

**Alternative Livelihoods Through Income  
Diversification: An Option For  
Sustainable Coral Reef and Associated  
Ecosystem Management in Sri Lanka**

**Compiled and Edited by  
Nishanthi Perera**

A publication of the South Asia Cooperative Environment Programme (SACEP) in  
collaboration with Coral Reef Degradation in the Indian Ocean (CORDIO) Programme



SACEP

**CORDIO**

## Alternative Livelihoods as an Option for Sustainable Management of Coral Reefs in Sri Lanka

As an island nation, Sri Lanka's socio-economic development has always been closely linked with coastal and the marine habitats as they provide significant benefits especially in the form of food security and livelihood options. Coral reefs occur mainly as nearshore fringing reefs and patch reefs along 2% of the coastline. Fisheries are the main economic use of reefs and constitute about 15% of the total fish landing. The minimum economic value of coral reefs in Sri Lanka has been estimated at US\$ 140,000 7,500,000 km<sup>-2</sup> reef over a 20-year period.

According to the Reef at Risk Assessment, 86 percent of the reefs in Sri Lanka are under high risk. Bleaching due to increased seawater temperature (El - Niño related) is becoming a major threat to their survival while anthropogenic activities such as over exploitation, use of destructive fishing methods (dynamiting and the use of moxy-nets) have seriously destroyed the reef habitats and the fish stocks in many places. At Hikkaduwa and Pigeon Island, the reefs are overused by tourists and boat operators. Sea coral mining has resulted in large-scale destruction leading to increased coastal erosion in several places.

The country does not lack laws to protect its coral reefs and on the surface they seems to provide all the answers for physical breakage of coral, pollution and over harvesting of the fishery resource. However, various studies have shown that the implementation of these laws are problematic as poverty and lack of other employment opportunities force people to continue with unsustainable methods of harvesting or illegal mining of the reefs.

Policy makers have now realized the importance of a strong commitment from the local community for effective management of reefs. To motivate a community to protect the resource, the management options should be able to provide direct benefits to them. Provision of alternative livelihoods or diversification of livelihood options of coral reef users is one such management option identified. A consolidated effort is required to generate additional employment and high income for the rural poor in coastal areas, as it has to absorb the present labour force as well as the increasing populations of working age. This is an issue that not only concerns the conservation sector, but also a national problem that cut across all the different sectors of the country.

This publication brings together various alternative livelihood options that have been implemented and draws out recommendations for future initiatives.



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*The opinions presented in this document do not necessarily reflect the opinions of collaborating individuals and organizations.*

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# Foreword

Coral reefs are one of the world's biologically richest ecosystems, rivaling the tropical rain forests in their richness of life. They play a vital role in fisheries, tourism, aquarium industry and in controlling sea erosion. However, the past few decades have seen widespread degradation of these productive assets, some even beyond their regenerative capacity. Activities such as overexploitation, destructive fishing methods, sea coral mining, and land-based pollution are contributing on a large scale to this destruction. Further, due to global warming and El-Niño in particular, it is feared that the periods of bleaching and mass mortality of corals can become an annual occurrence in the near future.

There are numerous laws and policies protecting coral reef ecosystems. Their enforcement is, however, not adequate due to inadequate knowledge of the ecology of the reefs, as well as the socio-economic aspects of communities whose livelihoods depend upon them. One major setback to coastal resources management in the third world countries has been the lack of appropriate alternative livelihood options that can financially compensate the destructive resource users. Income generating projects based upon sustainable use of natural resources serve as a mechanism for changing the role of dependent communities from that of 'exploiter' to 'steward', leading to enhanced conservation of the resource. Further, less dependency of coastal communities on reef resources would make these people less vulnerable to future changes in the supply of food and income from these ecosystems.

At the inaugural session of the Sri Lanka Coral Reef Forum in April 2002, SACEP in collaboration with CORDIO initiated a project titled "Alternative livelihoods through income diversification: an option for sustainable coral reef and associated ecosystem management in Sri Lanka." One of the main objectives of the project was to prepare a resource guide for policy makers and ground level managers on factors to be considered while introducing new livelihood options to coral reef and other coastal resource users. It analyses the lessons learned in past projects and programmes and provides a list of recommendations for future initiatives. At the same time the report gives the reader a comprehensive picture on the status of the coral reefs of the country.

I have great pleasure in presenting this report and wish to extend the gratitude of the compiler of the report to the long list of collaborating individuals and organizations that have made this publication a reality. We hope that the information contained in the report will assist in sustainable utilization of the coral reefs of Sri Lanka without compromising the livelihoods of the poor reef resource users.

**Mahaboob Elahi**  
Director General/SACEP

# Contents

• Acknowledgements	I
• Acronyms and Abbreviations	II
• Executive Summary	III
Chapter 1: Introduction	11
1.1 A Global Overview of Coral Reefs	11
1.2 Status of Coral Reefs in Sri Lanka	13
1.2.1 Management Practices	16
1.2.2 Management Failures	17
1.2.3 Alternative Livelihoods as a Management Option	18
1.3 Objectives of the Present Study	19
Chapter 2: Reefs and Livelihoods	21
2.1 General Overview	21
2.2 Livelihoods associated with different Reef location	21
2.2.1 Livelihoods in People’s Perception in Reef Management	22
2.2 Reef Based Fishery	23
2.2.1 Introduction	23
2.2.2 Edible Reef Fishery	24
2.2.3 Ornamental Species Collection	26
2.3 Sea Coral Mining	29
2.4 Reef Based Tourist Activities	33
Chapter 3: Successes and Failures of Past Alternative Livelihoods Approaches	37
3.1 Alternative Employment Opportunities for Illegal Coral Miners	37
3.1.1 Provision of Agricultural Lands in the Monrovia Estate	37
3.1.2 Comparison of Poultry Farm Programmes at Rekawa and Ambalantota	40
3.2 Alternative Livelihoods for Coastal Fisher Communities	41
3.2.1 Micro-credit Scheme for Promoting Non-fishery Activities	41
3.2.2 Pottuvil Lagoon Eco-tour Venture: Sustainable Utilization of a Mangrove Habitat by Fishermen	44
3.2.3 Restocking the Rekawa Lagoon with High-Value Shrimps	45
3.2.4 Enterprises for Fisherwomen	46
3.3 Poachers Turn Environmentalists: Turtle Conservation Through Community Participation at Rekawa	48
3.4 Sustainable Exploitation of Natural Resources As a Basis for Generating Employment in Muthurajawela Marshes and Negombo Lagoon	50
3.4.1 Pilot Projects for Income Enhancement	50
3.4.2 The Muthurajawela Visitor Centre	53
3.5 Livelihoods Options from the Aquaculture Industry	55
3.5.1 Experimental Aquaculture Projects in Disused Inland Coral Pits in the Ratgama Electorate	57
3.5.2 Crab Fattening in Lagoon Ecosystems	57
3.5.3 Other Types of Culture Practices	59
3.5.4 Linking Small-scale Ornamental Fish Producers to the Global Market	60

Chapter 4: The International Approach	63
4.1 Livelihood Diversification in Marine Protected Areas	63
4.1.1 Komodo National Park: Mitigating the Live Fish Trade	63
4.1.2 Port Honduras Marine Reserve: A CBO Assisting to Overcome Resource Depletion	65
4.1.3 Adjustment to Cod Closure in Atlantic Canada	66
4.2 Culture Options	68
4.2.1 Sustainability of Grouper Culture in Tubigon Municipality	68
4.2.2 Overcoming Issues in Sustainable Mud Crab Culture	69
4.2.3 Restocking Giant Clams	70
4.2.4 Programmes to Breed Coral Reef Fish	71
4.2.5 Pearl Culture in the Maldives	72
4.2.6 Seaweed Culture in a Remote Island	73
4.3 Ecotourism	74
4.3.1 Coral Reef Conservation Through a Private Venture	74
4.3.2 Artificial Reefs Giving a Boost to Tourism in Bali	76
4.3.3 Consortium Togen	77
4.3.4 Tourism Development at the Sanya Reserve	78
4.3.5 Other Ecotourism Options	78
Chapter 5: Summary of Findings and Recommendations for Future Initiatives	81
5.1 Summary of Findings	81
5.1.1 Sustainable Management of MPAs	81
5.1.2 As Compensation to Prohibited Activities Outside MPAs	83
5.1.3 To Reduce Pressure on the Natural Resources not Protected by Law	83
5.1.4 Community Empowerment in the Decision Making Process	83
5.2 Recommendations for Future Initiatives	84
5.2.1 Socio-economic factors	84
5.2.2 Management Factors	85
5.3.3 Environmental Factors	87
• Annex 1	89
• Supporting Documentation	94

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# Acronyms and Abbreviations

ADB	Asian Development Bank
CBO	Community Based Organization
CCA	Coast Conservation Act (Legislation defining the powers and responsibilities of CCD)
CCD	Coast Conservation Department (Agency under the Ministry of Fisheries and Aquatic Resources concerned with protection of the coastal zone)
CEA	Central Environmental Authority (Institution under the Ministry of Environment and Natural Resources for environmental regulation.)
CFE	Caring for the Environment 2003-2007- Path to Sustainable development (A successor to the National Environmental Action Plans (NEAPs) prepared by the Ministry of Environment.)
CORDIO	Coral Reef Degradation in the Indian Ocean Programme, (A programme initiated in 1998 for the coral reef conservation).
CRMP	Coastal Resources Management Project (ADB funded project which is presently being implemented by the CCD)
DWLC	Department of Wildlife Conservation of Sri Lanka (Presently it is under the Ministry of Environment and Natural Resources)
EIA	Environmental Impact Assessment
FA	Fisheries Act
FD	Forest Department
FFPO	Flora and Fauna Protection Ordinance (Legislation defining the powers and responsibilities for the protection and management of fauna and flora)
GCRMN	Global Coral Reef Monitoring Network (The GCRMN-South Asia office operated from IUCN-Colombo Office until 2003).
GOSL	Government of Sri Lanka
ICLARM	ICLARM (The World Fish Center) (An autonomous, non profit international scientific and technical center established to stimulate and accelerate research on all aspects of fishery and living aquatic resources.)
ICRI	International Coral Reef Initiative
IRMP	Integrated Resource Management Programme in Wetlands (A Netherlands Government funded project implemented by the CEA)
ME	Ministry in charge of the subject of Environment in Sri Lanka. (Until 1997 it was called as the Ministry of Transport, Environment and Women's Affairs (MTEWA) and from 1997-2002 it was known as the Ministry of Environment and Forest (MFE) and from 2002 it is known as the Ministry of Environment and Natural Resources (MENR))
MH	Ministry of Housing
NARA	National Aquatic Resources Research and Development Agency
NGO	Non Governmental Organizations
SACEP	South Asia Cooperative Environment Programme (An Intergovernmental Organization established in 1982 for the protection, management and enhancement of the Environment in the South Asian Region.)
SAM	Special Area Management (A coastal resource planning method that is based on a decentralized collaboration between resource managers and users).
SEAFDEC -AQD	South East Asian Fisheries Development Centre – Aquaculture Development
SIDA	Swedish International Development Cooperation Agency

# Executive Summary

The main objectives of this report are to review and analyze the past experiences gained of providing alternative livelihood options for destructive coral reef and other coastal resource users and to develop a set of recommendations that can be applicable to the Sri Lankan context.

The report is divided into five chapters. The introductory chapter gives a brief global overview of coral reefs and then goes on to describe the present status of coral reefs in Sri Lanka. It also deals with different management practices and reasons for their successes and failures. Finally it explains why the international community and the Sri Lankan government have realized the importance of using alternative livelihoods as one of the management options in sustainable utilization of coastal resources.

The second chapter titled “Reefs and Livelihoods” comprises four sections. Section 1 gives an overview of livelihood activities associated with different reef locations in the country. Following sections describe in detail reef-based fishery, tourism and illegal sea coral mining with the use of case studies to illustrate the complexity of each situation. Further it refers to how land-based activities can adversely affect the marine ecosystems.

Chapter 3, analyses the past and ongoing alternative livelihood initiatives tried out in Sri Lanka under different projects and programmes. It gives a comprehensive picture on how people have responded to different economic options offered to them as compensation for former destructive livelihood practices. The chapter describes in detail the project outcomes, lessons and recommendations for future initiatives in economic diversification activities such as agriculture, poultry farming, development of small land-based industries through micro-credit, aquaculture, and ecotourism ventures.

Chapter 4 gives an insight as to how the international community has tried to solve the problem. It explores case studies from different parts of the world that can be adopted to the Sri Lankan situation with appropriate changes. This chapter is divided into three sections and deals with how marine protected areas are using different alternative livelihood options for sustainable fishery and the conservation of marine biodiversity, different aquaculture practices such as grouper, mud-crab, giant clams, and seaweed farming and ecotourism ventures.

Chapter 5 summarises the lessons learned in chapters 3 and 4 and gives recommendations for future activities. It concludes that alternative livelihoods have been used as a management option under four main conditions: when an area is declared as protected; when certain activities are prohibited under new laws and regulations (illegal mining, use of certain types of fishery nets etc); to reduce pressure on natural resources (which are not legally protected); and empowering communities in the decision making process. Poor monitoring and assessment of the programmes have limited the evidence on the extent to which the new livelihood options have assisted in the improvement of the natural resources.

An overall analysis of the projects and programmes described suggest that a holistic approach including socio economic, management and environmental concerns need to be addressed for the sustainability of a economic diversification venture. Some of the main findings can be summarized as follows:

- If the alternative livelihood options are not financially viable, the participation will not be forthcoming unless direct subsidies and or some other financial incentives are offered.
- There must be strong commitment from the Central Government to end destructive activities leading to coastal resources degradation and to support sustainable livelihood options within the community.
- The introduction of sustainable livelihoods should be part of a coherent wider effort in coastal resources management, directly involving the resource users in the design of interventions in partnership with relevant organizations.

- The proposed income generating activity should not be developed only to absorb the potential labour redundancies in fisheries or any other destructive activities, but also to absorb increasing populations of working age.
- Non-governmental agencies and community-based organizations such as fisher folk organizations and women's groups can play a vital role in the mobilization of community interest and support.
- A better understanding of the demographic and social dynamics of coastal communities and other natural externalities is needed before introduction of a new employment venture.
- Rather than trying to introduce new concepts, promoting employment activities that already exist within that area can be more sustainable
- The new livelihood options should not be destructive to the natural environment and particularly should not waste local resources.
- Law enforcement and public awareness programmes should also go hand in hand with the implementation of alternative livelihood options to obtain an overall success of the programme

# CHAPTER 1

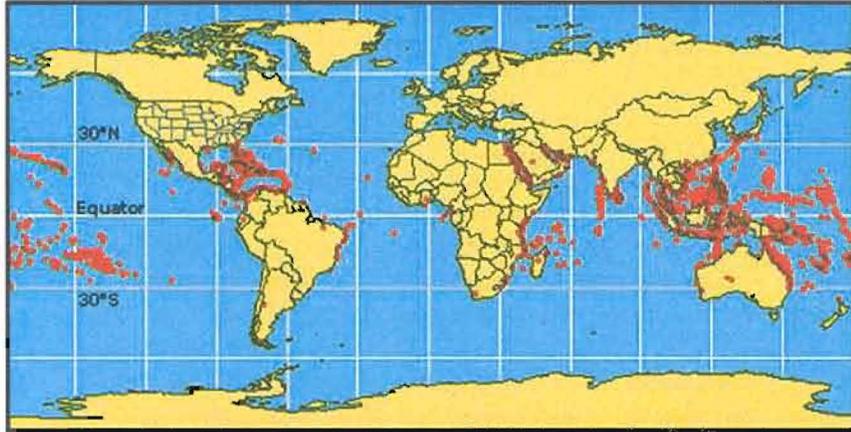
## Introduction

### 1.1 A Global Overview of Coral Reefs

Warm-water coral reefs are one of the most productive and biologically rich ecosystems on earth, second only to the tropical rain forests.<sup>1,2</sup> They support almost a quarter of the world's marine fish species, about 800 species of reef-building corals and over 10,000 species of invertebrates. Reef building through the accumulation of calcium carbonate is a very slow process and most of the

existing reefs are over 5000 years old.<sup>3</sup> In the global scale reefs are rare habitats, as they occupy less than one percent of the total area of the world's oceans. They can be found in near-surface shallow waters of around 101 countries, especially in the Indo-Pacific region (Fig. 1).<sup>1,2,3,4,5</sup>

Fig 1: Global Distribution of Reef Building Corals



Source: [www.nos.noaa.gov/education/corals/media/supp\\_coral05a.html](http://www.nos.noaa.gov/education/corals/media/supp_coral05a.html)

#### Important Facts About Coral Reefs

- Coral reefs have been evolving for the past 225 million years, and scientists estimate that over one million species are associated with the coral reef ecosystems.<sup>1,3,9</sup>
- Coral reefs are estimated to provide US\$375 billion per year in goods and services.<sup>3</sup>
- If properly managed, reefs can yield, on average, 15 tons of fish and other seafood per square kilometre per year.<sup>3</sup>
- 58 percent of the world's coral reefs are potentially threatened by human activities ranging from coastal development, destructive fishing activities, overexploitation of resources and land-based pollution.<sup>3</sup>
- The 1997-98 bleaching event reduced live coral cover by 10 percent globally, indicating that coral reefs are sensitive to climate change.
- Scientists are predicting a 40 percent loss in the world's coral reefs by 2010, unless urgent management actions are implemented.<sup>4</sup>

Reefs provide life-support systems to millions of human beings in terms of livelihoods, shoreline protection and recreation. Reef-related fisheries yield between 9 -12 percent of the world's total annual catch of 70 million metric tons which reflects only the recorded catch. Much of the coral reef fisheries are small-scale and is not traded in the market, instead, they are important providers of protein and food security for poor coastal communities.<sup>3,6</sup>

The marine aquarium species trade is a global multimillion dollar industry, worth an estimated US\$ 200-330 million annually. A total of 1,471 species of fish, 140 species of stony coral and around 500 other invertebrates (molluscs, shrimps and anemones) are collected mainly from South East Asia and from several island nations in the Indian and Pacific Ocean reefs for export. In 1997, a total of 1,200 tons of coral was traded internationally, with 56% imported by USA alone.<sup>1,5</sup>

Recent years have seen a spectacular growth in the demand for live fish in luxury Asian restaurants with a fish sometimes retailing for over US\$ 100 a piece. Predominantly groupers and the humphead wrasses are the preferred species. With such high values, many fish species have been decimated from the reefs around Southeast Asia, and now most of the collection is done from the Western Indian Ocean and the Pacific.<sup>1,7,8</sup>

In addition to existing extractive uses, scientists are also turning to coral reefs in search of pharmaceuticals, as experiments have shown that chemicals within reef-associated species may offer new treatments for leukemia, skin cancer, and tumors <sup>3</sup>.

The largest non-extractive value of the reef resource is tourism. Tourists are attracted by the beauty of corals and fishes, clear water and clean beaches for swimming, snorkeling and Scuba diving.<sup>1,3,9</sup> Around 100 countries benefit from the recreational value provided by their reefs. Florida's reefs provide \$1.6 billion into their economy each year from tourism alone.<sup>3</sup>

Reefs also act as protective barriers to tropical coastlines by acting as a buffer towards strong waves that could otherwise lead to coastal erosion. This protective function of reef is estimated to be valued at US\$ 9 billion per year. <sup>1,3,9</sup>

Despite the apparent value of coral reefs to humans, most of the reefs around the world are threatened or have been destroyed by anthropogenic and natural activities.<sup>1,2,3,4,9,11,12</sup> Globally about half a billion people live within 100 km of a coral reef and the growth of coastal cities have generated a range of threats to their survival.<sup>1,3</sup> Over harvesting, destructive fishing practices and land-based source pollution are the main human induced activities (Table 1.1). Natural causes include storms, change in weather patterns such as "El Niño", predation and diseases.<sup>4</sup> The el niño related coral bleaching in 1997 and 1998 was by far the worst on record and also the most geographically spread event ever witnessed. It led to the highest level of coral mortality, especially in the Indian Ocean where 50 – 95 percent coral mortality occurred due to extremely high sea surface temperatures.<sup>9,10,11,12b</sup>

Table 1.1: Major Types of Direct and Indirect Activities that Damage Coral Reefs<sup>1,3,4,13</sup>

<p><b>Direct</b></p> <ul style="list-style-type: none"> <li>• Ship grounding – Direct impact on relatively small areas of shallow reef</li> <li>• Anchor damage – Apart from the initial impact, anchor chains sweep over wide areas, smashing corals</li> <li>• Blast fishing – continuous blasting can destroy the whole reef.</li> <li>• Land reclamation – The most complete and irreversible destruction of wide areas of reefs, as reef flats and shallow lagoons are converted to land</li> <li>• Reef mining- Direct removal of coral for construction</li> <li>• Direct smothering- Solid waste and thicker elements of spilled oil can kill corals</li> <li>• Dredging – Dredging of channels and lagoons for passage of ships and blasting of reefs for construction of deep water channels</li> <li>• Storms and Cyclones</li> </ul> <p><b>Indirect</b></p> <ul style="list-style-type: none"> <li>• Global Warming – live coral cover is reduced</li> <li>• Over-exploitation of species – the ecological structure of the reef is damaged</li> <li>• Diseases – coral death and/less functionality</li> </ul>
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As indicated in the previous paragraphs coral reefs generate economic resources or environmental services to sustain more than one form of economic activity. Therefore, finding new ways to enhance the livelihoods of reef-dependent communities while not undermining the reef ecosystems' functional integrity is a major challenge faced by the policy makers.<sup>1,2,3,4,13</sup> The "Status of Coral Reefs of the World: 2002" <sup>12a</sup> recommends that there should be two parallel agendas to conserve coral reefs:

1. Direct management to reduce destructive anthropogenic activities through integrated coastal management combining policy, legal and economic mechanisms and the establishment of more effective Marine Protected Areas.
2. Global action to study the impacts of global climate changes on coral reefs and reduce emissions of greenhouse gasses.

## 1.2 Status of Coral Reefs in Sri Lanka

Sri Lanka is situated between 5° and 10° north of the equator at the southern tip of the Indian subcontinent. It has a total land area of 65,000 sq. km with a maritime area that is three times larger than the land area (230,000 sq.km.). The country's coastal zone, as defined by the Coast Conservation Act (CCA), is a relatively narrow coastal belt consisting of a two kilometre wide band of ocean and the adjoining strip of land extending 300 m landwards. Sri Lanka has a coastline of approximately 1,620 km including the shoreline of bays and inlets, but excluding lagoons.

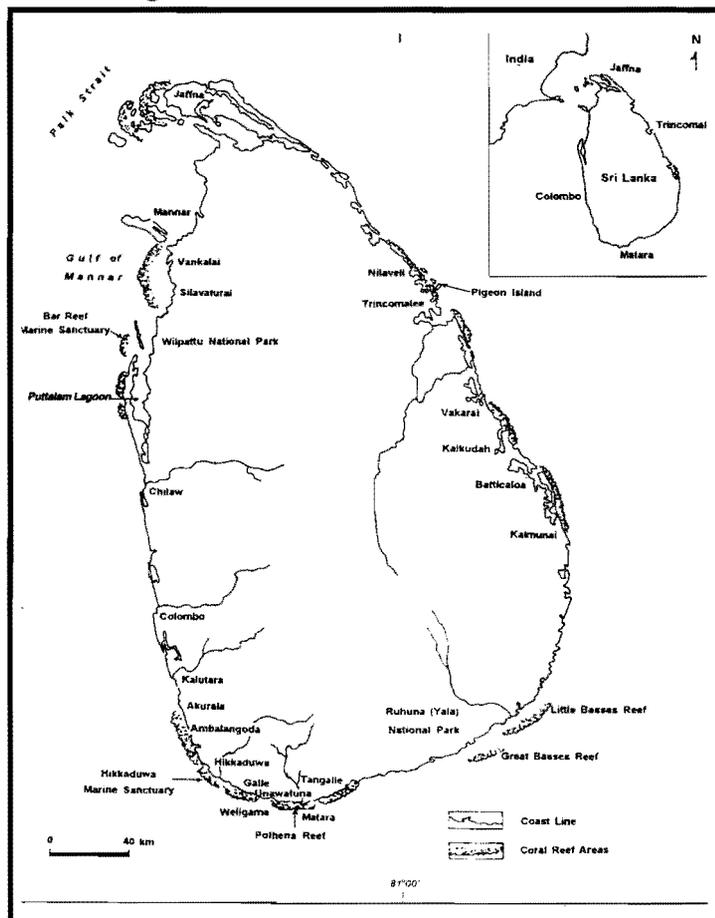
The island's coastal zone is endowed with highly productive and varied coastal and marine ecosystems, which include coral reefs, seagrass beds, mangroves, salt marshes, lagoons, estuaries, barrier beaches and dunes.<sup>14, 15</sup>

The reefs of Sri Lanka have not been comprehensively mapped, but the major reef formations are found within a 30m-depth contour (Fig. 2). Three types of reef habitats; true corals, sandstone and rocky reefs have been identified. The true coral reefs are found mainly as nearshore fringing reefs and patch reefs in the continental shelf. An estimated 2-3 percent of the coastline has fringing reefs, with larger reef areas offshore in the Gulf of Mannar and west of the Kalpitiya Peninsula. Coral reefs around the Jaffna Peninsula are less developed and generally occur around the coastal islands. The fringing reefs occur from Trincomalee to Kalmunai along the east coast, and from Tangalle in the south to Akurala in the southwest. The three barrier reefs are located along the west coast at Vankalai, Silvaturai and off Kalpitiya. While sandstone habitats are widespread along the coast, rocky habitats occur mainly on the west coast beginning south of Colombo, extending through the southern areas to the Trincomalee District in the Northeast.<sup>1,11,12,16,17,18,19,20,31</sup> Corals have colonized sandstone and rocky habitats to varying levels although the average coral cover on these habitats is usually less than 10 percent.<sup>18</sup>

Annex 1 gives a comprehensive list of reefs recorded in Sri Lanka.

The reef ecosystem supports high species diversity in both fauna and flora, of which some are not yet identified. Surveys have recorded 183 species of hard coral belonging to 68 genera, with staghorn coral (*Acropora* spp) as the dominant genera. Six species of spiny lobsters, various other invertebrates, sea turtles, dolphins and more than 300 fish species have been recorded. Many of the nearshore reefs around the country have a low percentage of living coral and a high percentage of sand or rocky substrates.<sup>1,11,12,16,17,18,19,20,31</sup>

Fig 2: Recorded Coral Reef Locations in Sri Lanka



Source: White and Rajasuriya 1995<sup>16</sup>

Well-being of the demersal fisheries and the protection of the coastline from erosion are two of the important services provided by the reefs. Traditionally, reefs and their associated resources have served the coastal communities of Sri Lanka in many ways. They provided food, building materials for houses, sheltered harbours for boats and safe areas for bathing and recreation. With the turn of the 20<sup>th</sup> century, in addition to providing the same needs for an expanding population, the reef resources are also exploited for other purposes such as the marine aquarium industry and tourism.<sup>20</sup> The "Reef at Risk Assessment - 1998", states that almost all the reefs in Sri Lanka are highly threatened due to human induced activities such as nearshore coral mining, destructive fishing practices, uncontrolled harvesting of reef biota, increased pressure from tourist related activities and land-based source pollution.<sup>3</sup> Over harvesting, has become a particular problem in the demersal, spiny lobster and ornamental fisheries and more recently in sea cucumber and sacred chank fishery.<sup>11a, 28,31</sup>

**Economic Value of Sri Lanka's Coral Reefs**

- The minimum economic value of coral reefs has been estimated at US\$ 140,000 – 7,500,000 km<sup>2</sup> reef over a 20-year period<sup>22</sup>.
- The gross value of the spiny lobster catch during 1997/98 financial year was around US\$ 20 million <sup>11b</sup>
- 5 percent of the world's marine ornamental fish exports are from Sri Lanka.<sup>5</sup>
- Out of the US \$ 8 million earned from ornamental species export in 1999, 70 percent constitutes Marine species <sup>11b</sup>.
- Coastal tourism contributes around US \$ 200 million per year to the national economy <sup>14</sup>
- Nearly 15 percent of the nearshore fish landing is from coral reef associated fisheries <sup>11a</sup>

Reefs located in the Southwest coastline experiences high loads of particulate matter, including sediments, especially during the monsoonal season. Sediment loads arising from unsound land-use practices, and other pollutants from households and industries are the major agents destabilizing reef ecosystems leading to reef degradation and loss of its biodiversity.<sup>17,21,28</sup>

In the 1998 climate related bleaching event, corals in most shallow reef areas at depths of 3-5m were destroyed. Surveys conducted in 1999 and 2000 showed that coral cover at Bar Reef Marine Sanctuary was near zero in shallow reef habitats and at Rumassala the reef had only 20 percent live coral cover. Recovery from this bleaching event has been variable in different locations. Coral cover in the Hikkaduwa National Park has increased from 07 percent in 1999 to 12 percent in 2002. The shallow reef at Kandakuliya, south of the Bar Reef Marine Sanctuary has been completely overgrown by *Halimeda* algae, killing almost all the new coral recruits seen in 2001. The coral reefs of Pigeon Island in Trincomalee largely escaped the bleaching event, but were damaged by a cyclone in 2000, however, some recovery has been observed.<sup>11a, 12a</sup> Populations of coral-eating crown of thorns starfish (*Acanthaster planci*) have been reported to periodically increase and form large aggregations in reefs on the northwest and the east. <sup>11a, 12a</sup>

The present status of several major coral reefs of the country are summarized in Table 1.2 and a more detailed description is given in Annex 1. Factors affecting the survival of reefs are given in Table 1.3. Chapter 2 will give a detailed account on human induced activities associated with coral reefs.

