTRUCTURE

Sector	*Infrastructure*	*Comment*
Education	No school	Primary (5–10 years), higher secondary (11–18 years) (government and private), polytechnic, women's college (private) are located in Keelakari.
Health	No health facilities	Primary health centre (government sponsored), private clinics and consultants are available at Keelakari.
Water	Only spring water is available	Sufficient for domestic use.
Sanitation	No sanitation facilities	Inconvenience is not felt by the people.
Religion	Unfinished temple is present	All are Hindus.
Markets/ supplies	No supply store or market	Nearest supply store/market is located at Keelakari.
Finance	No bank facility	National and scheduled banking facilities are available at Keelakari.
Fisheries	Limited support services	Ice factory, cold storage facilities and various fishing companies (e.g. Baby Marine, Kadal Kanni Frozen Food, Diamond Sea Food) function from Keelakari.

TABLE 8 INDIRANAGAR SOCIAL INFRASTRUCTURE

Sector	*Infrastructure*	*Comment*
Education	No school	Primary school is located at Muthupettai (1 km away). Higher secondary and an English missionary school is located at Periapattanam (3 km away). Both the schools are government sponsored schools.
Health	No health facilities	Health subcentre in Periapattanam caters to the needs of a 5000 population. A trained public health nurse is available there to attend minor illnesses and delivery cases.
Water	Piped water supply is available	Drinkable and adequate.
Sanitation	No sanitation facilities	Inconvenience is not felt by the people.
Religion	Two temples (Vinayaka and Kaliammam temples)	Both temples are Hindu.
Markets/ supplies	Small petty shops are available in the village	A number of grocery and provision stores are also available in Muthupettai and Periapattanam.
Finance	No banking facility	The nearest banks (national and scheduled) are located in Periapattanam.
Fisheries	Poor support services	Nearest service is available at Ramnad 15 km away.

The nearest island to Indiranagar is Valai Island approximately 15 km away from the village. The coral reef areas surrounding Valai and neighbouring islands are used for seaweed collection and fishing activities. Shells are not collected and seaweed collection is undertaken mainly by women. The 'trapped sea' area between the islands and the mainland coast, associated with the seagrass habitat is used extensively for fishing in particular for crabs.

Coconut and Palmyrah palms provide a source of land-based labour opportunities. Goat rearing, mat weaving and construction labour are also undertaken as land-based activities. Women's involvement in land-based activities is common and mostly involves mat weaving. Households with family members working abroad are commonly encountered (33%), although this does not feature as a primary or secondary livelihood option. As with Idinthakalpudur, the majority of households in Indiranagar are involved in sea-based livelihood options, with only 8% undertaking land-based options. Households have a similar tendency for associating with a single livelihood option (54% of households) or involvement in secondary activities (46% of households).

2.1.3 Thavukadu

Thavukadu village (Box 2) is situated in the eastern part of the Gulf of Mannar on Pamban island 11 km to the north east of Rameswaram township, 18 km from Pamban and 23 km from Mandapam close to Dhaniskodi, the eastern most village in the Gulf (Figure 2). Villagers live on the beach in *poramboke* land, 'nobody's' or common property land. Forty-five households are located here, all of which are constructed of thatch. The population numbers 191 (93 males and 98 females) with an average household size of size of 4.0. All villagers are Hindu and from a single caste group.

There is no electricity and no water supply or sanitation facilities in the village, the majority of other services are located in Rameswaram town 11 km away (Table 9).

BOX 2 ORIGIN OF THAVUKADU VILLAGE NAME

The name of the village was originally Thavupadu derived from '*thavu*' which means deep and '*padu*' which means catch and relating to the deeper area of water adjacent to the village which is used for shore netting. The named change in the period after the 1964 cyclone, when the Forest Department planted Causerina trees near the village and people began calling the place 'kadu' meaning forest, hence the name changed to Thavukadu

TABLE 9 THAVUKADU SOCIAL INFRASTRUCTURE

Sector	*Infrastructure*	*Comment*
Education	No school	Primary school (government) located in Ramakrishnapuram (3 km). Higher secondary school (government and private) is located in Rameswaram (11 km).
Health	No health facilities	Health facility is available at Rameswaram.
Water	Only spring water available	
Sanitation	No sanitation facilities	Inconvenience is not felt by the people.
Religion	No temple	Hindu religion.
Markets/ supplies	No store and market	Nearest supply store/market is located at Rameswaram.
Finance	No bank	Nearest bank facility is available at Rameswaram.
Fisheries	Limited support services	Ice factory, cold storage, offices of fishing. companies and the Assistant Director of fisheries are located in Rameswaram.

The nearest island to Thavukadu village is Shingle Island, located 15 km away. However, fishing is predominantly undertaken in the lagoon area adjacent to the village and also in Palk Bay a walkable distance (carrying boats) to the north of the Gulf. Seaweed collection is not undertaken in Thavukadu, although shells are collected from the shore and sandy areas offshore of the village, mainly by women. Unique to this village when compared with Idinthakalpudur and Indiranagar, is the use of shore-nets, which is made possible by the presence of deeper water immediately offshore from the village. Men and women are involved in shore net activities, with women constituting 73% of the shore-net labour force.

Casurina forest is found in and around the village, serving as grazing land for goats and sheep, which is the main source of land-based livelihood opportunities, undertaken by both men and women. Construction labour is another land-based option, as well as family members working abroad, which is considered the primary livelihood option for 4% of households. Again, the majority of households undertake sea-based livelihoods, although a slightly greater proportion (17% of households) also undertake land-based options. As with Indiranagar, households have a similar tendency for associating with a single livelihood option (55% of households) or involvement in secondary activities (45% of households).

2.2 ADMINISTRATIVE SETTING

Communities in the three villages interact with multiple organisations and government departments. The key organisations and institutions are listed below.

The Forest Department is responsible for management of the GOMMBR and enforcement of associated legislation.

The Fisheries Department is responsible for fisheries development and control. They provide support services such as the provision of ice boxes, cold storage facilities, rickshaw transport, subsidised diesel and operate saving insurance schemes.

The Taluk Office is responsible for standard government services, including land revenue collection and provision of certificates of birth, death, inheritance, land, etc.

The Panchayat Union Office provides rural development and welfare services, including the identification of households Below the Poverty Line (BPL) for administrative and monitoring purposes. (Distribution of ration cards is undertaken separately by the Civil Supplies Department, part of the Revenue Department.)

The Fisheries Union has a membership of nearly 80% of the small-scale fishermen through the local fishermen's *sanghams*. The union plays an important role in representing fishers' grievances and lobbying for fishers' rights, particularly in conflicts with larger commercial fisheries operations.

Market traders guarantee support and market for small catches of traditional fishermen through the *Sattambi* system (see Section 1.5).

Local NGO TRRM and self-help groups are focused towards the empowerment and development of local communities and are concerned with local participation in resource management. TRRM operates throughout Ramanathapuram district and although the main office of TRRM is some distance from the villages, a local organiser is present in every village. Almost 80% of the adult population in the villages participate in TRRM activities, which include micro-credit schemes, motivation camps, field exposure visits and regular training. Self help groups are co-ordinated through TRRM together with the Fisheries Union.

2.3 VULNERABILITIES

The main vulnerabilities and risks faced by the three communities are associated with their sea-based livelihoods. Dependence on the sea and marine resources exposes the small-scale fishers to vulnerabilities associated with working at sea, including seasonal monsoon winds, rainfall and cyclone depressions which interrupt and impact normal routines and access to resources. The high dependence on near-shore marine resources, including the islands, coral reefs and seagrass beds, also inherently expose the communities to risks associated with resource degradation. Restriction of access due to conservation measures also add risks to the traditional fishing occupations, many of which are now officially illegal.

In addition local communities also face the risk of losing their household productive assets, such as nets and fishing gear through theft or damage by larger commercial boats, a common occurrence in all villages. Social and political tensions are also apparent, particularly in connection with fishing and smuggling disputes on the border with Sri Lanka. This causes particular interference in Thavukadu community closest to the border.

3 POOR STAKEHOLDERS

3.1 OVERVIEW OF POVERTY

According to the South India Human Development report (NCAER, 2001) the development performance of Tamil Nadu is more impressive against social rather than economic indicators. The state ranks as the eighth poorest rural state in India and the fourth poorest in urban India. Between 1993 and 1994, the percentage of population below the poverty line was 32.5 in rural areas and 39.8 in urban areas, compared to an all-India level of 37.3 and 32.4, respectively (NCAER, 2001). According to the 1991 census, the coastal revenue district of Ramanathapuram ranked ninth amongst the 21 revenue districts of the state in terms of its Social Development Index (NCAER, 2001). However, these aggregate figures can obscure the complexity and diversity of livelihoods and development, particularly in the dynamic coastal context, with poorer and often marginalised households and communities living amongst those better off.

Poverty as defined by the Tamil Nadu Government for all its development interventions and inline with Government of India standards, is described by the following parameters:

- Those families having annual household income less than Rs 24 000 (~$511)
- Those who do not possess a television
- Those who live in huts and tiled roof houses
- Those who live in rented houses
- Those who do not possess any mechanised vehicle
- Those who do not have kitchen items such as a mixer, grinder
- Those who have less than Rs 4500 (~$96) per capita annual income.

In terms of monthly per capita income, the state ranks fifth and above the India average (Rs 2349 (~$50) average monthly per capita income in Tamil Nadu, Rs 2226 (~$47) all-India average) (NCAER, 2001). According to a socio-economic survey of the Gulf of Mannar conducted in 1998 (SSFRD, 1998) average annual household incomes vary between Rs 15 000 (~$319) and Rs 25 000 (~$532). In other words, the average household in the Gulf of Mannar exists below or at the poverty line.

The picture of poverty is extended through locally defined criteria to give a perception of poverty particular to the coastal context and the lives of those living along the shores of the Gulf of Mannar. In the three study villages, criteria which are considered locally to contribute towards poverty overlap to some extent with official parameters (Table 10). Ownership of land and property, including a house, fishing boat and gear, are considered important indicators of households which have escaped poverty or 'better off' households. Households with male labour, with savings or with family members working abroad and sending remittances are also considered to be 'better off'. In contrast 'poor' households were generally considered to include: those with limited workforce, such as female-headed households, or households with many female children; households engaged in land-based labouring, in sea-based labouring or seaweed collection; or households with little income and savings and with few physical resources.

Based on locally defined criteria, the overall distribution of households amongst the three categories of 'poor', 'less well off' and 'better off' indicate that in both Idinthakalpudur and

TABLE 10 POVERTY CRITERIA EVOLVED BY LOCAL PARTICIPANTS IN THREE VILLAGES IN THE GULF OF MANNAR

Poverty criteria	*Indiranagar*	*Idinthakalpudur*	*Thavukadu*
Households with only a single member earning	X		X
Female-headed households	X	X	X
Households with a nonworking male		X	
Widows		X	
Limited workforce in the household	X		
Households with many female children	X	X	X
Households engaged in land-based labour		X	X
Households exclusively working on seaweed collection		X	
Households engaged in labour on mechanised boats		X	X
Households without family property	X		
Households without land		X	
Households without savings		X	
Households surviving on a subsistence income	X	X	
Households owning boats on loan			X
Households who borrow money from vendors	X		
Households taking loans to meet normal expenses	X		
Households owning disco nets	X		

TABLE 11 DISTRIBUTION OF HOUSEHOLDS AMONGST THREE WEALTH CATEGORIES

Wealth ranking category	*Proportion of households (%)*		
	Indiranagar	*Idinthakalpudur*	*Thavukadu*
Poor	27	58	52
Less well off	56	31	35
Better off	17	11	13

Thavukadu the majority of households are considered poor, while in Indiranagar the majority of households are considered 'less well off' (Table 11). In each location, 'better off' households are in the minority.

3.2 INDIRANAGAR

Analysis of wealth ranking against household occupations and assets (Table 12) corresponds with locally defined poverty criteria, and indicates that labour on fishing boats comprises the main primary or secondary livelihood opportunity for poor households. In addition, all the female-headed households found in Indiranagar fall into the 'poor' category. The large 'less well off' category of households in Indiranagar are similarly characterised by boat labour as the main primary or secondary livelihood opportunity. However, these households also have family working abroad and a considerable number of these households own their own mechanised or non-mechanised country boats.

3.3 IDINTHAKALPUDUR

Analysis of occupations and assets with wealth ranking categories (Table 13) again corresponds with the locally defined poverty criteria. As with Indiranagar, boat labour is similarly associated with the 'poor' households, together with seaweed collection and occupation of a thatched house. All female-headed households found in the village fall into the 'poor' category. 'Better off' households occupy pucca (concrete) or tiled houses and are not involved in local land-based labour options.

3.4 THAVUKADU

Analysis of wealth ranking categories with household occupations and assets (Table 14) in general corresponds to locally defined poverty criteria, although there is a notable exception, namely the entire population occupy thatched houses, regardless of wealth ranking category. This may be explained by the fact that the village exists on the beach on 'nobody's' land, which prevents households from erecting a permanent dwelling for fear of displacement. In the case of Thavukadu shore-net labour accounts for the main primary and secondary livelihood option for 'poor' households. Female-headed households in the village, all fall into the 'poor' category. While 'better off' households own the shore-nets and have family members working abroad.

TABLE 12 CROSS-TABULATIONS OF POVERTY RANK, INDIRANAGAR

% of total households with primary or secondary livelihood option	*A*[1]	*B*	C
Own boat fishing	13	29	4
Boat labour	13	42	19
Land-based labour	2	6	6
Family working abroad	8	21	4
% of total households with assets			
Pucca house	4	0	0
Tiled house	10	19	8
Thatched house	2	42	17
Mechanised country boat	4	15	0
Non-mechanised country boat	10	19	4

Note: Although seaweed collection takes place in Indiranagar, no data exists to consider its correlation with wealth ranking categories
1 A, better off; B, less well off; C, poor.

TABLE 13 CROSS-TABULATIONS OF POVERTY RANK, IDINTHAKALPUDUR

% of total households with primary or secondary livelihood option	*A*[1]	*B*	C
Own boat fishing	4	22	16
Seaweed collection	2	11	22
Boat labour	7	4	31
Land-based labour	0	7	9
% of total households with assets			
Pucca house	9	0	0
Tiled house	2	18	11
Thatched house	0	13	47
Mechanised country boat	7	16	2
Non-mechanised country boat	2	9	13

1 A, better off; B, less well off; C, poor.

TABLE 14 CROSS-TABULATIONS OF POVERTY RANK, THAVUKADU

% of total households with primary or secondary livelihood option	*A*[1]	*B*	C
Boat labour	0	4	8
Shore-net labour	4	19	46
Land-based labour	2	4	4
Own boat fishing	8	27	17
Family members abroad	4	0	0
% of total households with assets			
Pucca house	0	0	0
Tiled house	0	0	0
Thatched house	13	35	52
Mechanised country boat	4	4	2
Non-mechanised country boat	0	23	19
Shore net	4	0	0

1 A, better off; B, less well off; C, poor.

4 REEF LIVELIHOODS

Coral reefs have the potential to provide a stream of benefits to the three coastal communities studied in the Gulf of Mannar. Some of these benefits arise because reefs can contribute to the *resources* that the communities have access to. These reef-related resources contribute to the building blocks of the livelihoods of the community 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 community interacts with the structures and processes that directly influence the way they 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 community exists, we refer to these as the *indirect influencing factors*.

The reef also has the potential to directly contribute to the *livelihood strategies* that the community 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 community ultimately benefits them, by contributing to positive changes in the *outcomes* of their livelihoods. These outcome changes are best defined and measured by the community themselves if they are to meaningfully represent positive improvements in their lives.

The following sections describe the many different streams of benefits to the livelihoods of the 'poor' households or stakeholders identified in the three study communities, focusing on reef benefits to household resources (Section 4.1); to enhancing interactions with direct influencing factors (Section 4.2); and to coping with the risks and vulnerabilities associated with indirect influencing factors (Section 4.3).

4.1 RESOURCES

The contribution of reefs to the natural, physical, financial, human and social resources of 'poor' stakeholders in the three communities is summarized in Table 15 and described in detail in the following sections (4.1.1–4.1.5).

4.1.1 Natural resources

The coral reefs in the Gulf of Mannar form an integral part of a wider coastal and ocean ecosystem, including coralline islands, seagrass beds, mangroves, lagoons and open sea, interlinked by nutrient, sediment and energy flows. Coral reefs, with their high biodiversity and productivity, form a key part in this system, a fact which is widely recognised amongst the fishers from the three communities (Box 3).

In all three villages, poor stakeholders are highly dependent on the near-shore fisheries for their livelihood. Between 83 and 93% of households in the three study villages are engaged in sea-based livelihood options. These options include direct exploitation of resources in the lagoons and reef flats surrounding the islands (e.g. for seaweed, shells, lobsters, sea cucumbers, reef fish), as well as exploitation of resources from the seagrass beds and 'trapped sea' between the islands and the mainland coast (e.g. for crabs, squid, fish and shells) (Figure 3).

A diversity of species are extracted from the reef and adjacent ecosystems, including seaweeds, shells, lobsters, reef fish, sea cucumbers and squid (see Annex 2 for a list). The islands of the Gulf of Mannar, which owe their existence to the reef, are also an important resource, providing a temporary resting place or at times a temporary camp for periods of up to a week, during seaweed collection and fishing activities (Indiranagar and Idinthakalpudur). At these times, a shrub found on the islands, known locally as the *Keeri* plant, is an important source of

BOX 3 LOCAL PERCEPTIONS OF THE REEF RESOURCE

Fisherfolk have an integrated and holistic perception of the ocean. Reefs are perceived as part and parcel of the ocean. So when fisherfolk reveal that they are dependent on the sea, this includes all the different resources associated with the sea.

The reef is recognised as being highly productive and fishermen expressed this on many occasions:

'It is the reef from where everything sprouts and spreads through out 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'

(Quotes from various participants from three study villages.)

TABLE 15 A SUMMARY OF REEF BENEFITS TO HOUSEHOLD RESOURCES

Resources	*Benefits from the reef*	*Communities*[1]
Natural	*Diverse resource associated with the coral reef*	
	Diversity of seaweed, shells, lobsters, sea cucumbers, reef fish	All
	Protects adjacent seagrass habitat and lagoons around islands	
	Crabs, squid, fish & shells harvested from seagrass beds and lagoons	All
	Promotes island formation	
	Islands used as a resting place or fishing camp	Id, In
	Keeri plant on island harvested for firewood	Id, In
Physical	*Physical barrier*	
	Protects property from storms	All
	Provides calm waters for fishing activities in 'trapped sea' between islands and mainland and in lagoons around islands	All
	Prevents access to larger commercial boats	All
	Source of building material	
	Coral mining for lime production (more in the past)	All
Financial	*Cash income from sea-based products*	
	Diversity of products, including seaweed, shells, fish, lobsters, squid, crab etc.	All
	Cash income from fisheries activities	
	Income from local vending of fish	All
	Income from boat labour	
	Exchange	
	Marine products exchanged for other products, e.g. toddy, labour or net mending	All
	Low investment	
	Low cost to engage in reef fishery	All
Human	*Protein from fish*	
	Main source of protein in local diet	All
	Discarded fish are free source of food and protein	All
	Medicinal benefits	
	Diversity of sea-based products used in local medicines	All
	Skills and knowledge	
	Practical skills for working in water	All
	Knowledge of different species, especially of those for exploitation	All
	Knowledge of poisonous or dangerous species, e.g. coral snakes	All
	Knowledge of currents, tides, behaviour of target species	All
Social	*Traditional beliefs*	
	Beliefs and rituals relating to fishing activities	All
	Beliefs associated with island and coral mound	All
	Beliefs associated with species	All
	Collaborative extraction	
	Women work together to harvest seaweed and shells	Id, In
	Crew or labour work collaboratively on fishing boats and in using shore nets	All

1 In, Indiranagar; Id, Idinthakalpudur; T, Thavukadu.

firewood for cooking on the islands and can be used immediately without need for drying. It should be noted that although the practice is reported to continue, the use of the islands is now illegal as access to the islands and adjacent waters are prohibited under GOMMBR regulations.

4.1.2 Physical resources

The coral reefs are well known in their role of providing a physical barrier against wave energy, thus reducing coastal erosion and the impact of storms. All coastal villages rely on the reef for such protection and this was widely articulated in the

study villages (especially so in Thavukadu, Box 4). As well as protecting property from storm damage and erosion, the reef's protection also creates calmer waters for fishing activities in the 'trapped sea' between the islands and the mainland coast and in shallow lagoons adjacent to the islands.

Not only does the reef provide a barrier to wave action, it also acts as a barrier to larger commercial boats, who cannot access the shallow reef areas. This is a significant benefit for the small-scale local fishers from the study communities, who can access these areas in their traditional small wooden country boats, while the larger commercial trawlers cannot.

Coral is also directly exploited for use in producing lime for construction. In the past, coral mining was a significant industry in the Gulf of Mannar, providing an income generating opportunities for many of the local fisherfolk. In 1981, Venkataramanujam *et al.* estimated that 15 000 tons of coral boulders and 10 000 tons of coral debris were being removed annually from the Tuticorin group of islands for lime production. Coral mining was banned with the establishment of the national park in the Gulf of Mannar and although there are reports of some illegal mining, there has been a considerable reduction in this activity. However, lime kilns still operate inland from the coast (Figure 4), some reportedly fired by illegal coral and shells.

4.1.3 Financial resources

The diversity of products harvested from the reef and associated resources are an important source of income in all three villages and for many poor households provide the only source of income. Potential annual income from sea-based products, estimated by local poor stakeholders, ranges from Rs 354 (~$7) per year for shells to Rs 9370 (~$199) per year for fish resources (Table 16).

Harvested products are also widely used in exchange. For example, fish and crabs may be exchanged for toddy or free labour, such as net mending. Such exchange is a customary practice and way of life in all three study villages. In some instances, particularly for female-headed households, activities such as net mending, are undertaken in order to obtain free fish or other assistance.

Income is also generated through fisheries activities, including fish vending and boat and shore net labouring. Fish vending is a livelihood opportunity commonly undertaken by women and which has the potential to earn an estimated net income of Rs 3600 (~US$77) per year. In the three study villages it was estimated that 4% of female-headed households undertook fish vending, which contributed to almost 50% of household income. Boat or shore net labour is a livelihood option commonly undertaken by men from the poorer households, lacking a boat themselves. Approximately, 60% of men in the three study villages are engaged in labouring activities, of which 76% labour on country boats (62% non-mechanised and 14% mechanized); 18% labour on shore nets (Thavukadu only); and 5% labour on commercial trawlers (Indiranagar and Idinthakalpudur only). Annual income for

BOX 4 THE MALE AND FEMALE SEAS OF THE GULF OF MANNAR AND PALK BAY

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.

Figure 3 Fishing in the lagoon inside the reef.

Figure 4 Lime kilns in operation inland from the coast at Keelakari.

TABLE 16 ESTIMATED RANGE OF ANNUAL INCOME FROM SEA-BASED PRODUCTS

Product	*Estimated annual net income per household*[1] *(Indian Rupees – Rs)*	*US Dollar equivalent*[2]
Seaweed	960–1150	20–24
Shells	354–1200	8–26
Lobsters	540–2850	11–61
Sea cucumbers	1200	26
Fish	1070–9370	23–199
Squid	3280–4025	70–86
Crabs	2750–7760	59–165

1 Income estimated through consensus of focus group discussion, range associated with variations between villages.
2 Exchange rate Rs47: US$1.

labour activities ranges from Rs 3420 to Rs 8625 (~$73–$184), depending on the type of labour and frequency of employment.

The financial resources required to engage in the near-shore fishery is generally low. Reef and reef-associated resources are accessible using only simple technology, which is locally available. 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 country boats, of which 66% are small non-mechanised wooden boats with a sail and oars for rowing, known locally as *Vathai*, and the remainder are slightly larger mechanised wooden boats, known as *Vallams* (Figure 5).

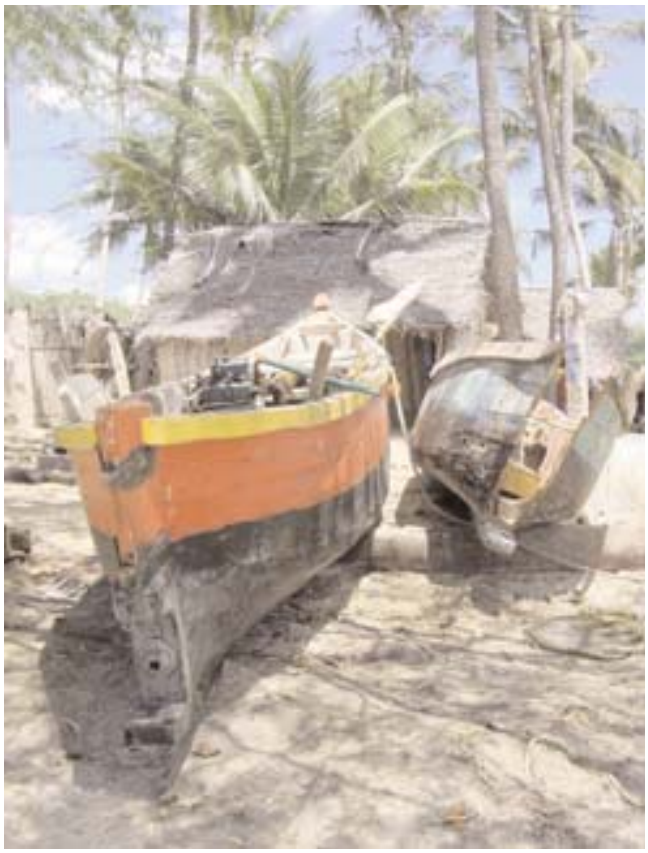

Figure 5 Mechanised country boats.

4.1.4 Human resources

Fish and other sources of edible products (e.g. crabs) are important sources of food and protein for the coastal communities. Fish is consumed daily throughout the year by all households in the three study villages. Fish is generally considered as a 'free' source of food and protein, while alternative sources involve extra effort and expense to obtain. For widows and female-headed households with low incomes and no fishermen to bring back catch, discards of smaller fish and crabs are an important source of food and protein.

The use of marine species for medicinal purposes was found to be extensive in all three villages, with the extent of use varying depending on availability of different species. Common species,

BOX 5 A LIST OF LOCALLY EXPLOITED MEDICINAL PROPERTIES OF MARINE SPECIES

Crab varieties *Kan nandu* crab is useful for coughs and colds, while *Kuzhi* crab is used to reduce urea.

Fish *Soodai* and *Mural* fish have high iron content and are used to prevent anaemia.

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.

Island herb the *Anjalai* herb is used to treat sea snakes bites.

such as *Mural* and *Soodai* fish, are available throughout the year and taken regularly as a preventative medicine against anaemia. Other examples of medicinal uses of marine species are outlined in Box 5.

The knowledge and skills associated with exploiting the reef and reef-associated resources were found to be extensive, including practical skills for working in water and with boats and fishing gear, and knowledge relating to fish species and the physical characteristics and properties of the sea and resources. Men and women from the three study communities were able to identify over 100 different species associated with the near-shore ecosystem and demonstrated an understanding of behaviours and potential dangers of certain species. Such skills and knowledge are essential to help ensure success in harvest and to avoid danger and they enable the local communities to exploit the diverse resource despite inadequate financial capital for sophisticated equipment or years of formal education. Thus, the human resource of skills and knowledge provide an important insurance for poorer households against the uncertainties of sea-based livelihoods.

4.1.5 Social resources

Traditional beliefs are part of religious life in all three study villages and beliefs and worship are important ways for people to overcome the insecurities associated with their livelihoods. The reef, reef species and fishery are the focus for a variety of religious beliefs and rituals in all villages (a selection of which are described in Box 6).

Collaborative activities associated with the fishery also provide a significant social resource, forming an important part of social networks and trust between members of the community. Collaboration is also a necessity for many fishing operations (e.g. fishing for crabs with nets, or shore-net operations), and it acts as a means of sharing access to resources with other households, such as access to boats, nets or labour. Approximately 30% of households in the three study villages rely on collaborative boat or shore-net labour as their primary livelihood opportunity. Collaborative work is also considered the basic nature of women's seaweed and shell collection: supporting the hiring of a boat to reach the islands; providing safety in numbers; and providing a chance for women to gossip away from the house.

BOX 6 A SELECTION OF TRADITIONAL BELIEFS

At dusk every Tuesday (the weekly holiday from fishing), local fishermen will undertake a ritual called *Neeratuthal* where they clean their boat and apply *Kungumam* (saffron) and sandalwood paste and light camphor.

The fisherfolk believe that a rare bird called *Antrada Paravai* (Daily bird) leaves its dropping on the coral reef, these are washed away by tides and finally reach the island shores. The droppings are called *Ponnamber* and it is believed that finding these brings luck to the fishing catch. If the *Ponnamber* is eaten by the Dugong, the Dugong's droppings are known as *Winnamber*. Fishermen believe that finding *Winnamber* brings even more luck to the fishing catch, as well as unexpected wealth and all-round well-being to the family.

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 nearby the island and close to an area known for dangerous currents and an underwater cave. In order to avoid the dangerous currents and whirlpools these places are identified as the abode of local deities and fisherfolk are warned not to approach these particular places in order to escape from the wrath of deities. It is believed that worship to *Sudalaimadan* will protect people from the danger associated with this place. People worship here throughout the year each time they arrive on the island. There is also a special festival (*Pongal*) once a year when locals from many nearby villages come to the island to offer prayers and animal sacrifice, and celebrate.

The Tonga fish or Box fish is available only in the reef area. In early days women used to wear a wedlock pendant designed in the shape of the Tonga fish.

4.2 DIRECT INFLUENCING FACTORS

Coral reef and associated coastal and marine resources are the focus of fisheries and environment-related policies, institutions, organisations and social relations. Directly and indirectly, therefore, the reef and associated resources give rise to structures and processes that can positively influence the lives of poor reef-dependent people. These positive influences are summarised in Table 17 and discussed in more detail in the following sections (4.2.1–4.2.4).

4.2.1 Policies

The diversity of reef and reef-associated products available in the Gulf of Mannar have provided opportunities for fisheries development policies promoting the growth of export markets, which have developed for products such as seaweed and crabs (Figure 6). These markets provide a constant source of income earning opportunities for an estimated 45% of households in the study villages. Market regulations controlling the size and condition of commercial catches also have positive impacts for the local communities, providing a cheap source of discarded fish products, which are particularly valuable for poor households, in particular female-headed households.

The Gulf of Mannar and its fragile coral reef ecosystem is also the focus of environmental policies promoting the conservation and protection of natural resources, and in particular the biodiversity of the reef and associated coastal ecosystems. These policies have attracted considerable funding supporting research and development programmes promoting community participation, training, awareness and development of alternative livelihood initiatives, alongside natural resource

TABLE 17 A SUMMARY OF REEF BENEFITS TO DIRECT INFLUENCING FACTORS

Influencing factors	*Benefits from the reef*	*Communities*[1]
Policies	*Fisheries development*	
	Export policies have promoted the growth of markets for products such as seaweed and crab	All
	Market policies controlling the size and condition of commercial catches result in discards of smaller fish or lobster which are an important cheap food source	All
	Conservation	
	Conservation policies recognising reef biodiversity and importance of habitat and species protection have attracted funding and programmes	All
Institutions	*Fisheries Department*	
	Support skills development	All (potential)
	Revenue Department	
	Provide pensions and relief to widows of fishermen	All
	Market traders and middlemen	
	Provision of market outlet for small producers	All
	Source of fishing gear and credit	All
	Source of information	All
	Local management	
	Community controls govern access of outsiders to fishing areas adjacent to the village or village landing site	T
Organisations	*Fisheries Unions*	
	Common voice and lobbying capacity for small-scale fisherfolk dependent on near-shore marine resources	All
	Restriction of commercial trawling activities in the 'trapped sea' between islands and mainland coastline to reduce conflicts with small-scale fisherfolk	All
	NGO – TRRM	
	Promote local community development and participation through networks and self help groups	All
Social relations	*Women*	
	Women play a direct role in harvest of shallow reef resources of seaweed and shells	Id, In
	Women play an essential role in cleaning crab nets	All
	Women are involved in fish vending and processing	All

1 In, Indiranagar; Id, Idinthakalpudur; T, Thavukadu.

Figure 6 Crab catch for export, Idinthakalpudur.

conservation and management. Examples include GCRMN- and ICRMN-sponsored projects initiating participatory assessments of the socio-economic status of coastal communities, a UNDP-GEF project undertaking coastal community development and a Pepsi-sponsored programme to develop artificial production of seaweed.

Although the positive impact of these programmes for the poor coastal communities has so far been limited (with alternative livelihood initiatives remaining at experimental stages), there has been considerable benefit through a heightened level of awareness amongst the three study villages of their common situation. Significant potential exists for future benefits through programmes promoting greater participation in resource management and greater support for enhancing the sustainability of resource-based livelihoods.

4.2.2 Institutions

Coral reef and associated resources and the near-shore, small-scale fisheries they support are the focus of various local institutions, through their concern for the development and welfare of the local fishing communities. Relevant local institutions in the three study villages, include the Fisheries Department and Revenue Department. Through local extension offices the Fisheries Department have recently begun targeting women's groups 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 order to improve women's livelihood status. These opportunities have yet to benefit women from the three study villages, although they have potentially benefited women from other coastal villages in the Gulf of Mannar. The Revenue Department, however, has provided important benefits to the study villages, through the provision of pensions and relief to widows of fishermen, on which some elderly widows are completely dependent to support their livelihoods.

Reef and reef-associated fisheries are also the focus of numerous private traders and middlemen, who apart from government departments, are key institutions in local fisheries activities in all three study communities, providing access to markets, gear, credit and information. The services provided by traders and middlemen are relied upon throughout the year and allow small scale producers (i.e. all the fishermen from the three study villages) to access higher value export markets. For the poor households in all villages, this represents the only easily accessible form of credit, which becomes a safety net at times of crisis or during festival periods, when expenditure is high.

In Thavukadu, near-shore resources are also the focus of local community management, controlling access to near-shore resources by outsiders. A fee is imposed on outsiders to operate shore-nets adjacent to the village or use the village landing site. These fees are kept as a common fund and spent on village festivals or common expenses. Thus, they provide common benefit, not only in securing local access to near-shore resources, but also providing a fund to meet common village needs.

4.2.3 Organisations

Reef and reef-associated fisheries and the dependent small-scale fisherfolk are the target of local organisations, concerned both with welfare and empowerment of the local fishing communities but also the conservation and sustainable use of the reef resources. For the small-scale fisherfolk, the most important organisation at the village level is the Fisheries Union, with 80% of small-scale fisherfolk (men and women) active members. The union provides the only common channel through which problems and issues can be voiced by local fisherfolk at higher levels. 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 GOMMBR. The success of the union has been demonstrated

through 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. It has also been demonstrated through the union's 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 (Figure 7). These bans were the outcome of a common consensus that these activities were both dangerous and destructive, 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. For example, it was frequently noted by locals that in locations where extensive coral mining had taken place the force of waves had also increased, it was also widely acknowledged that the use of the metal tool for seaweed harvest was preventing regeneration of the seaweed and damaging the reef.

