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## 6 Profile and Status of Coral Reefs in Maldives and Approaches to its Management by Abdulla Naseer<sup>1</sup>

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### 1. BACKGROUND AND INTRODUCTION

#### 1.1 Location and Geography

The Maldivian islands are located just south of Lakshadweep Islands (7° 06'N to 00° 45' S latitude and 72° 13'E to 73° 45' Longitude) about 480 km South west of Cape Comorin, India and 650 km South west of Sri Lanka (Fig. 1). It comprises of 26 Natural atolls and some 1190 islands. The total length of the chain is 648 km north to south and 130 km east to west forming a double chain in the center.

#### 1.2 Atoll Geomorphology

The physical setting of the Maldivian atolls vary from open structures with numerous *islands*, *faros* (ring-shaped reefs) *patches* and *knolls* in the atoll lagoon and around the rim to almost closed structures with few lagoons, knolls and patches. Faros are ring shaped reefs emerging during tidal low water each with their own sandy lagoon and are separated by deep channels. They generally have a rim of living coral consisting of branched and massive types. *Patches* rise to 40 meters above the lagoon floor and are topped by robust wave-breaking corals, *knolls* do not reach the surface and often support profuse coral growth, as do the reefs associated with many of the islands

In geological time the filling up of the lagoons of faros by reef sediments has resulted in the formation of *coral islands*. The geomorphology of these islands varies tremendously in different atolls and it is influenced by a variety of factors such as location, climate, currents, tides, sea level change and also human factors. The islands are thought to be situated on top of layer of beach rock (about 1m thick), underlying the islands at about 30 cm to 60m above present mean sea level. At the edges of the islands the beach rock dips slightly seawards and forms a platform on which the beach sediments are seasonally transported around the islands. Within the atolls, the water depth is about 60 meters.

The islands are made up of coralline sand and have a very low elevation (on the average they are no more than 2 meters above sea level). The soil is highly alkaline, the water table is high and the vegetation is sparse. Main vegetation types are coconut palms and salt resistant plants and mangroves.

#### [Figure 1. Location Map of Maldives](#)

#### 1.3 Climate and Oceanography

The south-west and the north east monsoons play a major role in climate and oceanography in the Maldives. The climate is totally governed by the monsoons. The south-west monsoon (May -Oct.) brings rain and the seas are moderate to rough during the SW monsoon winds. The north east monsoon (Nov. - April) are marked by calmer and dry conditions. Surface currents and winds, humidity and rainfall and temperature and salinity are strongly effected by

the monsoons.

The absence of rivers and runoffs mean that sediments from inland sources are almost nil and hence the waters around Maldives are very clear and exhibit ideal conditions for coral growth. The Maldives is located outside the normal cyclonic zones and thus violent storms are rarely been experienced. Precipitation is on average 160-230 cm/year. Air temperatures range between 24° -31° C. Spring tides range from 0.3-1.2m. Tides are semi diurnal sometimes mixed.

#### **1.4 Population and Economy**

The islands have population of about 280,000 scattered thinly over 200 islands. The capital Male, with an area of about 4 sq. km and a population of over 60,000, is located almost in the center of the archipelago. The population is young, 50% of the population is under 18 years of age and the population growth rate is 3.4%.

Being a country with more territorial sea than dry land, Maldivians depend on resources almost entirely from the sea. The coral reefs, which built the country, play a vital role in the economic and social well being of the country.

Fishing and tourism are the two main industries of Maldives. Both these industries are very healthy with good potential growth rates. They rely on healthy reefs for their existence. The majority of fish caught are tuna and tuna-related species. Other reef dependent species of fish and invertebrates are also exploited.

Fishery production has increased from 82,000 MT in 1992 to over 104,000 MT in 1996. The export earnings from marine products has increased from RF 332 million in 1992 to RF 433 million in 1995 (1US\$ = RF11.82). The reef fishery especially for the live food fish has increased tremendously from 127,000 nos. in 1994 to 400,000 nos. in 1995. Total fish production in 1996 was 105,000 MT of which reef fish landing for 1996 was 14,600 MT.

About 70 of the uninhabited islands are developed as tourist resorts and in 1996 there were more than 300,000 visitors. Visitors are thought to be constrained by the number of beds available.