Table 1.2: The Present Status of Coral Reefs in Several Locations of Sri Lanka <sup>11a, 12a, 31</sup>

<b>Reef</b>	<b>Status</b>	<b>Major Threats</b>
Bar Reef	Heavily degraded	Bleaching, destructive fishing gear, and predation by <i>A. planci</i> , algal overgrowths
Hikkaduwa	Heavily degraded	Bleaching, Tourist activities, sedimentation
Polhena	Heavily degraded	Coconut husk retting, coral trampling by visitors, overgrowth of algae
Rumassala	Degraded	Bleaching, blast fishing, sedimentation, ornamental fish collection, oil spills
Pigeon Island	Partially degraded	Tourism, fishing, predation by <i>A. planci</i> , destruction by storms.
Little and Great Basses	Un-degraded	Destructive fishing, Cyclones

Table 1.2: The Relative Importance and Extent of Human and Natural Factors Affecting Reefs in Sri Lanka (As modified from White and Rajasuriya, 1995)<sup>16</sup>

<b>Factors</b>	<b>Relative Importance of impact (5 high to 1 Low)</b>	<b>Extent</b>
<b>Human Induced</b>		
<ul style="list-style-type: none"> <li>• <b>Sedimentation from poor land use practices and dredging of harbours</b></li> </ul>	5	Throughout the coast, especially in South and West
<ul style="list-style-type: none"> <li>• <b>Illegal Sea Coral mining</b></li> </ul>	5	Southwest, East
<ul style="list-style-type: none"> <li>• <b>Edible fishery</b> <ol style="list-style-type: none"> <li>1. Blast fishing (dynamite)</li> <li>2. Bottom-set netting</li> <li>3. Use of non-selective fishing gear</li> <li>4. Indiscriminate netting in reef area</li> <li>5. Over-harvesting</li> <li>6. Discharge of waste oil and bilge water from fishing boats</li> <li>7. Damage by boat anchors</li> </ol> </li> </ul>	4	Throughout the coastline
<ul style="list-style-type: none"> <li>• <b>Ornamental Species collection</b> <ol style="list-style-type: none"> <li>8. Use of "Moxy" nets</li> <li>9. Excessive collection of species</li> </ol> </li> </ul>	4	Throughout the coastline
<ul style="list-style-type: none"> <li>• <b>Tourist related activities</b> <ol style="list-style-type: none"> <li>1. Reef trampling</li> <li>2. Sewage and solid wastes disposal</li> <li>3. Souvenir collection</li> <li>4. Boat anchorage, collisions and discharges</li> <li>5. Explosive growth of beach front infrastructure</li> </ol> </li> </ul>	3	West, South, East
<ul style="list-style-type: none"> <li>• <b>Coconut husk retting</b></li> </ul>	2	South
<ul style="list-style-type: none"> <li>• <b>Oil spills and anchor damage from ships</b></li> </ul>	2	West, South, Southeast
<ul style="list-style-type: none"> <li>• <b>Sand mining</b></li> </ul>	2	West, South
<b>Natural Causes</b>		
<ul style="list-style-type: none"> <li>• <b>Coral bleaching</b></li> </ul>	5	Through out the coastline
<ul style="list-style-type: none"> <li>• <b>Predation from <i>A. planci</i></b></li> </ul>	3	Northwest, East
<ul style="list-style-type: none"> <li>• <b>Algal overgrowth</b></li> </ul>	2	Northwest
<ul style="list-style-type: none"> <li>• <b>Wave action from storms</b></li> </ul>	2	South, East, Southwest
<ul style="list-style-type: none"> <li>• <b>Diseases</b></li> </ul>	1	Through out the coast line

### 1.2.1 Management Practices

Sri Lanka has a long history of conserving its reef resources dating back to the introduction of the Chanks Ordinance in 1842, for controlling the collection and export of chanks from the Gulf of Mannar.<sup>18, 20,27,48</sup> A ban on the removal of corals from certain parts of the seashore was introduced in 1865 under the Ordinance No. 20, which was replaced by the Seashore Protection Ordinance No. 12 of 1911.<sup>48</sup> The first real attempt for coral reef protection was in 1961 under the Fisheries Ordinance that declared 110 acres of territorial waters in Hikkaduwa, as an area where fishing was allowed only with a permit. In 1979 this area was declared a Marine Sanctuary under the Fauna and Flora Protection Ordinance (FFPO).<sup>45</sup> In 2002 it has been re-gazetted as a National Park. Since then two more Sanctuaries (Rumassala and Bar Reef) and one National Park (Pigeon Island) have been legally protected under the FFPO.<sup>46</sup>

The framework for Sri Lanka's coastal zone management programme is provided by the Coast Conservation Act, No. 57 (CCA) of 1981 and its amendments, enacted by the Coast Conservation Department (CCD). The main conservation strategies adopted and the institutions responsible for the protection of Sri Lanka's reef resources are summarized in Table 1.3.

Table 1.3: Conservation Strategies and the Institutions Responsible for Sustainable Utilization and Protection of Coral Reef Resources in Sri Lanka<sup>14,18,19,20,27,28,29,30,40,45,48,64</sup>

<b>Category</b>	<b>Conservation strategies</b>	<b>Responsible Agency/s</b>
<b>Sea Coral Mining</b>	<b>Coast Conservation Act (CCA) of 1981 and its amendments of 1988 and 1996</b> prohibits the possession, processing, storage, burning and transport of sea coral. Section 31 of the Act gives the authority to the Director of the CCD to take down any unauthorized structures such as limekilns within the coastal zone.  <b>Cabinet approval was obtained in December 1998 to ban the use of coral-based lime in government construction projects.</b> Awareness programmes to educate the agencies concerned have been carried out. Research is being done to introduce alternative sources such as Dolamitic lime, that has been identified as the best alternative.	CCD, police  MEN, MH, ITI (CISIR)
<b>Limekiln Operation &amp; Inland Coral Mining</b>	Permits are issued for kilns to operate outside the coastal zone, subjected to environmental regulations imposed by CEA. To mine the inland coral deposits permits can be obtained by GSMB. These permits are issued for 10 perch blocks for a deposit of Rs. 100,000/-, which is refunded on condition, that the pit is filled.	CCD, CEA, PS, GSMB
<b>Ornamental Fishery &amp; Other Exports</b>	Fish processing establishment regulations of 1998 made under section 61 of the <b>Fisheries and Aquatic Resources Act No.2 of 1996 (FARA)</b> specify that a license should be obtained for any fish processing activities including collection of ornamental fish, and packing for export. A gazette notification No 1036/13 issued in July 1998 under the above Act prohibits the export of 25 species of fish that are currently facing threat of extinction. It is mandatory to obtain permits for the export of 33 other species in live form.  Export of ornamental species collected in the wild has also been restricted under the <b>Flora and Fauna Protection Ordinance of 1938 and its amendments in 1964, 1970 and 1993 (FFPO)</b> . It protects the following number of species: 07 fish, 13 mollusks, 03 crustaceans, 02 echinoderms, gorgonians, cerianthus tube anemones, sabellid tube worms, soft and hard corals.	Department of Fisheries, Sri Lanka Customs  DWLC, FD, Sri Lanka Customs

Table 1.3 continued...

<b>Category</b>	<b>Conservation strategies</b>	<b>Responsible Agency/s</b>
<b>Tourism &amp; Infrastructure Development</b>	According to the CCA, a permit is required for specific development activities within the coastal zone. <b>The National Environment Act No, 47 of 1980 and its amendments in 1988, 2000 (NEA)</b> have provisions for the protection of coastal resources through EIA and the EPL process. The Tourism Master Plan 1992-2000 recognizes the major environmental problems of coast-based tourism	CCD, CEA, Provincial Councils  CTB
<b>Coral Reef Protection &amp; Management</b>	Under the <b>FFPO and its amendments</b> , coral reefs in Hikkaduwa National Park, Bar Reef Marine Sanctuary, Rumassala Marine Sanctuary and Pigeon Island National Park are legally protected. Schedule IVA of the Ordinance lists the protected coral species. <b>Section 36 of the FARA</b> gives provisions to declare fisheries reserves, which can be used to protect threatened aquatic resources and natural habitats, and breeding ground of species. In July 2001, 02 coral reef ecosystems were declared as Fisheries Management areas: off Yala (encompasses Great and little Basses reefs) and Madiha-Polhena. <b>National Aquatic Resources Research and Development Agency Act, No. 54 of 1981 as amendment by Act, No.32 of 1996, gives</b> NARA the authority to do research on aquatic habitats and organisms and advise to the government departments on natural resources utilisation and management	DWLC  DFAR  NARA
<b>Prevention of Pollution</b>	<b>NEA and the Marine Pollution Prevention Act No. 59 of 1981</b> gives the mandate to prevent, reduce and control pollution in Sri Lankan water from marine or land-based sources.	CEA MPPA
<b>Integrated Coastal Zone Management</b>	<b>Coastal 2000 of 1992 and its revisions in 1997 and 2003</b> recommends Special Area Management (SAM) Plans for participatory resource management in selected coastal areas.	CCD with the assistance of line agencies, and NGOs.

A number of projects carried out in the past have resulted in management plans and action plans for coral reef conservation: Coastal 2000: A Resource Management Strategy for Sri Lanka's Coastal Region (1992); Special Area Management Plans for Hikkaduwa Marine Sanctuary and the Rekawa Lagoon (1996). However most of the conservation actions recommended in these plans have not been implemented fully. The ADB funded Integrated Coastal Zone Management Project implemented by the CCD is presently carrying out coral reef management activities at Bar Reef, Hikkaduwa, Rekawa and Unawatuna.<sup>31, 47</sup>

### 1.2.2 Management Failures

As experienced by many other countries, it has become evident that coral resource management only through legal enactments is not sustainable in the long run. Government enforcement of regulations is not easy as reef fisheries and sea coral mining activities are mainly done on a small scale and is widely scattered along the coastline.<sup>15, 20, 28, 51</sup> Another problem associated with management of coastal resources is its ownership. Most coastal land is privately owned, owned and managed by the state, or owned by the state and leased to private owners. Although, nearshore coastal waters are under the jurisdiction of the state, sometimes it is treated as "communal property" subjected to user rules administered by well

defined user groups, such as fisher people or as open access regimes in which anyone is entitled to use the resource.<sup>14, 15</sup> The management of coral reefs are further aggravated by the various weaknesses in existing regulations and socio-political situations. Some examples are given below:

- To address destructive fishery, the Government of Sri Lanka recently established Fisheries Management areas in the Great and Little Basses Reef of the South Coast. Due to political interference there was partiality in the issue of permits for harvesting of sacred chanks in this area and this resulted in the collapse of the management regime.<sup>28</sup>
- Most of the management and conservation activities are done on project basis and lack continuity. For example, the Special Area Management Projects carried out at Hikkaduwa and Rekawa with the support of USAID have not been sustained after the projects were completed in 1996. Lack of commitment by the government has led the people in the area back to destructive activities.<sup>30</sup> Therefore, the ADB-funded CRMP project is now again trying to address the same problems.
- As the enactment of the CCA is limited to the coastal zone, the CCD and Police officers have no authority when the sea corals have been removed beyond the coastal zone for processing, burning etc. As inland coral mining outside the coastal zone is allowed with a permit from the Geological Survey and Mines Bureau (GSMB), there is problem of identifying inland coral from sea coral. Therefore, a closer coordination between these two organizations is needed to overcome the arguments on whether the coral used in limekilns is sea coral or land coral.<sup>14</sup>.
- In the protection of ornamental fish species, the differences in the list of species in FFPO and FARA pose problems for the exporters as well as to the Biodiversity Protection Unit of the Sri Lanka Customs Department.<sup>20</sup>
- The uses of bottom-set nets and moxy nets have been made illegal under FARA, but these gears are still used freely as there is little or no attempt to control such activities. Furthermore, fishermen continue to develop new forms of fishing gear that are damaging to reef habitats. As a result, destructive forms of fishing such as the bottom-set nets is used even in the coral reef habitats within the Bar Reef Marine Sanctuary which is the largest and the best marine protected area in the country.<sup>28</sup>
- An attempt by the government to ban export of live fish was abandoned due to protests by exporters who claimed that around 50,000 people were dependent on the industry.<sup>37</sup> Similar situations occurred when trying to stop sea coral mining, as its prohibition directly affects the livelihood of thousands of individuals. Legislation banning sea coral mining is not adequately supported by the provision of alternative employment opportunities for miners, and alternative sources of lime for construction.<sup>52, 72</sup>
- Local people in the coastal regions have direct influence over the politicians responsible for their respective areas. The problem is further exacerbated by the fact that different groups among the community affiliate themselves to different political parties. Due to this problem, it is becoming increasingly difficult to use the strength of local people to manage their resources.<sup>28</sup>

### **1.2.3 Alternative Livelihoods as a Management Option**

In most instances as mentioned above, the policy formulation and implementation for coral reef management is only partially focused on the people's interactions with the reefs and the main emphasis is given for reef conservation. However, there is a growing recognition that coral reef conservation cannot meet its desired objectives without more consideration on poverty issues and sustainable livelihoods of the reef- dependent poor communities.<sup>66</sup>

Effective management of coral reefs will be possible only if the population living in the vicinity directly benefit from the management option. One such management option is the provision of appropriate alternative livelihoods, which can financially compensate the destructive resource user. The “Renewed Call to Action” of the International Coral Reef Initiative highlighted that resource users and dependent local communities are the key custodians of coral reefs and measures to provide alternative sources of income are essential if community participation is to be sustained over a long period of time.<sup>2</sup> The International Coral Reef Initiative workshop for South Asia held in 1995, recommended the design and implementation of alternative livelihood options as management tool.<sup>56</sup>

Sri Lanka identifies poverty and unemployment as factors affecting the environment and human well-being and highlights the importance of enhancing skills and creation of new employment opportunities for the sustainable management of the country’s natural resources.<sup>58</sup>

The country’s first Coastal Zone Management Plan (CZMP) of 1990 has evolved over the years to include greater levels of community participation. The 1997 CZMP highlights the importance of developing alternative and lucrative economic opportunities in the coastal area as optional employment for those depending on depleted fisheries and coral mining. This was tested through the Special Area Management (SAM) Plans, which is a community- based collaborative process between residents and government departments that allows for comprehensive management of coastal resources in a defined geographic area. The SAM Plans for Rekawa, and Hikkaduwa highlights the links between poverty and lack of livelihood opportunities leading to illegal livelihood activities such as sea coral mining, cutting of mangroves and collection of turtle eggs. The third iteration of the country’s CZMP is in its final stages of development and the SAM process is set to remain a central element.<sup>14, 29,41,53, 54</sup>

### 1.3 Objectives

The present study was undertaken with the financial assistance from Coral Reef Degradation in the Indian Ocean (CORDIO) Programme, and was initiated in April 2002, at the inaugural session of the Sri Lanka Coral Reef Forum, where more than 40 stakeholders gave their initial inputs to prepare the report. The main objective of the study was to bring together the experiences that have been gained during the past in providing alternative livelihood options for coral reef resource users (miners, fishers, etc) to minimize their degradation and to come up with new set of recommendations, which are specific to the Sri Lankan context in introducing economic diversification activities as management option in sustainable utilization of the resource.

The Report will discuss the following in detail and when ever possible will use case studies to describe the situation more clearly.

- Description of the present livelihood practices in selective coral reef ecosystems in the country including their positive and negative aspects and impacts.
- Review and analyse past/present government and donor driven projects and programmes focused on alternative livelihood initiatives in the country in regard coastal resources management and the opportunities, constraints and effectiveness of these activities.
- Review alternative livelihood best practices from other parts of the world and recommend those that are applicable to Sri Lanka.
- Prepare specific programmatic recommendations for the development of alternative livelihoods.

At the 2<sup>nd</sup> Coral Reef Forum, which was held in November 2002, the draft report was discussed and the inputs obtain from the participants are included in this final report.

## CHAPTER 2

### Reefs and Livelihoods

This Chapter is divided into four parts: Part one gives a general overview of the different livelihood activities recorded from coral reef habitats of Northwestern, Southern and Eastern Coastal belt; Parts two to four discuss in detail the status of reef-based fishery, tourism and sea coral mining in Sri Lanka.

#### 2.1 General Overview

As an island nation, the destiny of Sri Lanka has always been closely tied to the sea and its coastline is a critical lifeline that anchors the country's social, economic and environmental development. The coastal zone holds approximately 24 percent of the country's land area and provides a home to above 33 percent of its population. The natural ecosystems found within the coastal belt, including the coral reefs play an important role in the daily lives of the people in terms of livelihood and food security.<sup>14, 15,48</sup> The extent of dependency on reefs for livelihood vary from location to location depending on the reef accessibility, and the socio-cultural background of its user communities.<sup>24,59</sup>

##### 2.1.1 Livelihoods Associated with Different Reef Locations

In the Northwestern coastal belt the main fringing coral reefs occur at Bar Reef, Kandakuliya and Talawila. Fishing is the primary economic activity associated with these reefs and is carried out year round, with a peak season from February to June. The use of bottom-set gill nets mainly targeting the highly priced lobsters cause major damage to the reefs. The destruction of Kandakuliya reef was accelerated with the introduction of such nets and high-speed outboard fibreglass boats in the mid 1980s. Collection of ornamental fish and invertebrates for export was initiated in the early 1980s. Around 34 species of butterfly fish, gobies, angelfishes, wrasses and reef shrimp are recorded from the Bar reef area. Mining of coral and collection of two species of bivalves for the production of lime, for cement industry was carried out in the past. The influx of refugees due to the civil unrest in the northern part of country, has added to the socio-economic and resource use problems in the area. Out of the 8,698 refuge households, 37 percent are involved in fishing.<sup>37, 38, 60,61,63</sup>

In the Southern coastline, the main coral belt occurs from Akurala down to Tangalle. Great and Little Basses reefs are also found within this area. The major economic activities associated with these reefs are tourism, coral mining and fishing. The coastal stretch from Ambalangoda to Hikkaduwa thrives on tourism with beaches well known for their scenic beauty. Along the same coastline coral mining is a source employment and income, particularly in Akurala, Kahawa, Madampe and several locations in Hikkaduwa. Production of white and brown fibre from coconut husks is a traditional industry in this area. The process of obtaining white coconut fibre involves soaking coconut husks in the sea or brackish water where the nutrients and suspended matter released has adversely affected coral habitats. The coral reefs at Koggala are threatened due to sewage outfall of the Koggala Free Trade Zone. The Weligama/Kapparathota reef is degrading at an alarming rate at the hands of the ornamental fish collectors. The Rumassala coral reef, one of the richest biodiversity areas of the island is earmarked to be reclaimed under the proposed Galle harbour expansion project. The container pier of this project will destroy the reef entirely and with the expected increase in shipping traffic, the survival of the adjacent Unawatuna reef is also threatened. The construction of a cement plant few years ago resulted in relocating of people the Rumassala Mountain and resulted in deforestation. Several large houses and hotels are being constructed on the mountain which can result in large-scale soil erosion unless the hillside is replanted with trees.<sup>11a, 20, 27,31,35,37,38,39</sup>

The Eastern coastal belt is generally noted for its beautiful beaches and healthy coral reefs. Trincomalee (Pigeon Island) and Batticaloa (Passikudah/Kalkudah) are the two main areas with reefs. Minor reefs exist around Tirrukovil, Foul Point, Nilaveli and Kutchaveli. Prior to the civil conflict, the East coast accounted for over 50 percent of the country's annual fish catch. Fishing families denied their livelihoods through the loss of boats, gear and or access to offshore fishing grounds have turned to the over-exploitation of lagoon and estuarine fisheries and sea coral mining. The onset of the peace process in early 2002, has led to a large influx of people to the area, which has accelerated the degradation of its natural resources. This is especially prominent in Pigeon Island, where unplanned tourism is affecting the coral reefs.<sup>32, 39</sup>

### 2.1.2 Livelihoods and People's Perceptions in Reef Management

In Sri Lanka, many of the people who depend on coral reefs for their livelihood are poor and in most instances less educated. Their perceptions on coral reef management depends on both how the community see the importance of coral reef for their survival and the long-term sustainable policy implementation by the government (see Case Study 1).

#### Case Study 1

##### Tale of Two Cities: Unawatuna and Kandakuliya<sup>60</sup>

The two communities represent contrasting demographic and economic situations: Unawatuna is highly urbanized, has a heterogeneous social composition, and depends principally on tourism for its economic survival having given up traditional fishery to a larger extent; while Kandakuliya is still rural, has a relatively homogenous social composition and still depends on fishery.

There is a significant difference between the two communities in the degree of awareness about reef-related issues. A higher degree of awareness is found in Unawatuna, while in Kandakuliya it is virtually nonexistent. In Unawatuna the community has taken steps to protect the reefs by setting up two conservation societies and even openly opposing visitors who harm the reefs, especially when they are collecting reef parts as souvenirs. In Kandakuliya the reefs have been subjected to severe degradation due to destructive fishing practices, accumulation of silt and pollution, which are products of macro forces over which the community has a minimum control.

The most crucial factor affecting the above community perception can be attributed to the perceived importance of the coral reefs for economy of each population. The people of Unawatuna has identified reefs as a resource bringing direct financial returns through tourism while to people in Kandakuliya, the reefs are not playing such a direct role. The social context of a community such as economic backwardness in Kandakuliya, where a large majority suffer from low educational attainment, female unemployment, gender imbalance, lack of sanitation facilities, and indebtedness during off fishing season which are linked to general poverty are also important factors contributing to people's perspectives about sustainable resource management. It was also noted, that the economic value of a natural resource alone is not a sufficient guarantee for the long-term survival of the resource. The resource will not be well cared for by those who profit from it unless good policy decisions such as promotion of ecotourism is taken into consideration.

## 2.2 Reef-Based Fishery

### 2.2.1 Introduction

The Marine fisheries sector in Sri Lanka contributes to over 90 percent of the total fish production and provides direct employment to over one million fishermen. Natural limitations on the marine fish resources around Sri Lanka are imposed by the narrow continental shelf and lack of large-scale upwelling areas.<sup>68, 69, 76</sup> In the 1980s the Jaffna fishery division with its 210 km coastline was the largest contributor to total fish landing, but due to the civil unrest the production pattern has changed and the fishing centres on the south and southwest coast have become more important.<sup>67, 70</sup>

As indicated in Table 2.1, four main categories of fishery contributes to the marine fish production. A variety of crustaceans (prawns and lobsters), and other non-fish resources such as holothurians are also exploited from the coastal waters and adjacent areas.<sup>64</sup>

More than 60 percent of the total fish production comes from the coastal areas (upto 40km from land), where the production had remained relatively stable in the past decade.<sup>67</sup>

The government of Sri Lanka has recognized that inshore fisheries have already been overexploited or is near exhaustion and therefore has targeted offshore fishery development. However, offshore fisheries can only benefit a few because the majority of poor coastal dwellers are unable to obtain the necessary equipment and crafts needed for this industry.<sup>28, 68</sup>

In Sri Lanka, the portion of marine fish harvested from coral reefs has never been calculated as a separate category. However, considering the overall marine fish catch data for 1989 from categories such as large demersals, it is estimated that around 15 percent of the marine fish landing are from reef associated species.<sup>11a, 11b, 27</sup> There are three distinct components of the reef fishery; domestic trade in edible species, small-scale subsistence fisheries for village level consumption and fisheries primarily for export (sea cucumbers, lobsters and ornamental species).

#### Important Facts

- The share of fisheries to the country's GDP in 2002 was 2.7 percent<sup>65</sup> and it provides the only source of income for about 80 percent of the fishermen.<sup>20</sup>
- From 1990 to 2000, the Marine fish production increased from 145,800 – 267,680 metric tons.<sup>67</sup>
- Sri Lanka exports shrimps, lobsters, crabs, bêche-de-mer, shark fins, frozen fish and a variety of ornamental species. The main markets are Japan, USA, Singapore and Hong Kong.<sup>68</sup>
- Sri Lanka exported 2,200 kg of live groupers to Hong Kong in 1997.<sup>8</sup>
- The gross value of the spiny lobster catch during the financial year 1997/98 was around US\$ 20 million.
- Sri Lanka supplied 5 percent of the total number of marine ornamental fish and 8 percent of the invertebrates exported worldwide, between 1997-2002.<sup>5</sup>

Table 2.1: Contribution of Different Fishery Categories to Total Marine Fish Production<sup>69</sup>

Category	Dominant Fish Groups	Production/yr (tons)	Status
Small Pelagic	Sardines, herrings, anchovies and mackerels	65,000	Exploited to the maximum
Medium Pelagic	Small tuna such as frigate mackerel, kawakawa, bullet tuna and barracudas	6,500 - 10,000	Expanding rapidly due to increased purse seine and ring net fishing operations
Large Pelagic	Tunas such as skipjack, yellowfin and bigeye, billfish and pelagic sharks	75,000 - 85,000	Species such as yellowfin and bigeye are under-exploited.
Demersal Fish	Reef associated finfish (emperors, snappers, groupers) and semi-pelagic finfish such as jacks, travallys, sharks and skates	30,000	In the west coast, they are exploited to maximum, while other areas are under-exploited

### 2.2.2 Edible Reef Fishery

Out of the officially recorded nine edible fish categories, three can be considered as reef fish (sharks, skates and rockfish). There are around 30 edible fish species that are considered as coral-reef dwellers.<sup>11b</sup> The economically important food fishes caught from the coral reefs are the groupers, snappers, emperors, rabbitfishes, sweetlips, surgeonfishes, parrotfishes and barracudas. At present there are several types fishing methods used on the coral reefs by fisher communities (see Table 2.2).

Table 2.2: Reef Fisheries Catches from Coral Reef Sites <sup>11b</sup>

Site	Type of fishery	Fishing effort per fisherman/day	
		Average catch	Average Income
Negombo	Bottom-set trammelnet	48 kg	US\$ 54
	Hook and line fishery	06 kg	Mainly for subsistence
Kandakuliya	Bottom-set trammelnet	32 kg	US\$ 36
	Encircling seine net for trevallies	250 kg	US\$ 277
Matara/Polhena	Hook and line fishery	6 kg	Mainly for subsistence

The use of bottom-set trammelnets, although legally banned are still operated in reefs as they can apparently harvest significant fish catches which generates a good income.<sup>11b</sup>

The system of free entry to reef resources leading to an uncontrolled fishing pressure largely from destructive fishing methods is a serious threat to the survival of reef habitats of Sri Lanka. Declining fish stocks in areas such as Kandakuliya had led to the consumption of previously undesirable species such as Soldierfish, Squirrelfish and Bullseyes (See Fig 2.1).<sup>11a</sup>

The lobster fishery, sea cucumber fishery and the dynamite fishery have negative impacts on coral reefs while anchorage, and wastes (oil, fish-wastes etc) from fishing vessels also affects the health of coral reefs and other nearshore habitats.

**Spiny Lobster (*Panulirus species*) Fishery:** In Sri Lanka, lobsters are found mainly in shallow waters upto 20m depths especially in coral reef areas where the bottom is rocky. Eighty percent of the lobster catch consists of six species of spiny lobsters. Due to the high demand from local tourist hotels and export industries, this resource is being heavily exploited. The present lobster production is around 1000 tons/year. Fishing is done with the use of bottom set gill nets, trammel nets, hoop nets and diving. Trammel nets and bottom set gill nets are known to damage the coral reefs by getting entangled with corals.<sup>61, 69</sup>

Fig. 2.1: Fish Catch Using Bottom-set Nets from Kandakuliya Reef



Source: Arjan Rajasuriya.<sup>11a</sup>

The most profitable lobster fishery is concentrated along the Southern coast of the country, where the sustainability of the resource is affected by over fishing, harvesting of juveniles and gravid females, and due to adverse impacts on the coral reef habitat from mining.<sup>64, 69</sup> DFAR issued eight permits for live lobster export in 2000, where as in 1999, only three permits were issued.<sup>67</sup> Two species of economically unimportant slipper lobsters (Scyllaridae) are found in northern and northwestern areas.<sup>64, 69</sup>

**Sea Cucumber Fishery:** The bêche-de-mer (sea cucumber) fishery has been operating for several centuries in Sri Lanka, with records dating back to 1808. Out of the 70 species recorded 17 are consumed, and the dominant species *Holothria scabra* is selectively harvested. Harvesting is mainly carried out by skin divers at depths of 2-16m and some animals are caught as by-catch from shrimp trawlers.<sup>64</sup>

Traditionally, harvesting of sea cucumber was limited to estuarine environments, but the demand for export has caused many divers engaged in the collection of ornamental species to use scuba diving to collect these resources from coral reef habitats. The entire production is exported mainly to Singapore and Hong Kong.<sup>28,72</sup> There is clear evidence that the sea cucumber resources in the Kalpitiya and Batticaloa areas are over harvested.<sup>27</sup> Illegal fishing practices, such as use of toxic chemicals and dynamite in the bêche-de-mer collection are also threats to the survival of this fishery activity. Ornamental species such as *Tetrasoma gibbosus*, *Lactoria cornuta* are unintentionally harvested together with sea cucumbers and they are generally thrown away.