Through their concern for the local small-scale fisherfolk dependent on reef and reef-associated resources, local NGOs also provide important benefits. In the study area the NGO TRRM has been active in promoting local community development and participation through networks and self-help groups in 90 of the 98 coastal villages in the Gulf of Mannar. Almost 80% of the adult population of the coastal villages in Ramanathapuram district participate in TRRM activities and 33% of the TRRM staff belong to the coastal communities.

Figure 7 Village elder with seaweed scraping tool.

4.2.4 Social relations

The accessibility and open access nature of shallow reef flats and lagoons provide opportunities for all stakeholders, regardless of caste, class or gender. In particular reef resources have provided an opportunity for women to play a direct role in harvesting seaweed and shell resources. In some villages in the Gulf of Mannar (not the three study villages) some women are also involved in harvesting from boats and diving for shells and sea cucumbers. Beyond their involvement in direct harvest, women also take part in cleaning crab nets (Figure 8) and in fish processing and vending. The role of women in the small-scale fisheries of the Gulf of Mannar is a key factor in providing them with independence to control income and spending and support the household. Their role is often seen as pivotal in fisheries activities, for example fishermen often commented that without women to clean the crab nets, it would not be possible for them to go to sea frequently enough to support their household. It is also often remarked that the women from communities of the same *Mooper* caste found inland are not as outgoing and independent as those among the coastal communities, which may largely be due to their greater involvement in fishery activities.

The importance of the women's involvement is also demonstrated in their active participation in the Fisheries Union and local NGO (TRRM) activities. Of a total of 305 women in the three study villages, approximately one third are members of the Fisheries Union and their membership in TRRM is actively promoted.

For female-headed households, reef-based fisheries opportunities are critical in securing food and income. For widows the income from reef-based products is often the only source of income apart from their widow's pension. These are amongst the poorer households and constitute on average 13% of households in the study villages, with on average 5% of female-headed households lacking any male labour.

4.3 INDIRECT INFLUENCING FACTORS

The contribution of the reef and reef resources to the communities' ability to cope with the risks or opportunities associated with the background factors of seasonality, shocks and trends is summarised in Table 18 and described in the following sections (4.3.1–4.3.3).

Figure 8 A woman cleaning crab nets in Idinthakalpudur.

TABLE 18 A SUMMARY OF REEF BENEFITS TOWARDS COPING WITH INDIRECT INFLUENCING FACTORS

Influencing factors	*Benefits from the reef*	*Communities*[1]
Seasonality	*Complementarity and stability*	
	Fisheries opportunities are available in one form or another throughout the year	All
	Seaweed and shells provide income when other fisheries resources are low	Id, In, (T)
	Low season for agriculture (April–June) corresponds with peak seasons for squid and crabs	Id, (T)
	Crab and lobster resources are available throughout the year	All
Shocks	*Safety net*	
	Seaweed and shell collection, fish vending or ownership of a crab net is a source of livelihood and a coping mechanism for female-headed households or widows	All
	During drought periods reef resources were relied on heavily for food and income	All
	Reduces impact	
	Reduces impact and damage from cyclones	All
Trends	*Market growth*	
	Export market for crabs and seaweed	All
	Tourist market for shells as curios and jewellery	All

1 In, Indiranagar; Id, Idinthakalpudur; T, Thavukadu.

4.3.1 Seasonality

The diversity of near-shore marine resources enables households to exploit the fishery throughout the year, with the peak in harvest of different species complementing one another throughout the year and providing overall livelihood stability. Thus, seaweed and shell resources provide income when other fisheries resources are low, while crabs and lobsters provide a source of income more or less constantly throughout the year. Even during the windy months of August–October when non-mechanised country boats cannot access the sea, there are opportunities as labour on mechanised boats. Complementarity also occurs between fishery and agricultural production, with the peak season for squid and crab resources corresponding with the low season for agriculture in Idinthakalpudur and to a lesser extent in Thavukadu.

4.3.2 Shocks

The accessibility of the shallow reef resources provide a vital coping strategy for female-headed households (Box 7). Approximately 50% of female-headed household income comes from sea-based sources (seaweed, shells, crab nets, fish vending), increasing to 70% from crab nets in peak seasons.

The reef resources have also played an important role in the past by providing a safety net during severe cyclones and drought. Ramanathapuram district is considered drought prone and during the severe drought of 1966 and 1973–1974 coastal communities and landless agricultural labourers had to 'eat fish or starve'. There is also a recognition amongst all villagers of the reef's role in protecting against the forces of cyclones. 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 the extreme weather.

4.3.3 Trends

Reef and reef-related resources, encouraged by fisheries development policies, have stimulated the growth of high value export markets (as outlined in Section 4.2.1). At the same time, the tourist market in Rameswaram for shells (as curios and jewellery) has also grown, especially since the construction of Pamban Bridge in 1984 and the associated increase in tourists. These growing markets have brought benefits to all study communities, with shell collection carried out in all villages and approximately one-third of households in Indiranagar and Idinthakalpudur undertaking seaweed collection.

The presence of diverse markets (local and export) for reef and reef-associated products has supported commercialisation of the small-scale fisheries and likewise the opportunities for income generation amongst the small-scale fishers of the coastal communities. The majority of households in the three study villages are dependent on fisheries as their only source of income to meet growing household expenditures.

BOX 7 THE REEF AS A SAFETY NET FOR FEMALE-HEADED HOUSEHOLDS

Female-headed household 1:

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 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, she is knowledgeable about the various types of species and which can be exploited for income.

Female-headed household 2:

The husband of a local woman from Idinthakalpudur was both fishing and fish trading, but now he is aged and incapacitated due to abdominal surgery. Since the local woman realised that she would have to support her family she quickly learned fish trading from her husband and for the last 6 years she has been fish trading in the vending place permanently taken for lease by her husband in Keelakari fish market. For 6 months of the year it is risky to do fish trading as the fish prices are high and it is difficult for small traders to get a margin. During this period she goes to the sea to harvest seaweed and shells along with other women in the village. Through fish trading and seaweed collection she feels that it is the sea which has sustained her and her family.

5 CHANGES, CAUSES AND CONSEQUENCES

Livelihoods are dynamic and are constantly changing in response to direct and indirect influencing factors, which impact upon the strategies households are able to adopt and the ultimate outcomes of those strategies. The major changes, causes and consequences identified by poor households in the three study villages are outlined in Table 19 below.

TABLE 19 A SUMMARY OF KEY CHANGES IN REEF-DERIVED LIVELIHOODS, CONTRIBUTING FACTORS AND IMPACTS IN THE GULF OF MANNAR

Changes in reef-derived livelihood	*Contributing factors*	*Impact on strategies and outcomes*
Decreasing catch in terms of size, quantity and variety	• Increasing coastal population • Destructive fishing practices (dynamite fishing began during the 1980s) • Use of nets with smaller mesh size	• Increasing conflicts between fishers, especially between the small-scale and commercial sectors • More members of family have become involved in fishery activities, including women • Women's involvement has resulted in increasing workload • Injury due to dynamite fishing has resulted in loss of livelihood options for those affected • Increased participation in fisheries unions, promoting ban on dynamite fishing, coral mining and lobbying support for small-scale fishers • Increasing competition and low returns • Increasing livelihood insecurity (food and income)
Increasing technology and mechanisation of fishing (including mechanisation of boats, use of synthetic materials for fishing nets, increasing numbers of species specific nets)	• Increasing commercialisation of fishery • Fisheries development policies of government • Growth of markets and emergence of traders and middlemen who promote and supply new fishing gears	• Increasing conflicts between fishers, especially between the small-scale and commercial sectors • Increasing dependency on traders/middlemen to access markets and gear • Increasing reliance on credit from traders/middlemen • Increasing participation in fisheries unions lobbying for support for small-scale fishers • Increasing income insecurity for small-scale fishers
Growth of commercial markets for marine products (crabs, seaweed, shells)	• Diversification and increasing demand of inland market • Increasing demand for seaweed products for Agar processing industries and for export • Trade policies promote development of export markets • Growth of tourism due to improved access to Pamban Island (bridge construction 1984) • Increasing awareness of value of certain shell species, e.g. sacred chank as well as greater buying power amongst tourists (before the market was limited to more affluent families)	• High value products and market demand encourage more people to take up harvest as livelihood opportunity • Increasing dependency on traders/middlemen to provide specific gears and access to markets of export species • Increasing reliance on credit from traders/middlemen • Increasing income security, due to diversification • Increasing income security, due to diversification and added value for the reef products through market growth
Loss of access to near-shore marine resource	• Growth in environmental legislation as a result of international and national concern for biodiversity • Recognition of declining reef and near-shore resources • Official declaration of islands and surrounding waters as GOMMBR • General recognition of local resources users as 'source' of negative impacts on biodiversity • Increasing legislation controlling exploitation and access to resources • Emergence of regulations to control access to near-shore resources by large scale commercial fishing operations	• Some locals reportedly continue to access islands and adjacent shallow reefs and seagrass beds illegally and harvest prohibited species • Loss of ownership and responsibility for resources • Increasing reliance on unions to voice problems and deal with conflicts

Changes in reef-derived livelihoods in the Gulf of Mannar, have had both positive and negative outcomes for people's lives.

5.1 POSITIVE OUTCOMES

The most significant positive outcome in the lives of the three study villages has been the growth of commercial markets for marine products. Supported by the diversity of reef products available, including high value species, market growth has been the product of increasing and diversifying demands from inland markets, as well as the growth of export markets (as described in Section 4.2.1). Growth in the tourist market for shell products at Rameswaram, associated with improved access since the construction of Pamban bridge, combined with increasing awareness and buying power of tourists, has also increased market opportunities. With growing markets local livelihoods have become commercialised and income security has been enhanced. For the small-scale fisherfolk this has largely been supported by traders and middlemen who have provided the infrastructure to access different markets.

5.2 NEGATIVE OUTCOMES

Many changes in people's lives in the three study villages have not been positive. These changes can be attributed to three main causes, namely increasing technology, declining resources and loss of access.

5.2.1 Increasing technology

While the commercialisation of fisheries has brought about positive outcomes, it has also been a contributing factor to increasing levels of technology and mechanisation of the fishery, supported by government policy and the emergence of traders and middlemen. With mechanisation and increasing technology, small-scale fishers, lacking the financial resources and social networks to access new innovations, have become marginalised by a larger and more resourceful commercial sector. In the Gulf of Mannar, this has resulted in increasing conflicts between commercial and artisanal fisherfolk, focused primarily on the resources in the 'trapped sea', where artisanal fisherfolk frequently lose their nets in collisions with commercial trawlers. Loss or damage to nets is a significant risk for small-scale fisherfolk. This became such an issue that it led to increasing participation in the Fisheries Union and ultimately the emergence of regulations controlling access to near-shore resources, such that commercial trawlers and small-scale fisheries activities are restricted to separate days of the week.

Increasing technology has also brought about a growing dependency on traders and middlemen, who supply new nets specific to the target species for export (e.g. crab nets). As mentioned above, traders and middlemen provide important services, supporting small-scale fisherfolk in entering commercial fisheries and accessing markets. However, this has also created a dependency and increasing reliance on traders and middlemen as a source credit, which is frequently inequitable and exploits the small-scale fisherfolk leading to income insecurity.

5.2.2 Declining resources

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 overexploitation (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 the 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.

Despite the overwhelmingly negative outcomes of resource decline, there has been a positive side-effect through the increasing awareness of local communities and participation in the Fisheries Union promoting local bans on destructive fishing practices and lobbying for support for small-scale fishers.

5.2.3 Loss of access

Recognition of the declining resources in the Gulf of Mannar, together with increasing international and national concern for coral reef resources and biodiversity have led to the emergence of environmental policies and legislation promoting coral reef and species conservation. Legislation has largely viewed the local resource users as the 'source' of resource degradation and declining biodiversity, and consequently has prohibited many of their activities. This has led to restrictions on the typical sea-based livelihoods of the coastal communities of the Gulf of Mannar and has displaced local communities from using the adjacent natural resources. Although presently the enforcement of legislation concerning the use of the islands and adjacent shallow reefs and seagrass areas (Section 1.2, Box 1) is weak, it has the potential to greatly impact upon local fishing communities, in particular the poor households and female-headed households, with no access to viable alternatives.

Participation in the Fisheries Union is enabling fishing communities to voice concerns and obtain better support. There is also potential for greater participation in resource management through research and development programmes supported by environmental policies and donor interests in promoting sustainable use of coral reef resources (Section 4.2.1). However, so far reports suggest there is little integration of the Fisheries Union activities, or development of community participation in management decisions concerning the GOMMBR.

6 SUMMARY AND CONCLUSIONS

The Gulf of Mannar, on the southern border of Tamil Nadu, is home to an extensive system of shallow coral reef, fringing 21 low lying coralline islands and sheltering mangroves, shallow lagoons and large areas of seagrass, separated from the mainland coast by a relatively shallow 'trapped sea'. Along the coastline live a large and growing population, who are well connected to the rest of the state and local and external markets. Government support and services are well developed and the people of the Gulf of Mannar in general enjoy above average standards of health and education. However, despite positive social development indicators, the incidence of poverty in some places is high, in particular among the small coastal villages existing on the edge of development and often in marginal lands on the sandy shoreline. For these communities, the coral reef and near-shore resources are the foundation of livelihoods, supporting the majority of households.

Amongst the coastal fishing communities of the Gulf of Mannar, poverty was found to be significant, with the average household income below the national poverty line and the majority of households in the current study classifying themselves as 'poor' or 'less well off'. Typically poverty is associated with those lacking financial and physical resources, it was also associated with households with a limited workforce, such as female-headed households or households with many female children. For these poor households, livelihood opportunities are defined by caste and are almost entirely associated with the traditional small-scale near-shore fishery. Limited opportunities are available for some households as labourers in coastal agriculture, or in tourism activities associated with the pilgrim centre at Rameswaram, on the eastern side of the Gulf. However, in general the diversity of livelihoods is limited and in the heavily populated and drought prone coast alternatives are few.

The coral reefs of the Gulf of Mannar form an integral part of the coastal ecosystem: creating the islands; sheltering the lagoons and seagrass habitats; and providing a nursery and feeding ground for ocean going fish. For the coastal communities the coral reefs and near-shore resources are the basis of their livelihood. They provide shelter to their homes and property, sources of income, food, medicines, and are the focus of an extensive knowledge system and diverse range of skills. Complex traditions and rituals are associated with the fishery, some of which relate to particular areas of reef or particular reef species. Thus the reef and near-shore resources are at the centre of the culture and way of life of the coastal people of the Gulf of Mannar and have been so for many centuries. As articulated by a local fisherman (Box 8), the extent of the benefits arising from the reef and reef-associated resources reaches far beyond the coastal villages themselves.

Many poor households depend on the reef and reef associated resources as their main source of protein and income throughout the entire year. For some, the accessible shallow reef flats and shallow lagoons provide an important keystone resource when bad weather makes other resources inaccessible. For coastal farmers, seasonal lows in agricultural production are compensated by peak seasons in certain near-shore resources, providing important sources of food. For others, the near-shore resources provide a critical safety net and coping mechanism in the face of sudden crises, protecting their homes and property from the full impact of cyclones and providing a source of food during periods of drought. For female-headed households or widows the shallow reef resources can be accessed by foot, and allow their involvement in direct harvesting of seaweed and shell resources. This provides a crucial fall back, when faced with the sudden loss of the main provider, it also offers an important means for women to gain some independent income and can increase their control over household finances.

For small scale traditional fishery operations the coral reef is a refuge, whose shallow and complex structure and high biological diversity prevent access by larger industrial operations. The open access reef resource, which requires little investment and simple local technology to exploit, is also an accessible sink

BOX 8 MULTIPLE FISHERIES-BASED OPPORTUNITIES

'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.'

for migrants, lacking financial and physical resources. The diversity of reef products offers a multitude of market opportunities, feeding the demand of both a growing local population and high value export markets. Indeed, reef products have been exported from the Gulf of Mannar for nearly two thousand years, when pearls were traded with the Roman Empire. Such lucrative export markets offer considerable opportunities and have attracted many outsiders to the Gulf to profit from the rich resources.

However, many of the benefits which the coral reef and near-shore resources of the Gulf of Mannar have provided for many centuries are beginning to seriously decline. The growing population is placing increasing pressures on the reef resource, driven both by their own subsistence needs, as well as local and external demands for reef products. In many cases, this is leading to over-harvesting and damage to the reef resource. The reef is also being degraded by the impacts of externalities from agriculture, industries and the high population density bordering the Gulf of Mannar, whose waste products concentrate in the shallow waters of the Gulf and contribute to the overall degradation of the near-shore environment. In addition to these impacts, global warming and increasing sea surface temperatures have caused widespread coral bleaching and coral mortality throughout the Gulf of Mannar. Natural diseases and outbreaks of coral predators also take their toll. Thus, combined, these pressures are acting to increasingly erode the benefits provided by the reef and threaten the role of the reef resource in supporting local livelihoods, such that reef dependence is becoming the source of vulnerability amongst the coastal communities.

Concern for the degrading reef and near-shore resources and the consequent loss of biodiversity is one expressed at global, national and local levels. It has led to national policies and legislation aiming to conserve the Gulf of Mannar resources (through the GOMMBR and associated laws and regulations). It has also seen increasing international and national funding for research and development programmes to better understand the resource, how people interact with it and to promote sustainable development and greater community participation in resource management. Concern at local levels has also been apparent through increasing participation in the local Fisheries Union and the emergence of a number of locally agreed bans on destructive activities, in support and extending existing government bans.

These responses at various levels have great potential to benefit both the local communities and the resource they depend on, helping reduce the risks communities face in light of increasing resource degradation and ensure the sustainability of the reef itself. However, so far the local evidence suggests that these efforts have yet to work in synergy and the balance has been towards the priorities of reef conservation, with only limited inclusion of the complexity of interactions between the local communities and the reef resource and the needs and aspirations of local poor reef stakeholders. There is clearly an urgent need for local needs and priorities to be linked into wider societal objectives for the reefs of the Gulf of Mannar to create a solution which is locally applicable and equitable.

7 REFERENCES AND NOTES

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NOTES

1 For example: DOD, 2001; Deshmukh and Venkataramani, 1995

2 Government of Tamil Nadu, Commissioner of Fisheries, website: http://www.tn.gov.in

3 Government of Tamil Nadu, Commissioner of Fisheries, website: http://www.tn.gov.in

ANNEX 1 OVERVIEW OF RLA METHODOLOGY

This annex gives a brief outline of the methodology developed during the Gulf of Mannar RLA case study. For a more detailed description of methods, refer to IMM and SPEECH (2002).

The RLA case study methodology was based on DFID's Sustainable Livelihoods Approach[1] (SLA) and employed and developed a range of participatory research techniques (see IMM and SPEECH, 2002; and Bunce *et al.*, 2000). The research process undertook the following series of steps:

(1) Understanding the livelihoods approach and reef livelihoods framework
(2) Applying the reef livelihoods framework
(3) Implementing the research process

- Village selection
- Community level analysis
- Poor stakeholder identification
- Poor stakeholder focus group analysis
- Individual household and key informant level analysis
- Validation.

UNDERSTANDING THE LIVELIHOODS APPROACH AND REEF LIVELIHOODS FRAMEWORK

Developing an understanding of the livelihoods approach and its adaptation to reef livelihoods helped focus the research towards the specific outputs required. This was principally undertaken by research groups reviewing the RLA Global Overview document and SLA literature.

APPLYING THE REEF LIVELIHOODS FRAMEWORK

To assist in the process of applying the reef livelihoods concept to the realities of fieldwork and the specific outputs required, two guides were applied:

1 Reef livelihoods checklist

The reef livelihoods checklist was developed based on the Global Overview. It is a checklist of questions concerning the type of benefits which may be expected to arise from coral reefs to all aspects of a person's livelihood. It is intended to be used as a guide to help focus the use of research tools. It is an extensive, but by no means exhaustive list of questions and in the time available for the research it will clearly be an impossible task to find an answer to each question. Furthermore, it is likely that new questions will arise as our understanding develops.

2 Benefit criteria tables

These tables were used to assist in tracking and compiling the information collected in the field in order to ensure the following was collected for the different poor stakeholder groups:

- Numbers of beneficiaries
- Types of beneficiary
- Importance of/dependence on benefit
- Seasonality and frequency of benefit
- Role of reef in benefit (direct/indirect)
- Alternative benefit
- History of benefit
- Cost of benefit.

The benefit criteria tables describe these benefits, provide indicators for their measurement, suggest means of verifying those indicators and provide some examples.

IMPLEMENTING THE RESEARCH PROCESS

The research involves a participatory process between the field team and case study communities. The process involves a series of research tools, which are used to apply the reef livelihoods framework guided by the checklist and benefit criteria, in the following series of steps.

Step 1: Village selection

Time available for the study limits field research to only three small villages or communities in the study area. While this is too small a sample size to be representative of the full diversity of the study area, selection of the villages should take into account the major differences in the area and represent as far as possible a 'norm' or 'average' village or community (i.e. avoiding extremes).

Thus, the first stage of the village selection process involves understanding the major differences in the study area in terms of:

- Livelihood options and diversity
- Access to the reef
- Seasonal variability of livelihoods
- Community organisation.

The information required for village selection may be obtained from secondary data or it may be necessary to organise consultations with village representatives and undertake a village livelihood matrix.

Step 2: Community level analysis

Once the villages have been selected, the following series of tools are used at a community level:

Social mapping: to develop an overall view of the village composition, occupational options and gender roles.

Wealth ranking: to understand local perceptions of poverty and to use local poverty criteria to categorise households accordingly.

Occupational matrix: to understand risk, investment, return, women's involvement for different livelihood strategies or livelihood activity groups.

Overlapping livelihood analysis: to understand household livelihood strategies and establish those mixed or diverse strategies and crosscheck who is involved in such strategies.

Resource Mapping: to understand the biodiversity of coastal and reef areas, occupational access to and control of resource areas by vulnerable groups, resource conservation practices and social/religious beliefs and activities associated with places and local knowledge of resources and resource use.

Step 3: Poor stakeholder identification

For further analysis of the types and extents of benefits from the reef to poor members of the village or community a group of poor stakeholders was identified for focus group work. Identifying the poor stakeholder group uses information obtained during social mapping and wealth ranking exercises. The selection is undertaken from the lower ranking households and attempts to maximize the number of different poverty criteria represented.

Step 4: Poor stakeholder focus group analysis

Once a group of poor stakeholders was identified, the focus group work applied the following research tools:

Seasonal diagrams: to understand seasonal diversities and fluctuations in terms of access to resources, availability, employment, income and expenditure patterns, and patterns of migration.

Trend analysis: to understand changes in reef-based livelihoods (including factors such as harvests, markets, physical access, perceptions, population, status of reef area, conservation practices and beliefs) and to understand what factors have led to change, what impact these changes have had on the vulnerable groups, and what coping mechanisms have been employed.

Venn diagrams: to understand local institutions, organisations and policies, their service level and their relationships, linkages, functions and relevance as perceived by locals. To understand how the institutional and policy context has changed and what impact this has had from the local perspective.

Step 5: Individual household and key informant level analysis

Semi-structured interviews were carried out in order to cross check and validate information from community and focus group levels, and develop an understanding of key issues, including:

- Trends, historical knowledge base and resource use patterns from oral histories
- Traditional knowledge, including; folk taxonomy and medicinal values
- Social values, beliefs, rituals, exchange networks and collaboration
- Intrahousehold distribution of income, decision-making and vulnerability
- Individual household coping strategies.

Step 6: Validation

Throughout the research process information was cross-checked, both within and between research tools and between participants. On-going cross-checking and triangulation of data was essential to ensure the information collected was valid. This was assisted by the use of field tracking tables.

Where possible, a validation process also took place at the end of the research, whereby the findings were presented back to the community in an accessible format for their final comments and approval.

NOTE

1 For more information on SLA refer to http://www.ex.ac.uk/imm or http://www.livelihoods.org

ANNEX 2 BIODIVERSITY OF LOCALLY EXPLOITED SPECIES IN THE THREE STUDY VILLAGES IN THE GULF OF MANNAR

Type of resource	*Local name*	*Scientific or common name*
Seaweeds	Marikolunthu pasi,	*Gelidiella* spp.
	Alva pasi,	*Gracilaria*
	Pakoda or Karutham pasi	*Turbinaria*
	Khorai pasi	*Sargassurn* spp.
Fish	Mural	*Albenner* spp.
	Ooli/karaooli	*Sphyraena*
	Choodai	*Sardinella*
	Udagam	*Gerres* spp.
	Seraiah	*Pomadasys* spp
	Madanam	*Gaterin* spp.
	Paarai	*Alectis* spp.
	Vilaimeen	*Lethrinus* spp.
	Thirukkai	*Dasyatis*
	Seela	*Cydium* spp.
	Katla/parai	*Scomberodes*
	Sura	Shark
	Naharai	
	Kilinjan	
	Valai	
	Poola	
	Kumula	
	Tholan	
	Muduvalli	
	Panna	
	Nethali	
	Kattiklalai	
	Kalvetti	
	Vannathi	
	Vali	
	Vengarai	
	Thondan	
	Kuthippu	
	Vaval	
	Sehani	
	Sivaram	
	Savalai	
	Saral	
	Kutha	
	Keeri	
	Pachallai	
	Pali meen	
	Kilathi	
	Kendai	
	Matlish	
	Mailmeen	

Type of resource	*Local name*	*Scientific or common name*
Crustacea – crabs	Pullika nandu	
	Kolukattai nandu	
	Yerumanakku	
	Peikalnandu	
	Kulzhinandu	*Scyllaserrata*
	Oolakalnandu	*Portunees pelagicus*
	Silivainandu	*Chaybdis* spp.
Crustacea – lobsters	Singi	*Panulirus sewelli*
	Matta singi	*Thenus Orientalis*
	Thala singi	*Panulirns Homarus*
	Mani singi	*Panulirns Ornatus*
	Ponvandu singi	*Panulirns Versicolor*
	Rama singi	
	Povali singi	
	Kauthran singi	
	Kilathi singi	
	Kolta singi	
	Kuduva singi	
	Karai singi	
***Crustacea* – prawns**	Vellai viral	
	Patchai viral	
	Karuvandu viral	
	Chunambu viral	
	Narai viral	
	Kooni viral	
Molluscs	Chovi	Cowrie
	Muthu	Ornamental shell
	Chanku	*Xanchous pyrum*
Sea mammals	Avulia	*Doang doung*

A Case Study from South Andaman Island

Aparna Singh

Harry Andrews

ACKNOWLEDGMENTS

Thanks are due to many people who contributed to this study. Aparna Singh, Andaman and Nicobar Environment Team, led the study on South Andaman Island and committed considerable energies throughout. Mr Harry V Andrews, Director, Madras Crocodile Bank Trust/Centre for Herpetology, and the Projects Coordinator Mrs R Rajyashri provided encouragement and support during the entire project. Dr Rauf Ali also made valuable inputs and the field assistants, who lent their sense of camaraderie essential to the successful completion of the project.

Philip Townsley and John Devavaram provided training and guidance for the fieldwork, which was a key factor in the implementation of the project.

A special thanks to Dr Ravi Sankaran and Mr Manish Chandi for useful discussions, information and editorial help in writing the report. Finally, Mr Udai Singh for his support, encouragement, and enduring patience.

We are also grateful to the local communities from the three study villages, who gave up their time and imparted their knowledge for the purposes of this study. We thank them and hope that the discussions and knowledge they shared will benefit potential future work with ANET and external programmes concerned for the coral reef and sustainable development of the Andaman and Nicobar Islands.

All photos in Study 3 were supplied by James Wilson, Kusi Lda.

NOMENCLATURE

ACRONYMS

ANET	Andaman and Nicobar Environment Team
APL	Above the Poverty Line
BPL	Below the Poverty Line
GCRMN	Global Coral Reef Monitoring Network
ICRMN	Indian Coral Reef Monitoring Network
NGO	Non-Governmental Organisation
MGMNP	Mahatma Gandhi Marine National Park
RJMNP	Rani Jhansi Marine National Park

LOCAL TERMINOLOGY AND ABBREVIATIONS

Dhonghis	Locally made wooden boat, either mechanised or non-mechanised, 1–2 m in length and constructed of wood with a dugout hull and plank sides
Rs	Indian Rupee (exchange rate ~47Rs: 1US$)

BACKGROUND TO THE SOUTH ANDAMAN CASE STUDY

The South Andaman Island case study was carried out in partnership with ANET and in consultation with the Indian Coral Reef Monitoring Network (ICRMN). The main work was undertaken over a period of 6 weeks beginning in June 2002, following a 3-day training workshop in RLA methodology set out in IMM and SPEECH (2002). The latter was largely adhered to, but some key changes were made to the methodology to successfully secure improved data capture and cope with local constraints in data collection (as outlined in Annexes 1 and 2).

The following case study report provides a detailed overview of reef-based livelihoods on South Andaman Island, focusing on three fishing communities. The study highlights the nature of reef-based livelihoods amongst fishing communities, who have been migrating to the islands from mainland India since the 1960s. It illustrates a situation where families have often migrated away from poverty with the hope of improving their livelihoods from the abundant natural resources available on the islands. It also represents a situation where the local economy has been highly subsidised by the government and where fisheries and more recently tourism (partly reef-based) have emerged as major growth poles. However, at the time of the study, the Andaman and Nicobar Islands were facing a major upheaval of immigration patterns through a Supreme Court Order (Box 1, Section 1.4), which is curtailing all future illegal settlement opportunities and is currently affecting existing migrants, many of whose status is considered illegal.

The first two sections of the report give a contextual overview of the study area and study communities, outlining key social, ecological, economic and administrative characteristics of the area and local livelihood systems. Section 3 discusses the features of poverty in the study communities, identifying what characteristics locally define poor households and estimating the extent of poverty existing in the communities. Benefits arising from the reef resources to all aspects of the livelihoods of the poorer members of the communities are described Section 4, entitled Reef Livelihoods. Section 5 outlines how reef-derived livelihoods have changed and discusses the causes of these changes and impacts on poor people's livelihoods. Finally, concluding remarks are made in Section 6, summarising the key aspects of the benefits of reef resources to the livelihoods of poor households and how these have responded to change.

1 STUDY AREA CONTEXT

The Andaman and Nicobar Archipelago is a group of 306 islands and 206 rocky outcrops situated in the Bay of Bengal off the eastern coast of the Indian mainland. The islands lie in a crescent that stretches 740 km from north to south (13° 41' N to 6° 45' N) and 190 km from east to west (92° 12' E to 93° 57' E) from Cape Negrais of Myanmar to Banda Arc of Sumatra, Indonesia (Figure 1). The islands are divided into two groups: the Great Andaman group in the north; and the Nicobar group in the south. The nearest landmass to Great Nicobar Island is Sumatra, 145 km away, while the Myanmar coast is roughly 280 km north of Landfall Island, the northernmost island in the Great Andaman's group.

1.1 SOCIAL SETTING

The populace of the Andaman and Nicobar Islands is comprised of indigenous groups and settlers.

1.1.1 Indigenous groups

The tribes of the Andaman and Nicobar Islands belong to the Negroid and Mongoloid races. They are hunter-gatherers living principally on honey, roots, wild boar and fish. The total tribal population, as of the 1998 census, was estimated to be 25 935 of which 96% were Nicobarese. The other tribal groups consist of the Jarawa (300), Shompen (214), Great Andamanese (32), Sentinelese (100) and Onge (97).

1.1.2 Settler population

The settler population originate from mainland India, however, there are also considerable numbers of Karens from Myanmar (around 3000, concentrated in Webi and Karmatang in Mayabunder on Middle Andaman) and Sri Lankans (on Katchal Island in the Nicobars). The Karens were brought over by the British from Myanmar as early as 1925 to clear forests for settlements and for forestry operations. In the 1980s, 300 Sri Lankan settlers were brought over, and their population has now increased to almost 1000. They are now the subject of controversy with the indigenous Nicobaris over the legality of their settlement and a public interest litigation has been filed in court by the Tribal Council.

From 1942, farmers were encouraged to settle in the Andamans by providing allotments of 5 acres of hilly land and 5 acres of paddy land to each family. In the 1950s South, Middle and North Andaman Islands were opened up for settlement by refugees from erstwhile East Pakistan. From 1955 to 1959, the majority of settlement took place in the Diglipur area on North Andaman Island and on South Andaman Island. The Indian Government also settled Ranchi tribals (from the Chhota Nagpur, Bihar state), throughout the Andaman and Nicobar Islands, who are mainly employed in government jobs especially in the Forest Department.

From 1960 to 1981, the government settled 92 fisher families. Under the settlement scheme there was a provision to settle 20 fishers a year with the purpose of increasing the fishing economy in the islands and providing fish to the island populace. These early fisherfolk settlers were provided with financial assistance for the sea fare (Rs 200 ~US$4), fishing implements (Rs 1000 ~US$21), house construction (Rs 800 ~US$17), and a subsistence allowance (Rs 200 ~US$4 per month per family). The first settlement of fisherfolk settlers consisted of five settler families from Kerala, who were settled in Hope Town, also known as Panighat. Subsequent fishers were brought in and settled as shown in Table 1.

The present settler population numbers 356 265 as shown in Table 2. The majority of the population (88%) live on the Andaman Islands, which since 1991 has seen a decadal growth rate 1.4 times the growth rate for India as a whole. In contrast, population growth in the last decade on the Nicobar Islands is significantly less than both the Andaman Islands and India as a whole (Table 2). During the current study it was estimated that fisherfolk constitute approximately 6% of the total settler population, amounting to over 20 000 people and almost double the number in 1995. In the last three decades there has been a spurt of immigration with fishers from various parts of India, including Andhra Pradesh, Kerala, West Bengal, erstwhile East Bengal and Tamil Nadu. New immigrants are attracted by the possibility of a better livelihood than on the mainland, with land easily encroached from forest areas and good potential for fishing. Their immigration has been supported by subsidised

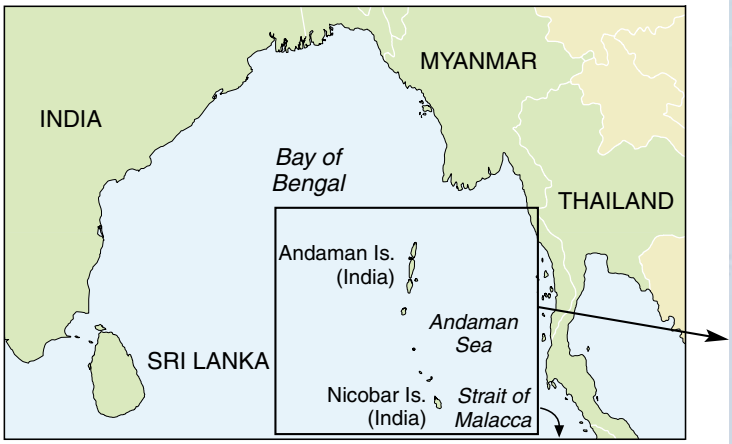

Figure 1 Location of Andaman and Nicobar Islands.