Industrial activities especially those relating to fishing and tourism are being developed in many atolls. Usually one island is developed for a particular economic activity. Tourist resorts and fish processing facilities are examples of such development. Over 80 tourist resorts are developed in Baa, Lhaviyani, Male, Ari, Vaavu, Meemu, Dhaalu and Seenu Atolls. Fish processing and cold storage facilities are situated in Laviyani, Gaafu Alif and Laamu Atolls. Laamu Atoll has also been declared as an industrial zone.

#### **1.5 Marine Ecosystems and Ecology**

The predominant ecosystem being coral reefs in the Maldives, much effort has been put into the study of diversity and dynamics of reefs. However the remoteness of many reefs and their wide distribution makes it all very difficult for research work. The reefs that have been best studied are in Male atoll, Ari atoll, and Addu atolls. Pristine reef areas are still found in many parts of the country. Hence the majority of reef areas are unexplored. Important ecological areas include:

##### *Open seas and deep seas*

The Maldives has more sea than land. Open seas and deep waters are important resource bases in the country. Very little work has been carried out to identify fauna of the open seas. Commercially important species of pelagic fish especially Tuna are abundant in the waters of

the Maldives and they are perhaps the best known of all marine animals in Maldives. Work is ongoing to study deep-sea fishery resources.

### *Coral reefs*

The Maldives is entirely made up of atolls and associated coral structures. Extensive and largely intact reefs are found in pristine conditions and comprises of perhaps the most complex reef systems in the world. Several of the atolls have unusual ring shapes reefs locally known as faros in the atoll lagoons each with its own sandy lagoons and rims of lining corals. The atoll lagoons also have numerous knolls and patch reefs.

### *Seagrass beds*

Seagrass patches are very often found in the shallow lagoons just behind coral reefs and various fish, molluscs and crustaceans inhabit the seagrass beds. It is widely believed that coral reef fishes migrate to seagrass areas for breeding. Seagrass beds are not very extensive in the Maldives and few studies have been carried out on these areas at ecosystem levels.

### *Mangroves*

Fringing mangroves are not found in the Maldives. Mainly depression mangroves are found in enclosed areas along the coast. Inland fresh water systems though very rare are found in some atolls.

Though a representative number of islands were surveyed during 1992, it was felt that there is a need to obtain more information on a countrywide basis. A clear pattern of distribution of mangrove species was observed during this initial study. For example *Brugiera cylindhca* (kandoo) was the dominant species in the northern atolls whereas *Rhizophora sp.* was the dominant species in the south.

## **1.6 Coral Reef Biodiversity**

The Maldives consists entirely of coral reefs the most diverse of all marine ecosystems. Coral reefs are known to host many levels of biodiversity ranging from planktonic organisms to sharks. The dominant species on reefs are corals and fishes. Both these account for a large share of the diversity of coral reefs.

Although the corals are the major organisms that form the basic reef structure, there is bewildering array of other organisms associated with reefs, such that these areas are perhaps the most diverse and species rich areas that exist in the marine environment today. Members of practically all phyla and classes may be found on coral reefs.

A total of over 1000 species of fish have so far been catalogued from the Maldives. Over 300 of these were recorded from the Maldives for the first time. Seven species have been described as new to science, several more await description. Over 400 have been identified and catalogued and many are now held in the reference collection.

Scleratinian corals of the Maldives have been relatively well studied. Descriptions of 147 species, and literature records of a further 94 species, making a total of 241 species have been recorded. The total number of coral species recorded from the Maldives to date is about 200, representing over 60 genera.

5 species of turtles have been recorded for the Maldives of which only *Chelonia mydas* and *Eretolochelys imbricata* are the most common two species that breed in the Maldives.

51 species of echinoderms, 5 species of sea grasses and 285 species of alga have also been identified. Studies on crustaceans, sponges, tunicates as well as deep sea fishes are being

carried out at present. Sponges have gained a special interest as five species have already being identified as having anti-tumor and anti-cancer properties.

A reference collection of all marine species collected so far is kept at the Marine Research Section of the Ministry of Fisheries and Agriculture. There are also a number of specimens that have not been identified.