Presently, there is no monitoring of catches or exports, although exporters get registered in the Ministry of Fisheries and submit the value and weight of the exported product.<sup>20</sup>

**Dynamite Fishery:** Dynamiting is a highly destructive fishing method used within three miles from the shore and at depths upto 30 m. It targets small pelagic fish such as Indian mackerel, carangids, herrings etc. This method kills a considerable quantity of fish including eggs, larvae and juveniles within a radius of 15 m of the explosion, while also damaging the coral reef structure. Effects of dynamite fishing on the reef are:<sup>64,71</sup>

- Non-selective killing of fish in the blast and shock zones
- Damage and destruction to coral and reef substrates
- Scaring away of pelagic species (Carangids, Scombrids etc.)
- Reduced catch by conventional fishing gear
- Reduction of the structural relief of the reef
- Loss of coral cover

Fishing by dynamiting is prevalent in the south and southwest areas of the island, particularly during the northeast monsoon. Fishermen have dynamited considerable portions of the reef at Rumassala, an area which was formerly lush coral is now barren piles of flattened rubble (see case study 2).<sup>39,71</sup> It is also a very serious problem in the Eastern Province and is prevalent in Trincomalee Bay and off Kalmunai, where dynamite is used to kill demersal fish on coral reefs. Dynamited fish are easily detected at markets (haemorrhaging, external bruises, pale gills etc). The middlemen pay a very low price for them, but in turn sell it at higher prices in Colombo. Therefore these middlemen have a direct economic incentive to perpetuate dynamite fishing and it is generally acknowledged that they procure and supply dynamite to the fishers.<sup>73</sup>

Dynamiting has a long history in Sri Lanka and attempts by the authorities to stop this activity has not been successful mainly due to the failure to organize mass support from the fishermen and other stakeholders.<sup>71</sup>

**Anchorage Damage:** Fishermen living in the vicinity of coral reefs recognize the convenience of anchoring their mechanized boats in the sheltered waters located behind coral reefs. Reefs are sometimes breached with explosives in order to gain access to these sites.

In 1960, the Irrigation Department built a groyne at what is now the northern boundary of the Hikkaduwa National Park with the purpose of preventing sand bar formation at the mouth of the Hikkaduwa lagoon and river. Local fishermen informally began using the protected waters behind the groyne as a boat harbour. Over the years, the mooring capacity of the harbour has been reduced due to siltation. Consequently, some of the vessels now use the well-protected inner lagoon of the National Park as their harbour. The boat hulls, anchors and chains have reduced the coral into rubble in the mooring area. Large coral boulders have been smashed and overturned by fishing boats colliding against the reef.<sup>29,26,45</sup> In locations such as in Madiha-Polhena in the Matara District, fishermen have blasted the reef to move in and anchor their boats in the calm sheltered waters behind the reef. In Weligama the reef lagoon was used as a natural harbour where large coral colonies were used as mooring platforms.<sup>21</sup>

## Case Study 2

### Blast Fishing at Rumassala<sup>71</sup>

The Rumassala/Buona-vista coral reef is located in the Eastern end of the Bay of Galle at the base of the Rumassala hill. The Nature Conservation Group, a local NGO has been involved in regular monitoring of the reef from 1992.

Dynamiting incidents have been recorded from the reef area since the early 1980s. The frequency and the power of the charge used have changed from a mild concussion charge to powerful explosion that could pulverize a 2m *Porites* dome.

At Rumassala, this fishery is different to the organized offshore blast fishing operation around Galle. Here two influential locals control the activity.

Almost all blasts are carried out from the shore, between 6-9 in the morning when the beach is still empty. The dynamiters work in small groups with a lead man, spotters and a few collectors. The spotters would scout the reef for shoals of fish from high points on the cliff. Once a fish shoal is spotted, the lead man throws in a charge of explosives and then the collectors using snorkeling gear enter the water to collect the fish. The catch is collected into gunny bags and then transported in three wheelers to local markets at Yakdehimulla and Deweta.

Dynamiters are fully aware of the long-term effects of their action, but high financial gains and the maintenance of social hierarchy motivates the continuation of this destructive activity. On average 30 kg of fish is collected per blast and at a rate of 10 blasts per month a single operator can earn around Rs. 18,000, as the market price for 1kg is Rs 60. On rare occasions the collection from a single blast could exceed the average monthly earning. The main operator retains 80-90 percent of the profits, while the accomplices receive marginal income. Most of the blast fishermen are also involved in other fishing activities such as bottom-set netting. The reasons for the high prevalence of dynamite fishing in Rumassala can be summarized as:

- Isolated & secluded location that is hardly visited by the authorities
- Lethargy, indifference &/or corruption of local law enforcement authorities
- Abundant and free availability of dynamite from the rock quarries in the area
- The topography of the area, which assist in easy spotting of fish.



Source: Prasanna Weerakkody

### 2.2.3 Ornamental Species Collection

In Sri Lanka, the ornamental fishery export industry has been in existence since the 1930s, and became well established in the 1960s. Presently there are around 1,000 full-time and part-time collectors in operation and around 60 export companies. The fish are exported to over 40 countries and in 2002, the industry provided Rs. 529 million in foreign earnings especially from USA, Japan and European countries.<sup>5,65,80</sup> Out of the fish exported 80 percent by weight are freshwater species of which around 90 percent are cultured. However, over 80 percent of the income earned comes from the 20 percent of marine and brackish water species. They are captured from natural habitats such as coral reefs and sea grass beds, since it is difficult to breed them in captivity. Recent trends in the marine trade have witnessed its expansion in the number of species and the quantity of fish exported (from 139 species and around

200,000 individuals in 1985 to around 200 species and almost one million individuals at present). There is also an increasing trend to import fish from areas such as Maldives, Red Sea, Arabian Gulf and the East African coast for value-added transshipments.<sup>5,20</sup> Thirty three percent of the fish collected from Maldives is sent to Sri Lanka for re-export.<sup>5,80</sup>

Wrasses, damsels, anemone fish, butterfly fish, gobies, groupers, basslets, angelfish, triggerfish, surgeonfish, moray eels, scorpion/lion fish and tangs are the most exported fish groups. Experienced collectors have a good knowledge of which species are most in demand and they will harvest those that bring them the highest price. Eg: One Clown Triggerfish (*Balistoides niger*) is about six times the value of Powder Blue tangs. Indiscriminate extraction has led to extinction of certain species. Eg. Bicoloured cleaner wrasses and *Rhinecanthus aculeatus*.<sup>74,75</sup>

Ornamental marine fish are distributed all around the island, but their specific distribution patterns have not been fully documented. The Southwest and Northeast monsoon rainfall patterns have compelled the fish collectors to move to different areas of the country and therefore fish are collected year around from different parts of the country. This has been a blessing in disguise as it provides a time lag for the replenishment of the depleted stocks. But due to the civil war in the northern part of the country, in the recent past most of the collection was from the Southern part of the island.

Fish for export are collected mostly from nearshore areas where coral reefs occur. In the west coast species are collected from the reefs from Kalpitiya to Negombo and also from Dehiwala and Beruwala. In the Southern part of the island, majority of collection is done in areas around Galle, Welligama and Tangalle. Before it became a Marine Protected Area, the Hikkaduwa National Park, was also a popular collecting spot. Trincomalee is another important collection area in the country. In the past, Jaffna was also an important collection site that provided species not found elsewhere.<sup>75</sup>

In the collection of fish, shallow reefs (0-6 m) are usually fished by skin divers, while deeper areas (25-30 m) are harvested by using Scuba. Divers use different kinds of techniques and gear depending on the species and the nature of the habitat.<sup>75</sup> The bulk of the specimens are captured using a combination of large and small hand nets while cast nets, moxy nets and goby nets are also used. Some collectors use specially made small tubular nets for capturing species that live in shallow burrows. The mouth of the net is placed over the entrance to the burrow and fish are "tickled" out of their refuge using a fine rod. As they emerge into the net, the mouth is closed with a drawstring. The illegal moxy nets are popular especially among snorkelers. It is shaped like a cast net and the collectors drape the net over corals and then flushes the fish out by banging on the coral with a stick.

Considerable habitat destruction is also caused to rocky reefs during the collection of red shrimp (*Lysmata debclias*). Rocks are overturned and pushed aside in order to collect many specimens as possible.<sup>74</sup>

Most of the fish collectors and divers are not trained and some work as free lancers while others are regularly employed by the exporters. At present, insufficient information is a major problem in studying the trends in the collection and trade of marine ornamental fish in Sri Lanka. Case Studies 3 and 4 will try to give a detailed picture of what is happening in two locations of the country.

The export of live corals (*Goniopora stokesti*, *Catalaphyllia jardinei*, *Plerogyra sinuosa*) was an important commodity until the ratification of CITES convention forced the Sri Lankan authorities to implement the ban on coral export.<sup>27</sup>



Use of a Moxy net  
Source: Arjan Rajasuriya.<sup>61</sup>

**Chank Fisheries:** Chank (*Turbinella pyrum*) occurs in shallow areas along northern, northwestern and southeast coasts.<sup>76</sup> This fishery has been carried out in Sri Lanka for more than 150 years and the shells are exported mainly to Bangladesh and India for producing bangles and other ornaments. In the past the resource was mainly harvested in the Gulf of Mannar and the Palk Bay. Recently it is widely occurring in the southeast of the country with the use of scuba. There is concern that this activity could be unsustainable, as regulations are not adhered to in the collection and export process. Further, there is no monitoring of the catch rates in relation to the resource, and there are only records of the weight of export products.<sup>20</sup>

**Pearl Harvesting:** Pearl oysters were abundant in the Pearl Banks of the Gulf of Mannar, where it was harvested for centuries, but now the species has been exploited to commercial extinction. Successful pearl oyster fisheries have been reported in 1925 and 1958, while the last recorded harvest in 1961 gave a low production.<sup>17, 64</sup>

### Case Study 3

#### Ornamental fishery in the Northwestern coast<sup>61</sup>

Harvesting ornamental species at Kandakuliya and Talawila commenced in the late 1980s and was expanded to the Bar Reef area in early 1990s. This was a direct result of over-exploitation of former collecting grounds along the western coast and due to the abundance of economically important species such as yellow wrasses (*Halichoers leucoxanthus*), reef shrimp (*Lysmata amboinensis* and *L. debelius*) and large number of butterfly and angelfishes. A total of 57 species of fish including 17 species of butterflyfish were collected for export from this area.

Collection is done during the non-monsoon period from November to April and the majority of collectors are migrant divers from the western, southern, and eastern coastal areas. The operational bases are generally makeshift huts on the beach. During 1994-95 there were approximately eight groups operating from Kudawa and Mampri and each group of collectors may have upto ten divers.

Scuba diving is done in deeper areas (more than 15 m) targeting reef shrimp, angelfishes, clown fishes, wrasses anhdids and gobies. Snorkeling is done in shallow areas to collect butterfly fishes. The non-harmful hand nets are used to capture fish on relatively even substrates such as sandstone reefs, while destructive moxy nets are used among coral patches. In the shallow coral habitats of this area, night collections were done targeting butterflyfishes. Corals get damaged due to trampling by the divers.

### Case Study 4

#### Ornamental fishery around the Unawatuna area<sup>58</sup>

At Unawatuna ornamental fish collection has increased in the recent past owing to the expanding export market. Five export companies are presently purchasing the catch through their local agents. Collection is concentrated in three locations in the coastal zone stretching from Rumassala to the lagoon mouth of Koggala with the involvement of around 72 divers:

- Rumassala reef –22 divers
- Talape to Habaraduwa reef – 30 divers
- Koggala to Kabalana area –20 divers

Collection is carried out from reefs at depths varying from 6 - 40m. The divers use moxy nets to catch the fish and sell the harvest to local agents who in turn supply the export companies.

A diver can earn an average of Rs. 500/- per day during the season that lasts for about six months starting from October each year. Most divers have no other income during the other months except occasional casual labour.

The divers are aware that the live coral is essential for the ornamental fish to thrive, and therefore providing training/awareness building on less damaging harvesting techniques could be promoted for the sustainability of the reefs. Although these ornamental fish collectors condemn dynamiting, there is no organized front to prevent this destructive activity as it is carried out by economically and politically influenced persons.

## 2.3 Sea Coral Mining

The lime industry of Sri Lanka dates back to antiquity and has been operated as a cottage industry. Dolomite, inland coral deposits, shell formations and sea coral are the raw materials used in the production of lime (see Table 2.3). A survey conducted by the CCD has revealed that as much as 92 percent of the coral mined is used as plaster in buildings, and out of it 74 percent is purchased by private sector institutions. The coral based lime is also used for removal of acidity in soil in agricultural lands and as a chemical in the ceramic and steel industries.<sup>52</sup>

Table 2.3: Types of calcareous deposits found in Sri Lanka and their usage <sup>85</sup>

Type	Distribution	Usage
Sediment Miocene	Puttalam to Jaffna	Manufacture of cement
Inland Coral deposits	Ambalangoda to Devinuwara & Valachchanai to Kalkudah	Production of lime
Sea Coral Reefs	Specific locations throughout the coastline	Production of lime & plaster
Shell Deposits	Tangalle to Bundala	Poultry feed
Calcite	Balangoda	Ceramic industry
Deposits of crystalline dolomitic limestone	Matale, Dambulla, Badulla & Kandy	Substitute for lime & as a fertilizer

Traditionally only inland fossilized coral deposits were mined on a limited scale by a small number of people belonging to a particular cast. Among the Sinhalese the Hunu caste and among the Tamils, the Kadayar caste were initially involved in this industry.<sup>18, 36</sup> The use of lime gradually increased and came to a peak in late 1960s and '70s as a result of rapid expansion of the construction industry. This led to the exploitation of new sources of coral, including coral debris from the beach and breaking the live coral itself.<sup>52, 86</sup>

Live coral reef mining is mainly carried out in the southwestern, southern and eastern coastal belts where there is easy access to the nearshore fringing reefs.<sup>14, 84, 86</sup> Although it is illegal to mine corals from the sea, mining has continued for the past few decades and has resulted in the loss of large reef tracts in the southern province, particularly at Akurala, North of Hikkaduwa. Extensive coast protection barriers have been built by the government to prevent sea erosion in areas where coral mining has destroyed the natural barriers.<sup>18</sup>

### Coral Mining and Shoreline Erosion

Coral debris collection from the beach and live reef breaking can increase shoreline erosion, which is a serious coastal problem in Sri Lanka. By collecting large amounts of coral debris from the beach, the amount of material available for beach nourishment is reduced, accelerating erosion either locally or down drift. Reef breaking reduces the size of the fringing reef and its natural ability to absorb the energy of breaking waves. Without the protective reef, the full force of waves strikes the shore, thus increasing the rate of erosion.<sup>52, 86</sup>

A study indicates that the economic consequences of coral mining exceed the net benefits by as much as US\$ 6, 610 000/ km<sup>2</sup> reef over 20 years. The highest costs were associated with decreased tourism (US\$ 2-3 million) and increased erosion (US\$ 1-4 million). However, in rural areas there is still a strong incentive for coral mining, because in the short-term perspective it provides a more profitable business compared to fishing and agriculture.<sup>22</sup>

Sea coral is an open access resource except in protected areas. Therefore, when people lose their traditional livelihoods due to various socio-economic, environmental or political reasons, and when they have no other viable livelihood options available to them, they turn to destructive coral mining. The coral miners believe that it is a resource offered to them by the environment, which should be utilized to the maximum.<sup>82</sup>

In Rekawa, the replacement of traditional Hunu cast people by dominant Karawa cast, in lime production demonstrates how the new market economy made significant impact on traditional cast bound occupation systems. It further demonstrates how environmental conditions such

as severe droughts can play a role in turning a traditional farmer into a coral miner for survival (Case study 5) <sup>82,83</sup>. Case study 6 describes how the civil unrest in Passikudah, restricted the movement of migratory farmers and fishermen, who in turn shifted to coral mining. Studies indicate that most of the miners are aware of the problems and the consequences of their activity, but they are not ready to give it up, as it can be their only means of livelihood. <sup>52, 82</sup>

Other than the direct benefit from mining itself, it also generates employment in transportation, operation of limekilns and the gathering of fuelwood for coral burning. The work patterns of the coral industry are tied to the monsoon patterns. During the non-monsoonal months, coral industry workers collect coral an average of 20 days per month. Only kiln owners and workers who mine coral on land have work 12 months per year. The owners of kilns encourage coral mining activities by way of securing the employment of miners and by advocating the lime produced from sea coral is superior in quality than the lime produced by using inland coral deposits. A study conducted in 1985 revealed that around 1200 people directly depend on illegal coral mining as a livelihood along the southwest coast of the country and that the miners earn more when compared to earnings of land-based legal miners.

More than a decade of attempts to halt the destructive practices of coral mining and uncontrolled sand mining have demonstrated to the CCD that it cannot address the root causes of such problems on its own or through the imposition of regulations. It is now evident that such regulation alone does not lead to effective resource management <sup>15</sup>.

To control the adverse impacts of coral mining, the CCD implemented several strategies including direct regulations, enforcement of penal provisions, alternative employment activities for coral miners, introduction of alternative sources of coral base lime and the conduct of education and awareness programmes.<sup>79</sup> In Sri Lanka the legislation surrounding coral

mining has had a difficult and complex history. Controls on coral mining in 1970 were not implemented due to the large number of people that would be unemployed. A total ban on sea coral mining was imposed under the provisions of the Coast Conservation Act No. 57 of 1981 and its Amendments of 1988 and 1996. These bans were selectively enforced, especially where there is a multiplicity of reef use, such as tourism-related activities.<sup>72</sup>

Studies conducted by CCD showed that from 1984 to 1998 the amount of sea coral collected has reduced from 7,660 tons to 2,200 tons in the coastal sectors from Ambalangoda to Dickwella (See Table 2.4), although the total amount of coral collected has increased. This decline in sea coral mining can be mainly attributed to the strict law enforcement from 1992. In 1993 and 1994 the CCD implemented a ban on operation of limekilns within the coastal zone in order to prevent sea coral miners from transporting corals to the kilns. <sup>14</sup>

Table 2.4: Estimated Quantity of Coral Collected from Ambalangoda to Dickwella<sup>14</sup>

	<b>1984</b>	<b>1994</b>	<b>1998</b>
Inland Coral	10,400	15,800	28,300
Sea Coral	7,660	4,020	2,200
<b>Total</b>	<b>18,060</b>	<b>19,820</b>	<b>30,500</b>

A study in 1994 revealed that there are around 51 limekilns in operation in the Rekawa area alone and out of these over 20 are operating within the coastal zone. This cannot be due to a perception problem, as the villages complained that increased erosion due to coral mining had deprived them of a place to berth their fishing boats. In Madiha, which is a small fishing cluster, ornamental fish collectors strongly opposed coral mining because it was seen as a threat to the breeding of fish. Therefore, the most likely explanation to the ongoing mining problem is the simple fact that the income from this illegal activity is much higher, when compared with other economic activities available in the region such as small-scale fishing, agriculture and small businesses.<sup>82</sup>

The following are few other factors which contributed to the failures in the enactment of the law:<sup>79</sup>

- The enforcement as envisaged by the CCA was done through the Sri Lanka Police. As they were not aware of the environmental need for conservation of this natural habitat and the relation of coral mining and habitat destruction the police officers paid only minimal attention to the enforcement of CCA. They mainly took action to enforce the CCA when the CCD requested them to do so.
- Coral mining is a strongly organized activity in many areas and therefore they made use the support of local politicians to mine coral freely. For example, in November 2002, police officers launched a raid and managed to arrest five coral miners in Seenigama. But the police had to release all the suspects on the spot unconditionally due to a protest made by the villages.
- Manufacture of competitively low priced lime from alternatives such as Miocene limestone is not feasible due to high costs associated with mining and transportation of the material.

### Case Study 5

#### Sociology of Coral Mining at Rekawa <sup>83</sup>

According to old villagers, lime burning was not an economic activity in Rekawa prior to 1942 and was introduced to the village by a group of Hunu caste (lime burners) people who came from Godavanagoda, a village near Tangalle. They did not mine the coral reef but instead used debris and chunks of coral that were found on the beach. Therefore, at this early stage the activity of lime burning was not a threat to the natural coastal environment of the village.

In 1949, a person belonging to the Karava caste (fishermen) the dominant caste in the village started a limekiln by breaking his caste taboos associated with this occupation. In the Sinhalese caste hierarchy, Karava caste is placed the second in rank just under the Goyigama (paddy growers) while the Hunu caste occupies the seventh position. Therefore, the Karava community in Rekawa perceived that lime burning as an inferior occupation and it prevented Karava people from entering into the lime burning enterprise. However, the values accompanied by the new money economy clashed with the traditionally maintained values in the village. It made it easy for those who wanted to break away from some of the traditional social barriers such as caste taboos and as a result several other Karava persons started coral mining and lime production. By 1961 the number of limekilns run by Karava people increased up to six. The dominance of Karava cast in the lime production industry, forced the traditional Hunu cast people to shift into other livelihood activities such as carpentry and masonry.

A survey conducted in 1990 revealed that almost 30 percent of households in Rekawa were engaged in coral mining and lime production. According to the villagers, the prolonged drought in the late 1970's to the mid 1980s affected agriculture in the village adversely, and as a result, many farmers took to coral mining and lime burning as a livelihood. Most of the lagoon fishermen in Rekawa also joined them as a result of the depletion of the fish in the lagoon. These circumstances led to a rapid increase in the number of coral miners and lime burners in the village.

At present, almost all coral miners and lime producers in the village are of Karava caste. They no longer consider lime burning as an inferior-caste occupation. Instead, they believe and also express openly that the Karava caste has a customary right to exploit these resources. The Karava caste people realized that highlighting their dominant caste identity is the best way to keep their command of the resource and to keep others out of coral mining and lime burning.



Mined sea coral piles on Rekawa beach  
Source: Nishanthi Perera

## Case Study 6

### Civil Unrest and Lime Production at Passikudah <sup>36</sup>

Passikudah is situated in the eastern coast of Sri Lanka, where seasonal paddy farming and fishing were the traditional livelihoods. The armed conflict prevailing in this area for the past 20 years severely restricted these activities, which in turn resulted in people moving into destructive livelihoods such as sea coral mining and women venturing into primitive methods of fishing. A study conducted in 2002 revealed that the number of limekilns, operating in the village has increased from six in 1980s to 108 in 2002.

Lime production in Passikudah was initiated in the 1940's, as a government sponsored project aiming to provide employment to local people. Until the 1980s lime production was directly under the supervision of the Land Development Officer and the kilns were operated using inland fossilized corals. The Government Departments purchased most of the lime produced. With the aggravation of the armed conflicts in 1990, the lime industry in Passikudah started to increase, as it was located in a less confronted area with few other economically viable livelihood options.

Out of the 600 families living in the village, 400 were involved in the lime industry at various levels: coral miners, traders, kiln operators, suppliers of fuel and kiln owners. Around 275 people, including women and children were involved in mining and out of which 10 percent were involved in sea coral mining. A bag of live corals fetched a higher prize than fossilized corals, as this type of mining involved wading into the sea. Live coral mining took place in a 6 km stretch of land from the centre point of the bay of Passikudah. Around 25 people laboured for about 8 hours to collect an average of 9.7 tons of live corals per day. About 250 people mined fossil corals at a rate of 155 tons per day.

50 traders operated between the miners and kiln operators while around 25 persons from adjacent villages were involved in supplying fuelwood to the kilns.

Around 150 workers were employed in these kilns.

The kilns operated in the village can be categorized into three size groups according to the capacity of the kiln:

Kiln Category	Amount of lime used at a time	Approx. lime production/month	Number of kilns
• Large	6-8 tons	2437.5 tons	78
• Small	1.6 tons	10 tons	25
• Children's	400 kg	100-1500 kg	05

The large kilns produced the bulk of lime production, around 72 percent of the lime, while children under the age of 14 operated the 05 kilns that produced 5 percent of the total lime.

Category of involvement	Income per month (US \$)
Coral miners and workers at the kilns	<50
Transporters of corals, owners of small kilns	50-100
Owners of large kilns	300-400
Traders	>400

People involved in the lime industry at various levels earned different incomes;

Businessmen provided the initial investment for the construction of the kilns and purchased all products.

In the recent past, the erosion rate along the coast of Passikudah has increased while high salinity levels of well water have been also recorded.

## 2.4 Reef-based Tourist Activities

Tourism in Sri Lanka has been promoted since late 1970s and is currently the fifth highest income earner of the country. The industry had contributed US \$ 248 million in foreign exchange in 2002. Tourism provides direct and indirect employment to around 87,600 persons.<sup>65</sup> Due to civil unrest in the northern and eastern parts of the country, 70 percent of all tourism infrastructure are found mainly within the southwestern coastal belt.<sup>14</sup>

The contribution of reef-based activities to the tourism sector in Sri Lanka is relatively small. However, tourists, both local and foreign utilize reefs for recreational purposes such as coral viewing, snorkeling and scuba diving. The calm waters of reef lagoons provide safe bathing places. Coral reef areas such as Hikkaduwa, Polhena, Weligama, and Unawatuna in southern coastal belt and the Pigeon Island and Passikudah area of the eastern coast are popular among the tourists. Local employment and income directly related to coral reef viewing include operation of glass bottomed boats, trade in reef products and rental of underwater gear.<sup>17, 86</sup>

There are instances where tourist development has come into conflict with traditional occupations and has had adverse effects on environment. Prior to the introduction of tourism the people of Hikkaduwa were engaged in fishing and commercial activities such as making rope and coir mats. As tourism became more popular, their social behavior changed rapidly.<sup>78</sup> Tourist facilities in the area have increased from one hotel in 1960s to nine big hotels, 125 guest houses, 40 restaurants and 5 dive stations in 1992. The construction of these establishments has been mainly along the narrow strip of land between the motorway and the coast. Only nine percent of these establishments are approved by the Ceylon Tourist Board. Despite several management efforts, this rapid unplanned tourism development has led to user conflicts among tourists and tour operators, conservationists and fishermen (Case study 7).<sup>48</sup>

Polhena lagoon reef is mostly affected by physical damage due to the many visitors walking on the reef during low tides.<sup>21</sup> In certain areas such as Unawatuna, where there is a high concentration of tourist hotels and other establishments, the Pradeshiya Sabhas cannot cope with the garbage collection and disposal. Invariably, some of this garbage, particularly polythene is carried by the wind and deposited on the coral. Rumassala, which is a relatively isolated beach near Unawatuna, frequented mainly by locals faces similar problems.<sup>35, 60</sup>

With the initiation of the peace process by the Government in 2002, there is a rapid increase of coastal tourism in the northern and eastern parts of Sri Lanka. As free access to the Districts of Trincomalee, Batticaloa, Polannaruwa, and Ampara was possible after about two decades, over visitation is experienced. Important places of scenic beauty, archeological and cultural areas such as Nilaveli, Upuveli, Arugam Bay, Pigeon Islands (refer case study 8), Kanniya hot springs and several National Parks are very popular among the tourists.<sup>11, 77</sup> The near collapse of the tourist industry in the conflicts periods, allows for a fresh start to its redevelopment especially in the eastern coast, by learning from the mistakes made in southern and western coasts.<sup>32</sup>

## Case Study 7

### User Conflicts at Hikkaduwa National Park (HNP) 18, 21, 25, 27, 29, 33,45

Hikkaduwa is the major coastal resort area in southern Sri Lanka and encompasses the first national marine sanctuary of the country established in 1979. It was upgraded into nature reserve in 1992 and from 2002 it has been re-gazetted as a National Park to give more legality for its protection.

The tourism economy of Hikkaduwa is almost entirely dependent on the quality of the beach and coral reef along its 5km beachfront. Gross annual revenue from about 150 tourism establishments in the area is more than \$30 million. The coastal environment of this area is heavily degraded from development impacts and entire sections of the reef have been destroyed. Poor environmental planning, inadequate law enforcement, lack of consideration of socio-cultural issues and global warming are the primary underlying causes. Rapid development of tourism has contributed to degradation of the coral reef ecosystem, deterioration of coastal water quality, increased traffic congestion and conflicts between tourist and fishing interests.

Traditionally, the reef area within the sanctuary has been used for small-scale commercial fishing, as well as for collecting of ornamental fish and mollusks. These activities are now banned except for very limited hook and line fishing for non-reef fish by permit holders. Coral mining is prevented within the nature reserve due to strict enforcement, but occurs outside the HNP in the Totagamuwa GN division. Today, major causes of reef destruction occur due to fishing boats, glass-bottom boats and tourists.

These glass-bottom boats cause considerable physical damage to the reefs by running over the shallow coral patches especially in the monsoon seasons. In order to give a better view of corals to the visitors the operators often stop the boats over the reef and destroy the coral by dropping the heavy anchors on to the reef area. They pollute the water by throwing food items such as pieces of bread to attract the fish. Some of the tourists stand and walk on the reef. A patch of staghorn coral in front of hotel Blue Corals has been completely damaged due to a boat colliding against it. The rocky islets near the southern boundary that was declared a protected area for sea birds in the 1940s, no longer attracts seabirds due to disturbance caused by these activities.