TABLE 1 DETAILS OF THE EARLY SETTLEMENT OF FISHERFOLK

Year	*Number of families*	*Settlement area*	*Community origin*
1960	5	Panighat, South Andaman	Malayalee, Kerala
1960-61	9	Panighat, South Andaman	Telugu, Andhra Pradesh
1960-1961	5	Dandus point, South Andaman	Malayalee, Kerala
1968-69	9	Prem Nagar and Aberdeen, South Andaman	Telugu, Andhra Pradesh
1979	20	Panighat, South Andaman	Telugu, Andhra Pradesh
1980	20	Panighat, South Andaman	Telugu, Andhra Pradesh
1981	20+4	Panighat, South Andaman	Telugu, Andhra Pradesh

TABLE 2 ANDAMAN AND NICOBAR ISLANDS DEMOGRAPHIC DATA

	India	*Andaman and Nicobar Islands*	*Andamans*	*Nicobars*
Population[1]				
Total	1 027 015 247	356 265	314 239	42 026
Male	531 277 078	192 985	170 378	22 607
Female	495 738 169	163 280	143 861	19 419
Decadal growth rate[1] (1991–2001)	21.34	26.94	30.14	7.19
Population distribution[2]				
Urban	285 354 954	74 955		
Rural	741 660 293	205 706		
Population density[2] (ps/km^2)	324	34		

1 2001 census provisional figures
2 1991 census.

TABLE 3 A COMPARISON OF SELECTED SOCIAL DEVELOPMENT INDICATORS FOR ANDAMAN AND NICOBAR ISLANDS AND INDIA

	India	*Andaman and Nicobar Islands*
Literacy rate[1]	65.38	73.02
Male	75.96	78.99
Female	54.28	65.46
Sanitation[2] % households with a latrine	23.7	52.3[2]
Infant mortality per 1000[1]	72	23.06

1 1991 census
2 estimated from a sample of 1020 households.

ship fares, food and the opportunity to earn one of the highest average daily wages in India. Fishers have spread out to many different islands, but a large concentration of the fishing community are found in South, Middle and North Andaman Islands.

Fifty-eight per cent of the population of the Andaman and Nicobar Islands is rural, where population density is nearly 10 times less than India as a whole (Table 2). Indicators of social development rank the Andaman and Nicobar Islands above India as a whole, with higher literacy rates and lower infant mortality (Table 3). Sanitation also appears to be much better, although data for the islands are from only a limited sample (Table 3). According to statistics[1] from 2000, 99% of inhabited villages have an electricity supply, 100% have drinking water supplies and there are 123 health clinics on the islands.

The 1991 census indicates that the settler population on the islands is predominantly Hindu (68%), followed by Christians (24%), Muslims (8%) and Sikhs, Buddhists, Jains and others (each <1%).

1.2 ECOLOGICAL AND GEOPHYSICAL SETTING

The Andaman and Nicobar Archipelago is rich in both marine and terrestrial biodiversity and hosts probably the healthiest and least impacted expanses of coral reef within the Indian Ocean. The Andaman Islands are just northwest of the 'Coral Triangle', or the epicentre of marine biodiversity, an area enclosing the Philippines, Central and Eastern Indonesia and Northern and Eastern Papua New Guinea. The Andaman and Nicobar Islands also support a substantial cover of evergreen rain forest and the third largest extent of mangrove cover in India. Within these ecosystems there is a wealth of endemism and globally unique flora and fauna.

1.2.1 Coral reefs

The islands are fringed by some of the most spectacular and extensive coral reefs in the world. Vousden (2001) and Turner *et al.* (2001) have reported 197 species of coral within 58 genera. Kulkarni (2000) identified 115 species from the Mahatma Gandhi Marine National Park (MGMNP: see Figure 5) in an area of 220 km^2. The Andaman reefs contain about 80% of the maximum coral diversity found anywhere in the world, making them the richest coral reefs in the Indian Ocean and an area of global significance (Turner *et al.*, 2001;Vousden, 2001).

From satellite imagery Turner *et al.* (2001) calculated the total reef area for the islands as 11 939 km^2, which compare with estimates by Wafar (1986), who reported the total reef area used in reef fisheries yield calculations for the Andaman Islands as 11 000 km^2. The reef structure around the Andaman Islands, as described by Turner *et al.* (2001), is mainly offshore coral growth on exposed banks, shallow gradual sloping fringing reefs on the windward shores, reef patches in bays, and steep sloping channel reefs in sheltered narrows. Fringing reefs consist of gradual reefs sloping seaward off moderate reef flats, sometimes with extensive flats. Reef slopes rarely exceed 20 m depths levelling off to a sand base colonized by massive coral colonies. Offshore reefs consist of an elevated plateau occasionally bordered by steep slopes into deeper water. Interestingly, the most diverse reef areas identified by Turner *et al.* (2001),

coincide with the main fishing areas for fishers from North, Middle and South Andaman Islands.

1.2.2 Forests

Out of the total geographical area of the Andaman Islands (6408 km^2), forest covers 5628.62 km^2 of which 2928.76 km^2 is reserve forest and 2699.86 km^2 is protected forest (ANI F, 2001; Andrews and Sankaran, 2002). Floristically, Champion and Seth (1968) have classified these forests into 11 types and some of these areas are now known to be significant biodiversity hot spots. The Andaman Islands also support one of the world's most extensive mangrove ecosystems, covering 1011.72 km^2 (Balakrishnan, 1989; Dagar *et al.*, 1991). Due to their long isolation these islands have evolved a significant diversity of flora and fauna with high levels of endemism, including Andaman affinities to Indo-China and Nicobar affinities to Indo-Malayan (Das, 1996; 1999; Andrews and Sankaran, 2002).

1.2.3 Topography

In comparison to the flat plains of the Nicobar Islands, the topography of the Andaman Islands is hilly and undulating and the elevation ranges from sea level to 732 m, with the highest peak, Saddle Peak, located on North Andaman Island. The main large islands, including Landfall, North Andaman, Middle Andaman, Baratang, South Andaman, Rutland and Little Andaman have a mosaic of mangrove creeks and freshwater streams, including freshwater swamps and peat bogs (Andrews 1999a; 1999b; 2000a; 2000b).

1.2.4 Geology

The origin of these islands is approximately dated as late Pliocene to Pleistocene (Chibber, 1934). The Andaman group of islands is an extension of the Rakhine (Arakan) Yomas range of Myanmar. The Nicobar group is considered to be a continuation of Mentaweri island, south west of Sumatra, and is of volcanic origin with coral reefs contributing to the upheaval of banks (Rodolfo, 1969; Weeks *et al.*, 1969; Ripley and Beehier, 1989; Das, 1996; 1998; 1999). The islands are seismic prone and have been discussed in detail by Ravi Kumar and Bhatia (1999).

1.2.5 Climate

The climate is characterised by heavy rain, with mean annual rainfall approximately 3500 mm. The islands receive rainfall for much of the year (during 1999 it rained for a total of 209 days in Port Blair), being exposed to both northeast and southwest monsoons. Maximum rainfall is between May and December, while January to April is comparatively dry. During the wetter season the sea is rough due to the rains along with high wind speeds and currents, making navigation very difficult. During the months of August and September there are two bouts of cyclonic spells, each generally lasting for more than a week. Temperatures range from a minimum of 18°C to a maximum of 34°C.

1.3 ECONOMIC SETTING

Development emphasis has been and continues to be focused on terrestrial rather than marine resources, with the main investment by government focusing on transport, energy and forestry (Figure 2), while fisheries, tourism and agriculture have had relatively low allocations. The islands rely heavily on imports from the mainland, as well as heavy subsidies from central government. The two most valuable growth options for recent developments are marine fisheries and tourism.

1.3.1 Forestry and agriculture

Forestry has been the primary focus of the economy since settlement began in the islands. Based on 1995 statistics, the revenue earned by forestry activities represented 50% of the total revenue for the islands. In 1997, the estimated number of

Figure 2 Felled timber, South Andaman Island.

workers in the forest industry totalled 19 800, including 6000 within the Forest Department, 3000 in private industry, 800 in the Forest and Plantation Development Corporation and 10 000 in the furniture-making industry. Currently the Supreme Court Order has put a stop to all forestry operations.

Agriculturalists began settling in the islands in the 1940s, brought over by the administration to provide food for the growing settlement. The land is more suited to plantation crops than paddy cultivation and over half of the agricultural area is dedicated to coconut and areca nut plantations (Andrews and Sankaran, 2002). With current increases in population it is likely that the agriculture carrying capacity has been surpassed (Sirur, 1999).

1.3.2 Tourism

Tourism was officially declared an industry in 1987 and expenditure on the tourism sector has increased from 1993. However, net earnings from tourism have so far been negligible due to the heavy subsidies on food and transport. Tourists are both from overseas and the Indian mainland, and are the focus of activities within the Mahatma Gandhi Marine National Park (MGMNP), where visitor numbers have grown from under 15 000 in 1991 to over 40 000 in 2001 (Singh *et al.*, 2002). Much of the tourism is focused on the natural resources, with beach and reef-based tourism forming the highlight of activities within the MGMNP.

1.3.3 Marine fisheries

Indigenous groups have been fishing in the Andaman and Nicobar Islands since their arrival. The history of fisheries development associated with the settlers dates back to the British Colonial era, when some of the indigenous people were employed as fishers during Archibald Blair's time in 1776–1779, specifically to provide fish for the nascent settlement. During British rule and the days of the penal settlement, the jail authorities in Port Blair had the responsibility of supplying fish to the public, and fishing was carried out by a team of convicts with an aptitude for fishing. Even after the abolition of the penal settlement, ex-convicts continued their profession, while the agricultural settlers of 1942 were already practising subsistence fishing. During this time, several private fishing companies attempted to start fishing operations in the islands, the first opened during the 1940s, followed by another in 1951. However, both these early operations were eventually disbanded.

The Andaman and Nicobar Island Administration established a Department of Fisheries in 1955. However, the Fisheries Regulation Act dates back to 1932 and landing profile data exist from 1942 to 2002. In 1950 the fisheries annual harvest was 44 tons, which has grown to a current harvest exceeding 30 000 tons.[2] Fisheries resources are considered to be plentiful, with an estimated potential of between 150 000 and 450 000 tons per annum, although little information is available on stock assessment or maximum sustainable yields.

Since 1988, the Blue Revolution has gradually been evolving the fishery in the Andaman and Nicobar Islands towards larger-scale export-driven commercial fishing. The involvement of local fishing communities in the export business is a very recent trend, which began 5 years ago. Prior to this fish was caught only for local consumption. The biggest market and export houses are located on South Andaman and presently three species of reef fish, are particularly important commercially for export: the Napolean wrasse (family: *Labridae*); and the locally known *Dollar fish* (Blue spot grouper, *Cephalopholis epinepheles*, or the Red Snapper, family: *Lutjanidae*).

The fishing craft and gear operated in the islands are mainly artisanal. As of 2002, a total of 2524 fishers were licensed to fish, employing a total of 1983 fishing crafts (Andrews and Sankaran, 2002). Of these fishing craft, 20% were non-mechanised country boats and 79% were mechanised country boats, known locally as *Dhonghis* (Figure 3). In addition, there are 18 larger craft owned by private companies for offshore fishing and trawling. Cast nets are used in shallow waters and for meeting subsistence needs, while gills nets and anchor nets are deployed from boats and target schooling pelagic species. Hand-line fishing is also undertaken extensively targeting reef species and often in combination with net fishing. Condemned or torn nets are also used in creeks, mangroves and small bays. Non-mechanised boats operate near-shore in harbours, bays, creeks

Figure 3 Tarring the bottom of a traditional mechanised craft or *Dhonghi* in Panighat.

and sheltered coves, and the fishing is undertaken on a daily basis. When weather permits, mechanised country boats may operate for longer trips of 3–5 days and fishers will often travel 10–12 hours with ice boxes to reach far off islands and deep reefs in order to obtain high-priced catches.

Fishing activities are governed by seasonal weather patterns, with the peak season corresponding to the period of low wind and rainfall from November to May during the north east monsoon. During this time the longer fishing trips can be made employing nets and lines. However, during the remaining months of June to October rainfall and winds are high and long distance trips and the use of nets is risky. During this time, cast nets are used extensively in shallow waters and hand-lines are used on nearby reef areas.

Fishers from the three communities use the same fishing grounds. As indicated in Figure 4, the distant fishing grounds for the peak season are the offshore areas of Mayabunder and Diglipur in the north, areas off Little Andaman in the south, areas off Havelock and Neil Islands to the East, and areas near Sentinel Island and the Jarawa tribal areas to the west. Fishing in and off tribal areas (Little Andaman, Jarawa, North Sentinel) is against the law, however it is reported to be commonly carried out due to insufficient enforcement (Andrews and Sankaran, 2002). Illegal fishing is also reportedly carried out in the Mahatma Gandhi Marine National Park (MGMNP: Figure 5), especially during the rough season.

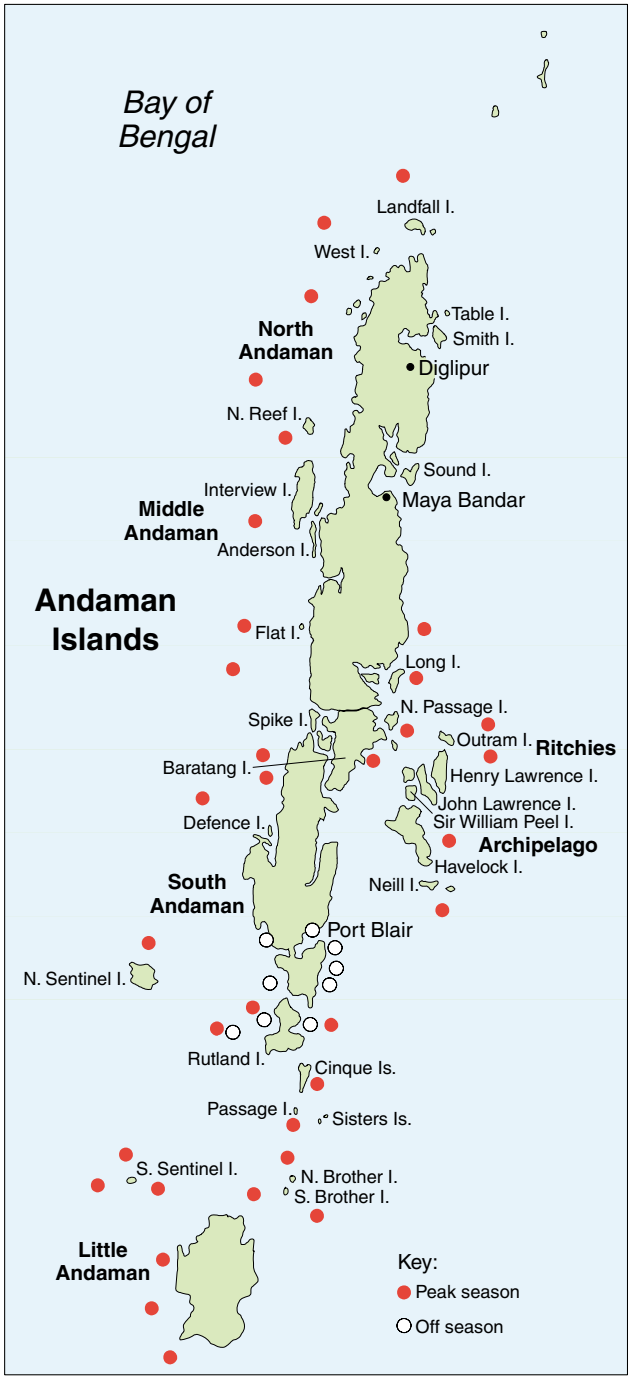

Figure 4 Peak and off-season fishing grounds exploited by fisherfolk from three study communities.

1.4 ADMINISTRATIVE SETTING

After independence in 1947, the Andaman and Nicobar Islands became a Union Territory of the Republic of India. A Chief Commissioner was appointed to the islands as the administrator. This post was later upgraded to Lieutenant Governor. An elected council of five counsellors looked after various portfolios. This was replaced by a decentralised *Panchayat Raj*, a three tier system consisting of *Zilla Parishad* at the first level headed by the *Zilla* president, followed by the *Panchayat* headed by *Panchayat* president, and finally the village level *Panchayat* headed by the *Pradhan* or president. The *Panchayat Raj* system is represented on the Island Council, which consists of nominated members headed by the elected Member of Parliament (MP), who represents the islands in the Home Ministry in Central Government and in the *Lok Sabha* (Lower House of Parliament). The MP plays a key role in deciding the policies to be adopted for the islands. Administrative staff are from mainland India and rotate their post on a 3-year basis.

Due to its strategic role, lying across one of the world's most important shipping lanes (the Straits of Malacca), most decisions regarding the islands are taken in New Delhi. This has had some consequences not conducive to the island situation. For example, road transport has been given preference over sea transport, which is much better suited to the islands.

The islands are considered as two revenue districts: the Andaman district in the north, encompassing 306 islands and

206 rocks and rocky outcrops of which 11 are inhabited; and the Nicobar district in the south, encompassing 24 islands of which 12 are inhabited. The districts are separated by the 10° channel and are further divided into subdivisions and Tehsils as outlined in Table 4.

Over 100 protected areas, tribal areas, national parks and sanctuaries, have been designated in the Andaman and Nicobar Islands, including two marine national parks: (1) Mahatma Gandhi Marine National Park (MGMNP), South Andaman; and (2) Rani Jhansi Marine National Park (RJMNP), in the Ritchie's Archipelago (Figure 5). The Department of Environment and Forests is responsible for national parks (including marine parks), sanctuaries and protected areas and all activities in these areas are strictly controlled, prohibiting extractive resource use, such as fishing. Coral reefs and marine resources located in unprotected areas come under the jurisdiction of the Directorate of Fisheries.

TABLE 4 ANDAMAN AND NICOBAR ISLANDS ADMINISTRATIVE DIVISIONS

District	*Sub Division*	*Tehsil*
Andamans	Mayabunder	Diglipur Mayabunder Rangat
	South Andamans	Ferrargunj Port Blair Little Andaman
Nicobars	Car Nicobar Nancowrie	Car Nicobar Nancowrie Great Nicobar

At the time of the study, the islands were undergoing the initial stages of a Supreme Court Order, concerning a petition filed by various NGOs concerned for the forest ecosystem and sustainability of development on the islands. Their concern arose due to the high level of immigration from mainland India together with unplanned development, which has resulted in forest encroachment on a large scale and consequently widespread degradation of the forests. As part of the Supreme Court Order (Box 1) evictions are to be implemented in phases, first in forest areas and then in revenue areas. Those families who immigrated to the islands post-1978 and living on encroached land will be evicted from this land and will have to find alternative homes (most likely rented accommodation) on designated allotted land. The ruling is to be strictly enforced and identity cards are to be issued to settlers and their descendants in an attempt to check further immigration.

BOX 1 AN OVERVIEW OF THE ANDAMAN AND NICOBAR ISLANDS SUPREME COURT ORDER

In order to halt the forest degradation and ensure sustainable development on the islands the order has ruled the following measures:

- Complete cessation of commercial logging activities by March 2003
- Prohibition of forest encroachment for agriculture or horticulture purposes
- Eviction of pre-1978 families remaining on encroached forest land, who have not yet shifted to allotted rehabilitation sites
- Eviction of pre-1978 families from land that is more than allotted entitlement;
- Eviction of post-1978 families from forest encroachments
- Issue of identity cards to all residents
- Complete phasing out of sand extraction over the next 5 years
- Restriction of any further tree felling to the barest minimum required to serve emergent public purposes and only after compensatory afforestation has been undertaken on the ground.

2 COMMUNITY CONTEXT

The following section provides an overview of the geographical, social, economic, ecological and administrative context of the three study communities on South Andaman Island. A direct comparison of the three study villages is given in Table 5 (page 159).

2.1 GUPTAPARA

2.1.1 Geographical and social setting

Guptapara village is located close to the north eastern border of Mahatma Ghandhi Marine National Park (MGMNP, Figure 5).

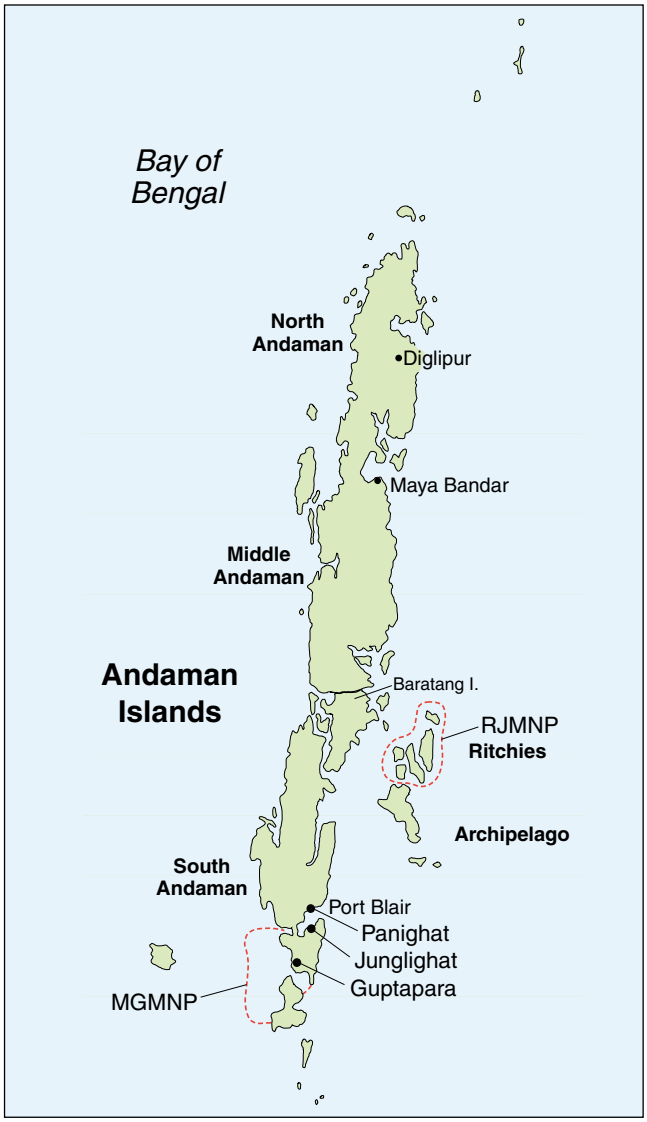

Figure 5 Location of study communities and marine national parks.

The village covers and area of 1.2 km^2 spreading from the mangroves along the shore, to the hilly slopes, which have been rapidly deforested through encroachment of the settler community.

The village was cleared to make an agriculture settlement in the coastal area in the early 1950s and was known originally as '*Hathidera*' or Elephant Camp. The population is mostly Hindu and of Bengali origin, the original families were allotted 5 acres of hilly land, 5 acres of paddy land and given Rs 20 (~$0.4) per month, as well as free rations for the first month. Originally there were nine settler families, but according to the 1991 census, the community numbers 743 people.

A road runs through the village, with a regular bus service to nearby Manglutan village, 4 km away. There is electricity in the village, water supplies, limited sanitation facilities and a number of small shops, all other services are located in Manglutan (Table 6).

2.1.2 Ecological and economic setting

The village was originally surrounded by forested hills to the east and mangroves along the coast. The hills have been deforested for vegetable cultivation and plantations of banana, coconut and arecanuts (beetle nuts), while low-lying land has been deforested for paddy cultivation. Mangrove areas have also been depleted through felling for construction timber and firewood.

Coral reefs are found close to the village and within the adjacent MGMNP. Nearby reefs have become degraded over the past 20 years due to fishing pressures and sedimentation. Coral reefs adjacent to the marine national park, around Rutland Island and Chidiyatapu Island and nearby areas can be accessed in non-mechanised country boats and are closer to Guptapara as compared to other study communities.

Thirty-five households have land holdings where they undertake farming activities, including paddy and vegetable cultivation. Women are involved in agricultural activities, undertaking cultivation, working as agricultural labourers and looking after livestock, such as cows, goats, chickens and ducks. Those families with considerable land holdings may supplement their income or food supply with fishing activities, either directly or through hiring their boats to other fishers. More recent settlers with small and fragmented land holdings, or no land at all, rely on agricultural labour or fishing opportunities for their livelihoods. Women are not involved in any fishing activities.

Fishing activities include cast netting, which is carried out in the near-shore shallow waters mainly for subsistence purposes, as

TABLE 5 VILLAGE COMPARISON TABLE

	Guptapara	*Panighat*	*Junglighat*
Natural resource access	*Marine resources:* nearby and distant reefs *Terrestrial resources:* paddy cultivation in low lying land and vegetable cultivation on hill encroachments	*Marine resources:* nearby and distant reefs *Terrestrial resources:* forest in buffer zone of national park and limited mangrove area for firewood	*Marine resources:* nearby and distant reefs *Terrestrial resources:* limited mangrove area for firewood
Social composition and settler origins	Hindu is predominant religion Bengali origin from West Bengal Settlement began 1950-1952	Hindu is predominant religion Initially Malayalee origin from Kerala, then Telugu origin from Andhra Pradesh. Settlement began 1960s	Hindu is predominant religion Telugu origin from coastal districts of Andhra Pradesh Settlement began 1976
Demography[1]	Population: 421 No of households: 78 (142)	Population: 3525 No. of households: 500 (174)	Population: 12 120 No of households: 2000 (1000)
Current settler status (% households and land/house ownership types)[2]	Allotted land: 24% Purchased land: 18% Encroached land: 13% Own house: 91% Rented house: 2%	Allotted land: 32% Purchased land: 3% Encroached land: 12% Own house: 68% Rented house: 18%	Allotted land: 42% Purchased land: 26% Encroached land: 0% Own house: 58% Rented house: 45%
Livelihood opportunities	Vegetable cultivation Paddy cultivation Livestock Fishing Fish vending	Fishing Fish vending Private business Government jobs	Fishing Fish vending Private business Government jobs
Livelihood strategies (% households)	Full-time fishing 67% Part-time fishing n/a Non-fishing 27%	Full time fishing 79% Part time fishing n/a Nonfishing 6%	Full time fishing 38% Part time fishing 38% Nonfishing 23%
Fishery operations (% of occurrence)	Cast nets: 5% Cast nets and hand-lines: 2% Hand-lines only: 65% Boat nets only: 0% Boat nets and hand-lines: 27%	Cast nets: occasional Cast nets and hand-lines: 0% Hand-lines: 26% Boat nets: 32% Boat nets and hand-lines: 41%	Cast nets: 0% Cast nets and hand-ines: 0% Hand-lines: 3% Boat nets: 68% Boat nets and hand-lines: 29%
Gender roles Key: M/F male/female ✓ Involved ❍ Not involved ✗ No information	***Principle occupation*** ***M*** ***F*** Fishing ❍ ✓ Fish vending ❍ ✓ Vegetable cultivation ❍ ❍ Paddy cultivation ❍ ✗ Livestock ❍ ❍	***Principle occupation*** ***M*** ***F*** Fishing ❍ ✓ Fish vending ❍ ❍ Private business ❍ ❍ Government jobs ❍ ❍	***Principle occupation*** ***M*** ***F*** Fishing ❍ ✓ Fish vending ❍ ❍ Private business ❍ ❍ Government jobs ❍ ❍
Household human assets[3]	Average household size: 5.4	Average household size: 7.05	Average household size: 6.06
Household productive assets	Nonmechanised country boats: 2% Mechanised country boats: 20% Cast nets: 7% Hand lines: 94% Boat nets: 27%	Nonmechanised country boats: 21% Mechanised country boats: 50% Cast nets: 0% Hand lines: 67% Boat nets: 73%	Nonmechanised country boats: 26% Mechanised country boats: 39% Cast nets: 0% Hand lines: 32% Boat nets: 97%
Vulnerabilities and risks	• Seasonal weather patterns (fishing and agriculture) • Net damage or loss • Fishing occupational hazards • Market uncertainty • Alcoholism and gambling • Supreme Court Order	• Seasonal weather patterns (fishing) • Net damage or loss • Fishing occupational hazards • Market uncertainty • Alcoholism and gambling • Supreme Court Order	• Seasonal weather patterns (fishing) • Net damage or loss • Fishing occupational hazards • Alcoholism and gambling • Supreme Court Order

TABLE 5 (CONTINUED)

	Guptapara	*Panighat*	*Junglighat*
Local institutions	• Surmai Co-operative Society present • Nearest Fisheries Department office in Port Blair • Public Works Department site office located in the village	• Self-help groups located in the village • Nearest Fisheries Department office in Port Blair, 40 km away Blair by road • Public Works Department nearby	• Surmai Co-operative Society present • Fisheries Department in Port 3 km away • Public Works Department nearby

n/a, data not available.

1 Number of households: figure underlined is the estimate from social mapping and participant estimates in the current study; figure in brackets is estimate as per 1991 census. Differences may be due to a number of factors, including immigration, undefined village boundaries, discrepancies between revenue and forest areas.

2 As per 1991 census.

3 High occurrence of encroached land and rented houses and low occurrence of allotted land and house ownership indicates settlers of recent origin and vice versa.

well as hand-line and net fishing from boats. Boats are mainly mechanised country boats, which provide opportunities for fishing labour to an estimated 58% of households. Hand-line fishing is the focus of fishing activities, either exclusively (65% of operations) or combined with net fishing (27% of operations). Fish traders, who have been operating in the village for 30 years, purchase the majority of the catch and transport it on ice to local and export markets in Port Blair, they also supply fishers with bait, ice, diesel and loans. A few local men also purchase fish, which they sell on cycles for local consumption. During the

TABLE 6 SOCIAL INFRASTRUCTURE IN GUPTAPARA

Sector	*Infrastructure*	*Comment*
Education	• Primary school and middle school 2 km away • High school in Manglutan 4 km away	• Education is free and uniforms, books and meals are provided • A government bus service connects Guptapara with the middle school • Most children leave school at 13 years old (8th grade) as lacking in inclination and attitude to education. Some school leavers often end up engaging in illegal activities, such as poaching, sand mining, shell and sea cucumber collection
Health	• Primary health centre in Manglutan, 4 km away	• Provides basic health facilities to treat common ailments plus infant care and vaccinations. For advanced treatments patients go the general hospital in Port Blair 16 km away
Water	• A large stream flows through Guptapara village • Public water pipes, government wells, agriculture tanks, ponds also supply water	• Public water supply once in 2 days • Women have to fetch water from the public pipes and wells which are located in only a few places • Water demand is great in the summer • Agriculture tanks are also used for domestic purposes by owners
Sanitation	• Limited sanitation facilities are available • Fields, forests and mangroves are used for personal ablutions	• 9% of households with low cost latrines • The domestic sewage flows around the houses along with the drainage posing a health risk and providing a breeding ground for mosquitoes
Religion	• One temple in the village and a holy Peepul tree (holy Ficus tree) where the villagers worship	• Predominant religion is Hinduism
Markets and supplies	• Fair price shop, private stores and shops for groceries and vegetables present in the village	• Market with fair price shop and other stores close by
Finance	• No bank in village	• Cooperative and state bank 4 km away

peak fishing season fish traders organise temporary seasonal migrations of between 60–70 fishers from West Bengal to work as fishing labour, concentrating only on hand-lines for reef fish of export value (e.g. the dollar fish, *Cephalopholis epinepheles*; or red snapper, *Lutjanidea* family).

Before the ban on shell collection 2 years ago, most households were also involved in shell collection, which they would opportunistically pick up during fishing trips or from the reefs nearby and sell to traders. Some of the men in Guptapara are also involved in sand mining operations.

2.1.3 Administrative setting

Guptapara village comes under the jurisdiction of Guptapara *Panchayat* in the Ferrargunj Tehsil of South Andamans subdivision.

A Public Works Department site office is located in the village, which is responsible for maintaining roads and water supplies. The Surmai Co-operative Society is also present, comprised of 13 members from outside Guptapara and a president from Junglighat. The society helps people involved in fishing-related activities by providing loans and selling gear at subsidised rates. However, despite playing an important role in the past, the co-operative society is now widely perceived as a defunct institution, dominated by a few influential members.

Middlemen and moneylenders are key people in the community, not only in the sale of fish and provision of fishing supplies, such as ice and bait, but also in supplying money and loans. The nearest Fisheries Department office is in Port Blair, 16 km away, although Fisheries Officers will make periodic visits to the fish landing centre to collect landing statistics.

2.2 PANIGHAT

2.2.1 Geographical and social setting

Panighat is situated in North Bay along the south eastern slopes of Mount Harriet National Park to the north of Port Blair (Figure 5). The village covers an area of 3.4 km^2 along the steep stony slopes of Mount Harriet.

The fishing community here is one of the oldest non-indigenous fishing settlements in the Andaman Islands dating back to 1960. The first batch of settlers consisted of five families from Kerala, this was followed by 64 Telugu families from Andhra Pradesh, who settled from 1980 to 1981 and were allotted 400 m^2 of land for a house and an allowance of Rs 4000 (~$85). Immigration of fisherfolk from the mainland to this site mainly from Andhra Pradesh continued until recently when the Administration increased ship fares causing a decline in immigration. The lack of space, due to the steep slopes of Mount Harriet and the national park, in addition to lack of access to transport and fishery infrastructure, such as gear, ice, diesel supplies and markets (Section 2.2.2), has also contributed to a decline in immigration to this area. Currently the estimated population is 3525 distributed among 500 households.

The main road runs along the shoreline, where a retaining wall is also built and five footpaths and steps lead up from the shore into the village. A slipway was sanctioned by the government 5 years ago, but did not materialise. Port Blair town is located across the bay and is accessed by hourly ferries or by a 40 km journey overland by road. There is electricity and water supplies to the community, but no sanitation facilities. The nearest market and shops are located at Bambooflat 4 km away from Panighat, where a number of services are provided, as outlined in Table 7.

2.2.2 Ecological and economic setting

The land around Panighat is hilly and stony and was once surrounded by forest. The forest area has now been deforested through encroachment, which extends into the official buffer zone of Mount Harriet National Park, where villagers collect fuel wood. Coastal mangroves have also been depleted through felling for house construction and firewood, except for a small patch near the Panighat wharf. The coral reef area adjacent to Panighat and the North Bay area has been badly degraded by dynamite fishing over the last decade and currently very little of the reef remains. However, a few villagers still occasionally employ cast nets near the reef for subsistence needs.

Panighat is primarily a fishing community and was established as such through the first batch of government-led fisheries settlements in 1960. Due to the local topography and proximity to Mount Harriet National Park, livelihood opportunities have remained limited mainly to fishery-based options, with non-fishing options restricted to private businesses, such as small shops, or government jobs. These non-fishing livelihoods are undertaken by both men and women. Fish harvesting is only undertaken by men, with women's involvement limited to fish vending and some fish drying in the dry season. Fishing is undertaken on non-mechanised and mechanised country boats, with mechanised boats providing fishing labour opportunities to an estimated 29% of households. A quarter of all fishing from Panighat is exclusively hand-line fishing for reef fish. Otherwise, non-mechanised boats are frequently used for net fishing, either at nearby fishing grounds and reefs, or in combination with mechanized boats at distant fishing grounds and reefs where both net and hand-line fishing are undertaken, constituting 41% of fishing operations.

A processing plant was set up at Panighat for processing the liver of dog sharks, however, this stopped functioning after a ban

TABLE 7 SOCIAL INFRASTRUCTURE IN PANIGHAT

Sector	*Infrastructure*	*Comment*
Education	• Primary school in Chunabhatta 1 km away • Middle and high school 4 km away	• The teachers come from Port Blair town • Educational level of children is limited as they tend to leave in middle or high school
Health	• Public health centre located in Bambooflat 4 km away • Government dispensary located at Chunabhatta, 1 km away	• Public health care has inpatient facilities. • Only basic treatment is available. For advanced treatment patients are referred to Port Blair general hospital 40 km away by road
Water	• Public water taps and tanks • Two water tanks are shared with the adjacent Indian Oil Gas Plant	• There is high demand on the water supply and water scarcity can be a problem
Sanitation	• No sanitation facilities • Forest areas are used for ablutions	• The domestic sewage flows around the houses along with the drainage posing a health risk and providing a breeding ground for mosquitoes
Religion	• Two temples	• Most of the fishers are Hindus and Telugu origin from Andhra Pradesh
Markets/supplies	• No shops in Panighat	• Fair price shops, vegetable shops, fishmarket and other shops in Bambooflat, 4 km away • Nearest supply of diesel and fishing gear is Port Blair
Finance	• No bank in Panighat	• Cooperative and state bank in Bambooflat, 4 km away

on shark fishing in October 2001. All support services for fishing are located in Port Blair and no middlemen or fish traders service the village with fishing materials. Fishers therefore spend considerable time in procuring materials from Port Blair and must also transport fish catches for export to traders in Port Blair. Locally fish is sold in the small market at Bambooflat, it is also taken house to house by cycle in Bambooflat, Mannarghat and Wright Myo, nearby Muslim communities, and some women take fish to sell in Port Blair. There is no cold storage accessible to the village, so when the catch is too great the price is reduced and sold locally.

2.2.3 Administrative setting

The village comes under the jurisdiction of Panighat *Panchayat* in the Ferrargunj Tehsil of the South Andamans Sub Division.

Self help groups are found in Panighat, promoted through the Ministry of Rural Development. Their membership includes fishing, as well as non-fishing households, and their objective is to obtain subsidies and loans from the government to provide self-employment and alleviation of poverty in rural areas.

Interaction with the Fisheries Department is limited, with the nearest office in Port Blair.

2.3 JUNGLIGHAT

2.3.1 Geographical and social setting

Junglighat is located in the heart of Port Blair town to the south of Junglighat wharf, covering an area of less that 0.5 km^2 (Figures 5 and 6). The site was named originally after the 'Andaman Homes' created during the British pioneer days to 'civilise' the Great Andamanese. Later most of the area was held by the armed forces, but fisherfolk gradually encroached on the land and after occupying it for 35 years, legally regularised and registered the land in their names.

The community consists of Telugu people from the coastal districts of Andhra Pradesh. Originally four families were

Figure 6 The waters edge of Junglighat community.

settled in Junglighat by the Administration, they were provided with plots of land and were to start commercial fishing. Immigration has continued ever since, with most people arriving in 1976, from Srikakulam district, Andhra Pradesh. Many families have migrated to escape from the impacts of drought and famine, and to seek better livelihoods in the islands. Fishers were attracted to the Junglighat area because of its location in the heart of Port Blair town and proximity to facilities and services, such as a harbour, markets and cold storage. The constant influx of migrants to Junglighat has made it the most densely populated area of Port Blair, with an estimated 2000 households and population of 12 120. Most of the households in Junglighat are of recent immigrants and original settlers are now few.

The proximity of Junglighat to the centre of Port Blair provides good access to all the urban facilities available in Port Blair as outlined in Table 8. This includes good access to transport, enabling the community to market their fish in more distant towns. A jetty for landing boats was proposed and sanctioned, but has not yet materialised. Within Junglighat there are numerous large and small shops and markets. Electricity and water are supplied, but there are only limited sanitation facilities.

2.3.2 Ecological and economic setting

Nearby coral reefs and mangroves have been severely degraded through heavy fishing pressure, firewood collection and pollution from rubbish and sewage disposal. Depletion of mangrove cover and nearby coral reef areas has resulted in severe coastal erosion and the municipality has been forced to build a retaining wall to prevent further erosion. Loss of mangrove cover has also exposed the formerly protected boat anchorage, increasing the risk to boats from storms and heavy weather.

Livelihoods in Junglighat are primarily fishing-based, although the proximity to Port Blair provides employment opportunities in government jobs and in small private enterprises associated with development activities in the town. Both men and women undertake non-fishing livelihood options. In the fishery women are only involved in fish vending, which they undertake at the landing site, in the nearby market, or house to house throughout Port Blair independent from middlemen. Occasionally men will also undertake fish vending, although predominantly they are involved in fish-harvesting activities. These are undertaken on non-mechanised and mechanised country boats, with mechanised boats providing fishing labour opportunities to an estimated 35% of households. Fishery operations are mainly net fishing (68% of operations),

TABLE 8 SOCIAL INFRASTRUCTURE IN JUNGLIGHAT

Sector	*Infrastructure*	*Comment*
Education	• Primary, middle and high school 1 km away	• Primary school is within Janglighat • All schools can be reached by walking • It is estimated that more than 70% of the children leave at middle school level and start working in fisheries
Health	• Junglighat public health centre 1 km away • Dairy farm public health centre 1 km away	• The public health centres provides all the basic medical care and free treatment • The general hospital in Port Blair is 2 km away
Water	• Public water taps, some private house connections and wells constructed during Japanese occupation	• The water supply is available every day • Demand for water at the public taps is high and there is a daily rush to obtain water
Sanitation	• Public toilets available in one part of Junglighat • Remaining area has no toilets and people use shore area for ablutions. • Rubbish is disposed around houses and on shore line	• Despite limited public toilets in part of the community, level of sanitation is generally poor and there are frequent cases of diarrhoea and dysentery
Religion	• Four temples	• Hindus
Markets/supplies	• Fair price shops in Junglighat • Vegetable market, fish market and shopping area within 1 km	• Other shops and markets in Port Blair town
Finance	• United Bank in Junglighat	• Other banks in Port Blair town

followed by combined net and hand-line fishing (29% of operations).

The fishers from Junglighat migrate seasonally with their boats to camps on the west coast of South Andaman Island, mainly to North Wandoor and Loha Barrack, where they access better fishing grounds and avoid local high winds during the peak fishing season between November and May. During the low fishing season, in the rainy months of June to October, creeks on Baratang Island (6 hours away) are used for prawn fishing. It is also common for non-mechanised boats to fish locally in the nearby bay and entrance to the harbour selling the catch daily to the market in Junglighat.

2.3.3 Administrative setting

Junglighat is located within the Port Blair municipal limits and is governed by the municipal board, which is comprised of various wards. Junglighat community falls under wards 7 and 8 and community members are elected to the wards through municipal elections. The high population density here is a substantial vote-bank for politicians, and some community members are political party workers.

The Fisheries Department is only 3 km away and is used extensively by the community for the cold storage facilities located there. If the local market is flooded with a certain variety of fish, then fish vendors in Junglighat frequently use the nearby cold storage facilities to store fish until the market recovers.

Middlemen and moneylenders run and control the financial institutions for poorer households. The president of the Surmai Co-operative Society lives in Junglighat, however, the society's activities are limited. A Public Works Department, responsible for maintaining roads and water supplies, is nearby.

2.4 VULNERABILITIES

The main vulnerabilities and risks faced by the three communities are linked to the seasonal patterns of weather, which affect both fishing and agricultural activities.

During the long rainy periods, high wind speeds, currents and turbulent waters associated with the south west monsoon from June to October make it difficult for the fishers to go out to sea. During this time they are restricted to fishing around nearby islands and reefs and in sheltered areas on a daily basis, as longer and farther trips incur too high a risk. Even in the peak season for fishing during the north east monsoon from November to May fishers risk occasionally being caught in bad weather and may have to delay their trip and anchor in nearby islands. As well as dangers at sea associated with bad weather, the constant exposure to the wet and cold incurs health risks and fevers are common during the bad weather of the south west monsoon.

In addition to the seasonal and weather-related vulnerabilities associated with fisheries-based livelihoods, there are also risks of losing nets, which may drift off in strong currents, get caught on rocky beds or coral reefs, or destroyed through collisions with passenger and cargo vessels of inter-island and mainland shipping routes. Uncertainties in markets for perishable fish products also expose communities to vulnerabilities. For example, in Panighat there have been instances when a good catch has had to be thrown back into the sea for lack of marketing and storage facilities, meaning a total loss in terms of investment in diesel, ice and bait. In Guptapara, a delay or cancellation of the ice truck operated by the fish trader results in additional and unplanned expenditure for the fishers to transport their fish to the cold storage in Port Blair. Such risks are considerably less in Junglighat, where there is an accessible cold storage facility and diverse market outlets.

The inherent uncertainties and irregularity of fishing livelihoods as described above is frequently seen to result in alcoholism and gambling addictions amongst the fishers of all three communities. This tendency exposes many households to further associated uncertainties and risks, particularly in households where the women have little control over expenditure and saving.

For the Guptapara community, there are also additional risks associated with the agricultural activities occurring there together with fishing activities. Agriculture in Guptapara is mainly rain fed, with few alternative irrigation facilities available. Thus, agricultural activities are vulnerable to the uncertainties of weather, which dictate the success of cultivation and harvest.

Currently, recent immigrants from all communities have been evicted from encroached land as a result of the Supreme Court Order. As described in Section 1.4, all those households occupying encroached land or non-allotted land will be evicted. For those immigrants who arrived post-1978, there are no immediate plans for compensation and they will have to find alternative housing on allotted land, in most cases rented from others. It is expected that with growing demand the price of renting or purchasing allotted land will increase significantly, with many families having no alternative but to return to mainland India. There are indications that this action has significantly affected some households and may drive other families into, or deeper into poverty.

2.5 EXTERNAL FACTORS CONTROLLING LIVELIHOOD OPPORTUNITIES

For the coastal fishing communities of South Andaman Island there are a number of factors which influence the nature of their livelihood opportunities, many of which have been discussed in the previous sections and which are summarized below:

Settler status: The length of time which has elapsed since immigration to the Andaman and Nicobar Islands largely determines a household's livelihood outcome, with early immigrants obtaining better outcomes than those recent immigrants. It takes time for immigrant families to build up networks and support systems, recent immigrants cannot access subsidies and loans from the Fisheries Department and it is more difficult to obtain credit or loans from middlemen and traders without an established relationship of trust. It also takes time to build up the physical resources which have been left behind on the mainland. Overriding all these factors at present is the potential impact of the Supreme Court Order, which for recent settlers may well mean returning to mainland India and rebuilding lives left behind.

Local resource status and availability: This includes both marine and terrestrial resources. During the bad weather season fisheries activities are concentrated on local marine resources and their status and availability obviously impacts the success of fishing during this period. Of the three communities involved in the study, Guptapara has best access to healthy and productive resources, such that fishers from Junglighat migrate there seasonally in order to access the resources. In Panighat, the availability of terrestrial resources, in terms of suitable land for house-building, limits potential for future growth in this community and has deterred immigration.

Distance to services and markets: The availability of transport, cold storage facilities, fishing gear and diesel supplies and market outlets impact fishing activities and the potential for fishery development. Such factors restrict the fisheries activities in Guptapara and in particular in Panighat.

Seasonality: The underlying pattern of weather and its extremes is important in determining the type of fishing undertaken, i.e. which fishing grounds are exploited and what gear is used, as described in Section 2.4.

3 POOR STAKEHOLDERS

3.1 OVERVIEW OF POVERTY

Poverty enumeration is undertaken on a 5-year basis unlike the population census, which takes place every 10 years. Poverty census work began in the Andaman and Nicobar Islands in 1997 and is still in progress.

According to the present criteria, classification of families considered Below the Poverty Line (BPL) for rural or district areas, is as described in Table 9. So far 5569 BPL families have been classified under this scheme for rural areas of the Andaman district. Among the three study communities, Guptapara and Panighat fall into the rural classification, while Junglighat is considered under the urban category. Table 10 shows the distribution of BPL and APL families according to the current study, indicating that in all three communities a significant proportion of families have BPL status. In Panighat and Guptapara BPL families make up the largest category, while in Junglighat the larger category is APL households.

This picture partially agrees with a study undertaken by the Fisheries Department, which indicated that among the nontribal migrant fishers in the Andamans district, Junglighat and Guptapara fishers have opportunities for higher monthly incomes due to their links to export markets and mechanisation (Mustafa, 2002).

However, there are discrepancies in the BPL/APL status given to households. Recent immigrants require a certain period of domiciliation and proof of residence to obtain a ration card and therefore are not classified under this scheme. In addition, BPL status may be declared simply to obtain the ration cards available with BPL status (which provide kerosene, rice and sugar at subsidised rates), and it is reported that the ration cards may be procured illegally without the required domiciliation.

The distribution of poverty by locally defined poverty criteria (Table 11) enhances the picture of poverty in the three communities. Overall, this shows similarities with the BPL/APL classification (Table 10), with greater levels of 'poor' households in Guptapara and a larger number of 'better off' households in Junglighat.

To gain a better understanding of what the poverty categories summarised in Table 11 represent, the following sections discuss the different features defining poverty for each community.

TABLE 9 RURAL AND URBAN BPL CLASSIFICATIONS

	Per capita monthly expenditure (Rs)
Rural	269.07
Urban	381.04

TABLE 10 PERCENTAGE OF HOUSEHOLDS WITH BPL AND APL CLASSIFICATIONS IN THREE STUDY COMMUNITIES

	BPL	*APL*	*Households without BPL/APL status*
Guptapara	53	33	15
Panighat	76	6	18
Junglighat	32	48	20

3.2 GUPTAPARA

As summarised in Table 12, 'poor' households in Guptapara were generally those of recent immigrants living on encroached land or on other people's land. Land plots of 'poor' households

TABLE 11 PROPORTIONS OF HOUSEHOLDS DISTRIBUTED AMONG THREE WEALTH CATEGORIES

Wealth ranking category	*Guptapara*	*Panighat*	*Junglighat*
Poor	71	61	25
Less well off	21	11	34
Better off	7	28	42

TABLE 12 CHARACTERISTICS OF POVERTY IN GUPTAPARA

Factors contributing towards household poverty	*Factors alleviating household poverty*
• Large family • Small land plots on encroached or leased land • High expenses on alcohol	• Small family • Settler status • Owning land • Hard working • Co-operation amongst family members • High income • Savings • Women involved in finances

were commonly small and fragmented and households frequently relied on boat labour as a source of income. 'Poor' households were also frequently characterised by problems of alcoholism and large family sizes.

The 'better off' households in Guptapara were generally considered to be those with settler status, who owned land and had higher incomes. Interestingly, the involvement of women in financial decision-making (in making investments and procuring assets), was recognised as an important feature of 'better off' households.

3.3 PANIGHAT

In Panighat (Table 13) the 'poor' households were similarly considered to be those living on other people's property (renting rooms in other's houses) and commonly relied on boat labour as a source of income. These households also lacked productive assets such as nets or lines and were forced to take loans. Certain households were also recognised as 'poor' in Panighat as a result of losing fishing nets.

The 'better off' households in Panighat were also those with settler status, with allotted land, their own house and even in some cases land and a house on the mainland. Generally these households had multiple sources of income, from fishing and nonfishing sources, and had established good financial and physical assets.

TABLE 13 CHARACTERISTICS OF POVERTY IN PANIGHAT

Factors contributing towards household poverty	*Factors alleviating household poverty*
• Rented rooms • No nets or lines • Loans • Loss of nets	• Small family • Settler status • Allotted land • Own house • Land and house on mainland • Own multiple boats and nets • Government or private jobs • Women vending • Many earning members in household • Income from room rental • Bank accounts and invested money • Engage in money lending

3.4 JUNGLIGHAT

In Junglighat (Table 14) the 'poor' households were again those without financial or physical assets and generally relied on boat labour as a source of income. As in Guptapara 'poor' households in Junglighat were often encountered as having problems of alcoholism. Certain households were also recognised as 'poor' in Junglighat as a result of losing fishing nets.

'Better off' households in Junglighat were similarly characterised by having settler status, owning land, as well as boats and fishing gear. A number of the 'better off' households were also involved in fish and prawn trading as middlemen. Most households had multiple sources of income from fishing, as well as nonfishing sources associated with opportunities in Port Bair.

Overall, poverty was characterised primarily by the settler status of households, which dictates financial and physical asset ownership, as well as the type of livelihood opportunities available. Thus, 'poor' households are generally those who had recently arrived with little or no financial and physical assets and who generally engage in fishing labour opportunities. Other common features contributing to poverty were alcoholism, indebtedness and loss of fishing nets.

TABLE 14 CHARACTERISTICS OF POVERTY IN JUNGLIGHAT

Factors contributing towards household poverty	*Factors alleviating household poverty*
• Rented house • No nets or boats • Loans • High expenditure on alcohol • Loss of nets	• Own house • Settler status • Purchased land • Own multiple boats and nets • Own long lines • Government or private jobs • Rental income • More than one male earner • Women vendors • Gold savings • Invested money • Well educated

4 REEF LIVELIHOODS

Coral reefs have the potential to provide a stream of benefits to the poor in the three coastal communities of South Andaman Island. Some of these benefits arise because reefs can contribute to the *resources* that the communities have access to. These reef-related resources contribute to the building blocks of the livelihoods of the communities 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 communities interact with the structures and processes that directly influence the way they 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 communities 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 communities 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 of indirect influencing factors in which they operate. The services that the reef provides to the poor ultimately benefits them by contributing to positive changes in the *outcomes* of their livelihoods. These outcome changes are best defined and measured by the communities themselves if they are to meaningfully represent positive improvements in their lives.

The following sections describe the many different streams of benefits to the livelihoods of the 'poor' households or stakeholders identified in the three study communities, focusing on reef benefits to household resources (Section 4.1); to enhancing interactions with direct influencing factors (Section 4.2); and to coping with the risks and vulnerabilities associated with indirect influencing factors (Section 4.3).

4.1 RESOURCES

The contribution of coral reefs to the natural, physical, financial, human and social resources of poor households in the three study communities is described in following sections (4.1.1–4.1.5). A summary of these benefits is provided in Table 15 below.

4.1.1 Natural resources

In the Andaman Islands the coral reefs are a major component of the fishery resource and are targeted directly with hand-line fishing for a diversity of reef species (Figure 7). Hand-line fishing, either undertaken exclusively or combined with net fishing, constitutes a significant proportion of the fishing operations in the three study communities, ranging from the almost all in Guptapara, to two-thirds in Panighat and a third of all operations in Junglighat (94, 67 and 32% of operations, respectively).

Coral reefs are highly productive ecosystems supporting high levels of diversity and biomass. The vast expanse of islands

TABLE 15 A SUMMARY OF REEF BENEFITS TO HOUSEHOLD RESOURCES

Resources	*Benefits from the reef*	*Community*[1]
Natural	*Diverse and productive resource*	
	Diversity of reef fish	All
	Larger pelagic fish feeding around reef edge	All
	Opportunities for fishing without conflict between users	All
	Protects adjacent near-shore ecosystems	
	Mangroves provide habitat to juvenile reef fish	All
	Mangroves provide safe anchorage and source of firewood	All
Physical	*Physical barrier*	
	Protects coastal land from erosion	All
	Promotes land extension in some areas	All
	Provides calm waters for cast netting	G, (P)
	Prevents large scale commercial fishing operations	All
	Navigation	All
	Reef used as marker to locate fishing grounds	

TABLE 15 (CONTINUED)

Resources	*Benefits from the reef*	*Community*[1]
Financial	*Cash income*	
	Sales of a diversity of reef and pelagic fish species	All
	Wages from boat labour	All
	Fish for exchange	
	To gain favours from officials or pay tuitions fees	All
	Markets	
	Local market opportunities	All
	Export market opportunities	G, J, (P)
	Low investments	
	Reef fishing gear (hand-lines) inexpensive and easily obtained	All
	Reefs closer than pelagic fishing grounds so reduce expense (time/fuel) to access	All
Human	*Food and protein source*	
	Considered 'free' food source	All
	Excess catch and small fish for elderly, sick, widows	J, P
	Skills and knowledge	
	In operation and maintenance of fishing gear and boat	All
	Of fish species and those valuable species for export	All
	Safety	
	Near-by reefs less hazardous to reach compared to distant fishing sites	All
	Hand-lines less hazardous than nets	All
Social	*Collaborative extraction*	
	Social network associated with boat crews	All
	Rituals	
	Sprinkling water over boats to ensure safety and luck in catch	All

1 G, Guptapara; P, Panighat; J, Junglighat

and reefs found in the Andaman and Nicobar Islands combined with the productivity of the reef ecosystem itself, represent a resource that so far has been exploited without conflicts for access between users. It is for this very reason that this as yet 'untapped resource' has attracted so many immigrant fisherfolk from mainland India.

Coral reefs also indirectly support and interact with other parts of the fishery, in particular the pelagic net fishery, which is commonly conducted in channels running between or alongside reef areas. Net fishing, either undertaken exclusively or combined with hand-line fishing, constitutes a major proportion of fishing activities in the three communities, ranging from almost all in Junglighat, to nearly three-quarters in Panighat and about a third of operations in Guptapara (97, 73 and 27% of operations, respectively).

The coral reefs form an integral part of the wider ocean and coastal ecosystem, including mangroves, seagrass beds and the open sea, interlinked by nutrient, sediment and energy flows. Many juvenile reef fish use the mangrove as a nursery, while certain adult reef fish use the seagrass beds as a feeding area. In

Figure 7 Fish catch at Panighat.

turn, coral reefs provide shelter to wave action for both seagrass and mangrove habitats. Mangroves are found throughout the Andaman Islands and although adjacent to the three study communities they are degraded to varying extents, they provide important sources of construction material and firewood and safe anchorages for fishing craft. Little is known of the relationship between the communities and the seagrass habitats, although it is likely to provide a source of sea cucumber and shells for exploitation.

4.1.2 Physical resources

Coral reefs play a well-known function in protecting the coast from erosion and the impacts of storms and in doing so they also are known to promote land formation. In Junglighat and Panighat, the loss of reef protection (due to reef degradation and in Junglighat land reclamation over the reef) has resulted in increased erosion and wave action along the shore to the extent that reclaiming sea walls have had to be built. In Guptapara and to a marginal extent in Panighat, reef protection also provides calmer waters along the shoreline for cast netting. Although only accounting for 7% of fishing activity in Guptapara, cast netting is an important means of subsistence fishing when need demands.

The physical nature of coral reefs, their shallow and complex three-dimensional structure, combined with the diversity of the resource itself, means that reefs are not accessible to larger commercial fishing operations. They are, however, suitable for smaller craft that can navigate the shallow and hazardous reefs. These are in turn accessible to the local fishing communities and immigrant fishing labourers encountered in all three study communities. Thus the reef protects and provides a haven for the small-scale and low-technology fishing activities and a barrier against larger-scale, high-investment commercial fisheries.

The physical nature of coral reefs, causing waves to break along their shallow crests, creates markers for navigation around islands and for reaching fishing grounds. In the remote islands of the Andamans, where there are few if any man-made buoys or markers, reefs are used for navigation as a matter of course during all fishing trips and activities at sea.

4.1.3 Financial resources

Fishing activities represent the main and often only source of income for poor households in the three study communities. This may either be through fish sales to local markets, to export markets via fish traders, or through labouring on fishing boats. Boat labour represents the primary livelihood option and income source for households who have only recently immigrated, who are typically the poorer households in the three communities.

BOX 2 FISH IN EXCHANGE FOR TUITION FEES

An immigrant fisherman from West Bengal lives with his wife and two sons, who study in the 3rd and 5th standard of primary school. They have a small two-room thatched house and have purchased some land originally encroached by someone else. He owns one mechanised boat, which he uses for hand-line fishing on the coral reef. They send their sons for private tuitions and the fisherman finds it easier to supply the teacher with fish rather than pay the teacher tuition fees every month. He provides fish every month equivalent to their tuition fees and his children get extra attention and guidance from the teacher as both the fisherman and his wife are uneducated.

Fish products, either reef species or pelagic species, are also used as a form of currency in exchange for favours from officials or in payment for school tuition (Box 2). Bartering in this way is considered much easier than using cash, which may be tied up in credit or loans or be needed for other purposes. It may also be easier to influence an official with a large Seer fish or with Tiger Prawns than with cash.

The diversity of markets available for reef fish, both locally and for export, provide multiple opportunities for cash generation and sustain the fishery throughout the year. In Guptapara and the nearby village of Wandoor, between 1500 and 2460 tons of reef fish are exported annually, with higher market values compared with locally sold fish. In Junglighat, there are multiple local market outlets, from the landing site, to the fish market and traders, house to house by foot or bicycle, or even to neighbouring communities by taxi scooter.

In terms of the financial resources required to enter a fishing livelihood the investment is relatively low for reef-based fishing. 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, with limited financial resources and limited access to loans or credit, hand-lines are a more attainable 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.

4.1.4 Human resources

For Panighat and Junglighat communities and the newly immigrant households in Guptapara, fish provides the main and

at times only source of protein in the diet. Dependence among the more established settlers in Guptapara is slightly less as these households have built up land holdings and cultivation and livestock provide alternative sources of protein. However, for all communities, fish is available throughout the year and is considered a 'free' source of food, allowing households to save expenditure on alternative sources, such as pulses, which are often expensive, especially during the rough weather season, when supplies to the islands are uncertain. Part of each fish catch is inevitably not sold but taken home by the boat owner and labourers and consumed by their families, whose diet consists almost entirely of rice and fish. Occasionally in Junglighat and Panighat, on the request of elderly or sick individuals or widows, boat owners will provide free fish if there is excess catch or smaller discards.

In addition to providing a source of food and protein, the fishery is also a source of knowledge and skills, which are essential for ensuring a successful catch and safe fishing trip. Such human resources encompass skills in boat handling, operating fishing gear and in boat maintenance and repair, as well as knowledge relating to navigation and, of the different types of species and those that fetch high prices. New immigrants, who have previously been involved in fishing activities may already have many of these resources, others will have little or no previous experience and will acquire the skills and knowledge over time. These resource are valued by boat owners and are important in gaining a good labouring position on a boat, as well as building confidence and trust between boat labourers and owners.

In terms of health, reef-based fishing is considered to be less hazardous. Fishing on nearby reefs requires a relatively short and less exposed journey compared with fishing activities on far off islands and on the open sea. Hand-lines used in reef-based fishing are also less hazardous to use than the nets used for pelagic fishing, which may get caught in strong currents, or on reefs or rocks. It is for this very reason that nearby reefs are used extensively during the rough weather seasons.

4.1.5 Social resources

The nature of reef resources is such that fishing activities are best carried out on a collaborative basis. This usually involves three to four people working together on boats. Working in this way develops bonds and trust between members of the community. Such collaborative work is one of the main routes by which the newly immigrated boat labourers can build up networks and acquire a sense of identity in the community.

Religious beliefs associated with the reef and fishery are limited amongst the settler communities, which is likely to be a manifestation of their limited association with the local environment and fishing livelihood. One ritual which is carried out in connection with fishing activities, is the sprinkling of water over boats before they set off on a fishing trip, to ensure safety and luck in the catch.

4.2 DIRECT INFLUENCING FACTORS

Coral reef and associated coastal and marine resources are the focus of fisheries, environment and tourism-related policies, institutions, organisations and social relations. Directly and indirectly, therefore, the reef and associated resources give rise to structures and processes that can positively influence the lives of poor reef-dependent people. These positive influences are summarised in Table 16 and discussed in more detail in the following sections (4.2.1–4.2.4).

4.2.1 Policies

The productive coral reef and marine resources surrounding the Andaman and Nicobar Islands have provided considerable scope for policies promoting fisheries development. Fisheries policies in the Andaman and Nicobar Islands have encouraged fisheries development and have given rise to opportunities for fishery-based livelihoods, with the administration actively settling fisherfolk in the islands during the late 1950s to 1980s. The productive reef-based fisheries and associated opportunities provide a chance for migrants to improve their livelihood, with many families having escaped hardships, such as conflict, drought and famine, on the mainland. As revealed in earlier sections, for the majority of new immigrants to the three study communities, with little financial or physical resources, fisheries provide important opportunities to engage in fishing labour (men) and fish vending (women).

Coral reefs have also provided opportunities for the development of high value export markets of reef species. The Fisheries Department through the Fisheries Regulation Act has promoted the commercialisation of fishing focused on the development of export markets. The export market of reef fish has not only led to expansion of the fishery itself (clearly demonstrated in Guptapara, where 60–70 seasonal migrants come for reef-based fishing from West Bengal), but has also created a constant high value demand throughout the year.

The high biodiversity of coral reefs are also increasingly the focus of environmental policies recognising global and local declines in coral reef ecosystems and concerned with reef conservation. In the Andaman and Nicobar Islands this is manifested through the Wildlife Protection Act which promotes the protection of reefs through marine parks. There are two marine parks in the islands (Section 1.4, Figure 5), one of which (MGMNP) is located close to Guptapara community. MGMNP

TABLE 16 A SUMMARY OF REEF BENEFITS TO DIRECT INFLUENCING FACTORS

Influencing factors	*Benefits from the reef*	*Community*[1]
Policies	*Fisheries development*	
	Development of fishing sector through active settlement of fisherfolk from mainland India	All
	Fisheries Department promotes development of fishery focusing on export species (reef species)	G, J, (P)
	Marine park development	
	Wildlife Protection Act promotes protection of reef through establishment of marine park. Marine park shelter reef species and provide source to surrounding fisheries	All
Institutions	*Traders, middlemen*	
	Provide access to markets	G, J
	Source of bait, ice, fishing gear supplies	All
	Source of credit	All
	Fish landing sites and markets	
	Focus for social interaction, information exchange, news about new boat labourer opportunities	All
	Private tourism related enterprise	
	Opportunities for employment as guide on tourist boats	G
Organisations	*Fishing co-ops*	
	Advancing loans	All especially G
	Local NGO (ANET)	
	Promote local community participation in research and management	All especially G
	GCRMN	
	Funding for socio-economic monitoring and promotion of local objectives/aspirations in management	All
Social relations	*Women*	
	Fish vending opportunities for women to obtain cash income and control over expenditures	J, P

1 G, Guptapara; P, Panighat; J, Junglighat.

covers an area of 281.5 km^2, including 15 islands and large areas of coral reef. Entry into MGMNP is controlled by the Department of Environment and Forest on a permit basis restricted to tourists visiting the park, with all exploitation prohibited. While the MGMNP clearly restricts the fishing activities, particularly of fishers from Guptapara, it also has potential benefits through the enhancement of fish stocks and spill over to nearby fishing grounds.

In addition, the tourism industry associated with the MGMNP, which includes small private enterprises, such as tour boat operations, provide opportunities for employment for local communities, e.g. as guides on boats. The positive benefits to local communities of tourism-related enterprises is so far limited, with only one or two households benefiting in this way in Guptapara. However, potential exists for increased benefits in the future, with the possibility of expansion of tourist developments around the park and elsewhere on the islands and increasing participation of locals in tourism-related activities.

4.2.2 Institutions

The reef and reef-associated fisheries provide a diversity of products for sale, which in turn provide a large number of diverse opportunities for private traders and middlemen. Within and apart from the government-managed framework of fisheries development, fisheries are largely controlled and managed by the private fish traders and middlemen, who provide much of the critical infrastructure and services required to access markets, especially export markets, and supplies of fishing gear and bait. Middlemen and fish traders are also important sources of credit and may be influential in assisting fisherfolk in accessing government or co-operative society loan schemes. For all three communities, fish traders and middlemen ranked amongst the top three local institutions in terms of the frequency and perceived importance of their involvement with community members. While in all communities the provision of credit and loans was recognised as a key role of middlemen and fish traders, in Guptapara their role in providing access to export markets and fishing gear supplies (ice, bait, hooks and lines) was also significant. In contrast, in Panighat their role in providing supplies and access to export markets was not apparent within the community, but had to be accessed from Port Blair.

Fishing landing sites and markets were also recognised in the three study communities as playing an important role in the community. As well as the obvious benefit of providing an outlet

for fish sales, both landing sites and markets are also a focus for social interactions and information exchange in the community. For recent immigrants, these institutions are an important place to find boat labour opportunities.

4.2.3 Organisations

Reef and reef-associated fisheries are also the focus of local fishing co-operative societies, such as the Surmai Co-operative Society, which is a source of money and loans for the community. Once a fishing household has been established in the community for 3 to 5 years they can access these loans, which generally have a better rate of interest than others available. Out of the three study communities, Guptapara was the only community where a co-operative society was actively providing loans, but even there middlemen, money lenders and the bank were considered to be more important sources for loans than the co-operative society.

The reef resources are also of concern to environmental groups and initiatives, who seek to ensure the conservation of the coral reefs' rich biodiversity and ensure sustainable development in the islands. NGOs concerned with the coral reef environment and local community development play a part in providing benefits. For example, ANET, located in Wandoor, near to Guptapara, has, through this study and others, worked with local communities to promote their participation in sustainable management of reef and forest resources. In this way, the South Asia node of the GCRMN together with the national ICRMN initiative, have also provided indirect benefits to local communities adjacent to the MGMNP (including Guptapara), through their support of socio-economic monitoring and the promotion of local objectives in coral reef management.

4.2.4 Social relations

Unlike other coral reef areas, where women may access shallow reef areas and become involved in collecting reef products, women in the three study communities of South Andaman Island were not involved directly in fish harvesting activities. Despite this, the reef and reef-associated fishery still provides important opportunities for women through fish processing (mainly drying) and in particular through fish vending. Through these activities women play a pivotal role not only in the local fishing economy, but also in controlling the household economy (Box 3). In Panighat and Junglighat an estimated 70% of women were involved in fish vending, while in Guptapara, women were not involved in fishing activities, but played an important part in decision-making and controlling income from agricultural activities. In Guptapara women's involvement in financial management in the households was considered to be a factor contributing to the success of the household. In Junglighat the diversity of local market opportunities for fish vending offer women of recent immigrant households an immediate opportunity to start generating an income.

Women's involvement in fish vending not only gives them control of some of the household finances, it also gives them an active role and identity in the community and enables them to establish social networks, which they may later exploit for favours or credit.

BOX 3 WOMEN GAINING CONTROL OF HOUSEHOLD INCOME AND EXPENDITURE THROUGH FISH VENDING

A local woman lives with her family in a small hut, which is occupying encroached land on the shore in Junglighat. She has two daughters and a son who go to the nearby government school. Her husband used to go fishing as a boat labourer, but he fell ill and stopped going a year ago and is now looking for a job which is not so strenuous. Every morning the woman goes to the fish landing centre, takes fish on credit for vending and repays the credit by the evening to the boat owner. Her husband brings in some income through occasional employment he finds, but it is the woman who controls the household income and expenditure.

Most of the women in Junglighat and Panighat are involved in vending fish. If their husbands own the boats they are able to sell the best catch and give the rest to other women, such as the case study above.