The maximum number of boats allowed access was once set at fifty. Seventy boats are now registered with the Pradeshiya Sabha and an additional five are unregistered. During a busy weekend, a dozen boats may operate simultaneously in the same small area of the HNP. Due to the non-demarcation of the boundaries of the National Park, it is effectively an "open access" resource. Therefore, the restriction of the entry of new boats is not possible. A conflicting use of the area is created by the large number of glass-bottom boats operating in the same space where tourists are swimming and snorkeling.

The glass bottom-boat owners and operators are aware of the damage they are causing and acknowledge the need to change their current practices to enhance the health of the reefs. They formed an organization known as the Hikkaduwa Glass-Bottom Boat Owners Association (GBBOA) and they were successful in resetting the rates for boat rental. Additional threats come from polluted water from households and hotels, anchoring and dumping of oil by fishing boats, and sedimentation.

Over the last 25 years, the quality of the coral reef has declined significantly. In 1994 only 34 percent live coral cover was found and near the boat anchorage area the live coral cover was as less as 13 percent.



Glass-bottom boats in operation in Hikkaduwa  
Source: Nishanthi Perera

## Case Study 8

### Visitor Pressure Destroying a Unique Habitat: The Pigeon Island <sup>32, 62,76</sup>

Pigeon Island, approximately 500m away from the Nilaveli beach, north of Trincomalee consists of two small rocky islands covering an area of 4.6 hectares. The islands were declared as a Sanctuary as far back as in 1974, under the FFPO due to its importance as a habitat for the Blue Rock Pigeon. Although the oceans surrounding the islands are generally recognized to contain some the finest coral reef remaining in Sri Lanka, the reef itself covering an area of approximately 10,000 sq.m got protection under the FFPO only in late 2003. Now the island and the surrounding coral reef area has been upgraded into a National Park.

Historically there was a substantial recreational diving industry in the area, which was disrupted during the civil conflict. This has seen a revival with dive clubs coming from Colombo bring the necessary equipments. Snorkeling is also a very popular activity among the tourists.

Presently, around 3000 people visit this small area over a weekend, accessed mainly by visitors to the Nilaveli Beach. It is estimated that around 15-20 boats are in operation during the weekend and each boat charges approx. Rs.600 for a round trip to the island, that takes about 15 minutes. Private boat owners, fishermen and the Nilaveli Hotel operate these boats for the visitors. There is no regulatory body to monitor the approach of tourists to the islands from the Nilaveli beach. The motorboats damage the corals in the shallow reef areas and due to lack of control, live corals are often collected as souvenirs by tourists. The islands are littered with waste disposed by the tourists. Non-sustainable practices such as dynamiting and spear fishing are apparently common.

In the coming years, if the peace process succeeds the number of visitors will increase. To accommodate them several major hotel chains are holding land in the area for the construction of new hotels. This expansion of the tourist industry could lead to more destructive activities if not properly managed.

## CHAPTER 3

### Successes and Failures of Past Alternative Livelihoods Approaches

Several Government Institutions and NGOs in Sri Lanka have already tested the concept of providing alternative livelihoods options within the coastal community for sustainable management of coral reefs and other nearshore coastal habitats. Often foreign technical assistance from is used for this activity and multilateral and bilateral donors such as ADB, WB, USAID, SIDA, and the Netherlands have provided financial assistance to implement the activities.

#### 3.1 Alternative Employment Opportunities for Illegal Coral Miners

Finding alternate employment for coral miners and others who are involved in lime industry depends on a number of factors, including the skills and experience of the individual workers, as well as the socio-economic viability and acceptance of the new venture. Coral mining can be either a primary or a supplementary income generating activity. Those who use coral mining as their primary income earner will need new employment ventures that are as or more lucrative as coral mining. The second group should be encouraged and assisted to devote more time for their primary income generating activities (such as fishery, self-employment etc). On the other hand the kiln workers who are poorly paid are more willing to accept new livelihood options, while providing alternative employment options to kiln owners will be more problematic as they earn a good living.<sup>52, 79, 89</sup>

As discussed in Chapter 2.3 prohibition of sea coral mining in the coastal zone under the CCA, led to the loss of livelihoods of several thousands of people and as the implementing agency, the CCD was responsible for providing alternative livelihood options to the affected. In this respect, the Southwestern coastal zone has been the geographical scope of CCDs activities since 1978.<sup>52, 90</sup>

The most popular solution for assisting coral miners to leave the industry is undoubtedly the proposal that they turn to fishery. Experience however, has shown this not to be a good alternative. For example, when miners were given boats to earn more income from fishing, in many cases the boats were used for more efficient coral mining.<sup>52, 79</sup> As another strategy to reduce coral mining, the miners were relocated and encouraged to earn an income through agricultural activities.<sup>82, 84</sup> When 138 coral mining families from Totagamuwa, Werallana and Seenigama GS divisions were relocated in system B of the Mahaweli Development Project in 1985, 99 of the families returned back to their villages as they were unable to adjust to a vastly different socio-economic and physical environment.<sup>82</sup> The main contributing factor to the failure of this programme was financial, as agricultural activities provided less financial benefits than mining and at the same time you had to wait several months to earn any money from the venture. Again in 1989 land were given to 93 families in Monrovia estate and this situation is discussed in detail under section 3.1.1

##### 3.1.1 Provision of Agricultural Lands in the Monrovia Estate <sup>52, 82, 84, 88,</sup>

This pilot programme was introduced to coral miners in Seenigama, Totagamuwa and Werallana areas of the Hikkaduwa Divisional Secretary's (DS) Division in 1989. The project aimed at providing 100 families, (33 percent of the total coral mining families) with agricultural land in Monrovia Estate located, about 16 km away from the beneficiaries native place. Other facilities such as housing loans, food stamps, seedlings and training on agriculture were also included within this relocation package to assist the beneficiary families to adjust to their new living conditions.

The funds and other inputs for this project were provided by several government and semi government organizations such as Hikkaduwa AGA's Office, the Land Commissioners Department, Department of Agriculture, National Housing Development Authority, Coconut Development Board, Department of Education, GTZ and CCD. Non-governmental organizations were not involved in the programme.

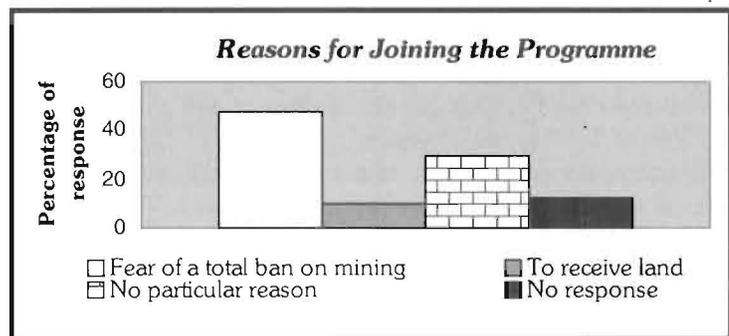
**Project Outcomes and Lessons Learned**

Out of the 386 applicants received only 93 families were selected by GS officers of the respective divisions as beneficiaries and the final approval was given by the AGA Hikkaduwa. As a result of the absence of clear selection criteria and due to political interference, few non-eligible families (eg, businessmen and farmers) initially received land and these lands had to be reallocated when the mistake was realized.

The entire land area of the estate consisted of 97 blocks (acres), out of which 42 were coconut, 40 rubber and 15 blocks of bare land. The coconut and rubber lands were distributed among 82 families while 11 families received one acre of bare land, and two acres were allocated as a cemetery. At the time of programme implementation, 80 percent of the coconut palms were bearing nuts and most of the rubber trees were at the stage of tapping.

A study conducted by the University of Peradeniya in 1995, found that 48 percent of the beneficiaries joined the Monrovia programme due to fear of a total ban on coral mining. Ten percent joined the programme to obtain land as they did not have a permanent place to live and their income level was also lower than the other coral miners (as they were collectors of coral debris from the beach or workers in the limekilns).

Only 41.3 percent settled down during the first two years. Major reasons being the unavailability of material and funding to construct houses and lack of schooling facilities for children. Ownership of properties in the village was another major contributing factor, as the majority of families who returned to their native village were those who had lands, houses or other properties in the village.



At the end of five years only 22 families remained in the estate, out of which 12 settlers were from coconut lands and 3 from bare lands. From those settled only 12 families have moved out from coral mining as an income generating activity and were engaged in activities such as agriculture, fishing, day labour and self-employment. Around 32 percent of the remaining beneficiaries continued coral mining while also receiving additional income from activities such as small businesses, carpentry and hired labour. From those who returned to there original homes, around 27 percent went back to coral mining as the sole income generating activity. Four families leased out their lands to non-coral miners living in the vicinity of Monrovia Estate, before returning.

The following factors attributed to the low progress of the programme:

- **Insecurity:** The relationship between the settlers and the villagers were damaged from the beginning as the villagers considered the settlers as a group who deprived them of benefits such as pasture land and a source of firewood (the estate was previously used for these purposes). Although, the settlers believed that a strong social organization among themselves would be a solution to overcome this problem, the conflicting attitude amongst them did not give an opportunity for this to establish.

- Insufficient income:** The income from agricultural activities at the Monrovia Estate was far below the anticipated level (less than Rs. 2,500) and around 26 percent of the beneficiaries discontinued the programme as they earned no income from the land. As seen in Table 3.1, there is a positive relationship between previous agriculture experiences and continuation of the programme. The settlers on the bare lands could cultivate according to their preference, but settlers in coconut and rubber lands had to deal with the already planted trees. The settlers in rubber lands suffered due to lack of experiences in latex tapping and processing and therefore out of 40 only 7 families remained. The two-day training on agriculture and one week training on skills for rubber tree tapping provided before the resettlement was not sufficient for the settlers to acquire the required skills. As a result, 90 percent of the rubber trees were damaged and the expected yield went down by 50 percent.

Table 3.1: Relationship between Experience and Programme Continuation

<i>Agricultural experiences</i>	<i>Percent Continued</i>	<i>Percent Discontinued</i>
Had experiences	100	00
No experiences	48.7	51.2

- Lack of facilities and funds:** Basic facilities such as transport (the estate was located 4 miles away from the bus route), health and schooling were not sufficient. Most of the Government organizations involved in the implementation of programme faced difficulties to undertake the activities allocated to them as they lacked the necessary financial and human resources. For example, the NHDA could provide housing loans for only half of the beneficiaries and the loans were not sufficient to construct the houses. At the same time regular monitoring of the programme was not possible due to lack of staff.

### Recommendations for Future Initiatives

- At the project preparation phase, sufficient emphasis should be given to the beneficiary selection criteria (eg. the degree of dependency on coral mining/related activities for income generation) and the selection process should be a joint and a coordinated effort with the participation of the key stakeholders. A committee comprising of important Government representatives, villagers, NGOs and private sector should be set up at the initiation of the project.
- Non-governmental agencies, banks and the private sector should be included as programme support organizations as they have resources and expertise for the long-term sustainability of a venture like this (eg. banks can provide loans to start small businesses and NGO's can assist in educating the people)
- The alternative livelihoods introduced should be able to generate an income higher than mining related activities. Often it this requires the introduction of several economic options to the community, which in turn will increase the economical security.
- A proper monitoring plan should be in place, with sufficient back up components (financial, technical, etc) to identify problems, and to address them.
- Different strategies should be applied when deciding upon alternative livelihood options for a community rather than considering the whole community as a unit. Educational, income and other socio-cultural aspects of each participant should be taken into consideration for the final decision on appropriate livelihood options.

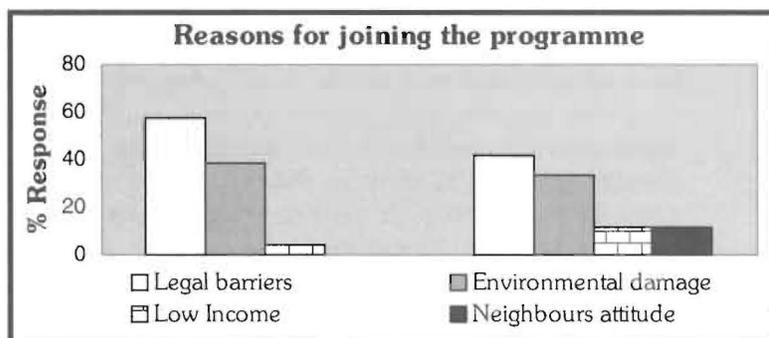
### 3.1.2. Comparison of Poultry Farming Programmes at Rekawa and Ambalantota <sup>84, 89</sup>

The CCD introduced poultry farming to the coral miners in Rekawa as an alternative employment opportunity in 1995. This was carried out under the CRMP project for the implementation of SAM process in the area. The project was designed to benefit 140 families in 7 Grama Niladhari Divisions in two stages, but due to financial constraints, only 30 families were selected and given training on poultry farming.

The Ruhunu Farm, which is a private enterprise, implemented the Ambalantota programme, where 52 families residing nearby were involved as outgrowers.

#### Project Outcomes and Lessons Learned

A study conducted in 1996 revealed that in both Rekawa and in Ambalantota a large number of people joined the programme in fear of prosecution and punishment by the authority if they continued illegal coral mining. Concerns for the environment were also an important factor in both locations and this indicates that people are aware of the damage caused by mining. It also implies that they are willing to try out viable alternative livelihood options if offered.



At the time of the study, 80 percent of the participants were continuing the programme at Ambalantota while only 43 percent continuation was found in Rekawa. Out of the 20 percent who gave up poultry farming in Ambalantota 50 percent returned to coral mining.

In both areas over 60 percent of the project participants were males and as shown in Tables 3.2 and 3.3, this was mainly due to a substantially higher income earned. Further it was revealed that most beneficiaries in Rekawa and Ambalantota earned more money from poultry farming than from coral mining. In Ambalantota, 50 percent of the participants received more than Rs 7,500 per month, which in turn contributed to a higher continuation.

Table 3.2: Income from Poultry Farming

Monthly Income (Rs)	Rekawa (%)	Ambalantota (%)
0-2500	25.0	15.5
2501-5000	66.7	19.2
5001-7500	8.4	15.3
>7500	0	50
Mean Income	3332	11649

Table 3.3: Relationship Between Income from Agriculture and Continuation of the Programme

Monthly Income (Rs)	Continuation (%)	Discontinuation (%)
No income	4.5	26.1
0-500	13.6	39.1
500-1000	36.4	26.1
>1000	45.5	8.7

The higher success rate in Ambalantota can be attributed to the provision of services such as training, extension and marketing facilities by the Ruhunu Farm to their outgrowers. In Rekawa around 20 percent of the participants used more than 3 channels for selling their products, but in Ambalantota due to the contract farming system the Ruhunu Farm was the only main marketing channel.

## Recommendations

- Computation of probable incomes at the planning stage of a project is necessary to ensure the success of the applicability of the livelihood option, as it should provide more income than the ongoing destructive livelihood practice.
- Involvement of the private sector is important, as they are capable of providing services such as training and extension, and marketing facilities to the participants as these organizations are driven by obtaining a higher profit and therefore motivate the participants do the same.
- To keep the participants from returning to illegal coral mining activities, it is necessary to strengthen the law enforcement, in parallel to the livelihood options and services offered.
- Provision of proper training is a must for the success of the programme, and when providing training the educational background should be taken into consideration.

## 3.2 Alternative Livelihoods for Coastal Fisher Communities

Reducing the dependency on fishery resources for food and livelihood is a key element to sustainable management of coastal resources. Assistance is needed to facilitate the exit from this sub-sector through the provision of non-fishing employment opportunities, such as investments in human capital through skills training, developing micro and small non-fishery enterprises, and giving access to capital for non-fishing purposes. Section 3.2.1 gives a detail account of a micro-credit scheme implemented under the ADB funded Fishery Sector Development Project, while Section 3.2.2 describes the Pottuvil Lagoon Eco-tour venture, a joint economic activity developed by fishermen and other stakeholders to sustainably utilize the mangrove ecosystem.

Empowerment of communities in the decision making process through assisting them to improve their economic conditions is another management tool for sustainable resource utilization. Section 3.2.3 present a successful case study where a low-income traditional coastal community was motivated to unite and self-regulate fishing pressures in the lagoon, so that the whole community can benefit. Alternative livelihood programmes need to target the entire fishing household, women included, as increasing their contribution to household income will complement efforts to reduce dependence on fishery resources. Section 3.2.4 describes two micro-enterprises developed under the Bay of Bengal Programme to promote the skills of fisherwomen to improve their social and economic conditions.

### 3.2.1 Micro-credit Scheme for Promoting Non-fishery Activities <sup>47, 91, 92</sup>

In 1993 ADB provided financial assistance to the GOSL through the Fisheries Sector Development Project to address the major constraints and issues faced by the industry. As an option for sustainable coastal fishery resource management, the project implemented a micro-credit scheme to divert the fishing community into land-based income generating activities.

Out of the total project cost of US \$33 million, 17 percent was allocated to the micro-credit activities with the objectives of:

- Providing self-employment opportunities to unemployed youth and women
- Providing supplementary income to artisanal fishermen
- Helping the coastal communities to expand their existing land-based enterprises
- Encouraging the coastal fishing communities to divert from coastal fisheries to land based activities.

This scheme was operated by the National Development Bank through a wide network of participating credit institutions (PCI) from Puttalam to Hambantota. It was also assisted by the field staff of the Department of Fisheries and the social mobilizers provided by the project. Credit was approved for micro, small and medium scale enterprises that were economically viable, labour intensive and employment generating. These ventures should utilize local raw materials, have provisions for marketing and be technically, financially and environmentally sound. Eligibility for a loan required a certification from the Fisheries Inspector indicating that the person was from a fishing community in the area.

### Outcomes from Loan Disbursement

Loan disbursement commenced in 1995 and was terminated in 1997. An amount of Rs. 153.3 million was distributed among 1275 borrowers as indicated in Tables 3.4 - 3.5. The popular self-employment activities such as bakeries, fresh fish trading, and sales of consumer goods (shops) accounted for 43 percent of all projects. Transportation of goods, fresh fish trading and retail outlets accounted for around half the amount lent out.

Following are some of key outcomes of this scheme:

- 1590 employment opportunities were created under this scheme.
- Out of the total enterprises financed, 927 are non-fishery based activities representing 71 percent of the total.
- There were 465 female borrowers representing 36 percent of the total borrowers, which was a higher percentage compared to past credit schemes.
- 461 (36 percent) borrowers obtained loans to undertake new enterprises while the rest used the credit for expansion of existing enterprises.
- More than 50 percent of credit has gone for bigger loans (more than Rs 500,000) which represents only 10 percent of total number of borrowers.
- Loan recovery remained around 73 percent.
- While some borrowers have completely repaid their loans, there were more than 100 defaulters (most of them fall under the category of loans above Rs 500,000) and some PCIs have instituted legal action against these.
- Few enterprises financed under this credit scheme have been abandoned.

Table 3.4: Classification of Loans according to size range

<i>Size range</i>	<i>No. of Projects</i>	<i>Amount (Rs million)</i>	<i>Percentage of Total Loans</i>	<i>Average loan Size (Rs)</i>
Below Rs. 25,000	728	4.8	2.6	11,400
Rs. 25,000 – 50,000	299	8.7	4.7	29,300
Rs 50,000 – 100,000	217	12.0	6.5	55,400
Rs 100,000 – 500,000	288	62.2	33.7	216,200
Above Rs 500,000	114	96.7	52.4	848,800
<b>Total</b>	<b>1,346</b>	<b>184.4</b>	<b>100</b>	

Table 3.5: Industries funded by the FSDP Credit Programme

Type of Industry	No. of Projects and Percentage of total		Amount lent (Rs million) and Percentage of total		Average Loan size (Rs)
Agro-based	32	2.4	4.7	2.5	146,500
Aquarium	9	0.7	0.6	0.3	69,200
Bakery/Confectionery	161	11.9	9.7	5.3	60,295
Beauty Parlours/Day care	8	0.6	1.6	0.9	205,600
Boatyard	3	0.2	7.0	3.8	234,300
Coir/Wooden products	68	5.1	3.4	1.8	50,700
Production of Construction Mats	31	2.3	10.4	5.6	336,100
Dry Fish Trading	35	2.6	2.3	1.2	64,600
Dry/Maldives/Pickled Fish	73	5.4	4.6	2.5	62,800
Fishing Equipment	31	2.3	3.3	1.8	107,600
Food and Accommodation	18	1.3	3.3	1.8	187,305
Food Processing	1	0.1	0.1	0.1	100,000
Fresh Fish Trading	203	15.1	23.8	12.8	117,400
Fuel	14	1.0	6.9	3.7	499,300
Garments	81	6.0	4.6	2.5	56,200
Horticulture	9	0.7	0.5	0.3	65,000
Supply of Ice	6	0.4	1.5	0.9	252,700
Jewellery/Glassware	8	0.6	2.9	1.6	363,400
Leather/Rubber/Plastic Products	12	0.9	1.9	1.0	164,000
Grinding Mills	10	0.7	1.8	1.0	180,000
Passenger Transport	70	5.2	16.7	9.0	238,400
Poultry/Piggery/Dairy	70	5.2	3.1	1.7	44,800
Prawn Culture	11	0.7	3.8	2.0	347,400
Printing/Paper Products	5	0.5	1.3	0.8	250,000
Repair Workshops	15	1.1	1.6	0.9	108,500
Sales of Consumer Goods	215	15.9	19.2	10.4	89,400
Salt/Chemical/Products	44	3.2	1.4	0.8	32,900
Seashells & Allied Products	2	0.1	0.5	0.3	202,500
Spare Parts	15	1.1	6.6	3.6	441,300
Storage Facilities	1	0.1	1.02	0.8	19,800
Transportation of Goods	85	6.3	34.9	18.9	411,500
<b>Total</b>	<b>1346</b>	<b>100</b>	<b>184.6</b>	<b>100</b>	

### Lessons Learned

- Low disbursements were recorded at the beginning of the project. As a result, there was pressure from ADB and GOSL to activate the credit programme. This resulted in the PCIs approving large-scale loans to their best customers to improve the disbursement ratios (see Table 3.4).
- The demand of credit for land-based activities was mainly for small loans, but the majority of members of fishing communities cannot meet the collateral requirements of the commercial banks. It was found that Credit Institutions (NGO, RRDB) with grassroot level links were better suited to serve the fishing communities.
- Excessive documentation required by the PCIs and more importantly the requirement for collateral, resulted in many fishermen not being creditworthy in the eyes of the PCIs.

- There was a scarcity of grassroots-level credit organizations. SANASA and Sarvodaya, although recognized as PCIs in the project design, participated only in the latter part of the scheme under pressure from the Project Officer. Although strong fisheries cooperatives qualified as PCIs, none of them participated in this programme.
- There was a tendency to show less interest by the fishermen to engage in alternative trades due to attraction towards traditional sea-related activities

### **Recommendations for Future Projects**

- Credit institutions, with grassroot level links to the community need to be given high priority in credit disbursement.
- A considerable portion of the credit should be reserved for small borrowers as the low income fishing families received less benefit.
- Fisheries organizations (such as District Unions) should be encouraged as far as possible to make use of loans of bigger quantum.
- Maximum limit of the loan should be decided carefully.
- Loans of high quantum should be limited to industries
- Measures for the proper identification of target groups must be developed at the project appraisal stage.
- Training on alternative ventures and awareness on the credit scheme should be provided at the very beginning of the project.

### **3.2.2 Pottuvil Lagoon Eco-tour Venture: Sustainable Utilization of a Mangrove Habitat by Fishermen** <sup>103,104, 105</sup>

Located 2km north of Arugam Bay, Pottuvil Lagoon is home to over 70 types of birds as well as abundant prawns, fish, water snakes, monitor lizards, crocodiles, monkeys and even the occasional elephant. More than 60 percent of the mangrove forest in Pottuvil Lagoon has been destroyed over the past two decades, as a consequence of the civil conflict. Since the 2002 peace process, encroachment for new housing and expanding farming activities have arisen as new threats to the lagoon.

In 2002 Sewalanka Foundation (SLF), with the financial assistance from the Netherlands Embassy's Local Environment Fund, initiated a project with the Hidayapuram Fishermen's Cooperative Society (FCS) to replant degraded mangrove areas and improve the management of the lagoon's resources. Under the one-year project SLF staff worked to strengthen the organizational and management capacity of the FCS by:

- Conducting a natural resource survey of the lagoon,
- Organizing a three day training course on managing and replanting mangroves in collaboration with the Small Fishermen's Federation in Chilaw and
- Exploring the possibility of setting up an eco-tour venture in the lagoon.

The location of Pottuvil Lagoon next to the popular east coast tourist destination of Arugam Bay presented a unique opportunity to incorporate tourism into the project. As a result "The Pottuvil Lagoon Eco-Tour": a two-hour canoe ride in the lagoon using traditional fishing canoes was developed jointly by SLF and the society. To promote this venture, SLF staff developed promotion posters and erected road signs along the road to and from Arugam Bay. A local hotel, the Arugambay Hillton agreed to support the venture and act as both the booking centre and intermediary between the fishermen and tourists. A small education centre has also been constructed to provide the necessary information.

The Pottuvil Lagoon Eco-tour provides a significant source of additional income for the local fishermen, who work as eco-tour guides. For each two-hour tour, fishermen receive Rs 200, which is 30 percent more than their average daily income from fishing. Fifty percent of the income generated by the eco-tour goes directly to the society. The society uses this income to finance the cost of replanting mangroves in the lagoon and to provide loans to society members through the society's revolving 'Credit Fund'. In 2003/2004 the society collected and replanted 9,285 mangrove propagules and seedlings, representing five mangrove species. This credit fund provides loans with an interest rate of 24 percent per annum. This compares favourably to the rates of interest fishermen are charged to borrow money from informal credit sources (up to 240 percent per annum).



Source: Sewalanka

### 3.2.3 Restocking the Rekawa Lagoon with High-Value Shrimps <sup>106,107</sup>

In the Rekawa lagoon shrimp fishery is carried out for seven months of the year using traditional non-mechanized boats, nets and various traps. At the pre-project stage, low value shrimps such as *Penaenus indicus*, was predominately harvested while high-value shrimp, *Penaenus monodon* made up less than one percent of the catch. This local community has resisted the expansion of shrimp farming industry by the private sector, fearing a disruption in their traditional lifestyle. In 1995 they formed the Rekawa Lagoon Fishermen's Cooperative Society (RLFCS) to create a united force against private ventures. Regular meetings of this voluntary organization are held to resolve conflicts through discussion and consensus.

In mid 1995, the Zoology Department of Colombo University in collaboration with the University of Millport, Scotland, initiated the programme of stock enhancement of the lagoon with post-larval stages of the shrimp *Peanaeus monodon*. The project was implemented as a part of the SAM process in Rekawa with the participation of RLFCS members. It aimed at finding whether this restocking-harvesting exercise will result in direct economic benefits that will lead to increased conservation of biodiversity within the lagoon. The community was made aware of the fact that the quality of lagoon water had to remain good to ensure rapid growth of the shrimp. They were trained to monitor the growth of stocked shrimps and to impose restrictions on themselves in harvesting shrimp, which will give lesser income. The RLFCS members periodically reviewed the status of their shrimp resources and adopted resource management practices through the regulation of fishing efforts and fishing gear. They also have opened a shop to sell their catch and store the shrimp in the community freezer. This direct sale to consumers has eliminated the involvement of the middlemen and brings the fishermen better prices.

A survey conducted revealed that the income earned from the shrimp fishery increased after the restocking programme and especially assisted the community during the off-season period. Other than enhanced income, the environmental awareness programmes helped to reduced destructive activities such as mining of sea coral, cutting of mangrove forests, etc which had provided supplementary income for the poor fishermen. The project also increased the economic value of the lagoon through the introduction of high quality shrimp and has prevented environmentally unsound prawn farming encroaching the lagoon area. Other than being cost-effective, the programme also led to community empowerment and as a collective action of the villages resulted in the removal of a causeway, which was affecting shrimp larval migration to the lagoon.

Although this initiative was envisaged as a programme where the community put away some profit to fund future restocking programmes, it was very slow in happening due to economic backwardness and poor management capabilities of the community.

### **Lessons Learned and Recommendations for Future Initiatives**

- Strong linkages and rapport between project personnel, local administrators community leaders, and the research institutions will lead to a more successful programme. The participation of local administrators in workshops and meetings is crucial to emphasize the importance of the venture to the community.
- The facilitator of the project needs to act in an integrated manner, with a common focus but with different approaches and strategies. This can be achieved through organizing regular meetings at different levels and by maintaining every stage of the project open and transparent, and by having a well-formulated plan of action. The involvement of strong community based organization like RLFCS throughout the project cycle assisted in the sustainability of the project.
- The stocking of larvae should be done in consultation with the upstream farmers, as the time frame in breaching of the lagoon mouth will also depend on agricultural activities.
- The translation of a time-bound initiative into a feasible, successful long-term venture requires the commitment of considerable time and energy as it involves moving people away from established habits to accepting new of behavioral patterns. Therefore a well-formulated integrated plan of action incorporating long-term sustainability plans is needed when funding is withdrawn at the end of the project.

### **3.2.4 Enterprises for Fisherwomen <sup>93</sup>**

In 1980, the small-scale fisheries project of the Bay of Bengal Programme (BOBP) initiated three pilot projects with the objective of promoting the skills of fisherwomen and thereby improving their social and economic conditions. Coir fibre processing at Ulhitiyawa, tailoring project at Mirissa and a lace (beeralu) making in Kudawella were selected. This selection was done after a stakeholder workshop revealed that the small-scale rural industrial sector provides scope for promoting women's skills and employments to improve their living conditions.

The Ministry of Fisheries in association with the Department of Small-scale industries implemented the Ulhitiyawa project, while the Lanka Mahila Samiti (LMS) took over the implementation of the Kudawella and Mirissa projects. At the stage of project planning the idea was to set up three technical training centres to train 30 women at each centre for six-months, after which the women were supposed to utilize their skills to find self-employment.

#### **Outcomes and Lessons Learned**

A study conducted to assess the status of two pilot centres at Ulhitiyawa and Mirissa revealed that the Ulhitiyawa coir fiber-processing centre was functioning well and had improved in many ways. The number of women working in the centre had increased, earnings had risen, and women had become more self-reliant in management matters. This development resulted from three basic factors:

1. The market demand for combed raw coir fibre had grown
2. More women were forced into regular work, as the male family members were unable to engage in migrant fishing due to the war situation in the north.
3. Realizing the positive impact of the project, the Welfare Division of the Ministry of Fishery and provided the managerial support that was initially lacking.

The Mirissa tailoring centre, on the other hand was in an extremely difficult stage. With few exceptions, the trained tailoring women have received no orders for months. Factors responsible for this negative development were:

1. Lower demand for locally tailored garments due to greater availability of imported and factory made garments. In addition the women lacked the technical and management skills to overcome this competition.
2. The withdrawal of management and coordination support from LMS due to its own regulations.

A more detailed description of the lessons learned from above two pilot projects are given below.

### **Project Preparation Phase**

- Many women in the community showed a reluctance to participate in coir processing as this enterprise like fish drying and vending, has traditionally been associated with poverty and it lacks social and economic status. Therefore this activity was a more suitable livelihood option for the poorest sector of the community.
- The project preparation took a fairly long time and was not smooth due to slow progress in the implementing institutions and a lack of commitment amongst the persons concerned with the project supervision. In the case of Mirissa, as there was no established women's society, the Matara LMS organizer had to establish the connection with the participants and act as the mobilizer. Frequent transfer of officers in the implementing agency (MF/Welfare Division) retarded the Ulhitiyawa Project.

### **Training Phase**

- Setting up a Trust Fund with the money earned by selling the high quality products produced during the training encouraged strict quality control at the Ulhitiyawa training centre. At Mirissa the quality of training was affected by the limited skills and teaching experience of the trainer.
- The fixed training hours, low training fee, household duties and child care accounted for the dropout of trainees. The day-care centre could take in a maximum of only two children per working women, but many families however had six or more children.

### **Production Phase**

- Development of a cooperative coir production centre that can handle the purchase of raw material and marketing assisted the Ulhitiyawa trainees to maximize their earning. This cooperative initiative resulted as none of the women owned coir looms and as individual access to raw material and markets were problematic. At the production center, the women laid down their own working conditions, such as working hours. Product diversification such as manufacture of combed raw fibre which needed no additional training but which were more financially rewarding also positively affected the durability of the programme.
- At Mirissa, insufficient promotion of the venture lead to low productivity. Many families in the village were not aware of the existence of the tailoring centre and therefore the trainees got very few orders. Incidents such as attempts to damage the centre due to political differences among group of trainees and young men in the village further discouraged the women.

### 3.3 Poachers Turn Environmentalists: Turtle Conservation Through Community Participation at Rekawa <sup>94,95,96,97</sup>

Rekawa is a small rural seaside village on the southern coast of Sri Lanka. The community are engaged in fishing and agriculture as their main livelihood activities and therefore have a close bond with the land and the sea. Its sandy beaches and lagoons fringed with mangroves gives it a rustic beauty indicating a high tourism potential, which is yet to be developed. The long, broad and mostly uninhabited beaches fronting the Rekawa lagoon provide an ideal environment for the nesting of sea turtles.

Five of the world's seven species of marine turtles come ashore to nest here with the Green turtle (*Chelonia mydas*) being the most common. Olive ridley (*Lepidochelys olivacea*), Loggerhead (*Caretta caretta*), Hawksbill (*Eretmochelys imbricata*) and Leatherback (*Dermochelys coriacea*) are the other species recorded. All five species of turtles fall under the category of threatened or endangered and is also listed in the Appendix 1 of the Convention on International Trade (CITES). Despite the protection provided under the Flora and Fauna Ordinance of 1972 and its amendments, marine turtles are still being exploited in Sri Lanka. In Rekawa, local residents remove the eggs from the nests for consumption while occasionally adult animals are also killed for the meat and shells (for handicrafts, jewellery etc).

In 1996, the Turtle Conservation Project (TCP) launched a programme in Rekawa, to address environmental and socio-economic problems that would serve as a model for marine turtle conservation in Sri Lanka. As an independent non-governmental organization (NGO), TCP aims to assist government departments, academic institutions and other NGO's in devising and facilitating the implementation of sustainable marine turtle conservation strategies.



Source: Thushan Kapurusinghe, TCP

#### ***In- situ Marine Turtle Nest Protection***

The programme employed 17 former turtle egg poachers as nest protectors to assist TCP, DWLC, NARA and University of Peradeniya research officers in the collection of biological data and the in-situ protection of marine turtle nests. The employed local people received a wage for their efforts, providing them with a non-exploitative alternative source of income. They were also directly involved in the decision making through their participation in the Rekawa TCP community committee, which managed the in-situ programme. From September 1996 to July 2000, 761 turtles, made more than 3,361 nests and around 300,000 baby turtles were successfully hatched and released to the sea.

In order to make this programme increasingly self-sustainable the TCP organized turtle-sensitive, nocturnal 'Turtle Watches' for fee-paying visitors. Under this a nature guide training programme was organized, where 16 community members were trained as nature tour guides with the support of the Ceylon Tourist Board and the Sri Lanka Hotel School. The aim of this programme was to provide a valid tourist guide license to the trainees so that they could make an income from their natural resources in a manner that was not destructive. In addition to this TCP have also developed a nature trail through a mangrove ecosystem that also includes bird watching. They are now in the process of developing tours in the lagoon for tourists using catamarans.

The TCP has undertaken various marketing efforts to popularise this activity within the Tangalle area, by distributing 'Turtle Watch' promotional leaflets to all hotels and guest houses. In addition, the TCP has advertised nationally on the radio and within local Colombo 'events' magazines. The TCP has also contacted the main tour agencies in Colombo, Galle and Hikkaduwa to promote the programme.

## Other Activities

In order to support the in-situ activities, and to increase awareness and knowledge on marine turtles and non-exploitative income generation options 14 people from the Rekawa community were given a 6-month training on educational methods and environmental subjects relevant to their locality. These Community Environmental Education Trainers (CEET's) then proceeded to conduct environmental education workshops for school children and community groups in the area. The workshops focused on the environment as a whole using techniques such as participatory resource mapping to identify conservation issues and seek sustainable solutions to problems of destructive practices. The TCP also employed four CEETs to run the core environmental and educational programmes such as a model medicinal garden, a mangrove nursery, providing free herbal drinks and maintaining a library in the area.

The TCP also carried out English language classes, with volunteer teachers from the United Kingdom. Around 350 children, and adults attended these classes from Rekawa and the surrounding area. With these classes, the TCP aimed at improving the employment prospects of participating community members in non-resource dependent jobs. The classes also helped to improve the communication abilities of community members who are working as tour guides.



Source: Thushan Kapurusinghe, TCP

In 1998, TCP established a rural clinic at Rekawa, where voluntary medical doctors conducted clinics on weekends. Two paid health assistants trained by the District Medical Officer of Tangalle (DMO) serve the community during the weekdays.

These types of additional services also contribute to increasing alternative income sources and the living standards of the community and thereby indirectly support the turtle conservation efforts.

Along with activities specifically in the project area TCP also carry out many workshops and exhibitions to raise awareness amongst the general public. They have also conducted series of educational workshops for students and teachers in schools along the southwest coast with the aim of gearing the new generation towards conservation.

In 1998 the TCP won a highly commended global award from the British Airways 'Tourism for Tomorrow' award scheme for its successes in the Rekawa community based conservation projects.

## Lessons Learned and Recommendations for Future Projects

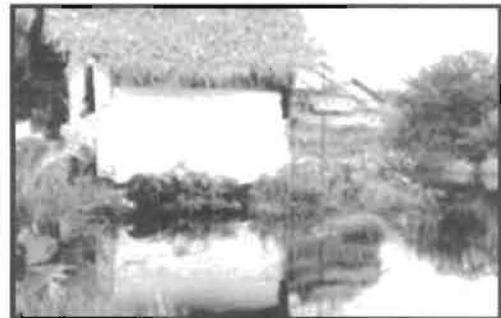
- Partnership building, collaborative management efforts that involve the community and the key departments and institutions is necessary for long-term support and wider outreach. The partnership developed between TCP, NARA and DWLC, has provided Sri Lanka with its first comprehensive database of biological data on nesting marine turtles and hatchlings and has developed a research methodology that can be replicated in order to increase data available on these species.

Sadly this collaboration lasted only for the project duration and presently, the DWLC has their own conservation programme in Rekawa beach, which is also used by TCP promoted tour-guides for the night turtle watch programme. Future sustainability of conserving this nesting area will only materialize if joint activities are undertaken with the involvement of all stakeholders.

- To keep the sustainability of the programme after the initial funding ended in 2000, TCP diversified their scope to other areas such as nature-tourism. Here the nest protectors were trained as tour guides and were awarded with a certificate from the Tourist Board. This helped keep the interest of the local community in conservation while also allowing them to approach the tourist hotels in the area to gain support for the programme.
- In a poor rural community like Rekawa where there is a lack of services and facilities, a conservation based project that addresses socio-economic issues as well can serve to increase the commitment of the community towards conservation. Therefore activities such as English classes, health clinics and maintaining a library has assisted the TCP to get high community involvement in the programme while also lending a hand to increase the well-being of the community as a whole.
- The project also showed that it was possible to combine research and income generation by creating a field laboratory, an educational site and a tourist attraction all in one. This area serves multiple purposes by providing the turtles with an undisturbed nesting site, generating income for the local community, a resource centre to study marine turtle conservation and research methodology and also serving as a general educational facility for locals and foreigners.
- Political stability and overall national agendas also plays a role in the sustainability of community based conservation efforts as resource poor communities have little room to deal with risk and uncertainty. This was felt in Rekawa in 1999 - 2000 when the tourist industry dramatically collapsed due to terrorism activities, which hampered the sustainability of the Rekawa programme.

### **3.4 Sustainable Exploitation of Natural Resources as a Basis for Generating Employment at Muthurajawela Marshes and Negombo Lagoon <sup>98,99,100,101</sup>**

The Muthurajawela – Negombo coastal wetland covering 6, 232 ha is situated in the Gampaha District, about 20 km North of Colombo. These wetlands have a high value in terms of biodiversity, in its functions of controlling floods and water quality, and in direct user values such as fish production, agricultural activities, recreation and scientific research. The GOSL declared the northern section of the marsh (an area of 1,777 ha) as a sanctuary in July 1996 under the Fauna and Flora Protection Ordinance.



Encroachment in the wetland  
Source: IRMP Project, CEA

A Conservation Management Plan for the area was prepared under the Wetland Conservation Project (WCP). In 1998, the Integrated Resource Management Programme (IRMP) selected this area to demonstrate a replicable model in ecosystem based natural resource management in the country. Both the WCP and IRMP were implemented by the CEA with financial assistance from the Netherlands Government.

#### **3.4.1 Pilot Projects for Income Enhancement**

Large disparities exists among household incomes in the villages associated with Muthurajawela Marsh and Negombo Lagoon. The households with lowest income were partially or entirely dependent on extraction of natural resources such as economically important plants of the marsh and fishery resources of the lagoon. The IRMP's primary focus was the conservation zone, where around 4,500 families have either direct or indirect interactions with the ecosystem for income and housing.

During initial exploration under the WCP, a wide range of income generating activities including micro-credit based activities were identified. IRMP, guided by this information initiated a number of small-scale household based “starter activities” aimed at gaining access and confidence of the recipients (See Table 3.6). Income supplementation was initiated through local CBO administered revolving funds, where IRMP generally contributed Rs. 50,000 to each fund. Each client was awarded a loan between Rs. 1,500 and 5,000 with a 2 percent monthly interest, depending on the type of activity and the number of participating clients. The IRMP had a deliberate gender focus based upon guidelines for Dutch development assistance and consequently 67 percent of the participants were women.

Table 3.6: The Status of Some of the Pilot Projects Implemented <sup>98</sup>

Name of the Project	No. of Clients			1998-1999	2000	2001	2002	2003 +	Institutions involved
	Start	Max	Now						
Coir weaving	90	95	20						3 CBOs, 1PC
Animal husbandry - Pigs	11	15	15						1 CBO, 1 GO
Animal husbandry - Goats	14	14	0						
Ornamental fish	50	50	0						1 PC
Sewing	10	10	03						1 NGO
Eco-tourism	15	25	07						1CBO, 1PC
Ornamental plants	10	10	0						01 PC
Clay pot decoration	9	9	0						1 GO, 1PC
Home gardening, at two locations	280	280	0						1NGO, 1 GO
Pandanus weaving, at two locations	44	44	02						2 GO, 1 PC
Kaduru seeds collection	21	21	02						2 PC
Wood carving	9	9	02						3GO, 3 PC
Coconut carving	12	12	0						1CBO, 3 PC
Bee keeping	22	22	0						
Mushroom production	2	2	0						
Job bank	14	62	02						2 PC, 3GO
Coir yarn production	5	5	0						1 PC
Brush making	6	6	0						1 PC
Family poultry rearing, at two locations	136	136	98						1 CBO, 2 GO
Income generation activities in 07 fishery communities	128	128	128						7 CBO, 1 GO

■ Projects under IRMP

■ Projects continuing independently

GO = Government Institution; PC = Private Company/Person ; CBO = Community Based Organization

### Project Outcomes

Some of the pilot projects have been very successful in achieving better resource management and helping people to get out of the ‘poverty trap’. Following are some of the project outcomes:

- The coir-weaving (making hammocks and bags) project initiated as a private-public partnership continued independently from the IRMP. Although the start was rather slow, after the development of the necessary skills a reasonable profit was achieved.
- Provision of micro-credit through the CBO’s revolving fund for pig fattening and pig rearing was one of the financially successful programmes. It can be highly recommended for areas

where the demand for pork is good. The results of the family poultry projects, mostly intended to supplement protein deficiencies for children, have been more mixed. The introduction of goats was not successful, as when a flood occurred many goats fell sick and died.

- The ornamental fishery project although successful initially ran into problems when the entrepreneur who supplied the fish fry to the community, abruptly terminated his operation due to low demand from the exporters.
- The sewing project initiated through an NGO to support poor women to earn a supplementary income was not successful, as the demand for their services did not last due to external market forces such as availability of cheaper clothes in the urban market.
- The handicraft projects were less successful for two main reasons: the skill requirement was too high for families with little or no tradition of doing this kind of work; and the semi-urban environment of Muthurajawela offers more rewarding job opportunities.
- The clay pot decorating venture was discontinued due to a very narrow profit margin. It proved very difficult to get a market for products by recently-trained producers, as there was well established traditional producers in other areas.
- The agro-forestry project for cultivating the indigenous plant, *Cerbera* sp., for the utilization in the handicraft industry was initiated based on the expectation that the National Craft Council would purchase a part of the nursery stock. This was not successful as the benefits of this programme can be realized only in the longer-term and as the demand was seasonal to create and maintain a sustained market.
- The job bank was attempted twice based upon the findings of a survey which indicated a demand for unskilled and semi-skilled jobs. This venture was hindered by the collapse of the labour market in the Negombo area due to the ethnic conflicts and especially by the attack on the International airport, which is situated nearby.
- Bee keeping was tried with 20 families, and initial training was provided by the Agriculture Department. The programme did not continue since maintenance of bee boxes was time consuming and the participants were more attracted towards immediate income from wage labour.
- Seven of the ten Fishery Committees in the area accepted financial assistance from the IRMP for a revolving fund to introduce different livelihood options among their members. As some of the Committees were politicized, the identification of beneficiaries was sometimes not transparent.

### **Lessons Learned and Recommendations for Future Initiatives**

- The poor often have highly unrealistic expectations in terms of income and other benefits from a project such as IRMP. Therefore the benefits from the pilot projects have to be estimated at a conservative level and expected outputs should be clearly explained to the community. In addition contributions and efforts expected from the beneficiaries also need to be properly explained and agreed at the start of the project. Initial non-selection as a beneficiary should not be seen as a loss of economic opportunity within the community. Social mobilization at the community level should be ensured to enable them to understand that pilot projects initiated with a limited number of clients, when successful can be more equitably distributed throughout the community

- The presence of a number of active NGO/CBOs experienced in working with universities and international organizations assisted the fast implementation of the project. From the side of project management, it has been proven rewarding to work with young people recently out of school or university, since they can be convinced to stay in the localities and to frequently visit the villages. Most volunteers, if properly informed and trained are very keen and good workers.
- Projects that were based on a revolving fund under a well-functioning CBO showed better results and the involvement of government agencies such as the Divisional Secretariat for authorizing loans was useful to prevent misuse of the funds. It also proved very useful to link projects such as animal husbandry with mainstream government development schemes, such as the Samurdhi Bank for continuity of the activity.
- Conflicts arising from opportunism of individuals, political interference, change of leadership or relatively inexperienced field staff can be minimized through proper selection of participants based upon clearly defined criteria, transparent bookkeeping and regular meetings.
- Family bonds, especially the husband-wife relationship has to be taken into consideration as the extra income earned by the women from pilot projects can easily lead to more frustration and jealousy from their husbands, which can lead to other social problems such as increase liquor consumption. Maintaining regular discussion with both partners by the social mobilizers can minimize this risk. Women were more interested in activities they could do at home when the regular household duties are completed.
- The fixed conditions of the credit can undermine the success of the activity, as market absorption capacity may not be enough for the selected type of activity. The project should be flexible to change on the basis of genuine problems. For example the CRMP relaxed the conditions for the fish selling programme, allowing dry-fish, prawns and other self-employment initiatives to develop with the credit.
- When initiating a venture such as a job bank it is advisable to include foreign job opportunities, as most community members desire it.
- Interventions utilizing naturally occurring vegetation such as Pandanus and Kaduru for the production of value added products such as handicrafts were less attractive to the urban community of Muthurajawela compared to the revolving funds for micro-credit ventures.

### 3.4.2 The Muthurajawela Visitor Centre <sup>99,101,102</sup>

The Muthurajawela Visitor Centre (MVC) was established in 1996 by the WCP and the IRMP subsequently supported its management and eventual transfer of its ownership to the community. The MVC was developed with the objective of investigating the replicability of the concept, which is used in many countries as an option for sustainable natural resource management. MVC was designed as a multipurpose, multifunctional facility, promoting nature-based education activities, a meeting place for community development activities, and as a recreational centre. The centre was named as "The Marsh" and was located immediately outside the Muthurajawela Sanctuary, an area with a high local and foreign visitor potential.

The main attraction of the MVC was a guided boat trip operated through a variety of landscapes and ecosystems. It started at the Old Dutch Canal, constructed in the 16<sup>th</sup> Century that connects into the Dandugama Oya, a picturesque river with various fishing activities along the bank. The river then opens into the Negombo Lagoon, where many bird life and fishery activities can be seen. These boats are operated by youth of the area.

Opposite the entrance of the Visitor Centre, the WCP initiated a herb and vegetable garden, which will not only allow visitors to see the plants and spices in their natural appearance, but also creates employment for a number of poor women from the area. This garden produced fresh vegetables, fruits and ornamental plants for very attractive prices. The shop "Marsh Memories" offered a variety of products, which were inspired by the marsh or the lagoon (T-shirts, Hats, Posters, Picture post cards), or made from locally available natural products (handicrafts).

The staff members (around 25) were recruited from the nearby communities and they worked as nature guides, boat operators, restaurant workers. The initial capital and assets such as boats, exhibits were provided by the WCP. Since then, all costs and salaries have been covered by its own income. Daily income was deposited into a special bank account under the supervision of the CEA. The main financial constraint on the centre was the high rent for the 5 acre private property, where the hotel was based. This property was rented by the CEA as there was opposition from the local community for developing the MVC within the marsh. By the end of 1997 more than 21,000 people visited the centre, out of which 90 percent were Sri Lankans. The center was very popular among the schoolchildren and also became a regular meeting place for stakeholders from all levels of society to discuss prevailing resource management issues.

After five years into operation, the Visitor Centre had to be closed down in mid 2001 due to the construction of the Colombo-Katunayake Expressway. The staff of the centre, suddenly confronted with unemployment, set up a new temporary establishment relocated to another section of the sanctuary. As the new venue is less suitable for its purpose, the income earned is only marginal. A permanent visitor centre is now being constructed in another location in the wetland under the ADB-funded Coastal Zone Management Project.

Up to 2002, the Visitor Centre was run by a management team, which was independent from the CEA and the WCP/IRMP. MVCs ownership was transferred to the Community Leaders' Network initiated by the IRMP in 2002. This network is now registered as an NGO and the MVC operates as an autonomous legal entity. The MVC is registered as the Muthurajawela and Negombo Lagoon Wetland development Foundation under the companies Act. No. 17 of 1982.

### **Lessons Learned and Recommendations for Future Initiatives**

- The site for a visitor centre should be "politically neutral" in order to prevent resistance to its use by community groups. Community meeting facilities at the centre and assisting them to sell their products (handicrafts, vegetables etc) is favourable in promoting a sense of ownership within the community.
- Long-term survival of the venture will also depend on the compatibility and support of the Government's development policy and programmes for the region.
- For the efficient operation of the centre, management and maintenance should not be the sole responsibility of government agencies. In the event that the venture is privatized, a governing board should be established with the participation of government institutions responsible for the resource management in the area. This will assist to assure resource exploitation within acceptable limits.
- Permanent staff should be kept to a minimum, based upon the months of low visitation. Other staff should be on contract, preferably on call as required. Use of volunteers is another option to minimize expenditure.

- Extended donor support has been a major contributing factor in the continuity of the venture. When the WCP was completed in 1997 the donor support was extended to another five years under the IRMP, which continued the activities of WCP. The ADB-funded Coastal Resources Management Project is financing the construction of a permanent visitor centre.
- Diversification of customer options (eg; conference facilities, restaurant, guide-operated tours, souvenir shop etc) can lead to higher income and more employment opportunities.
- Various advertising methods are needed to attract different types of customers. Advertisements in local papers or on television can be a guarantee for a higher number of local visitors but to attract foreigners a partnership must be build up with hotels.

### 3.5 Livelihoods Options from the Aquaculture Industry

Sri Lanka is endowed with large areas of freshwater and brackish water resources, with significant potential for aquaculture development. Around 260,000 ha of freshwater bodies and 120,00 ha of lagoon coverage have been estimated. In addition, 15,000 ha of coastal zone and 5,000 ha of water area have been identified as suitable for the development of brackish water aquaculture and sea farming.<sup>119</sup>

Inland fisheries have played a role in the subsistence and self-sufficient economy of the country from the earliest recorded history. However, no tradition of aquaculture or organized freshwater fisheries existed until the introduction of the fast growing exotic cichlid *Oreochromis mossambicus* in 1952. The Government's policy decision in 1990 to terminate state patronage for inland fisheries has negatively affected its development. This decision has been reversed since then, and now the government extends its fullest support to aquaculture development in the country. In this regard the National Aquaculture Development Authority (NAQDA) together with NARA is playing a major role.<sup>112, 114</sup>

At present, the only economically important coastal aquaculture operation in the country is the culture of brackish water tiger shrimp (*Penaeus monodon*), mainly targeting the export market. In the year 2000, production from inland capture fishery and aquaculture was 36,700 metric tones, accounting for 12 percent of the total fish production. Highest aquaculture production was reported from the Puttalam District, mainly comprising of shrimp production. Expansion of the shrimp industry, without any scientific backing has led to the loss of mangrove vegetation and water quality problems in the northwestern coastal belt of the country. Major shrimp disease outbreak were recorded in 1989/90 and in 1996 due to an epizootic spread, 60-70 percent of the farms had to stop production. Frequent, localized outbreaks of disease are also recorded in farms.<sup>61, 67, 112, 113</sup>

The livelihood outcome from the expansion of this industry varies considerably between communities. As indicated in Section 3.2.3, restocking of the Rekawa lagoon with *Penaeus monodon* led to enhanced community benefits while as indicated in Case Study 9 it can have mixed outcomes in other communities. The industry can also directly impact livelihoods through reduced availability of fish or crustacean species dependent on the coastal habitats replaced or affected by the shrimp farms. Estuaries and lagoons are of particular significance to poorer fishermen who often lack either access to the sea or seagoing gear and on a seasonal basis to other fishers, who are unable to fish during the monsoon months.<sup>53, 113</sup>

A number of other brackish water species presently being grown in Sri Lanka are mud crab (*Scylla serrata*), oysters (*Crassostrea madrasensis*), mussels (*Perna perna* and *P. viridis*) and seaweed *Gracilaria* sp. Cage culture (milkfish, sea bass, grouper, rabbitfish and sea bream), is another possible option that can be developed into economically viable livelihoods to coastal dwellers.<sup>113, 120</sup> Sections 3.5.1 and 3.5.2 and 3.5.3 will give a more detailed account on them.

## Case Study 9

### Livelihood Outcomes from Shrimp Farming in Ambakandawila <sup>53,118</sup>

Ambakandawila is a traditional fishing village in the Puttalam District, with a population of around 1284 people. The first prawn farm in the village was established in 1988 and by 1999 the number increased to 32. Out of these farms nine are established on private land, 11 are partly on private land but have encroached on to public land and 12 are totally illegal, as they have been established on reserved mangrove lands without entitlements. People with political backing took a leading role in invading the state lands. Most of the farms are very small and only four are larger than four acres. One of the reasons for small farms is that there were a high proportion of villagers involved in the industry (23 farms are owned by the villagers). However, three of the largest farms are owned by people from Chilaw and Negombo, while the biggest farm (30 acres) is a BOI approved venture.

The proliferation of farms were accompanied by the spread of prawn hatcheries. From the 32 hatcheries ordered the villages own 16 fully and three partially. Most families involved in prawn farming have a common origin from well-established fishing families of the village. As they have inhabited the beach area for a long time, they were in a position to claim it and receive titles or to obtain long-term leases. Some of these people sold their land to entrepreneurs from outside, while others started hatcheries themselves often motivated and guided by their neighbours' success. Their physical fishing asset such as boats and gears retained their utility and their accumulated financial assets gave them the potential to invest in shrimp production, which was both expensive and risky.

Poorer fishers on the landward side of the lagoon were in a different position. Their access to fishing opportunities was limited by the lack of fishing assets and geographic position, making them more dependent on the lagoon and vulnerable to a loss in its productivity. The lack of financial and social capital prevented them from investing in shrimp cultivation.

Some of the prawn farms and hatcheries in the village have created a significant number of permanent jobs, and some prefer these jobs than working in the fishing industry. However, as most farms are small, their day to day maintenance is done by family members. More people find employment on a daily basis in activities such as harvesting or pond preparation.

Whether or not the overall wealth of the village has increased through the introduction of prawn farming is difficult to assess as many still continue to go fishing, at least in the main season when income from the sea is high. The periodic collapses of the prawn industry due to viral infections led to large personal losses, as many depended on credit. Costs and benefits of the industry are not easily separable as fishermen complaining about the state of the lagoon have a stake in prawn farming themselves.

Other than the culture of food fish, freshwater ornamental fish production is also another important aquaculture practice with greater potential for further development. It is noteworthy that many aquarist in the country have embarked on programmes of captive breeding of endemic and indigenous freshwater species. These trends have led to successes with several species such as endemic *Puntius nigrofasciatus*.<sup>67, 75</sup> Section 3.5.5 discuss a venture carried out by an NGO to assist the development of small-scale ornamental fish producers.

### 3.5.1 Experimental Aquaculture Projects in Disused Inland Coral Pits in the Ratgama Electorate<sup>64</sup>

NARA carried out a feasibility study for culturing freshwater fish in a large number of disused/abandoned inland coral pits in Rathgama as an alternative income generating activity for coral miners. Preliminary investigation by NARA revealed that the water quality of many of the abandoned coral pits in Wenamulla, Dimbulduwa, Akurala and Narigama at Hikkaduwa were suitable for culture of fish such as *Oreochromis* sp and carps. The study carried out by NARA also determined the most suitable culture and capture methods, as many of these pits were very deep and the bottom topography irregular. Cage and pond culture were carried out to identify methods that minimize the cost without altering the existing pond structures.

For the project, five sites belonging to individual households were selected. Seven floating cages were stocked with *Oreochromis niloticus/mossambicus*, the red tilapia, and the Indian carp, *Labeo rohita*, while five ponds were stocked with *Labeo rohita* and *Oreochromis niloticus/mossambicus*. The initial weight of the fish stocked varied from 3–20 g. The experiment lasted 200 days and the results indicates that red tilapia showed the best growth rates in cage culture while all the fish in the ponds showed better growth rates than the fish reared in cages.

The nylon nets of the cages were torn by predators such as monitor lizards, and crabs and the fish escaped through these holes. Other fishes such as *Puntius* sp, and eels entered the cages through the holes. The caged carps showed no growth at all and this can be attributed to their feeding habits.