4.3 INDIRECT INFLUENCING FACTORS

The coral reef and related fisheries can positively contribute to the communities ability to cope and exploit the risks or opportunities associated with indirect influencing factors or the background changes which affect the social, economic, environmental and policy context in which the community exist. Table 17 summarises these positive contributions, which are described in more detail in the following sections (4.3.1–4.3.3).

4.3.1 Seasonality

The accessibility of near-shore reef areas allows them to be exploited throughout the year. This is of significance in the Andaman and Nicobar Islands, which are subject to seasonal weather patterns, making distant fishing grounds and off-shore areas inaccessible during the rough weather season months from

TABLE 17 A SUMMARY OF REEF BENEFITS TOWARDS COPING WITH INDIRECT INFLUENCING FACTORS

Influencing factors	*Benefits from the reef*	*Community*[1]
Seasonality	*Stability*	
	Nearby reefs accessible throughout the year	All
	Complementarity	
	Nearby reefs can be exploited during off season for pelagic fishery	All
	As protein source when alternatives are expensive	All
	As a complimentary source of income to agricultural sources	G
Shocks	*Safety net*	
	Fishers who have lost nets fall back on hand-lines	All
Trends	*Market growth*	
	Export market for reef species	G, J, (P)
	Local market for reef species	All

1 G, Guptapara; P, Panighat; J, Junglighat.

June to October. During this season, fishing activity focuses on using hand-lines on nearby reef areas and targeting valuable export species, which are in demand throughout the year. In this way, not only is income assured throughout the year, but also a source of food and protein, providing an important alternative to vegetable sources, which increase in price during the rough season.

In Guptapara, many households undertake both farming and fishing activities (Box 4). In this case, labour opportunities on fishing boats often provide an additional source of income and food for households. Likewise labour opportunities in agriculture provide an alternative source of income, especially during the rough weather or low fishing season. This complementarity adds stability to household livelihood strategies in Guptapara.

4.3.2 Shocks

Loss of fishing nets is a common occurrence amongst fisherfolk of the three study communities. This event can completely alter the livelihood status of a household, with lost opportunities for income and food. As described in Box 5, hand-line fishing on the reef provides a critical safety net and coping mechanism at these times, providing a source of income and food until a new net can be purchased.

4.3.3 Trends

The recent emergence of markets for reef fish both for export and for local demand has made significant contributions towards households involved in fishing in all three of the study communities. High value reef species, such as the *dollar fish* (Section 1.3.3) are in constant demand for export throughout the year and provide opportunities for low-investment, low-technology fishing, using non-mechanised boats and hand-lines. Such opportunities are accessible to poor households, who have the chance to earn good incomes. The export demand and market has also had a knock-on effect locally, increasing the local market for reef species thereby, diversifying outlets and acting to buffer any fluctuations in any single market, providing stability overall.

BOX 4 FARMING AND FISHING IN GUPTAPARA

A local villager of Guptapara lives with his extended family of 13 people, including four school-going children and one infant. Two of his sons are married. The family comprises of fishers and farmers. They have 3 hectares of land in which they cultivate paddy and vegetables. They also have farm animals such as cows, goats and chickens. All the family members are involved in farming activities for 4 months. Alternatively they work as labourers on others' boats.

BOX 5 FISHERS LOSING NETS AND FALLING BACK ON HAND-LINES

In Junglighat community, a fisherwoman lives with her three sons, a daughter and her husband, who recently became sick. The third son and daughter continue to go to school, but the other two sons dropped out of school to continue fishing. Recently, they lost their net which was torn by a cargo ship. They were forced to take a loan from money-lenders to buy a new net, costing Rs 50 000 (~US$1064), and until they could procure the new net they used hand-lines and borrowed nets whenever possible.

5 CHANGES, CAUSES AND CONSEQUENCES

Livelihoods are dynamic, they are constantly changing in response to direct and indirect influencing factors, which impact upon the strategies households are able to adopt and the ultimate outcomes of those strategies. The most significant changes in the reef-based livelihoods of the three study communities, the factors which contributed to the changes and the impacts of those changes on livelihood strategies and outcomes are outlined in Table 18 below.

TABLE 18 A SUMMARY OF CHANGES IN REEF-DERIVED LIVELIHOODS, CONTRIBUTING FACTORS AND IMPACTS ON SOUTH ANDAMAN ISLAND

Changes in reef-derived livelihood	*Contributing factors*	*Impact on strategies and outcomes*
Increasing opportunities within the fishery and growth of export and local market opportunities for reef fish	• Government policy of fisheries development • Emergence of export houses, traders and middlemen • Improving transport facilities • Landing centre built in Guptapara 1980 • Growth of tourism	• Reef fishery provides good alternative to pelagic especially in rough weather season • Emergence of larger-scale commercial fishing operations employing smaller boats to access reef • Increasing reliance on credit from traders or middlemen • Increasing opportunities for local fish vending, which may be undertaken by women • Increasing opportunities to improve income and food security • Sustainability of fishery uncertain, with potential for overexploitation of export-driven fishery, if not properly managed
Increasing difficulty in obtaining loans from Fisheries Department	• High level of temporary migration and insecurity of repayment	• Increased reliance on credit from traders, middlemen or money-lenders • Increase in gambling, alcoholism • Increased income insecurity and debt
Reduction in fish catches in nearby areas	• Increasing numbers of fishers • Resource degradation. • Nearby areas have been over-fished.	• Increasing competition amongst fishers for access to fishing grounds • Increased reliance on credit • Potential income insecurity in rough weather season
Loss of access to reefs within marine national parks	• Increasing concern for conservation and protection of reefs • Increasing value recognised in reef tourism associated with marine national park	• Increasing distance to travel to more distant reefs outside park • Increasing risk in rough weather season of lengthier boat trip to reef fishing grounds • Reportedly, some fishers opt to illegally fish in park • Increasing risk of punishment (imprisonment and fines) if caught illegally fishing within the park
Increasing numbers of women involved in fish vending	• Expanding local market with associated vending opportunities • Increasing household expenditures due to inflation and possibly also increasing gambling and alcoholism	• Increasing periods women absent from home • Physical exhaustion from carrying heavy loads • Increased income security • Increased control of household finance by women
Degradation of nearby reefs	• Overfishing of nearby reefs • Destructive fishing techniques (dynamite) • Reclamation for housing in Junglighat • Increasing sedimentation due to deforestation • Crown-of-Thorns starfish • Coral bleaching in creeks	• Increasing distance and risk to reach distant healthy reef fishing grounds • Loss of protection for cast net fishing • Increased possibility of coastal erosion and risks to boat anchorages and property

TABLE 18 (CONTINUED)

Changes in reef-derived livelihood	*Contributing factors*	*Impact on strategies and outcomes*
Loss of mangrove resource	• Removal for firewood • Removal for reclamation and housing	• In Junglighat loss of mangroves has led to loss of safe anchorage and increased time spent watching boats and bailing out water in exposed anchorage • Loss of firewood source
Increasing reliance on credit	• Race to improve income and status • Emergence of traders and middlemen • Loss of government loan schemes • Inaccessibility of loans through co-ops or banks for poorer households as they require collateral security • Increasing household expenditures, due to high cost of living and inflation of essential commodities • Increasing incidence of gambling and alcoholism and associated expenses	• Income insecurity and debt, or if credit managed well income security is possible because credit allows households to maintain purchasing power • Increasingly households bonded to trader, middleman or moneylenders • Increasing opportunities from credit to obtain gear, boats and enhance income security in the longer term
Loss of shell and sea cucumber collection opportunities	• Decline in availability due to over-harvesting in nearby areas • Local fishers are scared off by Thai poachers who collect sea cucumbers extensively and have arms and ammunition • Environmental legislation banning collection and sale as per notification Schedule I of Wild Life Protection Act of the Government of India dated 11.7.01 • Heavy fines if caught selling on illegal market	• Loss of income opportunity
Loss of opportunities for immigration to Andaman and Nicobar Islands	• Supreme Court Order	• Loss of opportunity to break poverty trap and improve livelihood opportunities
Total loss of reef-based livelihood for new immigrants (cut off date not yet fixed)	• Supreme Court Order	• Return to mainland and previous livelihood • Increasing vulnerability • Increasing income and food security • Return to poverty

Major changes to the reef-based livelihoods among the study communities on South Andaman Island fall into three main categories: fisheries development, conservation and migration.

5.1 FISHERIES DEVELOPMENT

Fisheries development has had both positive and negative impacts on the livelihood strategies and outcomes of households in the three communities. As fisheries have developed and export markets for reef species have grown, positive impacts have included increasing opportunities for improving income and food security throughout the year, and increasing opportunities for women in fish vending, with associated increases in income security and more equitable control of household expenditure. There has also been an increasing reliance and bondage to fish traders and middlemen, which has both positive and negative outcomes, depending on the level of exploitation and the ability of households to manage their finances. On the positive side, through the provision of infrastructure and credit, traders and middlemen provide opportunities to improve income security and build up resources. On the negative side, traders generally do not give fair prices to the fishers and there is a major risk of increasing debt and income insecurity if finances cannot be managed well. Fisheries development has also had negative impacts on nearby resources, causing degradation through over-exploitation and destructive fishing. Unless properly planned and managed, further fisheries development and commercialisation has the potential to extend these impacts on

the natural resources and reefs, with negative impacts on the sustainability of fisheries based livelihoods.

5.2 CONSERVATION

Changes associated with conservation, such as the loss of access to resources within the marine national parks and the loss of sea cucumber and shell collection opportunities, due to wildlife conservation legislation, have largely resulted in negative impacts on the livelihood strategies and outcomes of the three communities. The impacts have been felt by the communities through the loss of livelihood opportunities and increasing risks in either accessing alternatives (i.e. distant reefs outside the national park) or in continuing to undertake livelihood options illegally (i.e. harvesting marine resources within the national park, or harvesting prohibited species).

5.3 MIGRATION

Migration patterns have been both the outcome of fisheries and island development and the cause of many changes. Increasing migration and settlement in the Andaman and Nicobar Islands have opened up possibilities and improved the livelihoods of many families. However, it has also increased pressure on and caused depletion of local resources and in the fishery context has put pressure on the Fisheries Department in providing support to fishers through loans. Ultimately, through concern for the sustainability of island development and ecosystems, the high level of migration into the islands has led to the Supreme Court Order. While the Supreme Court Order has the potential to ensure future sustainability of the islands, it will also have serious impacts on the local communities and in particular the recent immigrant families, who are perhaps the least equipped to cope with this change.

6 SUMMARY AND CONCLUSIONS

The forest covered Andaman and Nicobar Islands lying off the east coast of India and the west coast of Myanmar and Thailand are surrounded by an extensive system of fringing and patch reefs and offshore coral banks. The population of these isolated islands includes six indigenous groups and a settler population, primarily originating from mainland India. Migration to the islands began with the British, who established a penal colony and forestry operations in the 1800s. Since independence the island administration has encouraged the migration of mainland Indians to take up forestry, farming and fisheries-based livelihoods. The current settler population of over 350,000 is relatively small by Indian standards and the population density is generally low. However, the population is rapidly growing, particularly in the Great Andaman Island group in the north, where immigration levels have been high.

Government support for the growing settlements has been significant. Good infrastructure has been developed and high standards of health and education have been reached. Support continues through economic subsidies, providing subsidised food and ship fares. The good support systems and relatively high standards of living have attracted many mainland Indians to the islands to improve their livelihoods, often escaping hardships, such as drought and famine. With land easily encroached from the forest, and a wealth of opportunities associated with the productive coral reef and near-shore resources, migrants have had a real opportunity to alleviate their poverty. In this context, poverty is largely related to how long a household has been settled on the islands, which dictates the extent of ownership and access to resources and formal and informal support systems. Thus, among the settler communities, the poor households are generally those who have only recently immigrated to the islands. They have little or no financial and physical resources and have weak social contacts and support both within the community and to the formal government support mechanisms, which depend on residency period. Typically these poor households are living in rented accommodation, on leased land, or on forest encroachments. Many of these families, living on encroached or non-allotted land, are now considered illegal as the result of a recent Supreme Court Order, which aims to limit the adverse effects of development on the islands in an effort to ensure sustainable development.

The wealth of reef and associated resources have provided opportunities for fisheries development in the islands and an entry point for immigration, offering a means of alleviating poverty amongst migrant families. It is currently estimated that the settler fishing community on the islands now numbers 20 000 people. For these settler fishing communities, the reef resource is a major component of their fishing activities. However, compared to communities who have had long associations with reef resources, reef dependence is not as well developed and knowledge and skills associated with the reef fishery are limited. Nevertheless, the accessibility of the reef means that they may still enter the fishery using simple and inexpensive hand-lines. Indeed, hand-line fishing over the reefs constitutes a significant proportion of fishing activities, often combined with net fishing in reef channels or along the reef edge. For the most recent migrants this is most easily accessed as labourers on others boats, an activity which is exclusively the domain of men. Unlike other reef fisheries where women can access shallow reef resources on foot, this is not the case in the Andamans, where women's involvement is restricted to fish vending. However, in many cases fish vending is mainly carried out by women and provides good income opportunities and a source of control over household income and expenditure.

Ultimately, the reef resource provides a stream of positive benefits to the livelihood outcomes of poorer households. Through fishery related opportunities, the coral reef and coastal resources provide the main source of income and protein for immigrant fishers, provide a product for exchange and shelter the coasts from erosion. Near-shore reefs can be accessed all year around, even during the rough weather season, when distant fishing grounds cannot be reached. Thus, the nearby reefs provide a critical resource, maintaining food and income security throughout the year. In communities involved in both farming and fishing, the reef provides an important complementary activity to farming and an additional source of food and income. Their accessibility also provides a key safety net in the face of hardships, such as the loss of fishing nets. The diversity of reef products offer opportunities for growing local markets and an expanding export market for high value reef species, which provides good livelihood opportunities and has resulted in an expanding reef fishery. The knowledge of the potential of the reef to provide is of great value to the new migrants, giving them significant peace of mind and confidence to take loans, against the assumption that the reef will act as a 'resource bank', and a good catch is always possible tomorrow to pay back a loan. Combined with the knowledge that there is a real possibility to progress and build up one's resources through fishing-based

livelihoods, the reef resources give a huge sense of well-being and hope for the future.

The fishery and reef resources in the Andaman and Nicobar Islands are still considered to be plentiful and generally in good condition. Externalities affecting coral reef resources are relatively few and mainly limited to activities within the islands, principally those associated with deforestation (logging and encroachment), which have increased sediment loads to the near-shore waters. Frequent incidences of poaching of reef products by Thai and Burmese fishers also poses some threat to the reefs. However, in general most reefs are considered relatively healthy, having suffered minimal damage during the 1998 coral bleaching event, which caused widespread reef mortality throughout the Indian Ocean. Despite this, the high levels of immigration and growing local population have resulted in increasing pressure on local resources, causing significant declines in forest cover and local depletions of coral reef and mangrove resources adjacent to fishing communities. The expanding export market for reef fish is also placing an increasing demand on resources with the possibility of future over-exploitation if not properly managed.

Concern for reef decline globally has promoted international and national policies to conserve biodiversity, increasing national legislation over the extraction of reef products. Areas of coral reef in the Andaman Islands are now off limits for fishing activities, protected within marine national parks, which focus on conservation and tourism objectives. These restrictions have on the whole been implemented with limited consultation with local fishing communities and for those who formerly relied upon protected reef areas during the rough weather season, this has led to a loss of access and reportedly in some cases to illegal fishing activities and generally increasing risks and transaction costs to local fishers. However, there is increasing emphasis through the efforts of the GCRMN, ICRMN and local NGOs to include local communities in monitoring socio-economic aspects of reef use and encourage the wider participation of local communities in resource management. These efforts are critical to ensure conservation efforts do not exclude the poor and that management is both sustainable and equitable, meeting both international and local priorities.

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NOTES

1 Source: National Informatics Centre, Ministry of Communications and Information Technology website: http://andaman.nic.in

2 Fisheries Department records.

ANNEX 1 VARIATIONS TO FIELD METHODOLOGIES

The field methodology specified in the guidelines for the study (IMM and SPEECH, 2002) were followed as closely as was appropriate and possible within time and human constraints. On some occasions variations were made to the field methodology in an attempt to improve data capture or modify the methodology to suit local conditions. This annex outlines the major differences in the applied methodology.

Due to the conditions created by the Supreme Court Order, the people in the study areas were extremely wary of the research team. Hence, a modicum of caution was employed in order to gain the necessary information, as people were often hostile and under the assumption that the research team were from the government or the Fisheries Department, in spite of repeated assurances that this was not so. This was a major constraint during the collection of data, thus techniques were used to gain information from people without arousing too much suspicion.

Due to the large size of the study communities, in particular Junglighat and Panighat, sampling techniques were used to sample the community, including probability and non-probability techniques, such as snowball sampling and availability sampling. The 'true' population size could not be accurately determined as data from secondary sources were neither precise nor adequate. There has also been unaccounted immigration and encroachment, so the 'true' population is expected to be greater than official estimates. In other cases, e.g. Guptapara, the population estimated by locals was actually less than official figures, which was thought to be due to changing village boundaries since the last census. The eventual sample size was determined based on all these constraints and availability of time.

Attempts at engaging communities in participatory techniques was constrained because of the large number of households in the study sites. In order to overcome this constraint, a household-based questionnaire was introduced as part of the sampling technique in the South Andaman Island study (Annex 3). The questionnaire listed questions pertaining to every aspect of people's livelihoods, as well as information about indicators, which were of relevance to ANET's future and ongoing work. Household data sheets also focused on data relevant to the 'Venn diagrams' and 'Overlapping Livelihood Matrix' (as outlined in IMM and SPEECH, 2002). Household questionnaire data were cross-checked and validated with key informants and focus groups.

'Triangulation of data' was also undertaken using key informants and focus groups. These focus groups involved both men and women. Separate groups comprising men and women were also approached to get a holistic picture of issues regarding households and women's role in earning income. This was aimed at gathering information about expenditures pertaining to gambling, alcoholism and other sensitive issues.

ANNEX 2 HOUSEHOLD QUESTIONNAIRE

Community data

Age group	in 1990	in 2002
12 to 20		
21 to 29		
30 to 38		
39 to 47		
48 to 56		
57 onwards		
Total		

Household data

Named of household and individuals	
Relationship	
Age	
Sex	
Education	
Caste	
Numbers of settlers/non-settlers	
Number of years since arrival	

House type	Kuccha	Pucca	Semi	Sanitation facility	Water supply
Own house					
Rented house					
Rent/month					
Relative or friends					

	Land type	Year	Revenue	Amount
Land owned				
Allotted Land				
Purchased land				
Encroached land				
Others land				

[In Junglighat area only]

Tax	Monthly	Yearly
Water		
House		
Land		
Others		
Total		

Occupations

Previous occupations (list)	
Current occupations (list)	
Alternative sources of income (list)	

Fishing-based activities

Number of years engaged in fishing	
Traditional/non-traditional	

Mechanised/non-mechanised	
Total number of nets	
Names of the nets	
Total number of lines	
Thickness of lines	
Total number of hooks	
Hook size no.	
Longlines and numbers of hooks	

Numbers of fishers in 1990 and 2002	
Numbers of family members involved in fishing in 1990 and 2002	
Number and type of craft used in 1990 and 2002	
Gear used in 1990 and 2002	
Fishing grounds	
Area	
Trips per month	
Season	
Months	
Duration of use of area	
Species caught	
Abundance of fish in 1990 and 2002	
Fish catch in 1990 and 2002	
Price of fish in 1990 and 2002	
Beliefs and customs associated with fishing	

Fishing season

	Month – Month	Trips per month	Total
Peak season			
Average season			
Off season			

Fish catch in kg	Per trip	Per month	
Peak season			
Average season			
Off season			

Income from fishing

Boat's share	
Own share	
Monthly share	
Yearly share	
Total income per month	
Total income per year	

Fishing expenditure

Expenditure/trip	Diesel	Ice	Bait	Ration
Peak season				
Quantity				
Rate/litre or kg/piece				
Total price				
Average season				
Quantity				
Rate/litre or kg/piece				
Total price				
Off season				
Quantity				
Rate/litre or kg/piece				
Total price				

Cost of net per kg	
Durability of nets	
Cost of net repairs	
Cost of boat repairs	

Gender

Number of women	
Women's role in relation to reefs in 1990 and 2002	
Reasons for involvement	
Mode of fish sales	
Income per month	
Women's role in relation to agriculture	

NONFISHING ACTIVITIES

Agriculture

Plantation	Production/year	Area covered	Income/month	Income/year	Expenses	Cost
Arecanut					Fertilisers	
Coconut					Pesticides	
Banana					Labour	
Other					Others	
Type of vegetable:						

Private business

Type of Business	No. of years	Income/month	Income/Year	Others
General shop				
Tea shop				
Vegetable vendor				
Stationery				
Middleman				
Others				

Festivals and marriages

Names of festivals	
Dates	
Expenses	
Marriage dates	
Marriage age	
Expenses	

Miscellaneous household expenditure

Expenditure	Monthly	Yearly
Ration		
School		
Tuition		
House repair		
Municipal tax		
Loans		
Others		
Total		

Household loans

	Year	Loan amount	Interest rate	Rate of subsidy	Time period of loan
Co-op Bank					
State Bank					
IRDP					
Panchayat					
Agriculture					
Fisheries					
Industries					
Money lender					
Others					
Paid back	Yes	No	Going on		

Household savings

Savings:	Yes/No	Monthly savings	Yearly savings	Total Co-Bank
State Bank				
Post Office				
Sahara Bank				
Uco-Bank				
Syndicate Bank				
Canara Bank				
Self saving				
Others				

Details of household involvement in lottery	

Problems faced

Problems description	
Occurrence	
Causes	
Impacts	

A Case Study from Lakshadweep

Vineeta Hoon

ACKNOWLEDGMENTS

Vineeta Hoon, her colleagues from CARESS and collaborators in previous fieldwork from Agatti Island and the Lakshadweep administration are responsible for providing all the information contained within this report. Thanks are due to all the local participants, who gave up their valuable time and knowledge in previous studies which contributed to this report. We also thank Vineeta Hoon for her considerable time in compiling this document and for responding quickly to our many questions.

All photos in Study 4 were supplied by Vineeta Hoon and from http://lakshadweep.nic.in

NOMENCLATURE

ACRONYMS

ASDO	Additional Subdivisional Officer
CARESS	Centre for Action Research on Environment Science and Society
CHC	Community Health Centre
CIFT	Central Institute of Fisheries Technology
CMFRI	Central Marine Fisheries Research Institute
DoE	Department of Environment
DoF	Department of Fisheries
DST	Department of Science and Technology
GCRMN	Global Coral Reef Monitoring Network
GoI	Government of India
ICAR	Indian Council for Agricultural Research
IMR	Infant Mortality Rate
LCRMN	Lakshadweep Coral Reef Monitoring Network
LDCL	Lakshadweep Development Co-operation Ltd
MMR	Maternal Mortality Rate
NGO	Non-Governmental Organisation
NIO	National Institute of Oceanography
SPORTS	Society for Promotion of Recreation, Tourism and Water Sports
ST	Scheduled Tribe
UT	Union Territory
ZSI	Zoological Survey of India

LOCAL TERMINOLOGY

Adi Bala	Shore seine
Aliv, Aly	Main entrance into the lagoon or big channel
Amin	The island headperson
Anganbadi	Children's crêche
Bala	Net
Bala Eddenna	Set net
Bala Fadal, Chandelle	Drag net
Chal, Shal	Shallow entrance into the lagoon or small channel
Coir	Coconut husk fibre
Copra	Dried coconut kernel
Ettuvali	Eight oars
Jelly	Pieces of coral or any other rock, generally used for construction purposes
Karanwar	The one who administrates the *Tharawad* property – generally the brother of the female-head of the family
Madrassas	School for religious instruction
Makkatayam	Patriarchal system
Manju	Traditional cargo vessels
Markez	Tuition centre
Marumukkathayam	Matrilineal system
Mas	Parboiled and dried tuna fillet
Neera	Sweet nectar collected from coconut trees
Oathapalli	School for religious instruction
Odam	Traditional sailing craft
Olabala	Fish scaring device used in *Bala Fadal*
Pandaram	Common land
Parai	Coral reef
Pitti	Sand bank
Rs	Indian Rupee (exchange rate ~47Rs: 1US$)
Shal kakal	Set net used at entrance points to the lagoon
Sharadam	Local board game using cowrie shell counters
Thankis	Fishing line
Tharappam	Traditional wooden rafts
Tharawad	Traditional extended family – descendants from the matrilineal line
Thingalacha	Self-owned property
Thoni	Traditional wooden boats
Velliyacha	*Tharawad* property, or traditionally owned property fom the matrilineal line

BACKGROUND TO THE LAKSHADWEEP CASE STUDY

The Lakshadweep case study was carried out as a desk-study in partnership with CARESS following consultation with ICRMN. The main sources of information for the study were previous studies undertaken by Vineeta Hoon and colleagues (Hoon and Seshadri, 1990; Hoon, 1997; Hoon, 1998; Hoon *et al.*, 2002; and Hoon and Shamsuddin 2002). The most recent of these, was carried out by CARESS as part of a Global Coral Reef Monitoring Network (GCRMN) South Asia assessment and monitoring project, which was undertaken on Agatti Island. Information contained in these sources were re-assessed and analysed following the RLA methodology guidelines (IMM and SPEECH, 2002).

The following case study report provides a detailed overview of reef-based livelihoods in the Lakshadweep Islands, focusing on Agatti Island, the westernmost island in the Union Territory. Lakshadweep was included as a case study, in order to highlight the nature of reef-based livelihoods on small coral atoll islands, where the local community has been co-existing with the reef for hundreds of years. It illustrates a situation where livelihoods have been highly subsidised by the government and where relatively recent social changes have brought about the emergence of new forms of poverty.

The first two sections of the report give a contextual overview of the study area and study communities, outlining key social, ecological, economic and administrative characteristics of the area and local livelihood systems. Section 3 discusses the features of poverty in the study communities, identifying what characteristics locally define poor households and estimating the extent of poverty existing in the communities. Benefits arising from the reef resources to all aspects of the livelihoods of the poorer members of the communities are described Section 4, entitled Reef Livelihoods. Section 5 outlines how reef-derived livelihoods have changed and discusses the causes of these changes and impacts on poor people's livelihoods. Finally, Section 6 provides a summary and concluding remarks, highlighting the key points of the study and aspects of the benefits of reef resources to the livelihoods of poor households and how these have responded to change.

1 STUDY AREA CONTEXT

The area considered for study is the Lakshadweep Islands located between 8°–12°3′ N latitude and 71–74°E longitude in the Arabian Sea about 225 to 450 km from the Kerala coast of India (Figure 1). They comprise 12 atolls, three reefs, five submerged banks, including 36 islands, with a total land area of 32 km^2, and useable land area of 26 km^2.

Lakshadweep is considered the smallest Union Territory of India with a population in 2001 of 60 595. However considering its lagoon area of 4200 km^2, its territorial waters of 20 000 km^2 and about 400 000 km^2 out of the 859 992 km^2 of Exclusive Economic Zone of the west coast of India, Lakshadweep is a large territory. Table 1 presents some basic facts about Lakshadweep.

1.1 SOCIAL SETTING

Eleven out of the 36 islands are inhabited. These are Agatti, Androtт, Amini, Bangaram, Bitra, Chetlat, Kadmat Kavaratti, Kalpeni, Kiltan and Minicoy. According to tradition, the first islands to be settled were Amini, Kavaratti, Androth and Kalpeni. People then moved on to the other islands, such as Agatti, Kiltan, Chetlat and Kadmat. An old dialect of Malayalam is spoken on all the islands except Minicoy, where the inhabitants speak Mahal and use the Divehi script of the Maldives.

Owing to its remoteness and difficult access the Union Territory (UT) of Lakshadweep is classified as a Scheduled Tribe (ST) area, which the government is committed to protect. Only those inhabitants who are born on the islands and whose both parents are born on the island are considered as scheduled tribes or native to the islands.[1]

In certain senses the Lakshadweep population is fairly homogeneous. 100% of the native population is Muslim, however, despite the influence of Islam, they follow a matrilineal code of conduct and the caste system still prevails based on occupation: landowners (*Koyas*); sailors (*Malmis*); and cultivators (*Melacheries*). The caste distinction between *Koyas* and *Melacheries* is no longer an issue as both castes have equal opportunity to study and seek employment.

The Lakshadweep population has been steadily growing over the last century. Population figures and decadal increases based on census reports are presented in Figure 2.

The island-wise break up of area and population is presented in Table 2. The population density is 1894 per km^2 in 2001 as against 1616 per km^2 in 1991 and 1258 per km^2 in 1981. Lakshadweep ranks fourth in the whole of India in terms of population density. The decennial population growth rate of Lakshadweep from 1991–2001 was 23.40%, as against 21.34% for India as a whole and 39.41% in the previous decade.

The growth in population poses a heavy drain on the natural resources. This can lead to serious shortages and environmentally harmful practices. The recent changes in building styles and living have already depleted fresh water supply. According to a NEERI report published in 1989, the Lakshadweep Islands had already exceeded their carrying capacity of population with respect to fresh water supplies (Hoon and Seshadri, 1990).

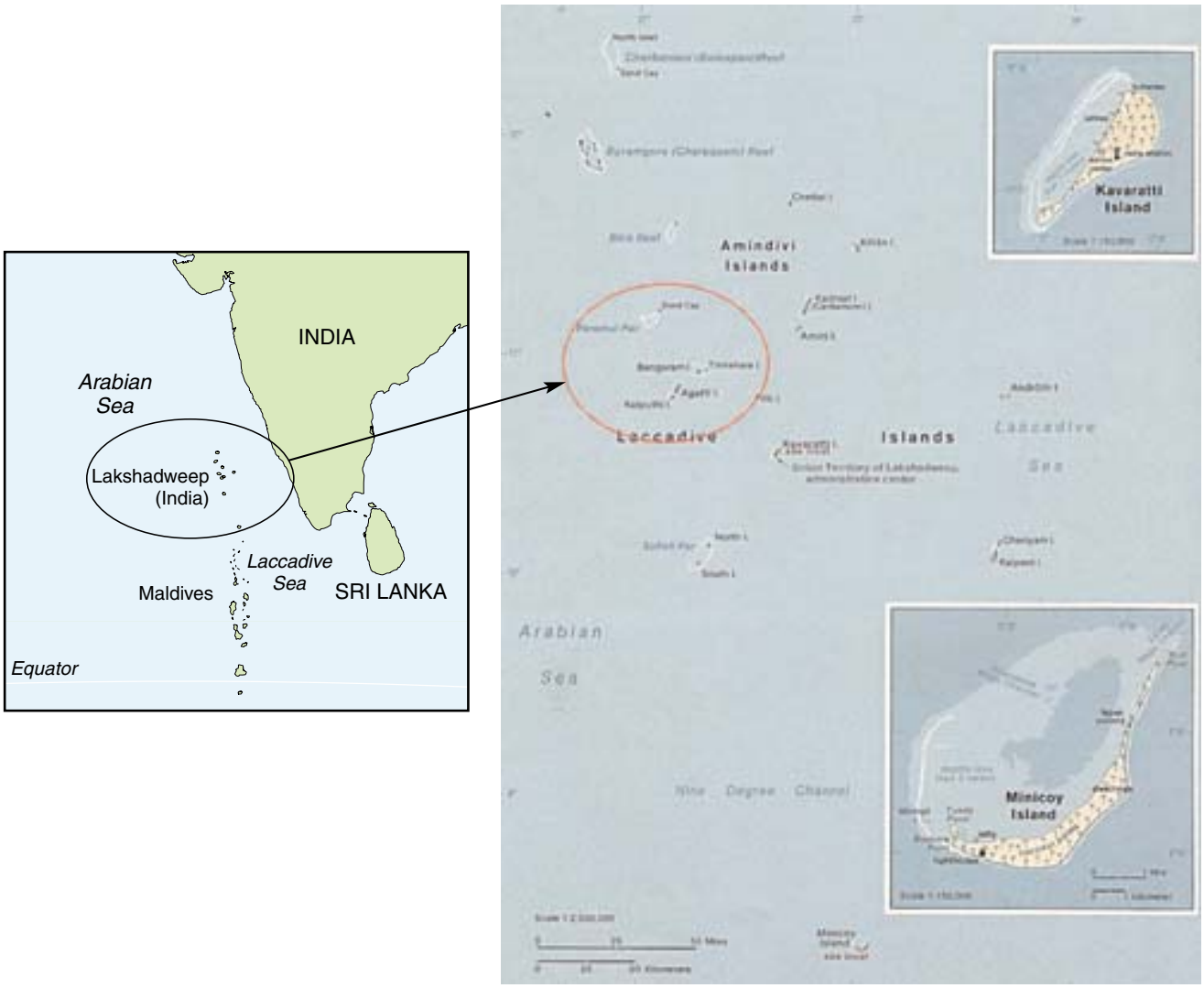

Figure 1 Union Territory of Lakshadweep and Agatti Island.

TABLE 1 LAKSHADWEEP ISLANDS, BASIC FACTS

Location	8°N to 12°N latitude and 71°E to 74°E longitude	Territorial waters	20 000km^2
Distance	Kavaratti–Calicut 340 km Kavaratti–Kochi 404 km Kavaratti–Mangalore 352 km	Economic Zone	400 000km^2
Islands	36 (10 inhabited, one tourist resort)	Population 2001 *Males* *Females*	60 595 31 118 29 477
Geographical area	32 km^2	Population density	1894 per km^2
Land use area	26.32 km^2	Temperature Range	Max: 35°C–38°C Min: 17°C–18°C
Lagoon area	4200 km^2	Relative humidity	70–75%
		Average annual rainfall	1500 mm in northern islands 1640 mm in southern islands

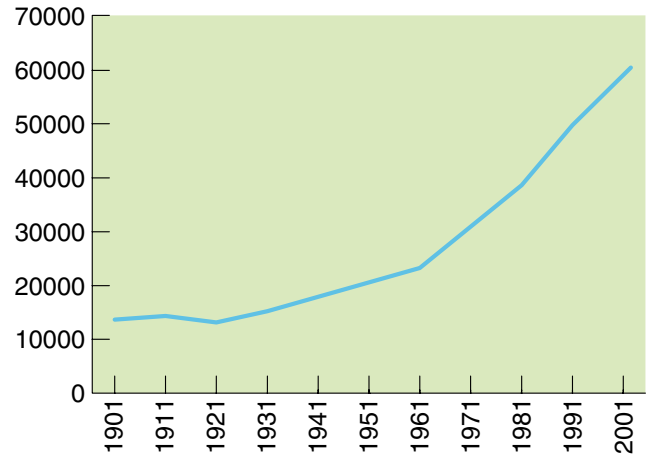

Figure 2 Population size in UT Lakshadweep since 1901.