To evaluate the most suitable harvesting method, different practices such as cast netting, gill netting and the complete emptying of the pit using water pumps were tried. The cast net tended to get entangled in various objects and a complete harvest was not possible due to uneven pond bottoms. The gill net as a whole was ineffective due to presence of vegetation such as water lilies. The water pump was economically viable only for smaller ponds.

On the basis of the results obtained, following recommendations were given by NARA for future aquaculture activities in association with coral pits:

- For an aquaculture project to be feasible at least 5-10 families in the same vicinity should be involved, especially to assist in stocking, monitoring and regular cleaning of the pit.
- Fingerlings should be freely available in the area and it will be appropriate if farmers from the vicinity can provide the fingerlings.
- If pond culture is to be attempted as a source of regular income, the minimum pond size should exceed 1/4-1/2 acre. The pond should be cleaned and the bottom levelled before the fish is introduced. The subsidy offered to the potential fish farmers by the Ministry of fisheries can be utilized for this purpose.
- To overcome the reluctance of the people to utilize freshwater fish, awareness programmes are necessary.

### 3.5.2 Crab Fattening in Lagoon Ecosystems<sup>73,110,113</sup>

Crab fattening is becoming increasingly popular in shallow lagoons in Sri Lanka due to factors such as low investment, simple technology and the high profit margins. Sri Lanka has been exporting both meaty and water crabs to Malaysia, Singapore and Thailand, who in turn fatten the water crabs in captivity and export them to Europe and Japan. Realizing the loss of foreign exchange due to the export of water crabs, the Sri Lankan crab exporters initiated crab-fattening ventures within the country from 1992.

Out of four species of the genus *Scylla* recorded from the Indo-Pacific region, three are found in Sri Lanka. *Scylla serrata* is the most common species, followed by *Scylla olivacea* and *Scylla paramamosain*

respectively. The value of the crabs also varies according to the species in local and international markets. A well-fattened individual of *Scylla serrata*, weighing over 500g, is priced at 450.00/kg in the local market while similar sized crabs of the other two species is priced at Rs. 350.00/kg.

A profitable business in crab fattening has been recently developed in the Eastern Province. The crabs are then sold to middlemen who then transport them to Colombo for export. Water crabs are purchased from collectors at Rs. 100 per kg and the fattened crabs are sold at around Rs 500 per kg. NAQDA is promoting the business in the area by providing free cages and technical advice. The demand for cages is much higher, and a programme is needed to provide the necessary credit to purchase the cages. The current reliance on juvenile wild crabs for seed stock is not suitable and threatens the viability of the fishery (see Case Study 10).

## Case Study 10

### Crab Fattening in Chilaw Lagoon <sup>115</sup>

A study conducted by NARA in 1997 revealed that 58 crab cages were operating in the Chilaw lagoon, with 14 operated as group ventures and the rest on an individual basis. The cages were made out of wooden frames and covered with plasticized wire mesh (1.5" in size) and submerged in shallow mangrove areas of the lagoon (1.5- 2 feet in depth).

Size of the crabs used for fattening operations varied from 12.5 cm - 17.0 cm carapace width and over 300-350g in weight. The sources of water crabs were from Mannar, Trincomalee, Jaffna via St. John's market in Colombo or from Chilaw and Puttalam lagoon areas. Majority of the crab farmers used small ray fish (6 inch width) as the feed. Crab farmers purchased "water crabs" at Rs.225/kg and sell them at Rs.450/kg after fattening. According to the farmers, there is negligible mortality during the fattening period.

#### Overcoming the Impacts and Recommendations for Future

- At present, both sexes of crabs are used for the fattening process and this practice may lead to depletion of broodstock. The high demand for wild crabs have in turn increased the fishing effort and this unsustainable utilization of the resources may threaten the viability of the fishery. Therefore, introduction of a licensing system to restrict and control the number of farmers entering the crab fattening process and restriction of the use of females for fattening is important to prevent the depletion of stocks in the wild.
- Technology for crab seed production is still not available in Sri Lanka, although Australia, Malaysia, Thailand and Taiwan have achieved some success in producing crabs in hatcheries. The technology developed in these countries can be adopted after adjusting to suit the local conditions.
- Although no evidence of water pollution from this farming practice has been recorded, precautions should be taken prior to further expansion of crab fattening to avoid possible pollution in the lagoon.

This is important, as mud crabs have been identified as carriers of viruses, which are responsible for mass mortalities of cultured shrimps. However, the degree of transmission of the infection via the mud crab is quite low, as they have been identified as asymptomatic carriers. Regular monitoring by authorities of cage culture/fattening practices will ensure the proper management techniques are employed. It is also recommended to use floating type cages instead of submerged type, leaving at least 2 m depth from the bottom of cage for proper water circulation.

- Conducting awareness programmes to eliminate misconceptions on crab fattening and training farmers to adopt environmentally friendly techniques is needed.
- Crab culture and fattening should be confined to small-scale operations until such time that the seeds could be produced in hatcheries.

### 3.5.3. Other Types of Culture Practices.

#### Seaweed Farming <sup>63, 72, 113, 116, 117</sup>

Out of the 260 species of seaweed recorded in the coastal waters of Sri Lanka, 20 are of commercial importance while only two varieties - *Gracillaria verrucosa* and *G. edulis* are commercially exploited (see Table 3.7). Export of seaweed dates back to the 1800s and had been a traditional livelihood practice in Puttalam lagoon and Trincomalee Bay during the off-fish season. Around 50-100 tons of dried *Gracillaria* were exported in the 1970s and the amount increased up to 150 metric tons in 1986. This industry was drastically affected by the civil disturbances, with figures for production falling to 10 metric tons in 1988. Since then no figures for the industry have been reported.

Table 3.7: Recorded Economically Important Seaweed Species

Species	Areas recorded
• <i>Gracillaria edulis</i>	Puttalam lagoon, Dutch Bay and Portugal Bay, Gulf of Mannar
• <i>Gracillaria verrucosa</i>	Koddiyar Bay, Gulf of Mannar Northern coast, Pearl Bank in the
• Sargassum	Gulf of Mannar, Southern coast from Amabalandota to Hambantota

Despite the global market growth in seaweed consumption and seaweed based industries there has been no sustained interest in the exploitation of this resource in Sri Lanka. It has so far not attracted adequate investment or interest from the industrial sector. Lack of adequate information on the extent and distribution of the resource can be considered as a main factor inhibiting the expansion of the industry in the country. NARA and several other organizations have carried out several pilot projects with limited success:

- A project set up in 1973 to produce liquid sodium alginate, failed as the most favourable Sargassum species (*S. cervicone*) was less abundant in the shallow waters.
- The BOBP initiated an experimental *Gracillaria* farming project in Puttalam Lagoon in 1988 together with NARA and Sarvodaya. The research, which concentrated in spore setting trials, was generally unsuccessful mainly due to prevailing high salinities. Poor results were also obtained from vegetative propagative culture techniques carried out in a village farm plot, where rabbit fish grazing and high salinity levels affected the production.

However, when considering the past production of seaweed from the northwestern, and eastern coasts, the potential for revitalizing the industry in these areas can be considered as a viable alternative livelihood option.

**Milk Fish <sup>113</sup>** : The milk fish (*Chanons chanos*) has been experimentally cultured in Sri Lanka, but there has been no commercialisation. Initial trials conducted by NARA with the pond culture at the Pitipana Fisheries Station using fry collected from the Northern Province, showed very promising results. Fingerlings from nursery ponds, averaging about 5g in weight were stocked in outgrowing ponds at a density of 3,000 fingerlings/ha and a production of some 1,150 kg/ha, equivalent to commercial yields in the Philippines, was obtained after five months. Subsequently, fingerlings were supplied to fish pond operators and for stocking in some seasonal reservoirs, but these activities have been terminated.

**Mollusc Culture <sup>113</sup>**: Field trials by NARA have demonstrated the technical feasibility of culturing oysters mainly in extensive lagoons and embayments of the east and northeast of the country. Abundant spat are reported from Trincomalee Bay. Weak demand in the local market is a constraint confronting the development of oyster farming in Sri Lanka. Tourism offers opportunities, provided the product can be certified as sanitary.

Mussels are another species that has been experimentally cultured in the country but is not yet commercialized. Although the market potential is not known, dried mussel meats from Trincomalee can be found in some fish markets.

**White Shrimp - *Penaeus indicus***<sup>113</sup>: The white shrimp is not widely cultured but is well suited to high salinity environments beyond the optimum range for *P. monodon*. It can thrive up to 50 ppt. salinity levels and the average size after 150-180 days of culture is 20g. Much higher stocking densities compensate for the lower size. A management strategy could include tiger shrimp production during low salinity and white shrimp during high salinity.

**Artemia (Brine Shrimp)**<sup>113,128</sup>: Brine shrimp are widely used in the ornamental fish industry both in Sri Lanka and abroad and is also vital to the shrimp hatchery business. Extensive field trials by NARA have demonstrated the feasibility of both biomass and cyst production in Sri Lankan salterns. The production potential of existing salterns appears too small to enter in to the international market.

#### **3.5.4. Linking Small-scale Ornamental Fish Producers to the Global Market**<sup>108</sup>

The Sarvodaya Economic Enterprise Development Services (SEEDS) initiated a project on ornamental fish farming in 1995, through its Rural Enterprise Development Service (REDS) arm, renamed the Enterprise Services Division (ESD), which promotes new and non-traditional business opportunities to rural communities.

As the first step, ESD officers assessed the community capability and their interest in farming ornamental fish as a backyard industry, and the availability of a market for the product. Given the positive results of the study, ESD staff participated in technical training programmes conducted by NARA to acquire knowledge and skills on various aspects of fish farming. Awareness programmes were then conducted for the members of Sarvodaya Shramadana Societies on ornamental fish farming as a potential income generating activity. Several one-day training programmes were held in nine districts for around 345 participants, out of which 115 stated their interest in starting ornamental fish farming as a business. The District Enterprise Promotion Officers assisted them with the preparation of feasibility reports to apply for a loan and assessed their feasibility prior to implementing the project.

To support the costs of starting the project, SEEDS provided loans ranging from Rs 7,500 to 25,000 to project participants. These loans were often used to finance pond construction and for purchasing fingerlings. Follow-up technical training was given two to three times a year per district and a "Business clinic" was organized to facilitate the consultation between experts in the sector and producers. Ten experts from University of Peradeniya, NARA, AgEnt (US-Aid project), the Ministry of Fisheries and export companies provided technical know-how and counselling services at the one-day clinic. Through this specialized service clients were able to discuss their problems with the relevant consultants.

The District Enterprise Promotion Officers provided the extension services by visiting the project participants regularly and assisted in solving problems as they emerged. These officers were instrumental in maintaining good relations between producers and buyers and in developing a feeling of confidence among participants. As a method to reduce the cost in transportation of fingerlings, three clients were given training in ornamental fish breeding by an exporter, so that they could supply fish fry to the rest of the outgrowers in the neighbourhood. A survey indicated that the average annual income from this venture was around Rs. 27,509 per participant, which was helpful in supplementing the family income.

## Lessons Learned

- Any increase in production will reach a bottleneck in the absence of strong buyers and a dynamic market that can absorb the additional production. Such a situation results in minimal increase in income, low-quality products and squandered resources. Therefore it is very important to assess the “demand” for a product before the initiation of the project.
- As ESD worked within an established network, (the Sarvodaya Shramadana Society, which is a well-established reputed institution in the country) it was easy to reach a large number of people, tap external experts and link with existing markets.
- Continuous capacity building within the implementing institution and the project participants is a must for the sustainability of the programme, as it will assist to gain the latest technical know-how.
- Lack of strong research and development programmes on fish varieties and technology, lack of information on overseas demand and inadequate transport and packaging facilities hamper the growth of this promising industry.
- A group approach can be appropriate for micro-entrepreneurs to tap into mainstream markets such as the export market. As the majority of participants do not have the interest or the skill to develop a large operation it is much easier to form clusters in their neighbourhood. This will reduce transportation and fingerling costs

## CHAPTER 4

### The International Approaches

This section of the report will explore case studies from different parts of the world that can be adopted to the Sri Lankan situation with appropriate changes.

#### 4.1 Livelihood Diversification in Marine Protected Areas

Development of Marine Protected Areas (MPA) for sustainable fishery or for the conservation of biodiversity can put a strain on coastal communities as they might find very few livelihood options, especially if the MPA is located in rural areas. Following case studies give few examples of overcoming this constraint.

##### 4.1.1 Komodo National Park: Mitigating the Live Fish Trade <sup>121,122,123,124</sup>

The Komodo National Park (KNP), established in 1980 is located in the centre of the Indonesian archipelago. In 1991, the park was declared as a UNESCO World Heritage Site, as it is one of the richest marine environments including coral reefs, mangroves and seagrass beds. The park is under threat due to land-based activities such as deforestation and poaching while destructive fishing practices (dynamite, cyanide, fish traps, reef gleaning and over fishing) threaten the marine habitats. There are around 20,000 people living in the vicinity of KNP, who are largely dependent on marine resources for their food and income. Some use destructive methods to capture fish for the lucrative live reef fish trade based in Hong Kong. Emerging threats include anchor damage by tourist boats.

In 2002 the government authorities with the assistance of the US- based Nature Conservation Society developed a 25-year Master Plan for the management of KNP. A key element of this management plan is the development of self-financing mechanisms for the park.

The specific goals for KNP management include:

- Establishment of strong and effective law enforcement in and around KNP, to eliminate blast and cyanide fishing.
- Development and promotion of sustainable livelihood practices to reduce the demand.
- Important spawning aggregations identified and safeguarded.

Following are the livelihood options promoted by the park management:

**Fish Aggregating Devices to Attract Pelagic Fish:** The present approach in KNP to convert destructive fishing practices and boats involved in demersal fisheries into sustainable pelagic fishing operations is through the use of Fish Aggregating Devices (FADs). FADs are deployed to develop small-scale pelagic fisheries for species such as tuna and skip jacks. The project has been working together with local communities, local government, fish traders and expert fishermen from other areas to establish this technique. Activities facilitated under this included feasibility studies, socialization, identification of models and systems, cooperative development, training in fishing techniques, fish handling, post harvesting techniques, coordination and development of strategic alliances and marketing improvement. A technical training for fishers was conducted in



Source:  
[www.komodonationalpark.org](http://www.komodonationalpark.org)

early 2001, to create the momentum needed for successful development of FAD. A total of 70 crew with their boats have joined the training programme and participated in various project activities.

There were 6 deepwater FADs deployed around the park in 1999 and 2000. Several of these FADs were lost and had to be replaced in 2001, as a result of vandalizing by purse seine boats from another area. Therefore from mid 2001, a more professional management system, including continuous guarding of the FADs has been implemented in close cooperation with local government agencies. This has led to the arrest of six illegally operating purse seiners. The size of the pelagic fishing fleet started to improve when the prices for Spanish mackerel and tuna increased. Many fishermen already see the profitability of this venture.

**Fish Culture Project:** The fish culture project, which is still under development aims to involve local communities in the grow-out phase of groupers, sea bass and mangrove jack, which is based on a full cycle culture. Fertilized eggs will be collected from a captive broodstocks of fish that will spawn in a hatchery. Then the larvae will be reared until they reach fingerling stage and supplied to community run sea cages to grow out. Once they reached marketable size, the fish will be returned to the hatchery to be exported to Hong Kong. A percentage of the revenue from fish sales will go to the villagers and the remainder will be reinvested in the project to fund continued operation of the hatchery. Villagers will be given the opportunity to operate the grow-out units as independent businesses after paying back the project for capital investments.

As the revenue of fish culture workers will be unlikely equal or to be higher than the money that is made by cyanide or blast fishers, the project only hopes to offer a sustainable livelihood that compares favourably to other occupations in the sea, including fishing by legal means.

**Ecotourism:** TNC together with the Indonesian Park Authority have designed an ecotourism concept with all stakeholder (private sectors, local dive operators, tourist guides and the community) participation. Tourism activities vary from watching the famous Komodo dragon to diving or fishing with special permits. A study conducted in 2002 identified the following livelihood options for promotion among the community: carving, weaving, making cake and pastry, sewing and embroidery.

### **Lessons Learned and Recommendations**

- The alternative livelihood programme created many opportunities to engage in education and awareness building with local communities and private sector industries on best practices and ecological and economic sustainability of a well-managed MPA. This point should be carried forward and put in the right policy and institutional context as a highly beneficiary impact.
- More attention should be directed to educate policy makers on the necessary shift from the perception that more than producing large quantities of fish, a well-designed mariculture venture can produce low ecological impact and create maximum community involvement and benefits. This in the long run will keep the community livelihoods from collapsing.
- The experiences in KNP fish culture project show that full-cycle farming of some high value reef fish are possible. There is an urgent need for guidance of best practices in mariculture throughout the country. For many species, technology and knowledge is still lacking for full-cycle farming. Any licenses or other support to set up high value grouper fish farms must be regarded with utmost care as the business may actually engage in grow-out of wild caught animals.
- As there is a trend in consumer preference towards sustainable produced fish, mariculture development would benefit from certification schemes that provide additional marketing value to fish produced under best practice conditions.

#### 4.1.2 Port Honduras Marine Reserve: A CBO Assisting to Overcome Resource Depletion <sup>125,126</sup>

Toledo located in the South of Belize is one of the poorest regions on Central America's eastern coast. A combination of over fishing, poor enforcement of regulations, destructive fishing methods, agricultural activities and gravel mining on the island poses a direct threat to the river and marine habitats.

To meet the growing environmental and development needs of the area, Toledo Institute for Development and the Environment (TIDE), a grassroots community-based organization was established in 1997. As a part of an environmental education programme, TIDE collected biological data with the assistance of the local community. During this process the community realized the need to preserve and protect marine life. Over the next three years, with TIDE's help, they lobbied for the area to be made into a reserve. This met with considerable pressure from commercial fisheries. Yet, the Belize Government endorsed the proposal and the area was legally made into a marine reserve in January 2000. This area, now recognized as the Port Honduras Marine Reserve (PHMR), includes 20 miles of pristine mangrove coastline, 500 square miles of sea and hundreds of small mangrove islands which provide food and shelter for juvenile fish and the endangered manatee.

TIDE was granted co-management authority of the reserve by the Government of Belize. For the sustainable management of the marine reserve, the measures used by TIDE to overcome the five critical challenges are as follows:

1. Ending damaging fishing practices such as the use of gill nets, cast and drag anchors, touching and removing the coral - These activities were made illegal and the marine reserve divided into zones: general use zone, conservation zone (no take zone), and preservation zone (no entry zone).
2. Stopping poaching – To overcome this problem demarcation buoys were put in place and a reserve ranger station set up in a key location with the financial assistance from several other organizations. Rangers stopped boats and discussed issues with local fishermen and resource users, working to educate them on the reserve's rules and regulations and the reasons why they were necessary. Rangers were present twenty hours a day in the reserve and the illegal catch is confiscated. The fishermen are given a warning on the first occasion, or a fine if they are repeat offenders. Rangers confiscated 30 gill nets in 2003 alone and some fishermen have voluntarily turned in their nets in exchange for more sustainable fishing equipment i.e fishing lines with single hooks, iceboxes to keep their catch for a longer time etc. Poaching of the manatee has now been eradicated.

TIDE carry out the day-to-day management of the reserve and hand over law enforcement to the Belize Government Fisheries Department.

3. Developing alternative livelihoods for fishermen- This was to overcome the immediate concern of the villagers in how to make an income if they had to sacrifice fishing areas.
  - a. Fly fishing was identified as a lucrative source of income and one that is aligned to conservation objectives. The waters around the marine reserve are pristine and abound in indigenous fish such as bonefish, snook, barracuda, bonito, kingfish. Two suitable partners were enlisted to invest in development of tourist fishing. A well-established fly fishing company donated equipment and staff to train fishermen to become highly skilled and qualified guides. El Pescador, a fishing lodge, promotes fishing and offers high quality accommodation for visitors. Finally, the self-employed fisherman turned guide takes guests fishing. These guides are also now reporting illegal activities such as gill net setting to the rangers. They

realise that without TIDE's protection the marine reserve will no longer be able to support their industry.

- b. TIDE Tours was established to support further micro enterprise and ecotourism training. Training is supported with grants provided by an international organization, which seeks to address issues of social and environmental concern, particularly those which affect disadvantaged sections of society. To date TIDE has trained 50 former fishers and hunters to serve as tourism brokers in flyfishing, kayaking, scuba diving, snorkeling, and other activities.
4. Ensuring community commitment and participation. - This is inextricably linked to livelihood, understanding, participation and local ownership. Rangers are all from the reserve's buffer communities. Every ranger was at one time a net fisherman. The Port Honduras Advisory Committee for the reserve is made up of local fishermen, fisheries department representatives, community members and local tour guides. Fishermen were taken on field trips to other reserves to help understand why the areas need to be protected. Another programme trains fishermen and tour guides as 'community rangers' in order to give staff a hand in spotting illegal activities. The community also assisted in drafting the reserve management plan.
5. Monitoring and maintaining ongoing sustainable management of the reserve - TIDE has been conducting a major baseline study in Port Honduras Marine Reserve, supported by The Oak Foundation and assisted by The Nature Conservancy's Belize office. The data gathered through the baseline study will be used to set up policies for the management of the reserve and will serve to accurately determine and measure changes in its ecosystem. TIDE is seeking funds to continue to monitor the park in order to attain more effective management.

#### **4.1.3. Adjustment to Cod Closure in Atlantic Canada** <sup>124,127</sup>

The cod fishery of the past provided a foundation for the social and economic structure in Atlantic Canada, especially in Newfoundland and Labrador, where harvesting began in the 1500s. Traditionally, the inshore cod fishery used a variety of gears to land their catches and steam trawler and otter trawls were introduced in the 20th century, as well as automated floating fish factories to process and freeze the catch at sea. These and other new technologies led to increasingly larger annual landings of cod, reaching a peak during the 1960s of almost two million tonnes. Cod landings declined dramatically during the 1970s to below 500,000 t in 1977.

To address these concerns, the Fisheries Department of Canada introduced several management measures including regulatory changes, increased surveillance and monitoring, raised licence fees, and closure some areas to the mobile fleet. Unfortunately, these measures only assisted slightly to reduce pressures on the stocks. Ecological factors, fishing pressures, and uncertainties surrounding the assessment of stocks, in addition to claims of foreign over fishing, illegal activity, and seal predation, only elevated concerns throughout 1991 and 1992. As the size and abundance of cod harvests continued to shrink, the government placed a moratorium on cod fishing in 1992, depriving around 40,000 fishermen and fish plant workers of their livelihood. Although, the fishery was partially reopened in the mid 1990s, in 2003 the government re-closed three of the four open stocks indefinitely.

With the 1992 closure, the following measures were taken by the government to compensate the fishers and fish plant workers:

- Emergency assistance payments of \$225 per week for 10 weeks to approximately 19,000 Canadians who had either exhausted their Unemployment Insurance (UI) benefits or who did not have enough working weeks to qualify for UI.

- Development of a comprehensive plan to address income replacement and adjustment, as well as industry restructuring measures over the longer-term
- Establishment of a Task Force on Incomes and Adjustment in the Atlantic Fishery to examine the income structure in Canada's groundfish fishery and to recommend a long-term programme of income supplementation and stabilization to Human Resources Development Canada (HRDC) and DFO.

A two-year Northern Cod Compensation Adjustment and Recovery Programme (NCARP) was announced on July 17, 1992, comprising income replacement benefits, skills training, professionalization and certification, and options for harvesters to voluntarily take early retirement or to voluntarily retire their fishing licences. NCARP also provided for the costs pertaining to vessel tie-ups, selective fishing techniques, and the development of new fisheries to maintain land-based processing.

In 1997, limited re-openings of the cod fisheries took place believing that the stocks in these areas had sufficiently recovered to allow modest levels of commercial fishing. However, stock assessments conducted by DFO presented a bleak outlook, leading to the 2003 closure.

In announcing the 2003 cod closures, which impacted around 3,000 fishers and plant workers, the Canadian government allocated around US 31 million in community based economic development assistance, targeted to provide short-term employment for affected workers and to ensure that they can qualify for unemployment benefits over the next two years.

Few of the alternative livelihood options offered to the fishermen by the government and the lessons learned during the process are as follows:

- Crab and shrimp fishery – the federal government has overseen a major expansion of existing crab and shrimp fisheries in the region due to improved market conditions in the US and Japan. Therefore, the government were able to give some of the cod fishermen additional access to these alternative sources.

There are now signs that the crab fishery, which welcomed cod fishermen is reaching its limit. The crab quota in some parts was cut by 40 percent, compared to last year. The increased shrimp quota of this year has directly benefited those affected by reductions in cod and crab.

- Tourism – a major focus of government development assistance was to make an increased contribution to the areas economy through a mix of product development, training and advertising campaigns highlighting the cultural, historical and environmental features of the province. As a result, from 1992 to 2002, the number of visitors increased by 40 percent.

Organizing ecotourism programmes involving multiple communities rather than addressing each community individually, the development agencies can take advantage of opportunities of collective strength.

## 4.2 Culture Options

Mariculture has been identified as an important alternative income source for poor rural communities, whose present livelihoods practices are affected by depleting fish stocks. The governments around the world are now giving increased emphasis on the sustainable development of this industry.

### 4.2.1 Sustainability of Grouper Culture in Tubigon Municipality <sup>129</sup>

The municipality of Tubigon, in Philippines has a long history of destructive fishing. There are around 1,463 marginal fishers in the area and most of them are poor while 50 percent do not poses boats. An European Union funded, Local Government Development Foundation (LOGODEF) Mariculture project, was initiated to address the following elements in Tubigon:

- Environmental management and protection
- Livelihood and employment generation
- Economic development and promotion

Grouper culture was introduced in 1998 as an alternative to unsustainable fishing methods such as the use of cyanide and dynamiting. There are now 141 grouper culturists in Tubigon, and many of them were involved in some form of illegal fishing in the past. They are organized into nine groups in seven villages. Seven groups are financially and technically assisted by LOGODEF, while the other two groups are supported by a NGO. The groupers are fed with trash fish from illegal fishing operators, a practice not sustainable on the longer run. The LOGODEG fishery technicians contact the buyers and negotiate the price and arrange delivery for the fish.

In 1998, the Municipal Fisheries and Aquaculture Resource Management Council was formed, with the participation of fishers, government officials, and NGOs. It advises and assists the municipal government in implementing its coastal resource management programme. The strong local government commitment to eradicate illegal fishing was supported by several local and international agencies. The work done by them over the years has built an important “fear of getting caught” mindset among the community. This has encouraged the uptake of alternative livelihoods including grouper culture.

Following are some of the main factors that influenced the community to adopt sustainable grouper farming:

- Two key technical issues impacting on the ability of fishers to adopt aquaculture are the limited supply of wild seed and the trash fish. There is a lack of production technology for grouper fingerlings and feeds within the technical support agencies and private sector in the Philippines.
- Policy reforms, especially formulation of a local policy on coastal resources management, devolution of resource governance to local government units and the declaration of municipal waters as an exclusive zone for small fishers some other key issues to be addressed. .
- Capacity building for local government units led to a more responsive delivery resource management services by the concerned officials.
- The large scale of investment required, relative to annual income of fishers, constrains uptake of grouper culture. Therefore without the financial and technical assistance from organizations such LOGODEF mariculture project, this option cannot be adopted by poor communities.
- Resource governance programmes are more successful when they are the joint responsibility of government and its constituency, with external development assistance.
- One of the factors for the success of the dramatic reduction in the practices of illegal forms of fishing in Tubigon is the local market rejection of such fish.

#### 4.2.2 Overcoming Issues in Sustainable Mud Crab Culture <sup>130,131,132</sup>

Mud crab (*Scylla Species*) culture is a promising alternative to the declining shrimp industry within the Asian region and is profitable due to the fast turnover rate and good survival.

In Sarawak, Malaysia, mud crab culture started in 1991, as a pilot scale project in small ponds and due to its success the Department of agriculture promoted the activity among the artisanal fishers along the coastal areas. The pen culture system was introduced in 1992 and almost all these farms were subsidized by a scheme where a farmer can obtain a grant up to rm\$1500 per pen. The farming was undertaken by either individuals or as small community groups. In 1998, a mini-estate scale crab farm was initiated by a farmer organization of the area. With the increase in prices and demand from the domestic and overseas market, this mini-estate scale farms has attracted the interest of the private sector. Further development of this operation is restricted by several limitations such as: low and inconsistent survival of the larvae; limited seed supply (wild); misidentification of juveniles of four *Scylla* species; and bacterial diseases in crab larval production.

To overcome the unsustainable seed collection from the wild, a commercially viable hatchery technology has been developed in the Philippines. It is a collaborative venture between the Southeast Asian Fisheries Development Centre (SAFDEC/AQD) and the Australian Centre for International Agricultural Research (ACIAR). The hatchery process starts with the sourcing of females as broodstock and ends with the production of juveniles (See Box).

SAFDEC/AQD offers training courses to both local and foreign participants on mud crab seed production. Five locals, who participate in this training, have conducted trial runs on larval crab rearing in their respective shrimp hatcheries, while one has started operation on a commercial scale. Since 1998, farmers have grown the hatchery reared crab juveniles produced in SAFDEC/AQD in ponds and pens. Hatchery reared juveniles are easily acceptable to crab growers because of the advantages such as certainty of identification, uniformity in size and availability throughout the year. Growth performance is also similar to those from the wild-source juveniles.