TABLE 2 LAND-WISE AREA, POPULATION AND POPULATION DENSITY

Island	*Area* km^2	*Population 2001*	*Population* density p/km^2
Minicoy	4.37	9495	2163
Kalpeni	2.28	4319	1548
Andrott	4.84	10 720	2215
Agatti	2.71	7072	1842
Kavaratti	3.63	10 113	2396
Amini	2.59	7340	2834
Kadmat	3.12	5319	1705
Kiltan	1.63	3664	2248
Chetlat	1.04	2287	2239
Bitra	0.1	266	2660
Bangaram	0.58	61	105
Uninhabited islets	5.11	0	0
Total	32	60 656	(Average) 1 894

Note: includes Bangaram population.

The average sex ratio in 2001 was 947 females for every 1000 males. Only one island, Minicoy, registered a favourable sex ratio of 1057 females per 1000 males, while Kavaratti registers the lowest sex ratio of 829 females for every 1000 males (Census, 2001). The unfavourable sex ratio for females is of interest since these islands are famous for their matrilineal society. However, despite the adverse sex ratio for females, there is no apparent gender disparity in education or taking up jobs.

Lakshadweep is famous for its matrilineal society, or *Marumukkathayam* system adopted from Kerala, where property is passed down the female line. Women consequently enjoy a special status being the owners of the house property and they are free to take up higher studies and work. In a recent study Hoon *et al.* (2002) revealed that the joint family or *Tharawad* system is beginning to break down. The Islamic S*hari'a* law is gaining popularity for property division, which favours male over female interests. Nuclear families and housing are growing and there is a boom in house construction. Sometimes the old *Tharawad* family name is abandoned and the children are identified by the new house name.

The average literacy rate is 87.52% and development aspirations are modelled on Kerala State which has the highest literacy rate in the country.

Lakshadweep has made important strides in health and in 1999 the infant mortality rate (IMR deaths per 1000 under 5 years) was 20.21 and the maternal mortality rate (MMR) was 0.84.

Satellite earth stations link the islands with the rest of the world. Direct dialling telephone and fax facilities are found on all the islands. Internet connectivity is as yet only in Kavaratti. Transport between the islands and with the rest of the country is restricted to weekly ship services, helicopter services and an air service between Agatti and Cochin or Goa. Emergency transport facilities, particularly during the monsoon months from May to August are provided by the helicopter service. Cargo and provisions are carried to the islands by four ships. Privately owned *manjus* and government-owned barges are also used to transport goods from Mangalore, Cochin and Beypore to the islands. Bicycles, motorised two wheelers, auto-rickshaws, tractors and for official purposes jeeps and cars are used for internal transport.

1.2 ECOLOGICAL AND GEOPHYSICAL SETTING

There are four natural ecosystems in the islands: land, lagoon, reef and ocean.

1.2.1 The land

Topography: The islands consist of coral formations built up on the Laccadive–Chagos submarine ridge rising steeply from a depth of about 1500 m to 4000 m off the west coast of India (Figure 3). The Union Territory of Lakshadweep along with the Maldives and the Chagos Archipelagos form an interrupted chain of coral atolls and reefs on a contiguous submarine bank covering a distance of over 2000 km. This ridge is supposed to be a continuation of the Arravalli Mountains, while the islands are believed to be remnants of submerged mountain cliffs (James *et al.*, 1986).

The islands are flat and scarcely rise above 2 m. On average they are 5–6 km long and less than a kilometre in width, rising 3–4 km from the floor of the ocean (Wafer, 1986). They are made up of coral sand and boulders, which have been

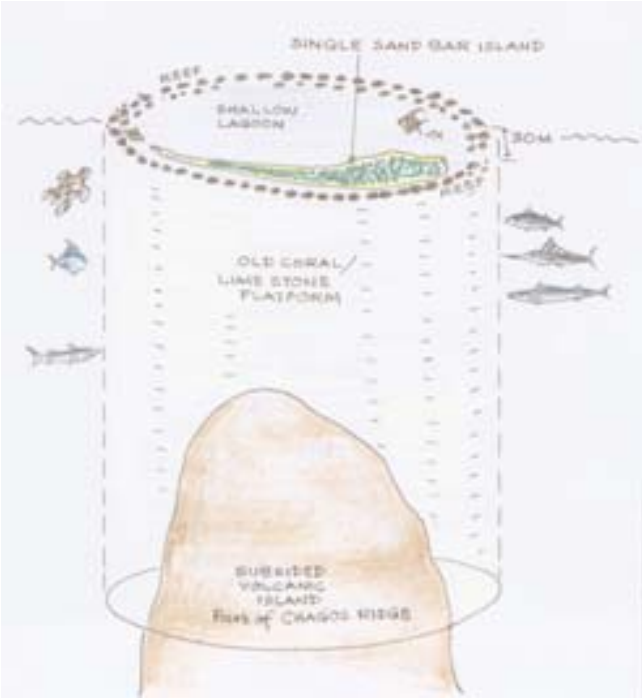

Figure 3 Diagram illustrating atoll island formation.

compacted into sand stone. There are many man-made pits and inland depressions in the islands dug out for the coir-retting industry and for growing cereal crops.

All the islands have a north–south axis, except for Andrott, which lies on an east–west axis. All of them are wide in the north and taper off towards the south. The human settlement in nearly all the islands is concentrated in the wider northern part. Several of the islands have small islets separated from them by a narrow channel. It is possible to walk to these islets during very low tides. The distance in between the inhabited islands varies from 32 km to 182.5 km, except in the case of Amini and Kadmat, which lie only 9.5 km apart.

Soils: The soils of the islands are structureless, formed by the disintegration of coral debris. The shore is rocky and composed of disintegrated corals in the east and extreme north and south of the islands. On the western side the soils are mostly sandy intermingled with patches of disintegrated coral debris. Soil fertility and water holding capacity are extremely poor in such parts and it is difficult to grow plants except for coconut on the western side of the islands.

Ground water: Freshwater resources are limited and the hydrological system is extremely fragile. The water is contained in a freshwater lens 1.5 m below the surface (Figure 4). This

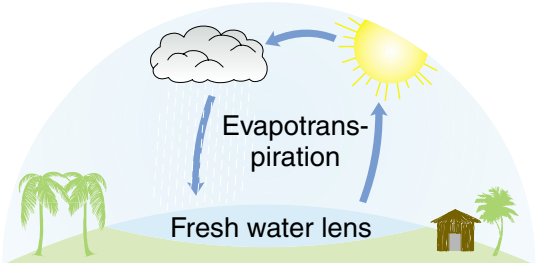

Figure 4 The hydrological cycle.

water is periodically renewed by rainfall. Conserving and protecting the freshwater lens from pollutants is of critical concern as it is likely to be very expensive to replace if depleted.

1.2.2 Reefs and lagoons

Coral reefs of the Lakshadweep Islands are mainly of atoll type except one platform reef at Androth. Almost all the atolls have a NE–SW orientation with the island on the east, a broad well-shaped reef on the west and a lagoon in between. These lagoons are protected by the reefs on the outer edge, and provide a safe anchorage for small vessels. The reef on the eastern side is closer to the island and the lagoon is very shallow. The coral patches in the eastern lagoon are exposed during low tide. The eastern reef flat faces the highest stress from trampling by reef gleaners and net operators since it is easily accessible by foot.

The reef flat occupies an area of 136.5 km^2, seagrass occupies 10.9 km^2 and the lagoon occupies 309.4 km^2 (Bahuguna and Nayak, 1994). The depth of the sea increases outside the coral reef and can reach up to 1500–3000 m. Androth is the largest island with an area of 4.84 km^2 and the only island that does not have a lagoon.

On the leeward side the reef slopes into the sea. The first plateau is found around a depth of 5–6 m. The second plateau with sandy patches is found around 25–30 m (Hoon, 1997). This area is locally called the bar area and is favoured by fishermen for harpooning and spearing specific kinds of rays and big fish.

During high tide, water exchange takes place between the lagoon and the open sea over the reef. The lagoons have sand bottoms with scattered coral boulders and pinnacles followed by extensive seagrass beds at the landward side. The lagoon opens to the sea through one or more natural entrance points. These include natural breaks in the reef that allow boats to ply between the ocean and the lagoon, as well as other small shallow entrances, locally known as *chals*. The *chals* are important since these are the points where the fish shoals enter and leave the lagoon with the tidal change. These *chals* are therefore favoured locations for reef fishing by net operators and are used extensively by the fishermen during the monsoon season (Hoon and Shamsuddin, 2002).

1.2.3 The ocean

The islands appear as tiny specks in the vast expanse of ocean and yet because of them, about 400 000 km^2 of the sea can be claimed by India as an exclusive fishing zone. The territorial waters used by the islanders cover only 20 000 km^2 of this entire area. The ocean contains substantial living and nonliving (e.g. coral shingle and sand) resources. Several tuna varieties, shark, seer fish and half-beaks move about in shoals around the islands. Sharks, rays and a large number of food fish are frequent in these waters.

As described in Box 1, the biodiversity associated with the coral reefs, lagoons and ocean ecosystems is great and has been well documented. Despite the high diversity of species on the reef, there are no large populations of any one kind. Hence species of fish, molluscs and crustaceans, which are favoured by islanders, are vulnerable to over-fishing and many species are classified as endangered in government notifications, prohibiting their exploitation by local islanders.

1.3 ECONOMIC SETTING

Human activity within the UT of Lakshadweep centres around fishing, coconut cultivation and coir twisting. Tourism is an emerging industry on the islands and is controlled by the Lakshadweep administration who leases out land for resorts to operators from the mainland. Until 1990 there was only one tourist resort at Bangaram catering for international tourists, in 1996 the Kadmath resort and dive centre opened up to target national dive tourists and in 1999 the Agatti Island beach resort opened. There are plans to promote more tourist resorts with dive centres in Minicoy, Kavaratti and other islands. There is also modest development of light industry, such as tuna fish canning in Minicoy and, coir fibre factories, coconut

BOX 1 REEF BIODIVERSITY IN LAKSHADWEEP

The National Institute of Oceanography (NIO), the Zoological Survey of India (ZSI) and the Central Marine Fisheries Research Institute (CMFRI) have undertaken several studies in this region during the past nine decades. The ZSI carried out extensive surveys in 1982–1987 and published in 1991 a volume on the fauna of Lakshadweep (ZSI, 1991). The CMFRI carried out a survey from January to March 1987 to study the fishery potential, which culminated in the publication of a special issue on Lakshadweep (CMFRI, 1989).

The coral fauna of Lakshadweep is known to harbour a total of 134 species (Pillai, 1996; Rodrigues, 1996). The lagoon and reef flat fauna are dominated by *Acropora spp*., *Pocillopora spp*., *Porities spp*., and massive and encrusting favids. *Psammocora spp*. is common in the northern islands. There is a profusion of blue coral (*Helipora coerulea, Millepora spp*.) which forms the dominant coral in the lagoon (Pillai, 1996). Eighty-six species of macrophytes, 10 species of Anomuran crabs, 81 species of Brachyran crabs, 155 species of gastropods, 24 species of bivalves, 13 species of sea stars, 6 species of brittle stars, 23 species of sea cucumbers, 15 species of sea urchins and 120 species of fish are found in Lakshadweep (Rodrigues, 1996). The green turtle and the hawksbill turtle are also found in all the islands – they graze on the seagrass beds and frequent the bar area and lagoon area.

Many of the species, as listed below, are now officially notified as endangered by the Government of India and their extraction is totally banned.

List of notified endangered species found in Lakshadweep

Reptiles	Hawksbill Turtle Green Turtle
Cetaceans	Dolphins
Fish	Sharks and Rays Sea Horse Grouper
Birds	Sooty, Noddy and Large Crested Terns
Molluscs (shells)	Cone shells Cowrie shells (*Cyprae tigris, moneta*, etc.)
Echinoderms	Sea Cucumbers (all Holothurian) Sponges (all Calcareans)
Corals	Reef building coral (all Scleractinians) Sea Fan (all Gorgonians)

oil press, printing press and pickle-making units on other islands.

Fishing is the mainstay of the economy, however, this was not always the case and historical records show that none of the previous rulers of Lakshadweep showed any attention to developing the coral reef and marine resources. Coconut cultivation and the coir trade were the main activities of interest for the rulers and significantly, owning coconut trees became the wealth and status marker among the islanders. Thus the high caste Koyas owned the coconut trees, while the lower caste Melacheris and Malmis were the coconut climbers and boatmen and sailors.

Fishing activities were merely a subsistence activity, with little scope for revenue. It was not until the 1960s that the administration started focusing on developing the fishery commercially and only in the 1990s did they recognise that there was an economic potential in reef-related tourism. In the late 1960s in Agatti and other islands of Lakshadweep pole and line tuna fishing was popularised from Minicoy where it is a traditional activity. Since then the tuna fishery has been streamlined through extending training and improving technology on all the islands. To encourage more youth to take up tuna fishing as a profession, the Department of Fisheries provides a 20% subsidy towards the cost of a tuna fishing boat and 33.3% subsidy towards the cost of a boat engine. Fishing technology and tuna fishing methods are also included as part of the curriculum as a unique feature of the school syllabus on the islands.

Women's involvement in the commercial fishery is mainly in post-harvest activities. In Minicoy the women undertake all the post-harvest activities, including preparation of the parboiled and sun-dried tuna *mas* or *mas meen*. This system was also followed on the other islands when pole and line fishing was introduced and it ensured that all the members of the *Tharawad* family, including women and children, were involved in the economic activity and thereby benefited. Today on Agatti Island the women have no role to play even in the post-harvest and preparation of tuna *mas*. Instead the profits are shared between the fishing boat owner and crew and the income no longer benefits the entire *Tharawad* family.

Outside the fisheries sector, government jobs are a major source of income and have allowed households to prosper and in many cases have resulted in them opting for a nuclear family. However, the less-educated, educated but unemployed or traditionally skilled members of the family have been left behind to pursue tuna fishing and reef-related activities as opposed to steady salaried government employment options. These changes are relatively recent but have rapidly created polarity and income disparity within the island populations.

1.4 ADMINISTRATIVE SETTING

Records show that various rulers and dynasties have administered the islands of Lakshadweep since the eleventh century. The Cheras ruled the islands followed by the Kolathris, Ali Rajas of Cannanore, Tipu Sultan and the Bibi of Arakal. The Portuguese and British also showed interest in these islands, attracted by the coir trade, and the British managed to wrest direct control of the islands from the rulers of Malabar in 1905.

In 1880 a system of dividing land into blocks was introduced by the British to the uninhabited islands of Tinnakara, Bangaram, Parali and Suheli. Bangaram was leased out to the *Amin* (local administrative head) of Agatti for 20 years provided he planted a certain stipulated number of coconut trees. The same was done at Kalpitti. In this way, the British administration enjoyed both revenue from land and the profits from the coir trade from the uninhabited and the inhabited islands of Lakshadweep. In 1904, the Amin of Agatti surrendered his lease and Bangaram was auctioned for another 5-year lease period. Even today the Indian administration has continued this system of auctioning and leasing land to tourist resort operators from the mainland.

Since independence, Lakshadweep has been a Union Territory and therefore does not have a state government machinery, but is directly governed by the central government in New Delhi. Kavaratti Island is the administrative headquarters. The administrator is the head of the Union Territory. The district magistrate who is also the collector-cum-development commissioner in the islands deals with matters relating to district administration, law and order. The Lakshadweep Development Corporation set up by the Island Development Authority oversees the economic and commercial activities of the islands. The administrator and all the other Indian administrative officers who are posted in Lakshadweep are directly answerable to the central government and are only posted to the islands on a short term of 3 years, in which they have to develop and implement 5-year plans.

In the immediate post-independence period, a Block Development Committee was present whose members were nominated by the Administration. In 1956–1958, this was replaced by the Citizen's Council again nominated by the administration, comprising 15 members from each island. In the 1990s the Island Council replaced this as an advisory body to the administration on island matters. Island Council members were almost always appointed by the administration and had no real administrative powers. The decentralised *Dweep Panchayat* system, which now exists, is a democratically elected local body which can make representations to the central government.

2 COMMUNITY CONTEXT

The study area chosen in Lakshadweep was Agatti Island, an atoll like most of the islands in Lakshadweep. The following sections provide an overview of Agatti Island and islanders, which is summarised in Table 3 below.

2.1 GEOGRAPHICAL AND SOCIAL SETTING

Agatti Island is the westernmost island in the UT of Lakshadweep located at 10°51′N and 72°11′E. The island covers a total area of 2.7 km^2 stretching 7.5 km in length with the width varying from 1000 m at its widest point in the north to 100 m at its narrowest in the south.

The traditional fishing and land rights of the people of Agatti extend as far as Perumal Par reef and include the small islet of Kalpitti off the south of Agatti Island (Figure 5). The area of human settlement is concentrated in the northern end of the island, where according to the 2001 census, a population of 7072, including 3688 males and 3384 females, lives. The sex ratio on Agatti of 918 females for every 1000 males. An explanation for this skewed sex ratio may be the introduction of male labour from Tamil Nadu, who have been enumerated in the recent census.

Figure 6 shows that Agatti has a steadily growing population, with a decadal growth rate of 23.40 between 1981 and 1991. The 2001 census indicates that the population density is over five times the national average with 1842 per km^2 as against 1492 per km^2 in 1991 and 731 per km^2 in 1951. The rise in population has led to an increase in the number of households in Agatti, which have quadrupled since 1951 (Figure 7). The 1991 census reports a total number of 868 households in Agatti Island. The exact figure for 2001 has not yet been enumerated.[2] According to a recent survey, the average household size is 9.36, ranging from 3 to 23 household members. Joint families are the norm and frequently three or even four generations live under one roof.

Despite evidence that the joint family or *Tharawad* system is beginning to break down, the *Marumukkathayam* system is still prevalent on Agatti, with 74% of households surveyed in a recent study reporting that the house they lived in belonged to their mother, while the others report that they live in their father's house *(Makkatayam)* or in their own house built on land inherited from either parent (Hoon *et al.*, 2002).

The Lakshadweep administration plans have been welfare-oriented since independence and have concentrated on improving living conditions on the islands and mitigating isolation as far as possible. Owing to the remoteness of Lakshadweep and the high cost of transportation, as well as the Scheduled Tribe status, most things are provided to the islanders at a subsidised cost. Thus, islanders are provided with free education and health care

TABLE 3 SUMMARY OF COMMUNITY CHARACTERISTICS OF AGATTI ISLAND

Characteristics	*Agatti Island*	*Lakshadweep*
Livelihood options and diversity	Deep sea – Tuna and shark fishing Lagoon – Net and line fishing Reef – Gleaning and collecting construction materials Land – Coconut plantation – Salaried jobs in government establishments – Jobs in tourism at Bangaram and Agatti resorts	As Agatti Island
Access to the reef	• High accessibility to island reef throughout the year. • Accessibility only during the fair season (Oct–May) to reefs lying far away from the islands, e.g. Perumal Par	As Agatti Island
Seasonal variability of livelihoods	• There is a change in livelihood options in the monsoon and fair season • Tuna fishing and bait collection dominates in the fair season and lagoon fishing in the monsoon season	As Agatti Island
Community organization	• Homogeneous community, with a single religion (Islam). Most of the households are members of the Island Co-operative Society	As Agatti Island
Community Services	• Agatti has an advantage over the other islands since the airport is located here. It therefore has developed at a faster rate and has better facilities than many of the other islands	Some islands have better facilities than others.

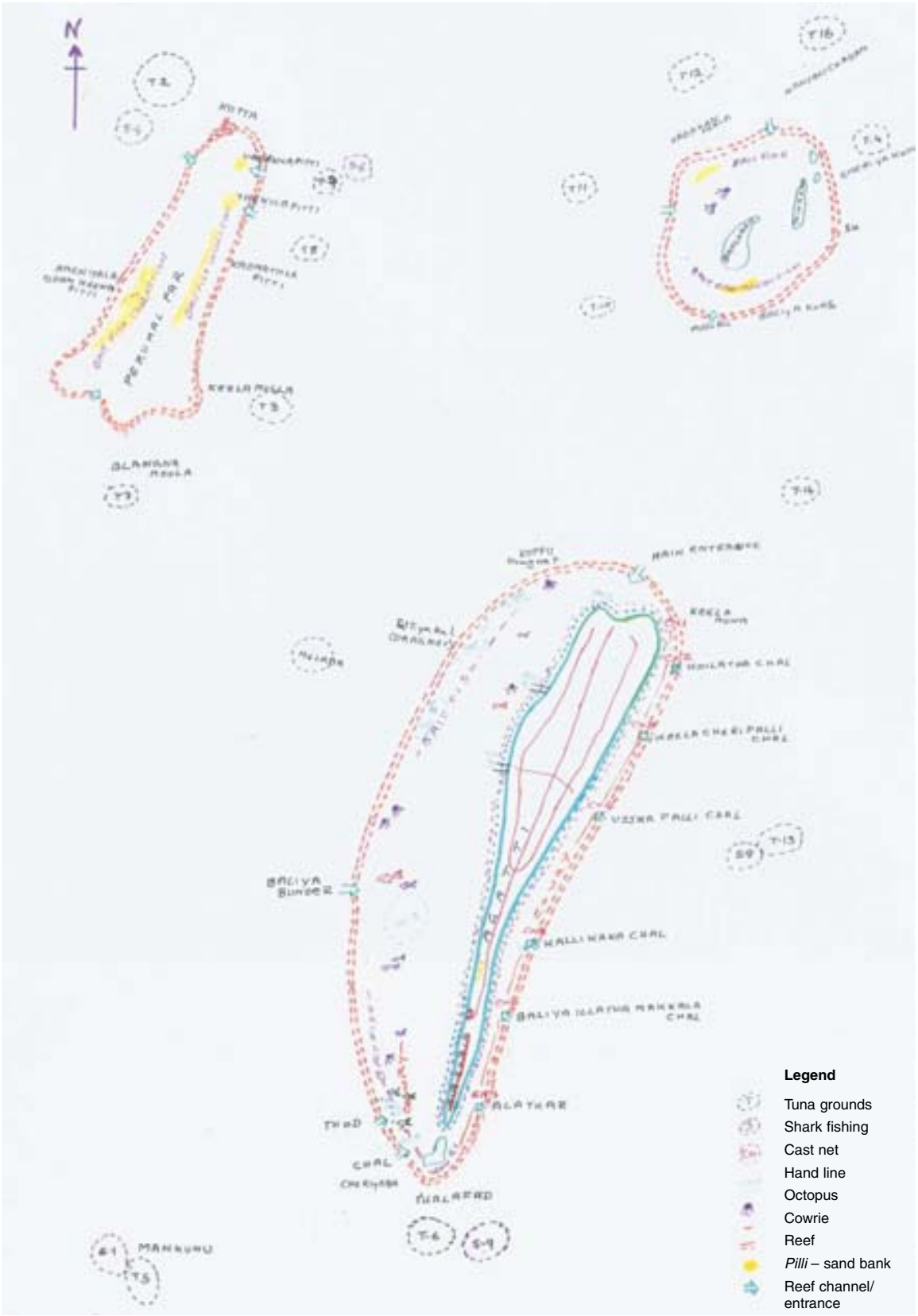

Figure 5 A map illustrating the traditional fishing and land rights of the people of Agatti (map not to scale).

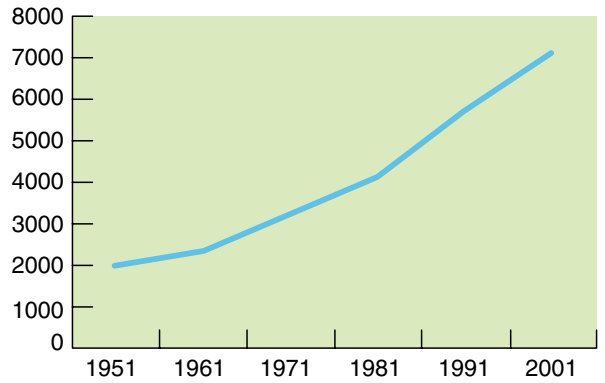

Figure 6 Population in Agatti since 1951.

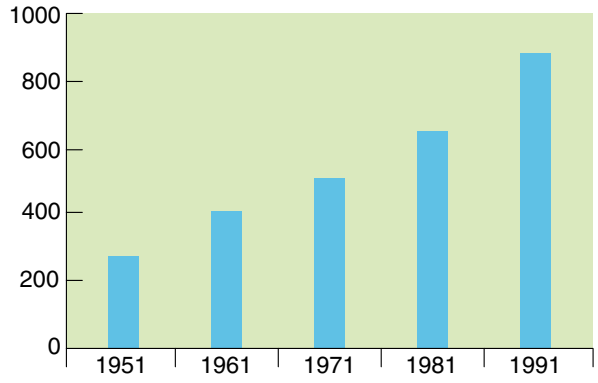

Figure 7 Total number of households in Agatti since 1951.

services as well as rations of cereals, sugar, palm oil and kerosene and subsidised transport to the mainland.

The Infant Mortality Rate of Agatti is 26.49 and Maternal Mortality Rate is zero, both figures are slightly higher than that the Union Territory average, but lower than the national average.[3] Literacy rate on Agatti is 88.5% out of a total literate population of 5170 (2272 women and 2898 men), which is slightly above the average literacy rate for Lakshadweep of 87.52%.

The Lakshadweep airport is located on Agatti and there is a daily flight from Kochi, on the mainland. There are also five passenger cargo ships that serve Agatti Island and connect it with mainland and the other islands. Two inter-island ferry vessels connect the islands with Kavaratti once a week in the fair season, during which period some private entrepreneurs also ply their boats between the islands as taxies.

The bicycle is the most common mode of private transportation. However, with affluence motorised two wheelers have become very popular. On Agatti Island more than one-third of the households own motorised two wheelers. Only government departments own four-wheel transport. Three-wheel autorickshaws provide a taxi service and other entrepreneurs have set up repair workshops for these vehicles.

Agatti Island was electrified in 1968 and long distance telecommunication has been made possible through satellite connections. A summary of other social infrastructure on Agatti Island is given in Table 4 below.

TABLE 4 SOCIAL INFRASTRUCTURE ON AGATTI ISLAND

Sector	*Infrastructure*	*Comments*
Education	Six educational institutions, including one high school, one senior basic school, three junior basic schools and one nursery school	Education is free and subsidised
Health	Community Health Centre	Health care is free and subsidised A health clinic has been functioning since 1998 and is currently being upgraded Serious cases are evacuated to either Kavaratti or the mainland by helicopter
Water	Well water Harvested rain water	Every household has a well, most with electric pumps Eighty households have plastic tanks for rain water harvesting promoted by the Public Works Department
Sanitation	All household with latrines and septic tank	No direct sewage pipe to the lagoon or sea Dry wastes from sewage buried in the beach
Religion	Forty-nine mosques Five *Madrassas* and one *Markez* (religious schools and tuition centres)	The population is entirely Muslim
Markets/supplies	Thirty-eight privately owned stores in Agatti	Multipurpose shops and services provided
Finance	Bank and post office	Syndicate bank functioning since 1976

2.2 ECOLOGICAL AND ECONOMIC SETTING

Agatti shares similar ecological characteristics to the other islands in Lakshadweep, as described in Section 1.2. A coral reef, which lies along its eastern arc, forms an ellipse, 8 km in length and 5 km in breadth, enclosing Agatti Island with a lagoon on the western side of the island. Also within the reef at the southern most end of Agatti, separated by a narrow channel, is the small uninhabited islet of Kalpitti (Figure 5).

The coral reefs closest to the island, which can be most easily accessed all year around, show greater degradation than those reefs further away (Rodrigues, 1996; Hoon *et al.*, 2002). The 1998 coral bleaching event caused widespread coral mortality on the reefs, which are currently showing some signs of recovery, with the exception of the eastern reef, which is constantly used for gleaning and reef walking.

In common with the rest of Lakshadweep, the surrounding natural resources form the basis of the traditional economy of the people of Agatti, which revolves around coconut grown on the land and fishing in the lagoon and ocean. Figure 5 indicates the areas from where the Agatti Islanders draw their resources, which includes the nearby islands and surrounding reefs of Bangaram, Thinnakara and Parelli and the sunken reef known as Perumal Par. These areas are owned by the Agatti Islanders and some of them have temporary shacks on Bangaram. There is no place to spend a night on Perumal Par reef, so boats only make day trips there for tuna fishing. In 1990 a tourist resort was opened on Bangaram Island and since 1991, 61 people, including the tourist resort staff, have shifted residence to Bangaram and live there all year around.

As illustrated in Figures 8 and 9, the present day economy on Agatti is driven by government sector employment, followed by the tuna fishery, and self-employment (e.g. grocery shops, motorcycle repair, teashops, etc.). Coconut cultivation, salaried employment in the tourist resorts and *Madrassa* (religious schools) or working as contract labour are also sources of income. Apart from bait fishing for the tuna fishery, reef-related activities, such as cast-netting, line fishing, cowrie and shingle collection, are undertaken by every household to supplement the main source of income. 80% of the households on the island have multiple sources of income, usually a combination of fishing or agriculture and outside employment. In addition, 90% of the households rear two or three goats and chickens as a dietary supplement.

2.2.1 Fishery activities

The total fish catch in Agatti during 2000 was 2 344 430 kg this was composed primarily of tuna (74%), followed by lagoon or reef fish (25%) and all other deep sea fish (1%) (Table 5). The market for reef resources lies on the mainland. This market is over and above what is directly consumed in the fisher households. There is now emerging a small market for fresh fish and other reef resources within the island itself. This market consists of the government employees, who do not have the time to fish but have purchasing power, as well as three pickle-making units and the tourist resorts. Fresh fish (reef fish and tuna) are sold for around Rs 20/kg (~US$0.4/kg) within the island.

Tuna fishing: Tuna fishing (Figure 10) is dependent on bait collected from the reef area, which is the most energy intensive and capital intensive of all reef-related activities. The returns for tuna fishing are high. According to an income survey a boat owner typically makes around Rs 60 000 (~US$1277) annually after paying all the running costs and the crew earns approximately, Rs 18 000 (~US$383) annually (Hoon *et al.*, 2002). On this basis one tuna boat of 10 people earn around Rs 240 000 (~US$511) annually and the 85 tuna boats in Agatti make a total income of Rs 20 400 000 (~US$434 043) after deducting their fishing-related expenses.[4] According to the 2000 fish landings data a total of 1 740 540 kg of tuna fish were landed for a total value of Rs 34 810 000 (~US$740 638) (Table 5).

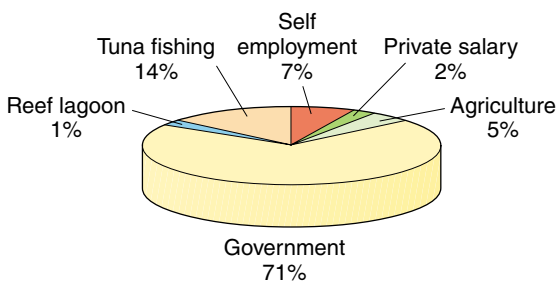

Figure 8 Sources of income generation in Agatti Island.

Source: Hoon *et al.*, 2002

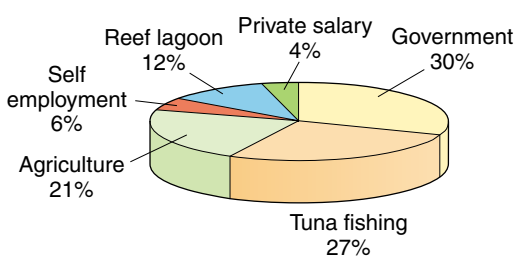

Figure 9 Patterns of primary employment amongst the economically active population of Agatti Island.

Source: Hoon *et al.*, 2002

Figure 10 Pole and line tuna fishing in Lakshadweep.

TABLE 5 FISH LANDINGS ON AGATTI ISLAND DURING 2000

Oceanic	*Landings (kg)*	*Reef and lagoon*	*Landings (kg)*
Tuna	1 740 540	Coral fish	320
Barakuda	360	Gar fish	2660
Sail fish	6090	Goat fish	290
Seer fish	5755	Octopus	1810
Shark	14 910	Purches	1750
Cornex	910	Rays	335
Flying fish	120	Trigger fish	140
Rainbow Runner	1080	Miscellaneous	567 360
Total	1 769 765	Total	574 665

Source: Department of Fisheries

Reef and lagoon fishing: Reef fish are caught in the reef and lagoon by a large variety of techniques and are consumed locally or sold to the tourist resorts for Rs 20–30 (~US$0.4–0.6) per kg. Catch is low and varies between 2–8 kg per unit effort of gear used. So far the reef resources are not extracted for high value markets, such as the live fish trade, aquaria trade or sea cucumber trade. All these activities have been banned by the government.

Cowrie collection: Cowries have a market in the mainland as curios and large cowries can fetch a price of Rs 15 (~US$0.3) each, while the small tiger and money cowries are sold for between Rs 0.50 and Rs 1 (~US$0.01–0.02). According to one of the *manju* (traditional cargo sailing vessels) owners, in the past he marketed 250 000 cowries in 1 year. However, as all cowries are now listed as endangered species (Section 1.2, Box 1), collection is now illegal and the future of this activity is uncertain.

Octopus collection: Agatti has an abundance of octopus, hence the octopus caught are dried and sold to other islands, such as Androth where octopus are not plentiful (Box 2).

Coral sand, shingle and boulder collection: Coral sand, shingle and boulder are required for building construction. Most people collect it for personal use. At a conservative estimate 500 tons of these materials are collected per annum for building construction. The market price for a 20 kg bag of any of these materials is around Rs 15–20 (~US$0.3–0.4). Only one-fifth of the amount collected is sold. There are said to be 10 people on Agatti who collect these materials for sale, while others collect it for their own use. However, this activity is now restricted through legislation (Box 2).

Post harvest activities: Limited indirect employment opportunities are available within the fish processing and marketing sector. Modern post-harvest facilities are not available in Agatti and therefore post-harvest processing is limited to the pickle-making units and producing tuna *mas* by parboiling and sun drying tuna fillets (Figure 11), and salting and drying octopus and shark fins. Other fish catch is sold fresh.

2.2.2 Agricultural activities

Coconut cultivation: Historically the traditional income source came from coconut plantations and the products derived from

BOX 2 SHARING OF RESOURCES BETWEEN ISLANDS

A 50-year-old octopus hunter on Agatti Island, is employed with his wife in government service, he with the Harbour Department and she with the *Anganbadi* (children's crêche). They have 13 children. The two older boys aged 23 and 21 are married and have one son each. The 11 younger children study in school.

He hunts for octopus after office hours and on holidays. He told us that three fresh octopi were dried to make 1 kg of dried octopus which could fetch Rs 150/kg (~US$3/kg). He began octopus hunting five years ago when a tourist at Bangaram presented him with a dive mask and snorkel. Armed with this equipment he found it easy to hunt octopus. He sells his dried octopus to Androth Island. The link with Androth developed since some traders from Androth visited his island and offered to buy all the dried octopus that he could supply.

the coconut tree; copra and coir. This is the main reason why owning coconut trees continue to have a high prestige value. Every islander strives to own a few coconut trees. The income derived from the coconut plantations is now marginal. Island populations have quadrupled and the per capita land and coconut trees owned have declined. However, there are still several landlords and owners of coconut trees in the island who provide income opportunities in tree climbing for harvesting the coconut. Such labourers are paid in kind and receive one-third of the coconuts harvested. The tree climbers also collect sweet necter called *neera* from the young trees and sell the same to the local resorts or make palm jaggery. They are also allowed to harvest leaves for weaving mats and making a variety of other things, such as fencing using the rib of the leaf. These are important sources of income for poor households in Agatti.

2.2.3 Government and private sector activities

Government sector jobs are currently one of the most important sources of household income on Agatti Island. 58% of households have at least one person employed in the government sector, contributing to 71% of the total income generated on the island and providing the primary employment opportunity for 30% of the economically active people on the island (Figures 8 and 9). This has been supported by government policy to provide employment to at least one person from every household.

Other jobs available are in the co-operative society (see Section 2.3 below), or as crew on cargo vessels, or in self-employment. Lower end jobs are also available at the tourist resorts such as boat drivers, escorts, waiters and room cleaners. A basic high school degree is needed for these jobs.

2.2.4 Gender roles

Women tend not to be self-employed and play a small role in the economic sphere of the island life. The economic activities of fishing and harvesting coconuts are work assigned to males. The unique situation in Agatti is that males carry out even the post-harvest work of processing copra and fish (Figure 11). Women confine themselves to domestic work or reef gleaning (cowrie collection) and only go for employment if they get government office jobs.

2.3 ADMINISTRATIVE SETTING

Today the top administrative staff are posted to the islands for 3 years from mainland India. Other posts are filled as far as possible by islanders. Administration departments with direct involvement

Figure 11 Men preparing tuna *mas* on Agatti Island.

in the coral reef resources include the Department of Science and Technology, responsible for monitoring, assessment and research; the Department of Environment, responsible for coastal management and biodiversity conservation and protection; and the Department of Fisheries, responsible for fisheries management and promotion of deep sea fishing. A Wildlife Warden or Science and Technology Technical Assistant, who also acts as a warden, is present on each island, including Agatti.

The Agatti Island Co-operative Supply and Marketing Society Ltd was first set up in 1962 to facilitate the islanders in buying provisions and rations and other essential commodities at a fair price. All islanders are members of this society and can exchange copra for provisions (general as well as consumer electric appliances) at subsidised rates. Those people with good mainland marketing contacts prefer to sell their copra directly to the mainland. However, 99% of copra is sold through the society. In 1999 the co-operative society also started to issue construction materials such as river sand, granite jelly, cement and iron rods on subsidy. Sources within the society say that 100 people have availed these subsidies for materials for house construction between 1999 and 2001 (Hoon *et al.*, 2002).

In addition to the government administrative system and co-operative societies, there are also 12 voluntary organisations or NGOs on Agatti focused on promoting arts, culture, games and tournaments. A recent study estimated that 80% of these organisations were not currently functioning (Hoon *et al.*, 2002).

2.4 VULNERABILITIES

The islanders of Agatti face a number of risks and vulnerabilities in their livelihoods. Fisheries-based activities are inherently risky, not only as a result of the hazards of operating a boat and fishing gear, but also the uncertainties of weather and fish catch. Weather in the islands is seasonal, with a fair season lasting from October to April, when the seas are calm, and the monsoon season from May to September, when seas are rough and there is heavy rain. During the monsoon season fishing activities are restricted to the lagoons and near-shore reefs and the islands are cut off from the mainland as ship voyages are cancelled. There is also the risk of cyclonic depressions and severe storms, which are a serious threat for the low-lying coral atolls of the Lakshadweep Islands. For example, during a storm in 1976 the Bangaram lagoon that encompasses the islands of Bangaram, Tinnakara, Parelli I, II and III was washed away. In the face of climate change and sea-level rise, the impacts of weather and storms will have increasingly severe consequences.

In addition to the risks associated with the weather, there are also uncertainties related to the surrounding natural resources. Fresh water resources are limited and with the growing population on Agatti this will become an increasing vulnerability in people's lives. The availability of marine resources is also a critical factor for local livelihoods, and is threatened by both natural and human disturbances. Coral disease, bleaching and damage from storms are examples of real dangers to the availability of near-shore reef and lagoon resources. Human disturbances, such as the dredging and widening of channels, coral boulder collection and boat anchoring have also caused damage to the near-shore reef and lagoon resources. In addition, the availability of these resources for local islanders is restricted by government legislation, which bans the collection of endangered species, such as cowries and hard coral. This has turned some traditional livelihood opportunities into illegal activities, with the risk of fines and punishment for those that continue to extract protected species.

2.5 FACTORS CONTROLLING LIVELIHOOD OPPORTUNITIES

For the islanders of Agatti there are a number of key factors which influence the nature of their livelihood opportunities, many of which have been discussed in previous sections and are summarized below:

Access to and status of natural resources: the limited terrestrial resources available determine opportunities for agriculture or other land-based activities, which are restricted primarily to coconut cultivation and coir production. In contrast the vast marine resource offers many opportunities, but access is limited by seasonal weather and threats to availability, as described in Section 2.4 above.

Population growth and breakdown of traditional Marumukkathayam and Tharawad systems: a growing population is increasing the demand on local resources and the competition for employment opportunities. It is also leading to the breakdown of the extended family and *Tharawad* systems and a growing numbers of nuclear families, with consequences for equity and poverty as discussed in the next section (Section 3).

Government support and subsidies: these have become a major part of the island economy, creating opportunities firstly in the tuna fishery, in government sector employment and more recently in tourism

Isolation: the geographical isolation of the islands and limited communications creates a high level of dependency among islanders to help one another in times of distress and a strong attitude of sharing work and resources. At the same time, the isolation of the islands limits access to markets, higher education and associated opportunities. However, as communications have improved this has become less of a barrier.

3 POOR STAKEHOLDERS

Owing to the affirmative action schemes of the Government of India, people of the lower castes have had opportunities to prosper, through higher education and secure government jobs. In Lakshadweep, government subsidies combined with affirmative action schemes targeting the Scheduled Tribes and lower castes have had positive impacts on the overall status of the islands and people. However, despite this the absolute numbers of poor people are on the increase, with the average proportion of people officially below the poverty line in Lakshadweep at 15% varying from 20–25% in Kadmat Island to 10% in Agatti (Shamsuddin, 2002; ASDO, 2002).

3.1 OVERVIEW OF POVERTY

Wealth in the traditional Lakshadweep context is described with reference to those families or individuals with considerable production of copra from self-owned coconut plots. Thus, until recently wealth was considered on the merit of owning large plots with large numbers of coconut palms in the plots. Wealth was also associated with ownership of sailing vessels known as *Odams* for transporting the copra and coir from the islands to the mainland and in turn rice and other commodities back to the islands. Now these families are referred to as those 'well to do'. On the other side of the scale, poverty refers to such families characterised by:

(a) lack of land and property;
(b) lack of a regular income for family subsistence; and
(c) inability to cover expenses during the year.

Today the above description of wealth has been replaced by a definition of wealth or poverty in terms of the financial status of each family. Wealth is explained based on the income generated from property, business, employment, industrial endeavours, labour, etc. Four different income groups or classes are found in Agatti Island as represented in Table 6. The system of joint family wealth has largely been eroded and the patriarchal system of individual possession of property and other assets is preferred over the traditional matrilineal *Tharawad* or joint family system. Thus two categories of wealth status can be observed: (1) those families with *Velliyacha* property, i.e. *Tharawad* property, and (2) those families with *Thingalacha* property, i.e. self-owned property.

Figure 12 shows the income distribution across households in Agatti. The average per capita annual income was Rs 7168 (~US$153) and the average household annual income was Rs 68 000 (~US$1447). However, the income earned is not evenly distributed and the households where more than two people have a secure government job are considered the wealthiest households. One percent of the households surveyed in 2001 reported an annual household income of more than Rs 300 000 (US$ 6383) (Hoon *et al.*, 2002). At the other end of the spectrum 10% of the total households in the 2001 survey, had an annual income of less than Rs 15 000 (US$319). These households are considered below the poverty line. Their per capita annual income is around US$34.

3.2 POOR STAKEHOLDERS ON AGATTI ISLAND

Poverty on the island is not immediately discernable since all the people appear to lead simple lifestyles and dress and eat simply. It must be noted, however, that the situation on the islands is very different from that on the mainland, and the nature of 'poverty' here must be seen in a different context, for the expenses, the nature of spending, the question of shelter, etc., are unique and cannot be compared with that of an average low-income group representative from other parts of the country. Nevertheless, it is important to also note that the society here is far from egalitarian.

There are no special caste differences for poor or rich families and a recent survey found that the poor families followed both the *Marumukkathayam* and *Makkatayam* systems and could be both nuclear and joint families (Hoon *et al.*, 2002). The most vulnerable groups are those who were forced into nuclear families due to disintegration of the *Tharawad* style joint family and those families who do not have an able-bodied man contributing to the household sustenance.

The *Tharawad* system provided a safety net for all its members. Every member contributed to the best of their ability and were in return assured a minimum meal and roof irrespective of whether they were earning members or not. The earning members pooled their earnings to a common kitty and the matriarch assured that no one went hungry. Now with the growth in population and break down of the *Tharawad* one can begin to see **poor relations**.

In common with the general description of poverty above, the local definition of poverty in Agatti is:

(a) households dependent on large landowners for livelihood;
(b) households without a source of regular cash income;

TABLE 6 WEALTH CHARACTERISTICS IN AGATTI ISLAND

	Rich	*Upper Middle class*	*Lower Middle class*	*Poor*
Annual income	Above Rs 250 000 (>US$5319)	Rs 250 000–60 001 (US$5319–1277)	Rs 60 000–15 000 (US$276–319)	Below Rs 15 000 (<US$319)
% of population	1%	39%	50%	10%
House type	Concrete modern house with compound wall	Standard modern house	Traditional house with tiled roof	House with tiled or thatch roof Often run down
Education	Post graduate	Graduate or high school	Secondary or primary school	Primary school
Occupation characteristics	• High ranking government official • More than two members on government payroll • Own *Manju* or business	• Lower level government job • Tuna fishing • Several earning members	• Tuna fishing boat crew • Lagoon fisherman • Casual employment in government department • Employed in private business or resort	• Depend on big landowners for livelihood • Live by taking alms • Devoid of regular income • No employed male • Widows or destitute women • Casual labour supplemented with reef, lagoon fishing and gleaning
Source of income	Multiple sources of income	Multiple sources of income	Single, multiple sources of income	Single, multiple source of income
Bank balance	Yes	Yes	Nil	Nil
Physical resources	• Own land, coconut trees • *Manju* owner • Tiller, motor cycle • Electrical conveniences such as washing machines, wet grinder, refrigerators, cooking gas stoves • Goats, hens, calves	• Own land, coconut trees • Own boat, outboard engine, auto-rickshaw, two wheeler • Goats, hen • Some electrical conveniences	• Some trees • Fishing rod • Nets • *Thoni*, outboard engine • Bicycle, two wheeler • Wet grinder, TV • Goats, hens	• No land or coconut trees • Cast net • Survival skills • Use firewood for cooking
Reef Use	Can pay to have others collect building materials and fish	Main use for collecting bait fish, octopus, etc.	Main use as a supplementary income or during monsoon for subsistence	Use for subsistence and survival

Source: Survey and focused group discussion held in Agatti (Hoon *et al*., 2002).

(c) households with inadequate purchasing power; and
(d) households with no able-bodied male.

The poor are those who are equipped with very few survival skills. They are illiterate or have primary education, hence cannot get gainful employment. They can also be educated unemployed who have no fishing skills. Elderly men, divorced women, widows with small children and the unemployed fall into the most vulnerable group.

The following three case studies (Boxes 3, 4 and 5) give clear examples of the living conditions of the poor on Agatti Island. The case studies represent two different kinds of situations. In the first case (Box 3), the case study is a fairly young householder and thanks to his fishing skills and labour he is able to take care of the minimum needs of food, clothing and shelter for his family even though the family lacks purchasing power.

The second case (Box 4), is representative of the poorest economic class, where the only male in the family is elderly with no access (or limited access) to the resources of both the land and the sea. Perhaps the tenets of Islam help in terms of communal sharing and the ideas of charity, which makes this case study's economic survival in Agatti far better than his counterparts in other states. Also there is very little scope for spending that may be seen as an important 'relief' factor in such cases.

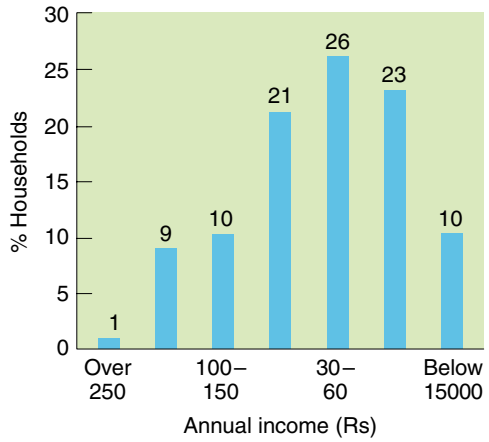

Figure 12 Income distribution on Agatti Island.

The final case study (Box 5) is an example of a elderly woman who has been pushed into poverty through the loss of her husband, a hardship which has been exacerbated by her own ill health and lack of direct family support. What support that does exist comes from the government welfare system, however this is not sufficient and has to be subsidised by support from her extended family.

However, government interventions distinguishing the economically lesser-off sections and providing them scope for earning a decent livelihood do not appear to be clearly visible. The 'blanket'[5] category of Scheduled Tribe for the whole island has undoubtedly helped the higher castes and more resourceful sections access support and subsidies compared to the more vulnerable members of society.

BOX 3 POOR HOUSEHOLD CASE STUDY 1

Case study 1 concerns a traditional reef fisherman, who lives with his wife aged 35 years and their six children, who are below the age of 15. He and his wife have only a primary school education and have no prospects of getting a salaried job. From time to time they are employed as unskilled labour in government employment schemes, but currently are left to their own devices. They totally rely on the reef and lagoon for their livelihood.

They live in a small house on the north eastern side of the island. The house is small and built with their own labour and help from friends using locally available shingle and boulders. They do not have piped water in the house and have to draw water from a well. Their home has an electricity supply and their electrical equipment consists of two light bulbs, a tube light and a fan.

The fisherman owns a *bala beeshal* (cast net). He goes cast netting everyday when the weather is favourable both at the reef entrance point and the shore. He also goes octopus hunting and joins other groups for collecting boulders and shingle. While he is unable to say how much income he makes from each of these activities, he is able to estimate that on averages he earns an annual cash income of Rs 12 000 (~US$255). His wife used to be a regular reef gleaner but now she finds she has less opportunity because of the new baby in the family. However, she and her older children glean the eastern reef whenever the opportunity presents itself.

Thanks to the free education on the islands, all the children of school-going age attend school and the *Madrassa*. The two children in the primary school receive one free midday meal at school.

The family's survival is totally dependent on their ability to toil and collect resources from the surrounding natural resources. They use firewood for cooking and the wife and children gather fallen coconut fronds etc. for cooking. Case study 1 claims that it is only thanks to his good health and the reef and lagoon resources that his family's survival is ensured.

BOX 4 POOR HOUSEHOLD CASE STUDY 2

Case study 2 concerns a man of 65 who makes and sells thatch from coconut leaves for a living. In the past, 30 years from today, he used to beat coconut husks, and would collect and sell the fibre of damaged coconuts. He used to supplement this by harpooning and fishing with others. He himself does not own any coconut trees and must request permission from the coconut tree owners to collect leaves. These days he rarely harpoons or makes thatch due to his age. Today he makes about Rs 200 (~US$4) a year. He says that he survives only by the help of fellow islanders. He calls himself 'the poorer of the poor' on the island.

BOX 5 POOR HOUSEHOLD CASE STUDY 3

Case study 3 concerns an 81 year old widow. Her husband, a harpoon fisherman, died 14 years ago. They lived off the reef and the coconut plantations of wealthy landowners. He harpooned fish and joined other teams of fishermen and helped them with fishing. Since they had a six-oar boat they never went far from the reef. She used to make coir from coconut husks and glean the reef for cowries and edible molluscs.

When she was in her late twenties she broke her arm in an accident and ever since then she has been unable to work with her hands and the household lost the supplementary income contribution she made. After her husband died she had no-one to support her for they had no children. The house she lived in started disintegrating for lack of maintenance and is now unfit for habitation.

She has been recognised as being below the poverty line and is eligible to receive 35 kg or rice per month at the subsidised price of Rs 3/kg (~US$0.06), against Rs 10/kg (~US$0.20) She however does not have enough money to cover even this subsidised price. Her niece, who is also her neighbour, provides her shelter and purchases the 35 kg subsidised rice which is enough to feed the whole family. The niece is also a widow and has six children, the eldest are a part of a tuna fishing crew and contribute to the family income.

4 REEF LIVELIHOODS

Coral reefs have the potential to provide a stream of benefits to the poor on Agatti Island. Some of these benefits arise because reefs can contribute to the *resources* that the poor have access to. These reef-related 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 they 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 of indirect influencing factors in which they operate. The services that the reef provides to the poor ultimately benefits them by contributing to positive changes in the *outcomes* of their livelihoods. These outcome changes are best defined and measured by the poor themselves if they are to meaningfully represent positive improvements in their lives.

The following sections describe the many different streams of benefits to the livelihoods of the 'poor' households or stakeholders on Agatti Island, focusing on reef benefits to household resources (Section 4.1); to enhancing interactions with direct influencing factors (Section 4.2); and to coping with the risks and vulnerabilities associated with indirect influencing factors (Section 4.3).

4.1 RESOURCES

The contribution of coral reefs to the natural, physical, financial, human and social resources of poor households on Agatti Island is described in the following sections (4.1.1–4.1.5) and summarised in Table 7.

4.1.1 Natural resources

As described in Section 1, the Lakshadweep Islands are surrounded by a vast ocean resource, with coral islands surrounded by lagoons and reefs and these in turn surrounded by the open

TABLE 7 A SUMMARY OF REEF BENEFITS TO HOUSEHOLD RESOURCES

Resource	*Benefits from the reef*
Natural	*Diverse and productive resource* Diversity of reef fish, octopus, molluscs Diversity of bait fish for tuna fishery Tuna fish on reef edge *Interaction with adjacent ecosystems* Lagoon and seagrass beds Island ecosystem – promotes island formation
Physical	*Physical barrier* Protects islands from erosion Provides safe harbour for anchorage Shelters lagoon for fishing and soaking coconut leaves for mat weaving *Construction materials and tools* Coral boulders, beach shingle and sand Cowrie shells as curios and games counters *Navigation* Passage around islands and into lagoons
Financial	*Cash income* Sales of reef products, including fish, octopus, cowries Indirectly from tuna fishery, through use of reef bait fish *Reef products for exchange* Sharing of reef products between islands Reef products for other products or favours *Low investment* Accessible without boat Simple locally available boats and gear
Human	*Food and protein source* Main protein source *Medicinal values* Cowrie shells *Skills and knowledge* Folk knowledge of reef resource Skills in operating diverse fishing gear
Social	*Island traditions and rituals* Folklore and songs associated with island and reef ecosystem Traditional practices and resource governance *Collaborative extraction* Undertaken in different fisheries operations and reef gleaning

ocean. All these natural systems are interlinked exchanging energy in the form of nutrients, sediments or the daily and seasonal migration of species. The coral reef is one part of the larger ocean ecosystem but the part it plays is a critical one, fundamental to island formation, protection of seagrass and lagoon ecosystems and as a feeding ground for larger pelagic predators.

Each part of this ocean ecosystem is a source of renewable resources for the island community.

The island is the source of fresh water and agricultural land resources primarily for coconut cultivation, providing coconut, copra, leaves for fencing and thatch (Figure 13), and also limited vegetable cultivation for household consumption.

The reef itself is highly productive and provides a diversity of species which are exploited for food and cash. It also provides the source of bait fish, essential for the pole and line tuna fishery, while the reef itself attracts schools of feeding tuna particularly during the fair season between October and April.

The lagoon and seagrass areas provide a source of food and income, with the combined fish catch from the reef and lagoon contributing to one quarter of the total catch for Agatti in 2000 (Table 5). The lagoon and seagrass areas also provide a home for juvenile reef fish and a feeding area for sea turtles.

The open ocean is the focus of the pelagic pole and line and deep sea fisheries, which provide nearly a third of primary livelihood opportunities for households on Agatti (Section 2.2, Figure 9).

4.1.2 Physical resources

Surrounded by vast oceans the islands are exposed to storms and cyclones. The reef provides protection from these storms for personal assets (houses, coconut trees, etc.). It also shelters the lagoon providing a safe anchorage and an area for soaking coconut leaves for mat weaving.

The corals that built the island also provide building material for house construction for the islanders (Hoon *et al.*, 2002). Coral boulders are collected from the lagoon, or shingle and sand (originally coral, which has been broken down through wave action or fish grazing) are collected from beaches around the island. For the poor households on Agatti this is an important 'free' source of building material and cash, with an estimated 10 households dependent on this to meet 40% of their cash income. Although collection of live coral boulders has been officially banned, illegal collection continues, especially by the poorer households who cannot afford the expensive alternative imported materials.

The shells collected on the reef are sold mainly as curios to traders on the mainland. One type of cowrie shell, known locally as *Pullikavadi* is kept by the islanders and used as a counter in board games known as *Sharadam*.

Figure 13 Weaving coconut leaves for thatching.

Reef crests and breaking waves are used as a matter of course in daily navigation around and between islands. Natural channels in the reef, known as *chals* (small channels) or *aly* (big channels), are used as passageways into the lagoons by local boats.

4.1.3 Financial resources

The reef contributes to income generation and subsistence on Agatti Island both directly from the reef resources and indirectly from reef-related ocean resources. According to a recent survey, 20% of the households on Agatti report lagoon fishing, or shingle, molluscs, octopus and cowrie collection as their main occupation (Hoon *et al.*, 2002). They make up 12% of the economically active population that depend on the reef or lagoon for their annual income and generate 1% of the total income of the island. When combined with the indirect benefits from ocean and land resources, the natural resources of Agatti contribute to 20% of the total income generated in the island and 60% of primary livelihood options for the islanders.

The direct contribution of the reef to the financial resources of poor households on Agatti is significant, with 12% of poor households completely dependent on the reef for 100% of household income, while 59% of poor households rely on the reef for 70% of their household income and the remaining 29% of poor households rely on the reef for 50% of their household income.

Reef resources are also used in exchange between islanders and between islands. Resources not locally available are the focus for exchange between islands, for example Agatti Island is known for its abundance of octopus which is exchanged with Androth Island. Locally reef products may be exchanged between islanders for favours, such as help in constructing a house or net mending, or they may be exchanged for other products such as rice, coconuts or fish on another occasion.

Figure 14 Kal moodsal fishing in Agatti lagoon.

In terms of the financial resources required to exploit the reef resources the investment is minimal relying on simple locally available tools and gear, some of which can be used without the need of a boat. For example, 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 of Agatti. 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 operating in the lagoon and near-shore reef are small non-mechanised traditional wooden rowing boats, known as *Thonis*, or rafts, known as *Tharappam*. These are constructed locally and have low running costs.

4.1.4 Human resources

The reef provides food and food security for the islanders, constituting 90% of the protein consumed by poorer families. Food sources from the reefs are diverse, including different types of fish, octopus and molluscs. These products are also an important source of cash for poorer families (as described above) for buying other food stuffs.

As well as acting as a food source, the reef and reef-related resources are used for medicinal purposes. The money cowrie, locally known as *Vallakavadi* is collected from the reef and is a common home remedy as a paste to treat cysts or stys in the eye.

During over 400 years of occupation and survival, the islanders, especially the subsistence fishers, have developed an intimate knowledge of the reef resource. They have knowledge of numerous different types of fish and where they can be found according to the tide or lunar cycle. They have also developed a local naming system or folk taxonomy, naming fish according to shape: depth of the body from dorsal to ventral fin. Sometimes the same species is given different names depending on its size and age. For example, a full grown Emperor fish is called *Metti* and a juvenile is called *Killokam*. The abundance of each species at different fishing grounds is also well known, as illustrated in Annex 1.

The islanders' intimate knowledge of the reef resource is used together with a wide range of skills and techniques which have evolved simultaneously in order to successfully exploit the diverse reef resource. A multitude of different fishing techniques are still used by the islanders, each with a specific niche targeting certain areas of the reef and particular species, as described in Annex 1.

4.1.5 Social resources

The reef is an integral part of island traditions and rituals. Ever since the islanders occupied Lakshadweep and made it their home they have developed traditions and a way of life reflecting the island ecosystem. Most of the folklore of the people of Lakshadweep revolves around the reef and sea. There is hardly any tale or song which does not mention the traditional sailing crafts, known as *Odams*, the journeys of enterprising 'heroes', the adventures of fishing in the sea and encounters with sea creatures (Box 6). Songs that women sing recollect the women looking for *Odams* and requesting the waves to be gentler and the breeze just right for the sails. There are stories of the 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.

The reef is regarded by the islanders as a common property resource and all the islanders have an equal right to use the lagoon and reef resources. In the past fishing groups would take permission from the *Amin* (island head person) and go fishing to the grounds allotted by him. On returning the *Amin* was given a share of the catch, normally one of the best or biggest fish. This practice no longer exists, however there remains a code of conduct or etiquette in using the resource (Box 7) and a common respect of this is an effective way of avoiding conflict or disputes.

Exploitation of such vast and diverse resources as the reef and lagoon surrounding the island has encouraged collaborative efforts mainly for purposes of safety, but also as a necessity in the operation of many fishing techniques, e.g. an indigenous gear and operation known as *Bala fadal* involves 25–30 men (Box 8). Reef gleaning for cowrie collection by groups of 6–10 women is also a common activity and today even though the economic significance for households has become marginalised, the activity continues as a recreational activity for the women involved.

BOX 6 A LOVE SONG FROM KILTAN ISLAND

Hei Puliparva (female flying fish)
Hello beautifully spotted puliparva
Bite bite the bait,
Swallow the bait on the hook.
Hei Puliparva
I have seen you on the shores of sheikpalli
I have seen you in the high seas,
I tried to catch you but you did not come to my hook,
So please come, swallow the tender bait which is offered.

I have seen you
on the road side near belliyapura
Dancing with your friends,
I have also seen you
On the white sands at the beach side
Playing sharadam (island chess)
Come come and swallow the bait.

Translated by Dr Mullakoya, September 2002.

4.2 DIRECT INFLUENCING FACTORS

Coral reef and associated coastal and marine resources are the focus of fisheries- and environment-related policies, institutions, organisations and social relations. Directly and indirectly, therefore, the reef and associated resources give rise to structures and processes that can positively influence the lives of poor reef-dependent people. These positive influences are summarised in Table 8 and discussed in more detail in the following sections. (4.2.1–4.2.4)

4.2.1 Policies

The extensive and productive reef and ocean resources surrounding the Lakshadweep Islands have been the focus of

BOX 7 TRADITIONAL KNOWLEDGE AND CUSTOMARY PRACTICES

The fishers practise a space-sharing etiquette while using the cast net at any given fishing site. The cast-net fishermen explained that *Mankkam* (Goat fish) generally abound in the western lagoon near the tower, the jetty, on *Kunthalpara, Parape* and such places. They have observed that shoals of *kanna chenna* (Carrangdeu family) enter the lagoon through *chals* or shallow entrances of the reefs at the beginning of high tide and move out during low tide. They move northwards, southeast and southwest of Kalpitti. *Thithira* (Mullet) occur at the entrance of the *Sheikhinna palliya chal* and move northwards. *Furachi* (Whip Fin Majjara) can be caught on the eastern side of the reef and western side of the jetty. *Kuluval* (Cerangid family) occur in *Parape*, near the sea shore.

These fish shoals can be caught while they move together as they enter with the high tide or when they leave with the low tide. The fishermen consult the tide. If the expected time is 7 a.m., the cast net fishermen will come to his standing place at the *chal* an hour earlier. He will then stand and wait for the shoals to appear and cast his net and catch the fish at the appropriate time.

Since there are limited number of *chal* or entrance points on the reef, there can be a problem if more than one fishermen wants to operate at the same *chal* at the same time. The customary practice is first-come, first-served. The late-comer is required to find another place to cast his net and if all are occupied he must return to the island without fishing.

BOX 8 *BALA FADAL*: AN EXAMPLE OF COLLABORATIVE FISHING ON AGATTI ISLAND

Bala Fadal involves 25–30 men and is carried out during the monsoon in the southern side of the lagoon near Kalpitti and occasionally in the northern end of the lagoon. The group is divided into two. One group stays at the shore and spreads out the net, the other group shoots the *olabala* (fish-scaring devices made of coconut fronds attached to 15–20 m of rope) over the reef forming an arc. The fish on the reef are attracted to the *olabala* and swim towards it. The *olabala* are then pulled slowly to shore with the fish swimming along until they reach the shore. Here the net operators quickly circle the fish and haul them up.

This operation is carried out around three times a week during the monsoon. There are two *Bala Fadal* groups on the island, only one group operates the *Bala Fadal* at a time. The average catch per operation is 250 kg, and this is shared amongst the operators and gear owners, and used primarily for household consumption, with excess sold at the landing site.

TABLE 8 A SUMMARY OF REEF BENEFITS TO DIRECT INFLUENCING FACTORS

Influencing factors	*Benefits from the reef*
Policies	*Fisheries development* Promotion of tuna and deep sea shark fishery *Tourism development* Establishment of tourist resorts *Environmental protection* Ban on use of plastic bags on islands Notification banning live coral collection
Institutions	*Administration (Dept of Science and Technology, Dept of Environment)* ICRMN and LCRMN provide opportunities for local participation and training *Research institutions* CIFT, CMFRI, ICAR *Local panchayat* Welfare support and alternative income generating activities
Organisations	*Co-operative societies* Fishermen's Co-operative Society and Lakshadweep Development Co-operation Ltd (LDCL) *NGOs (CARESS)* Opportunities for local participation and training through GCRMN/ICRMN initiatives
Social relations	*Community and women* Reef is accessible to young and old Accessibility of reef provides opportunities for women to engage in harvest

fisheries development, which began in the 1960s. This has mainly been focused on the development of the tuna pole and line fishery, which are dependent on reef bait fish, and deep sea fishing. In the early 1990s, with the intensive plan of the government and the Fisheries Department to exploit the sea for commerce, came many novel ideas about enhancing the potential of the fishermen of Lakshadweep. Boats were given on hire-purchase schemes at very low interest rates. In the early phase, 473 small boats (8 m) and five large boats (13 m) for tuna and shark fishing were given away, with diesel on subsidy. This has resulted in growing numbers of tuna boats, which in turn has increased job and income-earning opportunities on the islands. For the poor households on Agatti these policies and developments have provided livelihood opportunities as crew on tuna fishing boats. Around 6% of poor households on Agatti exploit this as a livelihood opportunity and source of food and income. At the same time, however, fisheries development has resulted in greater mechanisation and the loss of some job opportunities. For example, the introduction of the sprayer on tuna boats has replaced the job of two people, previously required to chum the water.

Coastal and reef-related tourism has also been the focus of development activities, which began in the 1990s. Currently there are two nearby resorts, one on Agatti Island itself and one on nearby Bangaram Island. These developments provide alternative sources of income either directly as staff on the resort or indirectly through their demand for fish, shells and local handicrafts. However, access to direct employment opportunities is restricted to those with good education, i.e. the middle-class households, and benefits to the poor households is limited to the sales of local products.

Over the last decade reef biodiversity and reef decline has been the centre of attention for international and national environmental protection policies. In Lakshadweep the concern also recognises the role of the reef resource in supporting the tuna fishery through bait fish. This was first highlighted in 1983 through a government circular emphasising the need to stop coral boulder collection and restricting lagoon and reef-fishing activities to locals for subsistence needs. In 1984 the government stopped blasting the reef for deepening and dredging navigational channels and in the 1990s several notifications were issued to regulate shingle collection and prohibit coral boulder collection. In 1998, the use of plastic bags on the islands was banned in order to remove the threat of entangling and damaging corals. Most recently in 2001 a government notifica-

tion has banned the collection of many reef resources, including coral, shells, sea cucumbers and certain species of fish.

The immediate impact of environmental protection policies for poor households is not always a positive one and in many instances they have restricted their activities. However, in the longer term and with enhanced participation by the poorer stakeholders and development of alternative opportunities, these policies have the potential to bring positive impacts by allowing the reef resources to rejuvenate and ensuring the sustainability of the resources on which the poor depend.

4.2.2 Institutions

In association with the concern for the reef environment and environmental policies, the Department of Science and Technology and the Department of Environment have set up the Lakshadweep Coral Reef Monitoring Network (LCRMN) in co-ordination with the Indian Coral Reef Monitoring Network (ICRMN) of the Ministry of Environment and Forests. This initiative has attracted government funding and is actively promoting training and opportunities for participation of local islanders in monitoring their surrounding reef resources. This participation has the potential of enhancing local involvement in resource management.

Coral reef resources and resource use have also been the focus of various research institutions (CIFT, CMFRI, ICAR), investigating ways of enhancing or diversifying resource use. Since the 1980s CMFRI has researched techniques to increase production of marketable species through aquaculture, while CIFT has developed technologies for income generation for women. Such research has potential to assist poor stakeholders in identifying and developing more sustainable livelihoods, however, the benefits of this research has yet to be felt by the poor stakeholders on Agatti.

4.2.3 Organisations

The reef and ocean resources and the fisheries they support are the target of a number of local organisations, some concerned with the welfare and rights of fishers, others concerned with promoting local awareness and involvement in coral reef monitoring activities. For the local fishers of Agatti, a Fishermen's Co-operative Society was established in the early 1990s to assist fishermen in securing direct markets for their fishery products and reducing dependence on middlemen for sales on the mainland. The question of marketing has always been a pertinent one in Lakshadweep. Through history, the islands have always depended on the mainland for their market, and even today only a small market exists within the islands itself for fresh fish and octopus. Despite the intentions of the Co-operative Society and the potential benefit for local fishermen, most fishermen today lament the fact that the co-operative has had little impact in securing an immediate market for their produce.

The Lakshadweep Development Corporation Ltd (LDCL) was set up as an autonomous body under the administration to fill the lacuna of a market. However, again it has so far disappointed people in not being able to live up to its basic objectives, nor has it been able to do away with the concept of middlemen.

In association with the LCRMN and ICRMN mentioned above and the regional Global Coral Reef Monitoring Network (GCRMN), NGOs, namely CARESS, have also been active in providing training and opportunities for participation in assessing and monitoring of the social, economic and cultural dimension of reef resource use. Once again, such initiatives are important as potential entry points and catalysts for local participation in resource management.

4.2.4 Social relations

The reef and lagoon resources of Agatti Island, in common with all the islands in Lakshadweep, are close by and shallow, making them accessible by foot. This is a significant factor, which permits access by young and old, male and female. Consequently, unlike many other fisheries, which are only accessible by boat and thus exclude women, women are involved in harvesting activities through reef gleaning and *Kal moodsal* fishing (see Section 4.13). Reef gleaning is a group activity (as described in Section 4.15), where all kinds of edible shell fish, octopus and ornamental shells, particularly cowries, are collected. Not only does this provide a supplementary source of income which the women can control,

Figure 15 Women reef gleaners on Agatti Island.