##### Rearing of Mud Crab Juveniles in a Hatchery

- Mature females sourced directly from ponds or buying stations are disinfected with 150 ppm formalin for 30 minutes prior to stocking in tanks. Females spawn within 1-5 weeks depending on the stage of ovarian maturity upon sourcing.
- Unprocessed feeds for broodstock include mussels, squid, fish or polychaetes given at 10-15 percent of the biomass daily. Formulated diets at 2-3 percent of the biomass are given in combination with unprocessed feeds. The reproductive performance of broodstock is better in females fed on a combination of natural food and artificial diet than on artificial or natural food alone.
- Newly hatched zoea are immediately stocked in larval tanks at 50-80ind./l. The rotifer, *Brachionus*, is commonly fed to larvae as they are easier to propagate in the hatchery than other live food. Newly hatched *Artemia* are given to late zoea and larger larvae. Fish, mussel or small shrimp are the major food given to the early crab stages.

Following are some of the constraints encountered that hinders the commercial production and adoption by the private sector:

- Low survival rates from larval to juvenile stages (bacterial and fungal infections, cannibalism at all stages and limited knowledge on the nutritional requirements of larvae)
- Maintenance of large scale production of natural food
- Longer culture period.

### 4.2.3 Restocking Giant Clams <sup>133,134</sup>

Giant clams (Family, Tridacnidae) have been harvested for both subsistence and commercial purposes by coastal communities in the Indo-Pacific region. Traditionally, they were harvested for their flesh for human consumption, and their shells for ornamental and utilitarian uses. More recently, they have also been harvested for trade as aquarium specimens. Due to unsustainable exploitation of the giant clam capture fishery, as well as general deterioration of coral reef environments, many species of giant clam became locally extinct. This resulted in all giant clams being listed under the CITES in 1983, prohibiting international trade between its signatories. In the mid 1980s, several countries, donors, and regional and international research organizations set out to address this problem by developing technologies to propagate juvenile giant clams in hatcheries and re-establish them in the wild. These initiatives resulted in placement of cultured giant clams on coral reefs in 16 countries.



Source: Mike McCoy, [www.reefbase.org](http://www.reefbase.org)

The successful re-establishment of giant clams in most places did not occur due to the high costs associated with the production and release of large numbers of individuals to rebuild stocks. Juvenile giant clams need to be maintained in a nursery for 9 months, and then in sea cages for up to four years, before they are large enough to escape predation from rays, triggerfish and turtles. The facilities and labour needed for this process are beyond the capacity of many small island developing states and therefore many of the restocking initiatives have collapsed.

The second factor is poaching. Cultured giant clams rarely reach adulthood in the wild, except when placed in marine protected areas or reserves operated by communities or resorts.

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To overcome the above mentioned setbacks, The World Fish Centre (ICLARM) is developing and testing a model that links restocking to the farming of giant clams. This model is being developed in collaboration with 30 small scale farmers in Solomon Islands, who grow-out cultured giant clams for the aquarium market. The farmers are given 2 – 3 batches of about 1000 seed clams (*Tridacna derasa*, *T. squamosa*, *T. gigas*, *T. maxima* or *T. crocea*) each year. When the clams reach market size, the farmers set aside two percent of their produce for restocking. The farmers continue to rear these clams until they are large enough to place on reefs. The clams are placed in protected waters under the control of tourist resorts.

This method can be considered as a good practice for the following reasons:

- It provides a viable way of re-establishing giant clams at virtually no cost to governments of small island developing states. They are only responsible for licensing arrangements for farms and verification that the clams have been placed in the wild.
- Local resource owners (the farmers and their relatives) participate in restocking programmes by rearing the clams and then protecting them on reefs under their tenure. This participation develops a greater appreciation of the need for conservation of coral reef resources.
- Giant clams are restocked at a wide variety of locations, thus increasing the chance that propagules will be dispersed to suitable nursery habitats.
- Multiple cohorts are released over many years, which aids maintenance of genetic diversity among the restocked animals and reduces the risk of altering the gene pool of the remnant wild stock.

### Results and Lessons Learned

- Several batches of *T. derasa* have now been placed in the wild. It is evident, however, that they should not be released onto reefs until they reach a size of at least 200 mm shell length, otherwise predation can be severe.

- The method for restocking outlined here is dependent on a viable giant clam farming industry. The essential components of such an industry in Solomon Islands are a commercial hatchery, well-trained out-growers (village farmers), and an export market for the products.
- For the success of restocking giant clams, placement of each species on coral reefs should be done to maximize survival, growth and reproduction. The number of individuals should be placed in an aggregation to optimize the trade-off between maintaining genetic diversity and distributing giant clams to as many sites as possible.

#### 4.2.4 Programmes to Breed Coral Reef Fish

##### A. Polynesia <sup>135</sup>

Currently there are only five major commercial producers who are involved in captive breeding. Only about 30 species of marine ornamental fish (of the 800 species relevant to the trade), and some invertebrates (*Tridacna* clams, seahorses, shrimp) are presently bred in captivity.

A French based company has developed a new technique for the culture of larvae of marine fish and invertebrates, with a view to produce high valued sought after aquatic species (live aquarium species, lobsters, groupers, other edible fish and invertebrates). Other potential applications of this larval breeding method include aquaculture of local species, restocking in overexploited areas or tourist sites and the production of pharmaceutical, cosmetic or biological substances of marine origin.

The technique, which draws on over ten years of research in publicly funded laboratories is implemented in two stages:

1. Collection of the larvae, followed by rearing them to a commercially acceptable size.
2. The fish and invertebrates are then transferred to a breeding environment, which is designed to suit the needs of each species. Many of these animals are translucent at first and subsequently metamorphose into coloured juveniles. The technique thus produces domesticated animals that have become identical to their wild counterparts.

The first fish farm of this type has been set up on Moorea in Polynesia recently. Tanks that are specifically designed for the early stages of development are sheltered, while those in which the species develop into adulthood are in the open. The collecting devices are quite large (20m by 14m), and comprise several sections to canalise the flow of breaking waves, sort fish from debris, concentrate the fish and finally sort them by size. Over 250 species are being collected using this method.

Many of these are of commercial value, such as:

- Aquarium fish: red band fish, angelfish, butterfly fish, surgeonfish and wrasse
- Food fish: groupers, snappers, dolphinfish and jacks
- Invertebrates: crabs, lobsters, shrimps and octopus

This technique has several advantages over other methods used to catch fish for the aquarium and catering trades:

- It is ecologically sound, as it has no impact on the number of fish already living in the reef, as they are not part of the catch. This preserves the entire stock of breeding fish, which in turn ensures that the larvae collected are produced naturally.
- The method only collects a tiny proportion of the innumerable larvae. As the vast majority (90 to 99 percent) are killed by their natural predators by "saving" these juveniles, it helps to give the aquarium trade a more ecological image.
- This is a passive fishing technique, which uses collecting devices that are fixed to the outer parts of the reef, minimizing the damage to the reef structure.

- As the larvae are captured before they become established in the reef, they adapt more readily to captive breeding and therefore, mortality is lower than among individuals collected inside the reef.

A negative aspect of the technique is that successful implementation requires specific hydrographical and geomorphologic conditions, including a low tidal range and a well-developed barrier reef with water flowing continuously over it. Therefore, there is a need for developing new collecting devices that no longer depend on these specific conditions. This would benefit a larger proportion of reef users and thereby promote better resource management.

Although this technical innovation is environmentally friendly, its implementation requires large investments. Therefore, it should be able to target the high added-value markets. It can be presented to export markets as ecologically sound, a concept that is increasingly valued by consumers.

#### **b. Solomon Island** <sup>136</sup>

In the Solomon Islands, people collect around 150 species of aquarium fish from coastal villages for the export market. The live reef fish trade targeting the markets in Southeast Asia is centred on relatively few high value species. To overcome the overexploitation of reef fish species a new artisanal fishery was developed based on the capture and culture of post larval coral reef fish. The programme is undertaken by ICLARM in collaboration with Australian Institute of Marine Sciences and the Fisheries Division of the Ministry of Agriculture of Solomon Islands.

The objectives of the project are to:

- Investigate temporal variation in availability of post-larval reef fish near Gizo over a 30-month period.
- Compare the species composition of catches of post-larval fish in light traps and crest-nets and determine the effectiveness of the two techniques in providing juveniles fit for aquaculture and
- Develop methods for village-based grow-outs of selected species of post-larval reef fish.

Overall, catches have been low compared to results of tests using similar methods in Australia and French Polynesia. Therefore, if catches continue to be too low after a full year of sampling is done, it will be necessary to identify other sites. Since July 1999, valuable post-larvae have been reared from the available catch in concrete raceways with flow-through seawater systems.

A summary of the results of live rearing was as follows:

- More than 60 species belonging to 20 families were kept alive and fed in concrete raceways.
- Most fish (with the exception of butterflyfishes) readily accepted food such as fish eggs from a variety of species, live rock filtered plankton and a prepared food supply.
- Damselfish were the easiest to keep but they are not of high value to the aquarium trade. Butterflyfish belonging to higher value groups are the most difficult to rear.
- There appeared to be potential for capture and culture of some novel species for the aquarium trade, such as juvenile spiny lobster and cleaner shrimp. These species were well sampled by crest nets and seems fairly easy to rear.

#### **4.2.5 Pearl Culture in the Maldives** <sup>137,138</sup>

A UNDP funded review in 1995 found a potential for pearl culture in the Maldives using penguin shell, *Pteria penguin*, which is a commonly occurring species. Following the findings of the above review, the Government of Maldives and UNDP with financial support from the Japan Human Resource Development Fund, developed and implemented a Pearl Culture Pilot Programme (PCPP) in Vaavu atoll, which was successfully completed in December 2001.

The initiative sprung from the widely identified need to diversify the economy from its traditional mainstays - fishing and tourism, and to assist the people who were disadvantaged by the banning of the collection of black coral in 1995 (as part of an environmental protection policy). The project also addresses the structural changes in the Maldivian employment market, especially evident over recent years. Women who used to be employed in traditional methods of fish processing, are being pushed out of the job market by the modern techniques of freezing and canning. The men are increasingly leaving the fishing industry for more lucrative jobs in the capital island Male' and in the tourist resorts. Therefore, the present project particularly targeted women and youth in the remote islands. It aimed at providing them with livelihood opportunities in oyster culture, pearl seeding and culture, jewellery making, tourism, product transport, quality control and marketing.

The PCPP demonstrated the technical feasibility of the venture, developed culture techniques and trained several Maldivians in marketing techniques. In addition the PCPP demonstrated that penguin shell spat could be collected in large quantities.

Having developed local knowledge and technical expertise in the field, the team has now transferred the technology to a private group in Vaavu atolls who has started using the rafts to culture pearls. For the atoll's fishermen it is a particularly attractive proposition. Already with the means of transport and with the small amount of day-to-day maintenance and supervision required, they have the opportunity to enter pearl culture while continuing to engage in fishing.

A new project on Pearl Culture Demonstration, Extension and Marketing (PCDEMP) is proposed to lay the foundation for a commercial pearl culture industry in the Maldives. It is designed to further improve the technical and human resource capacity to develop penguin shell culture and the half-round pearl culture industry for commercial application.

#### 4.2.6. Seaweed Culture in a Remote Island <sup>139</sup>

In January 2000, the University Malaysia Sabah (UMS) initiated a pilot project to test the feasibility of introducing seaweed farming as a new economic activity to extremely poor coastal communities in the Kudat/Banggi offshore islands. The project was financed by the Ministry of Rural Development, and was carried out in collaboration with the Fisheries Development Authority and the District office Kudat. The red algae, *Eucheuma* sp were the seaweed used, as it was a well established viable economic activity in the district. One metric ton of the dried seaweed was priced between US\$ 500 -700.

During the very initial phase of the project it became apparent that most people were interested in short-term gains, believing that project support will not last for a longer period. Several approaches and strategies had to be adopted not only to introduce seaweed farming but also to ensure the confidence and support of the target communities. UMS came with a programme of "Integrated Village Development" with was a multifaceted integrated approach that considered the needs of the community and addressed them at the grassroots level. Other than seaweed farming the UMS provided chicken coops, renovated an old well and a pipeline, and trained youth in hotel management.

At the initial meetings with communities it became apparent that many were reluctant to try the new venture as it was situated away from their village. Therefore, UMS decided to take the project to the villages rather than trying to get the people to a new site away from home. After initial surveys confirmed the suitability of land for the set up of farms, five interested villagers were taken to the UMS nursery for one week training. Then, the trainees were assisted to set up their own farms and other interested villagers were invited to join in harvesting and replanting exercises. A small allowance and food were provided to all participants on an accepted government community participatory system. This attracted 18 families from the village to join the venture. In the first three farming cycles only two farmers earned a good income and problems such as severe predation by turtles and fish, and storms discouraged the farmers.

Initial attempts to grow seaweed seedlings transported from a nearby island ended in failure due to poor quality of the seedlings. To overcome this a senior project personnel visited the seaweed farms in Semporna and selected good quality seedlings. A nursery farm was established to overcome seedlings requirements in expanding farms. Another strategy used was to encourage farmers to produce good quality seedlings to be used in new farms. The absence of buyers and market facilities was temporarily solved by the purchase of seaweed by the UMS itself. This arrangement needs to be replaced by a better system for long-term sustainability of the industry.

The UMS Eucheuma seaweed project slowly moved towards the project target of poverty alleviation. By the end of 2001, 31 farmers were actively engaged in the project.

### **Lessons Learned**

- Poverty alleviation requires a fairly long-term effort and holistic approach by dedicated and committed project personnel with an ability to win the confidence of the community.
- Integrated village development taking into consideration the culture, traditions and aspirations of the local community appears a good practical approach
- Motivation comes through success at making money, and therefore there is a need for a project to be flexible to seize opportunities to introduce other economic ventures such as farming, working in hotels etc.
- A committed team and regular evaluations as well as monitoring (possibly by an independent group) are necessary elements for the success of a project.

## **4.3 Ecotourism**

Ecotourism can be identified as a means by which communities can raise their standard of living without unsustainable exploitation of coral reef resources. It has the potential of offering the involved community members with alternative livelihoods while increasing the economic value of the reef, which in turn creates incentives for effective and sustainable management of the resource.

### **4.3.1 Coral Reef Conservation Through a Private Venture <sup>140,141</sup>**

Chumbe, Island in Tanzania, is situated 8 miles southwest of the town of Zanzibar, covering an area of approximately 20 ha. It is an uninhabited island bordered on its western shore by a fringing coral reef of exceptional biodiversity and beauty. Tanzania's coral reefs have been severely damaged by decades of destructive fishing, particularly with dynamite.

Chumbe Island Cora Park Ltd. (CHICOP), a private venture was established in 1991 for the sustainable management of the island. Based on the initiative of CHICOP, the island and a part of the fringing coral reef was gazetted in 1994 as a protected area by the government. CHICOP was given management rights of the park. Studies on the initial state of the environment were carried out in 1993, along with inventories. A management plan for the park for 1995-2005 was drawn up with the objective of creating a model sustainable conservation area in which revenue from ecotourism is used to support conservation and educational activities.

An Advisory Committee representing the relevant ministries, the Dar es Salaam University's Institute of Marine Sciences and village chiefs from neighbouring villages was established as a focal point for discussions on park management. About two thirds of the investment costs were financed privately by the project initiator while several project components, such as the construction of the visitors centre,

biological baseline surveys, the Aders' duikers sanctuary, the park rangers patrol boats and nature trails received some funding from donors.

The park's hotel installations (eco-bungalows) were designed with environmental protection in mind (local plant materials, rainwater collection, solar panels, sewerage and recycling of some of the wastewater for watering). The toilets work on the principle of anaerobic composting and are particularly well suited to conditions on a coral islet as no excess nutrients or pathogenic germs are released in wastewater.

Six fishermen from neighbouring villages have been trained as park wardens and are now stationed on the island. They patrol the reefs and forests, carry out some monitoring operations in the protected area and act as guides for the local population and tourists. They have played a particularly important role in raising awareness among fishermen, whose behaviour towards the park has become much more positive. The wardens assess various parameters on a continuous basis including breaches of park regulations and monitor impacts on the reef, such as coral bleaching or storms. Underwater itineraries with information panels on reef organisms have been created as well as information brochures and educational material. Training and education is provided for park wardens, fishermen, children from neighbouring schools and tourists visiting the park.

### Results and Lessons Learned

- The fact that the local communities did not use the reef previously for subsistence purposes very likely made the park's creation easier. It is unlikely that the park could have been created under the same conditions if the area had been part of traditional local fishing grounds.
- Reef monitoring operations have shown that protection has been effective: coral diversity and abundance are high, with 90 percent of all East African species represented; both the quantity and diversity of fish stocks have also increased. The park is one of the best preserved of all Tanzania's marine areas.
- The project has shown that a private protected area can be of major benefit to local communities especially by strengthening their skills, conserving biodiversity and restocking commercial species. The coral sanctuary provides a refuge for threatened species that are heavily exploited elsewhere along the coast. Studies of marine currents in the area suggest that adjacent fishing grounds are being restocked by species breeding in the coral sanctuary.
- As conventional marketing methods such as advertising in the media and participation in travel fairs were too expensive for a small project, CHICOP successfully chose a different strategy that included recognition by the international conservation community, international environmental awards and targeted marketing over the Internet.
- Conflicts with the authorities and fishermen became problematic on several occasions but the local populations now have considerable respect for the project, thanks to the hard work and patience on the part of the park wardens. There is no effective official policing of the park, and the wardens' explanations and demonstrations of the positive impacts of a protected area on fish stocks, patrols and non violent handling of damaging practices have gradually raised awareness among local people. Fishermen from neighbouring villages are refraining from fishing inside the park's boundaries, and are also reporting an increase in catches since the sanctuary was established.
- Because many different government officials and agencies were involved in numerous negotiations and discussions both prior to the park's establishment and in the preparation of management plans, the project has also helped to enhance awareness and understanding of environmental issues among local and national authorities. As a result, the law on environmental

management passed in 1997 stipulated that private management may be authorized for protected areas.

- Although private investment may be seen as inherently more sustainable than donor funding, it carries a number of risks when the political climate is uncertain as well as unfavourable. At present, the Tanzanian authorities are treating CHICOP in the same way as any other tourist operator with no particular consideration for its important contributions to environmental protection (E.g.: it is not being granted any tax relief) Some of the innovative and environmentally sound technologies used to build the park's installations such as the compost toilets are very costly. This increases tourist prices making it difficult for CHICOP to compete with low cost tourist destinations.

#### 4.3.2 Artificial Reefs Giving a Boost to Tourism in Bali <sup>142</sup>

Pemuteran, situated in the western side of the Bali National Park, has the largest area of shallow coral reefs that are easily accessible. As the area is located off the main tourism centres of the south, the reefs were unspoiled. The reefs near to the beach where most hotels are located were declared as no fishing zones by the community and were used only for ecotourism. Banning the blast and cyanide reef fishing has enabled the preservation of the resources, which in turn attracted a large number of divers and snorklers to view the corals. As a result more hotels and dive shops were built in the area making tourism earnings a major contributor to the local economy. The community who were poor with very few cash earning jobs quickly grasped the importance of ecotourism as a positive income earner. To ensure the conservation of the reefs education, protection and regeneration programmes were conducted.

Due to the 1998 economic crisis the vigilance in enforcing fishing bans became poor. As a result, a large number of fishermen from neighbouring communities in Java and Madura islands started to fish in the area. The destructive fishing techniques used by them steadily destroyed most of the Pemuteran's reefs. By the time the law enforcement was initiated, the reefs were mostly pile of broken rubble with no fish.

To overcome this situation, the hotels, dive shops, village fishermen, scientists and conservationists united and initiated the Pemuteran Coral Conservation Project. From 2000 to 2002 several artificial coral nurseries were installed in the beachfront area. Low Technology Mineral Accretion (Biorock™ – See Box) methods were used to restore the damaged coral reefs and reef fisheries. All the corals used for this activity were from broken pieces found on nearby reefs. As of May 2002, there were 22 Mineral Accretion coral nurseries spanning an area of 222 m in the 2.4 ha Pemuteran village protected area.

The fishermen are eager to see the coral nurseries expanded and fish habitat constructed in areas near to their fishing grounds. They protect the reef nurseries and keep records of the fish caught as a part of an experiment to improve the fisheries. Beside the economic interest of improved subsistence fishing the locals have taken the initiative to start dolphin watching tours. With the coral regeneration and fishing bans in the bay, spinner dolphins have returned in significant numbers. The village also retains rights to all snorkelling income from tourists. These alternative sources of income serves to reinforce their basic understanding that fish are more valuable when they can be viewed repeatedly by divers and snorkelers, versus their value as a single meal.

##### **Biorock™/ Mineral Accretion Technology for Reef Restoration, Mariculture and Shore Protection**

This technology is a method that applies safe, low voltage electrical currents through seawater, causing dissolved minerals to crystallize on structures that grow into a white limestone similar to that which naturally makes up coral reefs and tropical white sand beaches. This material has strength similar to concrete. It can be used to make robust artificial reefs on which corals grow at very rapid rates. The change in the environment produced by electrical currents accelerates formation and growth of both chemical limestone rock and the skeletons of corals and other shell-bearing organisms.

The local fishermen are eager to educate colleagues from other areas about the new methods so that they can be applied in other areas preventing encroachment on Pemuteran's fishing grounds.

They also have shown a preference to fish farming to secure sustainable fisheries and tourism for future generations. New research and training programmes in coral reef restoration, mariculture and ocean energy development will be implemented in the near future with the financial support from several organizations. At the National Coastal Zone Management Conference, the Pemuteran project was selected as the best coastal project in the country.

### 4.3.3 Consortium Togen <sup>143, 144</sup>

Consortium Togen is a joint project by Conservation International and the local non-governmental organization YABSHI (Indonesian Foundation for the Advancement of Biological Sciences). Since 1996, the project has focused on ways of integrating conservation and development in the remote Togen Islands, which is an archipelago of about 50 small islands in the Tomini Bay of Central Sulawesi, of Indonesia. The islands are rich in both marine and terrestrial biodiversity and a survey conducted in 1998 found around 400 coral species including 26 previously unknown to science.

The archipelago supports some 37 villages containing 27,000 people who are either farmers or fishermen. Activities such as unsustainable logging, and destructive fishing practices (dynamiting and poisoning, and oyster farming) are threatening both the islands biodiversity and the livelihoods of its inhabitants. As a solution to mitigate these destructive activities, ecotourism was developed in three villages.

The Consortium's support of ecotourism is being implemented through four steps:

1. Information gathering on both the tourists and attractions by means of a feasibility study.
2. A process of community development and empowerment by holding community meetings and training to improve local awareness of ecotourism possibilities and facilitation of meetings between tourists and locals to give the community further insight in to the needs, wishes and expectations of modern tourism.
3. Using the knowledge gained by the first two steps the marketable products are developed (e.g. a small group in Lembanto village developed a 375m boardwalk in a mangrove forests without cutting or destroying a single mangrove tree).
4. Consortium assisted the community to develop a marketing programme that links local and international tour operators.

This initiative has arisen from the Togen people themselves who were complaining about their small role in tourism activities and the involvement of outsiders who reaped the local benefits. The locals formed the Togen Ecotourism Network (TEN) to capture more benefits from tourism. Membership is open to all villages who are willingness to participate in ecotourism activities. Members include accommodation owners, vegetable farmers, and traders in salted fish, fishermen and tourist guides.

With the support of the Consortium, TEN is now implementing the following activities in accordance with ecotourism principles:

- Developing a community-based ecotourism model
- Increasing community awareness towards conservation
- Minimizing the environmental impacts of tourism activities
- Optimizing the generation of income from ecotourism businesses
- Providing job opportunities.
- Building capacity of ecotourism operators
- Promoting ecotourism to the wider Togeian community and
- Enhancing cooperation between local and the local and regional governments.

#### **4.3.4 Tourism Development at the Sanya Reserve <sup>145</sup>**

The Sanya Reserve is the only national coral reef reserve in China. Established in 1990, the reserve has a total area of 56 km<sup>2</sup>, of which about 50km<sup>2</sup> is in coastal waters. The coral reefs in Sanya are a source of income for coastal populations that derive their livelihood from the resources.

A management office was set up in 1992 with the initial aim of monitoring and ending the destructive activities in the area through education and law enforcement. In 1995, the authority in collaboration with a local enterprise initiated an experimental tourism venture as an appropriate use of coral reef resources. The activities included permitted underwater sightseeing of coral reefs from glass-bottom boats, swimming and water sports.

As Sanya city was named as one of the 119 major national scenic spots, two parts of the reserve have become tourist resorts for viewing coastal and underwater coral reefs. In 1997, around 1.3 million people visited Sanya City and about half of the tourists directly or indirectly participated in activities related to coral reef ecosystems. Part of the revenue received, has been used in the construction of substations of Sanya Reserve and for management activities.

This experiment appears to be successful in that alternative sources of livelihood have been established while the coral reefs appears to be protected. Although the tour operators are trained to disseminate environmental messages to visitors there is a need for monitoring the programmes, as the reserve is already subjected to increasing pressures from tourist activities. Therefore, when developing similar projects the authority should closely monitor the carrying capacity of the reef sites to ensure that the reefs are protected.

#### **4.3.5. Other Ecotourism Options <sup>146</sup>**

##### **A. Low Cost a Accommodation in Family Owned Guest Houses**

Prainha do Canto Verde in Brazil, is one of the last typical villages of country's lobster fishers, where the establishment of three family owned guesthouses have succeeded in preserving the natural beauty and traditional way of life from the invasion of large scale hotel developers. A room for two will only cost between US \$ 10-15.

The owners of the accommodation and all the other tourist service providers are members of the Community Cooperative for Tourism and Handicrafts called COOPECANTUR. Therefore, the tourism project of the village is managed by the organized community and over 80 percent of tourism revenue stays in the village and helps to keep the local economy going. Besides revenues from fishing which is the principal economic activity, tourism, arts and handicrafts assist the economy. The cooperative in close collaboration with the local high school provides professional training and through regular workshops raises awareness of the dangers of tourism, drugs and prostitution.

This makes a big difference when compared to villages where tourism has been developed from the outside and where drugs, prostitution, criminality, high prices and low income make life for the local communities very difficult.

##### **B. Keeping Traditional Lifestyles Intact With the Assistance of CBOs <sup>147</sup>**

Koh Yao Noi and Koh Yao Yai are two of the larger islands located east of Phuket in Phangana Bay, Thailand. Communities on these islands are Muslims and keep their traditional culture and have been largely unaffected by the tourist boom in nearby Phuket. In addition to traditional prohibitions, local

villagers have included a ban on destruction or collection of natural resources such as seashells and corals.

Here the tourists can enjoy the simple life styles of local fishing communities, traversing the many small islands and fishing during the day and staying in traditional homes in the evening. In the islands, the community-based organizations are well organized and managed with broad based participation. Local villagers set forth a comprehensive plan for tourism development including their own patrol boats to control encroachment and over fishing. The locals act as tour guides and control the number and frequency of visitors.

Lessons learned show that having strict moral codes of conduct and being well organized made it easy to establish a prohibition on degrading local natural resources, while at the same time earning a livelihood through ecotourism.

### C. The Coral Gardens initiative of Fiji and Solomon Islands <sup>148,149</sup>

The Coral Garden Programme is a unique coral reef restoration initiative that rehabilitates reefs while sustaining rural livelihoods in the Melanesian archipelagos of Fiji and the Solomon Islands. It is a community based initiative developed by Counterpart International and its Pacific partner, the Foundation for the Peoples of the South Pacific, Fiji (FSPI).

Developed by acclaimed biologist Austin Bowden-Kerby, Coral Gardens programmes assists the island communities to:

- Restore dead or degraded reefs and enhance reef habitats through removal of crown-of thorn starfish, creation of giant-clam and sea cucumber spawning aggregations and mangrove planting.
- Build new reef patches by replanting to improve local reef environments and foster growth of reef fisheries by providing new habitats for juvenile fish stock.
- Map the marine resources by utilizing participatory learning and assessment techniques
- Identify threats and design and implement action plans including community based no-take sites (marine protected areas)
- Accelerate natural coral reef formation and recovery, the development of no-fishing marine protected areas and the stewardship of reefs by the local communities who own them.

The programme promotes alternative livelihoods to reduce community pressures on the reefs including “green” coral aquaculture and ecotourism. Luxury resorts such as the Shangri-La in Fiji are helping to conserve and highlight the aquatic splendour by hiring local “reef guides”, trained by the programme to share the reef’s beauty with the 400,000 guests who visit Fiji annually.

### D. Floating Glass-bottom Rafts <sup>150</sup>

This glass - bottom raft will serve as an off shore floating place for aquaculture and tourism as well as a place for demonstration plotting. This idea that originated from “Glass bottom boat” model, can be taken apart from the raft and it can help visitors to see deep into the water. The raft with a wooden frame and floor was made by plastic barrels.



Source: [www.marine.org/ima\\_vietnam/](http://www.marine.org/ima_vietnam/)

## CHAPTER 5

# Summary of Findings and Recommendations for Future Initiatives

### 5.1 Summary of Findings

Given the wide range of threats facing the survival of coral reefs in Sri Lanka, especially from sea coral mining, the use of destructive fishing techniques (dynamiting, moxy nets etc), and over harvesting of reef species, it is becoming increasingly important to properly manage the remaining reef resources sustainably. The actual number of people involved in destructive livelihood practices and their levels of dependence are either not well documented or the data is outdated. For example, most of the comprehensive studies on coral miners are from the 1980 –1995 period and therefore the more recent impact and emerging issues are not clearly identifiable.

Attempting to mitigate or halt the destructive activities are complex as any measures taken to change the access to resources are felt right through the community. For example, banning sea coral mining will not only affect the miners themselves but the collectors, lime kiln owners and kiln workers as well. Similarly, changes in access to fishery resources can impact a range of people starting from fishers, fish traders and a variety of others associated with the industry. Many of these affected people are from the poorest sector of the community; therefore, when introducing legislation to regulate the use of natural resources, it is important to consider their needs for survival. Alternative livelihoods through income diversification offer one such option to assist the affected community while also preserving the resource sustainability.

Over the past few decades there have been various attempts by the governments, NGOs, CBOs and other interested parties (donors, researchers etc) to introduce alternative livelihood options as a management tool for sustainable utilization of coral reefs and associated ecosystems. Most of these initiatives were done on project basis lasting only for a specific period. There is only limited evidence on the extent to which these programmes really assisted in improving the condition of the natural resources because of the lack of monitoring and weak evaluation and impact assessment.

The livelihood initiatives that have been tried out so far can be grouped under the conditions that they were implemented: Sustainable management of a MPA; to compensate prohibited activities outside MPAs; to reduce pressures on natural resources that are not protected; and to empower communities in the decision-making process. A detailed description is given below.

#### 5.1.1 Sustainable Management of MPAs

MPAs aim is to reduce pressures on coastal and marine resources by legally declaring them as no take zones and allowing the habitats to regenerate naturally and continually. The limits of prohibition depend on the legal status of the MPA. The decision makers have now realized that traditional approaches in protected area management (command and control method) without benefits to the community are not sustainable in the long-term. This was clearly demonstrated in land-based protected areas such as Sinharaja tropical rain forest in Sri Lanka, where previous management policy prohibited activities other than conservation, research, education, and recreation. Similar situations occurred at the Hikkaduwa MPA. Although, its protection was upgraded from a Sanctuary to a Nature Reserve and recently to a National Park, implementation of the regulations has always been problematic. For example, to control

the number of glass-bottom boats operating within the protected area, alternative user options for the extra boats should be identified. The feasibility of using these boats in adjacent mangroves for bird and crocodile watching is one such option. Encouraging the use of glass-bottom rafts is another viable management option.

Recently the Pigeon Island in the East coast of the country was upgraded to a National Park, recognizing its importance as a tourist destination. Effective management of Pigeon Island as well as the Rumassala, and Unawatuna near shore reefs will require strong commitment from the community. Direct benefit from the management options will motivate the community to protect and restore the reefs.

As indicated in Chapter 4.1, the sustainability of a MPA depends upon developing new products and markets to assist the local communities whose livelihoods are affected or who were displaced as a result of the MPA. Therefore, the management goals of a MPA should ensure a healthy future for the area by safeguarding livelihoods, while promoting sustainable use of natural resources through encouraging environmentally sensitive development. For this purpose, the managers should be able to offer more than one alternative livelihood option to the community. Globally ecotourism has been recognized as an option that can generate multiple economic activities. A range of employment opportunities can be derived from ecotourism ventures (park rangers and other park management services, tour guides, tour operators, hotel services, sales outlets, etc).

In a country like Sri Lanka it is more appropriate to link nature based tourism with cultural tourism as the combined approach will be more marketable in the international arena. It is a well known fact that most foreign tourists visiting the country prefer to enjoy both the biological and cultural diversity. Visitor centres with a wide range of user facilities, community based home-stays and eco-lodges can be developed especially in the Southern and Eastern coastal belts of Sri Lanka. These areas also offer a wide variety of other tourist attractions such as scenic beaches, landmark buildings such as the Galle Fort, lighthouses, religious establishments, as well as large variety of biodiversity (marine turtles, whales, a variety of birds, elephants etc). The SAM Plan for Hikkaduwa identifies activities such as sports fishing using small boats in the non-monsoonal season, boating and canoeing in the lagoon and day tours in real fishing boats as potential employment opportunities.

Most of the reefs in Sri Lanka have less potential in developing dive tourism, as the live coral cover and biodiversity associated with the reefs are poor. Therefore, construction of artificial coral reefs can be a way to improve the diversity as indicated in section 4.3. For this purpose, it is important to involve different stakeholders such as dive operators, divers, hoteliers, research organizations and CBOs. Diving for shipwrecks is another important activity that can be promoted more widely.

The larger tourist resorts can contribute by giving more employment opportunities to the locals, especially to the younger generation with more education. Schools and technical training institutes can play a more proactive role by providing training in foreign languages and hotel management.

In the Bar Reef Marine Sanctuary (BRMS), which is situated further away from the main tourist routes as well as 14 km from the mainland, promoting ecotourism should be done in a different manner to the nearshore popular tourist spots. Here, home-stays and ecolodge concepts are more feasible. At the biologically rich Rumassala MPA, it is important to consider the entire mountain and the reef area as a single management unit for sustainable ecotourism development.

Activities that are hard to control within an MPA can also come from destructive resource user outside of the community (eg; migratory fishermen). In such instances managers as well as the communities should be empowered to tackle the situation. For example, in Port Honduras in Belize, to control the pressure on fishery resources from the fishermen in neighbouring countries TIDE worked with similar organizations across the border to familiarize them on its activities. TIDE is also a founding member of the Tri National Alliance for the conservation of the Gulf of Honduras (see 4.1.2). As most of the coral

reefs in the country are “open access” resource, there is a need to establish some form of “ownership” among the community through a governmental control system such as issue of permits and through additional educational and awareness activities.

### **5.1.2 As Compensation to Prohibited Activities Outside MPAs.**

Prohibition of activities such as sea coral mining, use of destructive fishing gear and harvesting certain size classes or whole species outside MPAs can be considered under this category.

Sri Lanka has more experience in dealing with single destructive activities mentioned above with community participation than in MPA management. For example, to overcome illegal sea coral mining, alternative livelihoods such as fishery, agriculture and poultry farming were offered as compensation, but were not successful due to various reasons as described in Chapter 3.1.

Although the community-based approach in turtle conservation in Rekawa has given more positive results, its sustainability is now threatened by lack of collaboration and cooperation between different stakeholders involved (Section 3.4).

When an activity is declared as prohibited, as recommended in the case of adjusting to Cod closure in Canada (refer 4.1.3), it is important to provide emergency assistance to the community and to develop a longer-term plan addressing income replacement and adjustment, as well as industry restructuring measures.

Most countries have tried out mariculture as an option to mitigate overuse of a resource. Grouper culture and mud crab farming are the more developed culture practices while marine ornamental fishery breeding is still at experimental stages. But on a global level as the consumers have already demonstrated their willingness to purchase organisms that are collected in an “Environmentally Friendly” manner, there will be an increased demand for the cultured organisms in the future.

### **5.1.3 To Reduce Pressure on the Natural Resources not Protected by Law**

One management option tried in this regard was the introduction of a credit scheme for diversifying the livelihoods of fishermen. They were encouraged to start new productive land-based ventures to reduce the pressure on nearshore fishery resources. (Refer Section 3.2). Although the scheme was mainly for small loans, the credit was disbursed by the main commercial banks and majority of the fishing community were unable to meet the collateral requirements of these banks. Through the involvement of grassroots level organizations such as SANASA and Sarvodya-SEEDs and development of community groups for loan application these negative effects can be minimized.

To reduce reef fishery giving training to fishers as underwater tour guides is one economically viable option. The trained and certified people can be assisted to get jobs in resorts as Scuba diving and snorkeling is a big and a growing business throughout the world.

### **5.1.4 Community Empowerment in the Decision Making Process**

The impacts on resource stability can come from external sources such as through investors who do not live in the area and who may not be sensitive to local traditions in access, tenure and resource use (eg: Prawn farming). In such instances, it is important to empower the community to handle their own resources. Eg: In Rekawa a lowincome traditional coastal community was motivated to unite and self-regulate fishing pressures in the lagoon, so that the whole community could benefit. Here this united front prevented outsiders from encroaching the lagoon for prawn farming.

In community empowerment attention was also given to address gender issues. Here the main objective was to assist in promoting the skills of women and thereby improve their social and economic conditions. E.g. Introduction of income generating activities under the Small-scale Fishery project of the Bay of Bengal Programme (Refer 3.2.4).

The Muthurajawela income generating projects were mainly “starter” programmes that assisted in building a closer relationship with the community to implement a much wider programme (Refer 3.4).

## **5.2 Recommendations for Future Initiatives**

Introduction of a new alternative livelihoods for income generation is an activity that is embedded within a complex system comprising of social, ecological, economic and technological dimensions. The proposed livelihood options are financially feasible from the destructive resource users’ perspective as well as environmentally sustainable. If the option does not make financial sense, the community participation will not be forthcoming unless direct subsidies and or some other financial incentives are offered. This is an important factor to be considered in situations such as in dynamite fishery, where a person can earn a very high income within a day.

For the new livelihood option to be continued in the longer run it is essential to identify the factors that threaten its sustainability and to address them in an integrated manner. Following paragraphs describe some of the factors that need to be considered when introducing a new livelihood opportunity to a community.

### **5.2.1 Socio-economic Factors**

- A clear understanding of the demographic and socio-economic dynamics of the people involved in destructive activities are needed to plan and implement new livelihood ventures.

Some examples of such factors are as follows:

- Population growth rates in fisher families are higher than average population growth rates in Sri Lanka, but in some instances overexploitation of local fishery resources can take place as a result of migratory fishermen or if that area is acting as a refuge for displaced people (e.g: The Bar reef area got overcrowded due to the civil unrest in the North).
- As the division of labour between men and women varies among communities it is essential to be aware of gender specific roles in designing projects to reduce destructive activities through meaningful participation and equitable distribution of potential benefits. E.g. In the Southern part of the country, nearshore illegal sea coral mining is mainly done by women; over 15 percent of the households are now headed by females in the Easter Province as a result of the civil war.
- Religious beliefs can play a major role in accepting a new livelihood. E.g. Introducing inland aquaculture or poultry farming in Matara district will not give positive results as the community in that area are dominated by Sinhala Buddhists. These activities can be more suitable for communities dominated by Christians.
- Older people tend to resist changes while the younger generations are more susceptible to them and willing to participate in new ventures.
- The proposed income generating activities should not be developed only to absorb the potential labour redundancies in fisheries and other coastal related activities, but also to absorb increasing populations of working age.
- Agriculture (paddy, coconut etc) is still the most common livelihood among the people living in the coastal zone as well as the other parts of the country and it has been affected by factors such as less water availability or due to inaccessibility as a result of civil unrest. Assisting these people to involve in sustainable agricultural activities will reduce the pressure on coastal resources.

- When introducing new technologies through training programmes, educational backgrounds of the participants should be taken into consideration.
- The younger generation living in the coastal belt has a reasonable level of education and presently some are employed in activities such as repairing boat engines and diving equipment without any technical training. These technical capabilities can be improved by giving them an opportunity to enter into vocational training centres, in which enrolment standards should not depend on formal education alone. Skills development in areas such as carpentry and masonry can be promoted especially to meet the demand for new jobs. The younger generation can also be trained in electronics, motor mechanics and computer fields, so that they will be in a position to venture into “modern” livelihood options that are not directly depended on natural resources.

### 5.2.2 Management Factors

- A strong commitment from the central government is vital to end any destructive activities leading to coral resources degradation. The government should also support and promote economic diversification actions as a management option while strongly implementing the existing laws.
- The introduction of new livelihoods should be a part of a wider programme of intervention in coastal resources management (e.g. SAM plan), involving the participation of resource users and all the other relevant stakeholders. The small-scale income diversification approaches should be linked with national poverty reduction approaches such as the Samurdhi Programme or with line agencies such as the National Design Centre to achieve better results.
- More than thirty government agencies have sectoral responsibilities for coastal resources management in the country. If each of these agencies acts in isolation to implement their own work programme without consulting the other agencies, the long-term sustainability of a resource will not be possible. E.g. In Rekawa, the number of sea coral miners increased due to decreased agricultural productivity which was related to poorly planned irrigation. Therefore cooperation between Departments such as Irrigation, Agriculture, Coast Conservation, and the farming community for the rehabilitation of agricultural activities.
- The agency that is proposing an income diversification programme should not take the full responsibility for each and every activity identified, but should be in a position to give only the leadership and build up partnerships with other existing agencies in implement specific components of the project. E.g. when introducing an aquaculture venture, there is training and capacity building with inthe community as well as a research component that has to be conducted in collaboration with an existing mechanisms such as a university.
- The process of obtaining an agreement from a community on the possible types of alternative livelihood schemes requires enough time to allow people to discuss different options, negotiate disputes and develop the necessary level of consensus. Effective implementation of the scheme also depends on the process of information exchange, building of rapport and trust between the intervening agency and various stakeholders. Non-governmental agencies and community-based organizations such as fisher folk organizations and women’s groups can play a vital role in this. Before an alternative livelihood programme is introduced to an area, such organizations should be identified and strengthened. This will assist in the mobilization of community interest and support. A positive example in this regard is the use of educated youth as catalyst in the Rekawa SAM process.

- Rather than trying to introduce new concepts, promoting and upgrading economic activities that already exist within that area is more sustainable. For example the coconut industry is well established in few coastal areas. Various coconut based activities such as production of copra, oil, fibre and arrack distillation and small-scaled traditional industries such as coir rope, toddy, and mat production is already well established within the rural households. These ventures can be made more economically viable through introduction of new technologies for increased quality and quantity of the final product and by assisting in identification of existing/new markets. Local products can be promoted in the international market by value added approaches such as using attractive packaging to call attention to the fact they are locally grown or made. At the same time new products such as bricks and flowerpots using coir can be promoted.

Another example can be taken from crab culture. Here importing “fattened crabs” are more economical than water crabs.

- Provision of financial services such as revolving funds, micro credit facilities and community development funds especially designed for poor communities is essential for the long-term sustainability. These financial mechanisms should be flexible to changes occurring in an economic venture such as changing market forces.
- Constant monitoring and period evaluations of progress of the new livelihood venture with the assistance of an independent evaluator is essential to appropriately respond to changing conditions, solve problems, and implement management of environmental impacts.
- Experiences learned at each project should be documented and disseminated to policy makers and ground level managers. This is important as the principles of community based management of natural resources vary from case to case and therefore it is essential to ensure that the policymakers will consider each new venture as a different entity. This will also assist them to make relevant changes in the legal frameworks and in other supporting policies. For example in some instances institutional reforms should take place giving more authority to local agencies to manage the resource.
- Networking with other similar ventures carried out nationally or internationally will assist in duplicating positive results and evading the negative impacts.
- Public awareness programmes should also go hand in hand with the implementation of alternative livelihood ventures to obtain an overall success of the programme. It is important to make the public aware of the values of the reef, the factors affecting it and the ways it could be protected. People who have never seen the underwater life and who are damaging it inadvertently need to see how the reef grows and understand that through dynamiting they will only catch fish once but that they can earn more money in the long run by developing the reef area as a diving sport for tourists.
- The use of destructive fishing methods can be controlled through introducing new technologies that are not harmful to the reef ecosystem. The promotion of alternative sources of lime should be done under full-scale government patronage to mitigate sea coral mining.

### 5.2.3 Environmental Factors

Many of the alternative livelihood approaches introduced are mainly based on the existing natural resources of the area and therefore the sustainability of such ventures depends on paying attention to environmental factors.

- The new livelihood options should not be destructive to the natural environment and particularly should not waste local resources. Issue of environmental certification for environmentally sound ecotourism ventures and green labels for organic farm products are few examples.
- Development of standards and master plans specifying green zones, footpaths, biking trails, public access areas and zones within which construction is prohibited is also important in ecotourism ventures.
- When promoting aquaculture ventures, the availability of seed and feed should be assured and enforcement mechanisms should be in place to prevent unsustainable exploitations of the resource (control wild harvest and to regulate effluent discharges). Estimation and modelling of carrying capacity of species cultured and development of standards for monitoring are some other factors to be taken into consideration.
- Setting standards and guidelines for the edible fish and aquarium fish trades is necessary to ensure that these resources are not being exploited and misused.

# Annex 1

## Present Status of Reef Sites in Sri Lanka

Reef site	Reef description	Recorded destructive livelihood practices	Other Negative impacts
<b>North-Western Coast line</b>			
<b>Bar Reef Marine Sanctuary (BRMS)</b> <sup>11a, 18, 21,24 27, 31,37,38,61</sup>	Located near the Kalpitiya Peninsula in the Gulf of Mannar region, it encompasses an area of 306.7km <sup>2</sup> . The area contains two types of reefs; coral and sand stone reefs. The Bar Reef was declared as Marine Sanctuary in 1992 and can be divided into two parts: 70km <sup>2</sup> core area supporting true coral reefs and a 236km <sup>2</sup> buffer zone containing extensive sandstones, sandy patches, and sea grass beds. 138 stony coral species, and more than 300 reef associated fish species have been recorded. Marine turtles, dolphins and sharks are also found in the vicinity. Prior to the bleaching event in 1998, this reef was one of the biologically richest reef areas of the island.	Fishing is the main livelihood associated with the reef and is done on a limited scale. Destructive fishing practices such as over harvesting (ornamental fishery and Holothurians (sea cucumber), use of bottom - set nets, netting on coral patches, boat anchorage have been recorded.	Predation by <i>Acanthaster planci</i> Bleaching in 1998 resulted in near complete mortality of branching and tabulate species of <i>Acropora</i> and foliose coral <i>Echinopora lamellose</i> . The live coral cover was reduced from 78.5% to nearly zero. The number of butterfly fishers associated with the reef reduced drastically. Overgrowth of the filamentous algae <i>Bryopsis</i> has been recorded. During the rainy season (November-January) the turbid water from Puttalam Lagoon covers the nearshore reef area.
<b>Kandakuliya Reef</b> <sup>24,31,37,38,61</sup>	Kandakuliya reef located south of the BRMS can be described as a disturbed shallow reef, covering an area of less than 10km <sup>2</sup> . It consists of two coral reef areas, a fringing coral reef at the Kandakuliya point and an offshore coral reef at a distance of about 1.5 km from the coast. The live coral cover on the off-shore reef is less than 25%, mainly due to damage of destructive fishery, while the fringing reef had about 35% of live coral cover.	Heavy fishery that destroyed the shallow reef prior to 1998 has now ceased, if left undisturbed, the reef may recover over the next decade. But use of bottom-set gillnets and trammelnets to catch lobsters and finfish, use of moxy nets to catch ornamental fish, over harvesting, and Anchorage damage are still seen.	Near shore reefs are buried by sand due to beach erosion along the northern shore of the Kandakuliya village. Bleaching and predation by <i>Acanthaster planci</i>
<b>Mampuri Reef</b> <sup>38</sup>	The reef is located 1 km from the shore and the reef substrate is a mixture of sandstone and dead corallines. A flat sandstone reef was also identified in deeper waters (15m).	Edible fishery and Ornamental fishery	
<b>Talawila reef</b> <sup>37,38</sup>	The coral reef is separated from the beach by approximately 500m of sandy bottom. It is parallel to the shoreline and is about 1km in length and 200m wide. 85 coral species have been recorded. Common coral genera were <i>Favia</i> , <i>Porites</i> and <i>Galaxea</i> .	Netting for reef fishes and spiny lobsters	

<b>Western Coast line</b>			
<b>Negombo</b> <sup>11a,11b,31</sup>	The main reef site at Negombo is located approximately 20 km offshore. The shallowest part of the reef is at a depth of 15 m and consists primarily of <i>Porites</i> domes. No bleached corals were seen in early 1999 and live corals were in good condition. However, an increase in the amount of filamentous algae on coral rubble and dead coral was recorded in early 1999. The reef supports many less abundant ornamental fish species, particularly the long-nose butterfly fish ( <i>Forcipiger longirostris</i> ) and <i>Chaetodon madagascariensis</i> that are relatively rare in other areas of the West Coast.	Use of damaging fishing gear such as drift gill nets and bottom-set nets.	Spread of Filamentous algae on coral rubble.
<b>Colombo</b> <sup>11a,31</sup> Pitagala & Gigiripita  Vatiya  Palagala	Pitagala is located 10 km offshore at depth of 18m while Gigiripita is located 15 km offshore at depth of 35m, within the outer harbour anchorage in Colombo. Both reefs are large coral mounds, 2-3 ha in extent with corals belonging to the families Poriridae and Faviidae.  Located 4 km offshore at a depth of 27-30 km and consist of sand stone and old limestone slabs. Living corals are mainly encrusting and laminar growth forms.  The reef lies approx. 1 km offshore and live coral cover is sparse.	A greater threat exists from shipping. Serious anchor damage was observed Pitagala reef in 1999. Strong currents bring in gill nets, which are spread over the reefs and damage the coral.	Influx of freshwater and pollution during the rainy season  Although bleaching was recorded in 1998, recent surveys indicate that the reefs are completely recovered.
<b>Itipandama</b> <sup>11a,31</sup>	Itipandama reef is a sandstone and limestone platform at a depth range of 8-12 m situated about 1 km offshore to Moratuwa. Live coral cover was 22% in 2001	Intensive fishing using bottom set nets and gill nets.	Pollution from land-based sources (sediments, sewage etc)
<b>Southern Coast line (including Southwestern and Southeastern parts)</b>			
<b>Hikkaduwa National Park</b> <sup>11a, 18, 24, 25,26,33,45</sup>	Hikkaduwa National Park is situated within the Hikkaduwa resort area. The fringing reef of Hikkaduwa is separated from the shore by a 2-3m deep shallow lagoon. Within the lagoon numerous smaller inner reef patches can be found. A recent survey has indicated that 59% of the reef consisted of dead coral and coral rubble.  The sandstone/limestone reef outside the NP, contained coral in good condition.	Destructive tourism – damage due to anchorage and oil spills from glass bottom boats, sewage from hotels, live coral and shell collection as souvenirs, reef trampling  Destructive fishery – anchorage, discharge of oil and bilge water from fishing boats, over fishing and lobster collection and use of destructive fishing gears.  Ornamental fish collection, especially during night	The shallow reefs were completely destroyed by bleaching in 1998. Accumulation of sand and sediment within the lagoon appears to be the major facto that prevents recruitment and the healthy growth of coral.  Over growth of <i>Halimeda</i> algae on the reefs

<p><b>Rumassala Reef (Buona Vista)</b> 11a, 21, 24, 34, 35, 39</p>	<p>Rumassala Reef is a nearshore fringing reef located at the southeastern end of the Galle Bay at the base of Rumassala cliff. The reef covers an area of 500m x 200 m contained roughly within the 8m depth contour. The live coral cover of the reef system is around 20% in 2000. The reef mainly comprises of <i>Acropora</i> spp. 484 species of fish have been recorded from the reef area, which is the highest number recorded from a Sri Lankan reef. Green and leatherback turtles were also recorded from the reef vicinity. This area has been declared as a Marine Sanctuary from 2003.</p>	<p>The reef and the surrounding area provide rich fishing grounds for many traditional fishermen. 24.16% of the recorded species are exploited for the ornamental fish trade using moxy nets. Collection of Cave coral, <i>Tubastrea /Dendropyllia</i> sp and algae, <i>Halimena</i> sp for the aquarium trade. Using bottom set nets to catch spiny lobsters Use of Dynamite to collect large shoals of <i>Caranx</i>, <i>Rastrelliger</i> and <i>Sphyaena</i>. Edible fishery using cast nets, gill nets, line and reef trolling. Collection of coral as souvenirs by tourist, reef trampling and garbage disposal. The proximity to Galle harbor and the presence of a shell fish farm also affects the reef habitat..</p>	<p>Live coral cover reduced from 71% in 1994 to 20% in 2000 due to bleaching. Sediment discharge by the Weggal modara canal and soil erosion due to deforestation of Rumassala mountain Periodic dredging of the Galle harbour channel Predation by <i>Acanthaster planci</i> Over growth of the green algae <i>Halimed opuntia</i> and the green Didemnid Ascidiars Diseases attacking the <i>Porites</i> head coral and Coralline Algae lethal disease attacking the encrusting pink calcareous algae</p>
<p><b>Unawatuna</b> 11a, 24, 31, 40, 51</p>	<p>This nearshore fringing coral reef is situated east of Rumassala, close to northwestern shore of the bay and a granite rock reef. Species of coral recorded were <i>Porites</i> sp, <i>Pocilloproa</i>, and <i>Acropora</i>. Fish abundance is low.</p>	<p>Reef is utilized for minor edible fishing and ornamental fish collection. Destructive tourism related activities are affecting the survival of reef.</p>	
<p><b>Weligama</b> 11a, 11b, 24, 30</p>	<p>The fringing coral reef in Weligama is situated in an east-westerly direction parallel to the beach. Prior to bleaching, the live coral cover was 92%. Act as a natural harbor for the local fishing fleet.</p>	<p>Anchor damage by fishing boats. Extensive damage is being caused by the indiscriminate catching of ornamental species by snorkel divers using crowbars to chase fish into 'moxy nets. Tourists remove and trample the coral</p>	<p>Parts of the ref that died after the bleaching are now covered in <i>Halmeda</i> sp and filamentous algae.</p>
<p><b>Mirissa rock reef</b><sup>21, 24</sup></p>	<p>The reef is situated approximately 200m south of the Mirissa headland and is dominated by bolders.</p>	<p>Limited fishing including lobster collection using SCUBA as well as ornamental fish collection.</p>	
<p><b>Polhena Lagoon reef</b><sup>11a, 21, 23, 24</sup></p>	<p>The coral reef at Polhena is situated in shallow water and exposed to air during low tides. The reef extends 5-100m from the shore and parts of the reef are covered by sand from the eroding beach and sediment from nearby river. Live corals were more common at the eastern end of the reef, where branching <i>Acropora</i> and <i>Pocillopora</i> are present. The reef had a high percentage of coral rubble and 13% of the reef was covered by algae. The Polhena Rock Reef, which is located about 300m offshore is subjected to relative rough hydrodynamic conditions.</p>	<p>It's a popular tourist location for the locals. Destructive tourist activities such as trampling, reef walking during low tide, and collection of live coral as souvenirs. Using the intertidal area closer to the reef for coconut husk seasoning pans for coir industry has seriously damaged the reef Ornamental fish collection, lobster and octopus fishery</p>	<p>Sedimentation and suspended matter from the fresh water discharges; Domestic Sewage and discharges from small hotels</p>

<b>Tangalle</b>	Fringing coral reef protected by an array of granite rocks from the seaward side	Edible reef fishery. (Other destructive activities are not allowed by Sri Lanka Navy as the reef is situated well in front of the Navy camp)	Extensive growth of corallimorpharian species over the dead coral surface. Sedimentation from Tangalle fishing harbor expansion activities and from Kirama ara outflow
<b>Rekawa</b> <sup>41,42,87</sup>	Located on the northern side of the Rekawa headland, the fringing reef is 100-150m wide and 300 m long. This neashore reef lies in 2-3 m depth. It is geologically young and therefore not well defined. The southern end is subjected to heavy wave action. A preliminary survey has shown that this reef is not well developed and the corals grow intermittently on sandstone and crystalline rock substrate. 21 species of stony coral species and 38 species of fish has been recorded.	Sea Coral mining has destroyed much of the shallow section closer to the shore. Destructive lagoon fishing using bottom set nets to obtain colorful shells and occasional dynamite fishing. Use of moxy nets for Ornamental fishery. Small scale collection of sea shells such as chanks and <i>Melo melo</i>	The Proties pink-bad disease have been recorded Increased sediment inputs from rivers.
<b>Great Basses</b> <sup>11a, 31,</sup>	Great Basses Reef is not a true coral reef but a combination of rock, sandstone and old limestone on which isolated colonies of coral grow. A recent survey has indicated a healthy hermatypic corals in the reef.	The recent increase in the harvesting of chanks and ornamental fish may have an adverse impact on the fauna of this area.	
<b>Eastern Coast line:</b> Data is limited			
<b>Reefs in Batticaloa</b> Kalmunai reef <sup>31,32</sup>  Passikudah <sup>32,36</sup> Panichchenkerni reef <sup>32</sup>	The areas surveyed were located around Kalmuani, which is about 20 km south of Batticaloa.  These reefs lies surrounding the Sallativue island and are in good condition	Ornamental fish collection by diving Sea coral mining, dynamite fishery	In 1998 the entire shallow coral reef was bleached  The reefs were badly affected by bleaching..
<b>Reef in Trincomalee</b> Pigeon Island coral reefs <sup>11a, 31,62</sup>  Elephant island <sup>11a</sup>	Pigeon Island located off the coast of Nilaveli, consists of two small rocky islands covering an area of 4.6 ha. The islands are surrounded by fringing coral reef area of approximately 10,000 sq.m <i>Acropora sp</i> were the dominant coral recorded.	Un-controlled tourism and lack of adequate facilities for tourists. 1. Coral breakage from the motor boats 2. Souvenir collection 3. Haphazard waste disposal  Local people carry out dynamite fishery.	The reefs were completely destroyed by outbreaks of Crown of thorn starfish during the 1970s and early 1980s, but since recovered. Overgrowth of corallimorpharians.  The 2000 cyclone slightly damaged the reef.

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