BOX 9 PROFILE OF A COWRIE COLLECTOR

On Agatti Island, a cowrie collector, aged 47, was one of the key informants about cowrie collection on the island. She was very knowledgeable about where to collect cowries and how to collect them. She enjoys collecting cowries since she feels free and unfettered on the reef, surrounded by the deep and vast ocean. In this period she can leave the domestic routine and go into the vastness of the reef, chat with her companions and be herself.

She learnt to collect cowries from her mother and aunts. She has been going to the reef with them from the age of 9 or 10. They mainly took her with them to the eastern reef flat. The eastern reef flat is very shallow and cowries were available in plenty. With practice she became an expert cowrie collector. She learnt to glean the reef and poke out cowries from the reef platform and mud flats using sharp sticks and iron hooks. No special clothing is worn to go for cowrie collection. To protect their feet, they wear rubber slippers or shoes to walk on the reef. This gear has not changed since she was a child.

She feels that the cowrie quantities are cyclic. Collection is seasonal and takes place only during the fair season. She explains that what they take during the fair season is replaced during the monsoon season. Others believe that other cowries from the deep sea come and take the place of the ones that are collected.

it is also the source of extensive understanding and knowledge about the reef resource, which women accumulate from a young age (Box 9). While on the whole financial dependence on reef gleaning has diminished, its importance for women as a recreation, as a break from household duties and a chance to chat together away from the men, is still of great value. In addition, for about ten households on Agatti where the people are old and uneducated living by subsistence means alone, reef gleaning forms an important share of household income.

4.3 INDIRECT INFLUENCING FACTORS

The coral reef and related fisheries can positively contribute to the community's ability to cope and exploit the risks or opportunities associated with indirect influencing factors or the background changes which affect the social, economic, environmental and policy context in which the community exist. Table 9 summarises these positive contributions, which are described in more detail in the sections following (4.3.1–4.3.3).

TABLE 9 A SUMMARY OF REEF BENEFITS TOWARDS COPING WITH INDIRECT INFLUENCING FACTORS

Influencing factors	*Benefits from the reef*
Seasonality	*Stability* Diversity of products throughout the year *Complementarity* Nearby reefs can be exploited during off season for tuna fishery
Shocks	*Safety net* Opportunity to cope with loss of earning member of households Food source in times of famine
Trends	*Market growth* Increasing income of local population provides local market for fresh fish Increasing demand from tourist resorts for fish, shells, handicrafts

4.3.1 Seasonality

The coral reef and associated coastal resources provide a huge diversity of habitats and species for exploitation. This diversity of opportunities provides a source of income and food throughout the entire year, overcoming seasonal variations in accessibility or availability of any particular habitat or species. The accessibility of the reef and lagoon and the protection offered by the reef in bad weather, means that the reef provides a constant and stable food and income source all year around, even during bad weather. In the monsoon season, when five months of bad weather prohibits boats plying the high seas, reef and lagoon fishing provide a critical alternative to the tuna fishery (Box 10). The reef resources also provide an important food source in these periods, when the supply ships are often cancelled due to the bad weather. For the poorest households, who are unable to stock up with food prior to the monsoon, the reef and lagoon provide the only source of protein during the monsoon.

4.3.2 Shocks

The accessibility of the reef resource throughout the year to all the islanders, without distinction of age, gender, caste or wealth means that the reef can provide an immediate fall back or safety net when households face a sudden hardship. Income or food from the reef and lagoon provide coping mechanisms when members of a household migrate away to exploit opportunities elsewhere and fail to send back remittances, or when a husband divorces his wife. In this way the reef resource can act as a critical safety net and buffer from abject poverty for female-headed households. 6% of

BOX 10 A SEASONAL CALENDAR FOR SEA-BASED ACTIVITIES ON AGATTI ISLAND

The seasonal calendar was prepared during a focused group discussion with stakeholders presently involved in these activities on Agatti Island (Hoon *et al.*, 2002).

Weather condition	Stormy	Wet				Calm season					Hot	
Activity	**May**	**Jun**	**July**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**
Cowrie collection[1]					♀♀♂♀♂♀♂♀♂♀♂♀♂♂♀♀♂♀♀♂♀♂♀♂♀♀♂♀♀							♂♀
Octopus hunting[1/2]	♂♂	♂♂	♂♂	♂♂	♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂							
Cast netting[3]	♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂					♂ ♂ ♂ ♂ ♂ ♂ ♂ ♂ ♂ ♂ ♂ ♂						♂
Drag netting[4]	♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂						♂ ♂ ♂ ♂		♂ ♂ ♂ ♂ ♂ ♂ ♂			
Harpooning[2]				♂♂♂♂ ♂♂♂♂ ♂♂♂♂♂ ♂♂♂♂ ♂♂♂♂ ♂♂♂♂ ♂♂♂♂ ♂♂♂								
Shore hand line[4]	♂ ♂ ♂ ♂ ♂			♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂								
Boat hand line[2/4/5]	♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂								♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂			
Light and sword[3]	♂♂♂♂♂♂♂♂♂♂♂♂♂								♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂			
Trap over boulder[1]	♀♂	♀♂	♀♂	♀	♂		♀	♂	♀		♂	
Pole and line Tuna[1/3/4]						♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂♂						

Key: [1] inner reef [2] outer reef [3] lagoon shore [4] lagoon [5] deep sea
♂ male ♀ female

the poor households on Agatti have been abandoned by their main earning member and have no alternative but to rely on the reef and lagoon resources to obtain food and some income to survive. The reef resources have also assisted households in overcoming famine (Box 11).

4.3.3 Trends

Although still limited, the local market for fresh fish has increased in recent years. Increasing population on the islands combined with growing prosperity, largely an outcome of the large and subsidised government sector, has provided opportunities for growth in the local fish trade and associated income-earning opportunities for local fishermen. Many of the households involved in government service have purchasing power but are unable to exploit the reef, due to lack of time or, in the case of nuclear families and families on transfer from other islands, no support from extended family to provide reef fish, octopus, etc.

In addition to the local population, the tourist resorts have also increased demand for reef products, including fish, shells and handicraft, although the sale of ornamental shells is discouraged by the resorts. Again, this growing demand for local products provides increasing opportunities for income earning among the local fishers.

BOX 11 REEF RESOURCES AS A COPING MECHANISM AGAINST FAMINE

A 52-year-old man on Agatti Island, with no education, belongs to the caste whose profession it is to climb coconut trees and harvest coconuts for tree owners. He is committed to work for four households on Agatti Island. In return he can tap the sweet nectar *neera* from their trees and convert it into vinegar and *jaggery*.

His family has always relied on local natural resources for their survival. He recalls that once there was a famine when he was a little boy. The yield from the coconuts was very low and they did not have any money to buy food. He recalls that his father used to catch *Karatty* or Trigger fish everyday from the reef. They ate the fish and used the liver oil to light lamps in the house after dark.

5 CHANGES, CAUSES AND CONSEQUENCES

Livelihoods are dynamic, they are constantly changing in response to direct and indirect influencing factors, which impact upon the strategies households are able to adopt and the ultimate outcomes of those strategies. The following section describes the key changes to reef-based livelihoods on Agatti Island and considers the causes of those changes and the impacts on peoples livelihoods (Table 10).

Changes to livelihoods on Agatti Island can be separated into either those which have increased livelihood options or those that have reduced livelihood options.

TABLE 10 A SUMMARY OF KEY CHANGES IN REEF-DERIVED LIVELIHOODS, CONTRIBUTING FACTORS AND IMPACTS ON AGATTI ISLAND

Changes in reef-derived livelihood	*Contributing factors*	*Impact on strategies and outcomes*
Decline in subsistence fishing species (variety and size)	• Absolute numbers of lagoon fishers has increased leading to over-fishing • Reef degradation	• Some conflict between the two groups of *Bala Fadal* fishing operations (Section 4.1.5). • Heavier reliance on tuna fishing • Increased reliance on imported food stuffs or other sources of protein • Food insecurity
Increase in tuna fishing and associated bait fishery	• Government policy to expand tuna fishery • Subsidies for boats and fuel • Introduction of new technology • Tuna fishing and processing included in school curriculum	• Increasing reliance on tuna and pelagic fish species in diet • Women have less active role in livelihood as they did before in the coir production of the past. Now their involvement is limited to fish processing. • Poorer households with no access to government subsidies and new tuna fishing opportunities marginalised • Increase in income and food security for tuna fishing households
Degradation of reef	• Increasing fishing pressure due to population growth • Crown-of-Thorns starfish • Coral bleaching • Channel blasting	• Decline in lagoon fishery • Increased coastline erosion • Changing geomorphology and current patterns have changed distribution patterns of certain fish species. • Reduced income and food security
Increasing control of resource use	• Increasing environmental concerns of central government • Increasing recognition of environmental problems • Introduction of legislation banning harvest of all endangered species, such as live coral, cowries, turtle, shark • Introduction of legislation restricting shingle collection to permit only. This has now been replaced by a complete ban on shingle collection	• Loss of livelihood opportunities • Loss of equitable access to resource • Poor households reliant on extraction of banned or licensed reef resources and without accessible alternative, undertake illegal extraction • Disfranchisement of local resource users from ownership and control of natural resources

TABLE 10 (CONTINUED)

Changes in reef-derived livelihood	*Contributing factors*	*Impact on strategies and outcomes*
Increase in average household income	• Increased employment opportunities in government service supported by policy to provide employment to at least one person from every household • Improved education has increased access to government jobs	• Increase in disparity between rich and poor • Less reliance amongst high income households on fishery activities or direct interaction with reef for subsistence • Increase in local market for fish and income opportunities for fishery-dependent households • Loss of status of traditional fishery jobs amongst the young and increase in number of disenchanted unemployed youth • Breakdown of traditional community values
Decrease in reliance on shell collection for income	• Cash income from other sources especially government sector jobs • Fall in market demand for shells • Legislation banning collection	• Increasing shell collection as recreation or hobby • Illegal collection by poor households still reliant on shells as a source of income
Increase in tourism related opportunities	• Government actively promotes reef- and water sports-based tourism development • Increasing exposure of island administration staff to scuba diving • Increase in literacy, communications and overall development of islands	• Increase in opportunities for tourism-related activities, e.g. fresh fish, shells and handicraft production, resort employment. But limited benefit to poorer households without appropriate skills and social connections • Increase income security for those households benefiting from tourism-related employment or markets
Loss of female interactions with fishery	• Displacement from fish processing activities	• Women lose control of household income

5.1 INCREASING LIVELIHOOD OPTIONS

Increasing livelihood opportunities have arisen in the fisheries, government and tourism sectors. In fisheries, new opportunities have been promoted in tuna and deep sea fishing, driven by fishery policy, subsidies, education and supported by the availability of the vast and productive reef and ocean resource. Similarly, in the government and tourism sectors, increasing livelihood options have been the outcome of supportive policies, subsidies or investment and increasing levels of education, as well as improved communication, infrastructure and overall development on the islands.

The impact of these changes has been both positive and negative for the lives of the islanders. On the positive side, increasing livelihood options have brought about increased food and income security for those households able to access the new opportunities, and overall have resulted in a rise in average household income on the islands. This in turn has increased the purchasing power of local islanders and resulted in the growth of local markets for local goods and thus additional opportunities for other islanders to supply this demand. However, on the negative side, for the poorer households, who do not have the skills, financial resources or social networks to access new opportunities, in sectors demanding high levels of education, new technology and high investments, the impact of these changes has been increasing marginalisation and income disparity between themselves and those who have accessed the new opportunities. This is accentuated by changing value systems associated with increasing prosperity and the breakdown of the traditional *Tharawad* joint family, leading to greater inequity as some prosper at the cost of ignoring the larger family. With new opportunities, particularly in the government sector, prosperous households have tended to become divorced from the reef

resources since they do not have the intimate daily connection and consequently they have lost the knowledge and awareness evident amongst the poorer and more traditional resource users. Traditional livelihood options of fishing and coconut cultivation have begun to lose their status amongst the educated youth, who often remain unemployed and disenchanted.

Thus, while increasing livelihood options have clearly brought benefits, the benefits have not been equitable, giving rise to more secure and stable livelihoods for some sectors of the community, but excluding other members of the community, who lack the resources to access the new opportunities, in other words the poorer households.

5.2 DECLINING LIVELIHOOD OPTIONS

Simultaneous to the emergence of new livelihood opportunities has been a decline or loss of existing livelihood options. The focus of this decline has been the reef-based activities as a consequence of social, environmental and political factors. At

BOX 12 LEGISLATING THE USE OF CORAL FOR CONSTRUCTION

The 1972 Wild Life Protection Act was the first to include corals as a protected species. This act has been amended in 1974, 1986 and 2001 to include more species from coral reefs for protection under Schedule A.

Recognising the construction needs of the islanders and because no other building material is available on the islands, the Lakshadweep administration modified this ruling to permit collection of coral shingle for house construction on a permit basis, but continued the ban on the collection of coral boulders. In 1996 a notification was passed that people could collect shingle by obtaining a permit from the environment wardens. Non-permit holders would be regarded as offenders. Despite this, illicit collection of boulder coral continues. In 1996, 22 permits were issued to collect a total of 4325 bags of shingle. In 1997, 45 permits were issued to collect 11 400 bags of shingle. The applicants had applied for double that quantity. A man who had recently built his house stated that while he had received a permit for 150 bags, he had collected around 300 to complete his house construction. It is therefore safe to assume that at least some islanders collect exactly the amount they need, irrespective of what is allowed in the permit.

In 1998, another notification was issued which stated that people wishing to collect shingle need to apply for a permit and remit Rs 5 (~US$0.1) per 20 kg bag that they wished to collect. It is interesting to note that the number of permit applicants abruptly declined. Field observations show that shingle collection has carried on regardless. The administration therefore no longer has a record of how much shingle is collected nor receives as much remittance for shingle collection.

Island stakeholders explain that one needs a minimum of 400–500 bags of shingle in order to construct a modest two-bedroom house. Each bag of shingle weighs 20 kg, which means 8–10 tons of shingle is required per house constructed. Islanders also estimate that a minimum of 20 houses are constructed every year. By a conservative estimate this would mean that at least 200 tons of shingle are collected and used within the island annually. This estimate is supported by the data collected by monitoring shingle collection.

More recently, license arrangements for the collection of shingle has been abandoned and instead shingle collection has been totally banned. The community must now either continue collection illegally or purchase expensive alternative construction materials.

Local perceptions

The people perceive coral shingle collection as their right and are unable to see how this can destroy the island. They explain that shingle is like the broken and dead twigs and branches of a tree that wash ashore. This is part of a cycle of life and is utilised for construction on the islands itself. When the houses break the shingle will return to the island for island building and hence there can be no harm in collecting shingle.

They want an explanation for the disappearance of the small Parralli III Island. They made the point that no person had ever collected a shingle or boulder from there and yet it disappeared.

The islanders said that before the law people only collected the amount of shingle they needed for their own construction purposes. Now because of the permit system, only some have the privilege of collecting shingle. These people tend to hoard shingle and sell it at a premium. Shingle sells for Rs 15–20 (~US$0.3–0.4) per bag. Currently around 12 people supplement their livelihood income through shingle collection alone. The recent change in legislation, completely prohibiting shingle collection, has made some locals very angry and only time will tell what will happen.

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

the very root of this change is population growth, resulting in increasing demands on the local resources and competition for access, which has led to the emergence of some conflicts between the large collaborative fishery operations, e.g. *Bala Fadal* (Section 4.1.5). High demand on the nearby resources has led to over-fishing and combined with other disturbances, such as coral bleaching, channel blasting and outbreaks of Crown-of-Thorns starfish, this has led to the degradation of near-shore reef resources and declines in reef and lagoon fishing and associated food and income security.

Global, national and local level recognition of and concern for the decline in coral reef resources has led to the increasing emergence of legislation controlling and restricting exploitation of the reef resource. On Agatti Island, legislation has banned the collection of many reef products and restricted the collection of others to licence arrangements. Consequently, livelihood options such as cowrie collection, which provide an important share of household income for a small number of poor households has become illegal. As described in Box 12, the collection of coral for house construction has also been prohibited. In the same way, this has restricted traditional livelihood options and for the poor households, without a viable alternative source of construction material or income, there is often no choice but to continue the activity illegally, with increasing risk of fines or punishment.

6 SUMMARY AND CONCLUSIONS

The Lakshadweep Islands lying off the west coast of India are comprised of coral atolls, reefs and submerged banks, which surround 36 low lying coralline islands. The total population of these islands is relatively small, but the population density is high and rapidly increasing, with over 60,000 people occupying only 11 of the islands, amounting to just over 26km^2 of land area.

The people of Lakshadweep are officially classified as a Schedule Tribe and the islands are governed as a Union Territory directly from the Central Government in Delhi, through a local administration. As a result of this status and the relative isolation of the islands, the government provides significant support and subsidies to the islands' infrastructure and economy. In recent years, this support has made significant developments in terms of health and education standards and has greatly improved communications and links to the mainland.

Livelihood opportunities for the Lakshadweep islanders are limited. Natural resources form the basis for the traditional economy of the people, in the past this was principally associated with coconut cultivation. However, this has now been replaced by the pole and line tuna fishery, which is considered the mainstay of the islands' economy. Increasingly, government sector jobs are replacing traditional livelihood opportunities, encouraged by government policy to provide employment to at least one member of every household. An emerging tourism industry also offers some opportunities for islanders, through direct employment in resorts or indirectly through the resort's demand for local products.

The Lakshadweep Islands may at first glance not appear to be a location where poverty and reef-related issues are of significance. Well resourced institutions, high levels of health and education and government support and subsidies, have brought increasing prosperity to the islands. But at the same time they have also brought increasing inequality and poverty for those who cannot access government support systems or new opportunities, and who are now no longer sustained by society's traditional norms and extended families, which are beginning to breakdown. An estimated 15% of households in the Lakshadweep Islands are considered to be poor, these typically include: those households no longer supported by the traditional extended family; people lacking in education and dependent on traditional livelihoods of fishing and coconut cultivation, such as the elderly or female-headed households; those without able bodied labour; and those educated but unemployed and lacking in skills in traditional livelihoods. Many of these households are becoming increasingly marginalised from society, as traditional livelihoods lose their status amongst the young and educated, and the traditional family support systems and matrilineal property rights, for which the islands are famous, breakdown, as a result of the rapidly growing population and increasing overall prosperity.

For all the islanders of Lakshadweep, the surrounding coral reefs are fundamental to their lives, forming the land on which they live and protecting the shoreline and their homes from erosion. Reef resources are the source of food, income, building materials and medicines, they provide bait fish for the tuna fishery and are the source of considerable knowledge, skills and traditional myths and songs shared amongst the men and women, young and old, who depend on the reef resource. For the poor households on Agatti Island and Lakshadweep as a whole, the coral reef resources are critical in providing livelihood stability. The income and food provided by the reef are essential for the sustenance and survival of poor households throughout the year. For many of these households the reef is a vital safety net, allowing them to survive and cope in periods of hardship. For women, who can directly harvest from the reef by foot, this may be the only way to cope with the loss of their husbands or the main household provider. For households just above the poverty line, the reef provides a keystone resource for subsistence during the rough weather of the monsoon and as a supplement to other sources throughout the year, keeping these households above the poverty line. For the more prosperous households, who have obtained government employment, reef dependence has changed and they often no longer directly exploit the reef for food, but rely on others to supply reef fish in growing local markets. For the poor reef stakeholders, however, with limited alternative opportunities available and an inability to fully take advantage of the availing government support systems, reef resources remain vital.

However, the availability and accessibility of reef resources for poor households is changing. Despite the limited externalities impacting reefs in the Lakshadweep Islands, the growing population is increasing pressure on the shallow reef resources through its increasing demand for reef products. Impacts from development activities, such as channel dredging, and damage associated with certain resource use patterns, such as coral boulder collection, are also affecting the reef. Furthermore, the reefs have suffered from infestations of the Crown-of-Thorns

starfish and were badly damaged by the 1998 coral bleaching event. As a result of reef degradation and concern for biodiversity conservation, increasing legislation has emerged to control and restrict resource use, prohibiting extraction of many reef products. These changes have disproportionately affected the poorer households who typically have no other viable alternative to reef use to fall back on. However, with continued population growth and global warming these changes increasingly threaten the security of all islanders.

At same time, the growing concern for the coral reef resources has led to efforts to improve our understanding of changes to reef and reef use and apply this to more effective management. Through the GCRMN, ICRMN, LCRMN and CARESS funding has supported training and monitoring programmes focused on the Lakshadweep reefs and its users, which have promoted the participation of local communities. The extensive knowledge of local islanders of their surrounding reef resources has greatly benefited this participation, which has the potential to enhance the role of the local communities in the management of their surrounding resources and ensure that the objectives of management reflect their needs and aspirations. These efforts must continue to be supported and strengthened by a better understanding of the poverty-related reef issues on the islands, and the development of programmes focused on enhancing the livelihood security of the poor.

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NOTES

1 This distinction of having to be born in the islands to avail ST status causes an identity problem for those children who are born in mainland hospitals, despite the fact that both the child's parents may be natives of the UT of Lakshdweep.

2 The additional subdivisional office in Agatti gave 870 as the total number of households during the study period.

3 Source: Directorate of Medical Services, Kavaratti.

4 Fishing-related expenses includes cost of diesel, nets, gear, and boat repayment.

5 The 'Blanket' category of scheduled tribe for Lakshadweep did not take into consideration the local hierarchy or caste system, of *Koyas*-(landowners), Melacheris-(land workers). The more powerful group could also take advantage of these affirmative action policies and because of their connection and astuteness were the first to take adavantage of the policies, subsidies, etc.

ANNEX 1 FOLK TAXONOMY WITH REFERENCE TO FISHES, FISHING GROUNDS AND FISHING TECHNOLOGY

	Gears used		*Types of reef product*		*Ranking*	*Location*	*Gender*
Reef related activity	*Local name*	*English name*	*Local name*	*Common or scientific name*	*Fish abundance*		
Appal Kuthal	Appal Kol	Iron rod	Appal	Octopus		Thod, Balliyaillatha	
Octopus hunting	Kavi	Hooked iron rod				Makkala Chal, Aliv	
	Chana Kol					Patanava, all reef areas,	
						Jetty area	♂♂♀
Bala Beeshal	Beeshi Bala	Cast net	Kulluval	Cerrengids			
Cast netting	Kotta	Coconut leaf bag		Stellatus	x x x x x	Mela muna,	
1. Shore operation	Sandex	Pair of slippers/shoes	Fiyada	—	x x x x	Pallia Aar,	
			Manakam	Goat Fish	x x x x	Keela muna	
			Furachi	Whip Fin Majjara	x x x	Kalpittiya Purukkumpar	♀♀
			Nillalam	Sturgeon Fishes	x x x	Ujrayya chal	
			Mookam	Thread Fishes	x x x	Chekina Palliya chal	
			Ball Meen	—	x	Pittiya Chal	
			Thidira	Mullets	x	Koilatha chal	
			Oola	Gar Fish	x	Kunthale par	
			Poonchi	Sea Chubs	x	Tower Aar	
			Bangada	Cerangids	x	Parrapp	
2. Reef operation			Phrungunny	Squirrel/Soldier			
(Normal night)				Fish	x x x x x		
			Kanakaduam	—	x x x x x	Near entrances	
			Chemmali	Snapper	x x x x	same as above	
			Manakom	Goat Fish	x x x x		
			Varipad	Sturgeon Fishes	x x x		
			Fala	Sturgeon Fishes	x x		
			Manjam	Emperor	x x		
			Oola	Gar Fish	x		
Drag netting	Adibala	Drag net	Furachi	Whip Fin Majjara	x x x x x x x x	Mala Munna, Vadakom	
1. *Bala Adiyal*	Baliyal	Coir rope	Kulluval	C. Stallatus	x x x x x x x	Thala, Purathpalliya Aar	
Shore netting	Kotta	Bag for fish	Manakom	Mulloidichthy S	x x x x x x	Kunnena Aar,	♂♂
			Mural	Half Beak	x x x x x	Theku Mepeda Thada	♂♂
			Ouram	—	x x x	Theku Keepada Thala	
			Fiyada	—	x x x	Keepada Thala	
			Oola	Gar Fish	x x	Police club Aar	
			Thidra	Mullets	x	Mepeda Thaliya aar	
			Bangada	Cerangids	x	Fibre Factory aar	
			Oram	Rabbit Fish	x	Aadaniya Palliya aar	
			Lammam	—	x	Tourist HUT, Airport Aar	
						Beliyodatha aar	
2. *Bala Attal*	Attal bala	Drag net	Chemmali	Snapper	x x x x x x x x x x x		
	Olabala-2	Coconut frond rope	Kilukkomk	Emperors	x x x x x x x x x x x	Kalpittiya	
	Balayil	Coir rope	Oola	Gar Fish	x x x x x x	Purakum puram	
	Kotta	Bag for fish	Manakom	Goat Fish	x x x x x	Airport aar	
	Sandex	Shoes	Chandy	Callyodan spp.	x x x x	Kallukakke aar	
			Naithala	Sturgeon Fish	x x x x	Chadi para aar	♂♂♂♂♂♂♂♂♂

	Gears used		Types of reef product		Ranking	Location	Gender
Reef related activity	*Local name*	*English name*	*Local name*	*Common or scientific name*	*Fish abundance*		
			Karukom	Sturgeon Fish	x x x x	Ujra palliya Aar	
			Perunganny	Squirrel/Soldier Fish	x x x	Vedimeunna Aar	
			Kankaduvam	—	x x x	Groundina aar	
			Lattom	—	x x	Adiyana Palliya aar	
			Kulakkathi	Big Eyes Emperor	x x	Kunnina aar	
3. *Bala Fadal*	Big ody-2	Boats	Metty	Emperor	x x x x x x x x x x	Melacheri	
	Olabala-45'	Coconut frond rope	Chemmali	Red Snapper	x x x x x x x x x x	Cheera Niyava	
	Balayil-50 m	Coir rope	Karukom	Sturgeon Fish	x x x x x x x x x	Kupp	♂♂♂♂♂
	Thani	Water	Naithala	Sturgeon Fish	x x x x x x x x x	Pattiya kal	♂♂♂♂♂
	Adibala	Cast net	Chandi	Callyodon sp	x x x x x x x x x	Thod	♂♂♂♂
	Purabala	Drag net	Kulluval	Cerrangids	x x x x x x x	Cheriya Perumon	
	Kandali bala	Drag net	Oola	Gar Fish	x x x x x x	Parrappu	
			Falli	Trigger Fish	x x x x x	Palliya aar	
			Thomp	Box Fishes	x x x x	Billom	
			Fulariyam	Snapper	x x x	Randikada	
			Feesom	Callyodon sp	x x	Bangaram Kaiyna	
			Kolas	Barracudas	x x	Mepada Tharam	
			Mural	Half Beak	x x	Keepada Tharam	
			Oram	Rabbit Fish	x		
			Ilimeen	—	x		
			Chemaniyam	—	x		
Chadum Pokk	Odam-1	Boat	Ayakura	Seer Fish	x x x x x	Thalafad	
Harpooning	Thula-1	Oar	Shurav	Shark	x x x	Koompuram	
	Kalu-3	Harpoon pole	Firuthaliam	Shark		Valiyathala	♂♂♂♂♂
	Fah-1	Sail	Manachurav	Shark		Valiyakon	♂♂♂♂
	Kumb-1	Sail rod (mast)	Thirandi Churav	Guitar Fish		Paraliya Vadakom Tharom	
	Uli-1	Harpoon	Kalla churav	Shark		Majeli Chadam	
	Kood Uli-1	Triple hook harpoon	Manabalkody	—		Melaba	
	Ott Uli-2	Single hook harpoon	Maram Churav	Black Tip Shark		Kandampar	
	Marakalu-1	—	Ola meen	Merlin	x x x	All Barana	
	Akathuli-1	Inner hook	Kudirameen	Sword Fish	x	Paraliya keel	
	Faravakol	Wooden fish	Maram	Indian Dog shark	x		
	Ove-1	—	Thirandi	Sting Ray	x		
	Kavi	Stick with iron hook	Kottar	Electric Ray	x		
	Choondal	Hooks					
	Cotton Nool	Twine					
	Kotta, thani	Bag and water					
	Thula-1	Sail					
Hand-line-shore			Chemmali	Snapper	x x x x x	Alive (keela alive)	
1. *Eriyal*	Thangees-4 sets	Lines	Kilukom	Emperor/Pig Face Bream	x x x x	Cheeraniyava chal	
	Choondal	Hooks	Kulluval	Cerangids	x x	Jetty-1	
	Kathi-1	Knife	Metty	Emperor/Pig Face Bream	x	Keelava reef	♂♂
	Sanji		Fally	Trigger Fish	x	Airport aar	
	Era	Bait	Oola	Gar Fish	x	Light house aar	
	Eayem	Lead sinker	Furachi	Cerangids	x	Vadakkella muna	
			Chammam	Reef Cod	x	Ujrra palliya aar	
			Malanji	—	x	Shekina palliya aar	

	Gears used		*Types of reef product*		*Ranking*	*Location*	*Gender*
Reef related activity	*Local name*	*English name*	*Local name*	*Common or scientific name*	*Fish abundance*		
Hand-line with boat 2. Bakkal	Thangees-6 sets	Lines	Metty	Emperor/Pig Face Bream	x x x x x		
	Choondal	Hooks	Chemmali	Snapper	x x x x x	Aliv	
	Odam or barkass	Boat	Manjam	Brown Reef Cod	x x x x x	Cheeraniyava	♂ ♂ ♂
	Kavi	Hooked pole	Chammam	Reef Cod	x x x	Thod	
	Era	Bait	Kulluval	Cerangids	x x	Baliya Bander	
	Anchor	Anchor	Fulariyam	Snapper	x x	Parrappu	
	Thandu 2-3 sets		Palli	Trigger Fish	x x	Manjathakkal	
	Thani	Water	Shabudu Kallam	—	x	Mettiyakal	
	Kathi	Knife	Oola	Gar Fish	x	Chammanalia chal	
	Kutty eaayam	Small lead sinker	Karatty	Trigger Fish	x x	Uppathal chal	
			Kallalam	—	x		
3. *Kol Attikal* Fishing with rod/log	Kol	Wooden pole	Fankuluval	Trigger Fish	x x x x x	Main Jetty, Fisheries jetty	
	Thangees	Lines	Bankada	Trigger Fish	x x x	Melamunna	♂ ♂ ♂ ♂ ♂
	Choondal	Lead sinkers	Feeyada	—	x x	Papada palliya aar	
	Kathi, kotta	Knife and bag				Kunninauda	
***Choot Kathich Kuthal* (Light and sword)**	Choot	Flame torch	Ferunganny	Squirrel/Soldier fish	x x x x x	Keelaba (Ern lagoon)	
	Kathi	Knife	Kankaduvam	Squirrel/Soldier fish	x x x x x	Kalpittiya Purakumpuram	
	Kotta	Bag	Mural	Half Beak	x x x	Chal	♂ ♂ ♂ ♂
	Chavalam	Kuth	Oola	Gar Fish	x x		
	Sandex	Shoes	Keram	Gar Fish	x x		
			Manakom	Goat Fish	x x		
***Kalmoodal* (Trapping over boulders)**	Kalmudna bala	Boulder covering net	Nilalam	—	x x x x x	Keelapaar (Ern reef)	
		Small cast net	Chamman	Reef Cod	x x x	Kalpittiya Purukam puram	♂ ♂ ♂
	Kotta	Bag	Varipad	Sturgeon Fish	x x		
	Sandex 1 jodi	Pair of slippers	Manakom	Goat Fish	x		
			Kilukom	Emperor/Pig Face Bream	x		
***Choora Bakkal* Pole and line tuna fishing**	Pablo boat	Mechanised boat				Ambalmugal	
	Choorakol-12	Pole	Mas Choora	Skip Jack	x x x x x x x x x		
					x x x x x x	Kotta 3 sides	
	Choora Choondal-20	Hooks	Ravundi Choora	Little Tunny	x x x x x x x x x x	Keelamoola	
	Chalabala-1	Bait net	Latti	Little Tunny	x x x x x x x x x x	Paraliyada thalapad	
	Olabala-2	Coconut frond rope	Cheviyam	Big Eye Tuna	x x x x x	Bilangina moola	
	Challapetty-1	—	Kindel Choora	Yellow Fin	x x x x x	Anchu Mottam	
	Chalabatty-2	—	Fallam Choora	Symnosarda sp	x x	Mannkunam, Moosa bar	
	Othikom	—				Mandi, Kunninauda	
	Chudithom	—				Paraliya Keepada Tharam	
	Balayil-5	Coir ropes					
***Oori Pidikal* or *Chala Pidika* Bait fish collection**	Chalabala-1		Manja Chala		x x x x x x x x x x		
					x x x x	Bangaram, Kosy pitti	
	Olabala-2, Chal		Rahiya	Sprattilloids japonicus	x x x x x x x x x x x	Poonina pitti, Poocha pitty	♂ ♂ ♂ ♂ ♂
	Petty, Chalakori, Othikom, Boat Ret-1		Bella Chala		x x x x x x x x x	Ayakura pitti, Bangada pitti	♂ ♂ ♂ ♂
			Madam Chala		x x x x x x x x	Agatti pitty, Billatha-2 sides	
			Bodhi		x x x x x x x	P'par, Thekila and Vadekila pitty	
						Aminyala odam	
						Meena pitty	

	Gears used		*Types of reef product*		*Ranking*	*Location*	*Gender*
Reef related activity	*Local name*	*English name*	*Local name*	*Common or scientific name*	*Fish abundance*		
Kavady Edukkal		Iron rod	Black Katty				
Thod			Kavadi	Snake Head	x x x x x x x x x x		
Cowry collection					x x x x	All reef Area,	
		Small bag	Bellakavady	Money Cowrie	x x x x x	East of Kalpitti, mandiyauda	♂ ♀
		Shoes	Baliya Kavady	Tiger Cowrie	x x	Mulli Alivna Keepada	
			Pulli Kavadi	Tiger Cowrie	x	Tharam	
Bepidal, Bala Idal	Mechanised boat		Thirandy Churav	Guitar Fish	x x x x x	Mankunnu	
Shark fishing	1/2" Nool	1.2" cotton twine	Atta Churav	Shark	x x	Parali pitti	
	Boyya	Buoy	Bella Churav	Shark	x	Perumalapar	
	Thirukkani	Steel wire	Poocha Choorav	Shark	x	Beliyapani	♂ ♂ ♂
	Choondal	Hook	Nayyam Churav	Shark	x	Manjappar	♂ ♂ ♂
	Anchor	Anchor	Meen Churav	Shark	x	Cheriyapani	
	Baliyal	Rope	Balam Churav	Shark	x	Elikalpeni	
	Bala	Net	Mara Churav	Shark	x		
			Komban Churav	Shark	x		
			Shirak Balam	Shark	x		
			Piruthaliyam	Shark	x		

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Note: Page references in *italics* refer to Figures; those in **bold** refer to Tables