## **2. PATTERNS OF CORAL REEF EXPLOITATION**

The marine environment is critical to the natural and cultural heritage of the Maldives. Marine ecosystems and resources are fundamental to the sustainable development of the country providing food, construction materials and a vast range of other products. It is widely believed that coral reefs in the Maldives are in a relatively pristine state, and of high aesthetic quality. However with increasing environmental pressures, rising environmental sensitivity, adverse effects may be felt sooner rather than later.

Apart from supporting a growing tourism and recreation industry, coral reefs also play a vital role in fisheries, and in the culture and life style of people in Maldives. Development undoubtedly effects the environment and bio diversity in a negative manner. Maldives is no exception. The traditional life style of the people had almost negligible impact on the marine environment, but recent socio-economic developments have led to deterioration of the environment. With the increase in population growth and increased wealth from tourism and fishing, the pace of development have increased at a significant rate in the country, during the last two decades.

The need for land led to land reclamation programmes. Harbours are dredged to facilitate economic growth in islands. The demand for building materials in the form of coral nodules has increased steadily and coral mining has become a major environmental concern in the country. In addition to this the country is faced with localised environmental impacts as a result of tourism and waste discharges. Tourism, reef fishing, coral mining, dredging, reclamation and the construction of maritime structures and pollution do have impacts on coral reefs. Both tourism and fishing, which represent the main industries in the Maldives, rely heavily on coral reefs.

### **2.1 Tourism**

Tourism began in the Maldives in 1972 and is now the largest industry in the Maldives. Tourist arrivals increased 300 folds from 1097 in 1972 to 338,733 in 1996. During the last 25 years of tourism development in the Maldives, positive growth rates have been recorded every year except for the years 1983 and 1986, which showed a slight decline. The number of resorts also increased over the last 25 years and there are 73 resort islands concentrated mainly in two atolls (Male and Ari Atoll). Tourism is a major source of revenue to the country. In 1996 revenue from tourism accounted for over 30% of the government's total revenue that amounted over 408 million Rufiyaa (Statistical Year Book of Maldives, 1997).

With the introduction of tourism in the Maldives, the coral reefs gained a major economic significance. Tourism in the Maldives is centered around coral reefs and relies on these rich and healthy reefs for the well being of the industry. Diving, snorkelling, water-sports, sun, and white sandy beaches are the major products sold for tourists in the Maldives. A significant proportion of the visitors who come to Maldives do so to enjoy and admire the beauty of underwater gardens of corals and the colorful fishes and invertebrates which inhabit coral reefs. If the health of reefs decline through ill-conceived management or other causes, then the tourism industry will be affected adversely. The tourism industry in the Maldives can only be sustained and prospered by proper management of its coral reef resources. Hence coral reefs are vital to the sustainable development of the tourism in the country.

It is evident that there are few serious environmental concerns in the tourism sector in the Maldives. Most resorts are conservation centers in real time due to high priority extended to the protection of the environment and to the management of the natural systems. Reefs happen to be one of the most important products the resorts are trying to sell apart from sun, sand and the seas. It is absolutely essential that reefs around resorts are maintained in healthy conditions. Hence many tourist resorts in the Maldives have stringent controls in the collection of fauna from the reefs. Collection of corals, shells and reef fishing are not allowed at tourist resorts. The government declared a tourism zone in the early stages of Tourism development in the country and this has certainly benefited the reef ecosystems. Sustainable use of coral reefs and successes in the development of tourism in the Maldives can be attributed to the following:

- One island - one resort
- Little intervention by locals and hence very few conflicts
- The government regulates and controls resort building and development efficiently
- It is the government who selects and decides which islands can be developed for tourism.
- Tourism zones has been established early in development
- Commitment by most resort owners to conserve reefs
- Awareness high among resorts on the marine environment
- Most dive centers at resorts are very committed to conservation and report illegal activities promptly
- Reef fishing and curios collection banned at resorts
- Pressure on reefs low due to wide distribution, scatteredness of resorts and hence the tourist population.

The second 10-year tourism masterplan has been drawn up for tourism development in 1996 and 14 islands have been selected for development under the plan.

There are localised impacts of tourism. Diver and snorkeller damage to reefs have been described. Anchor damage to reefs has been highlighted as a major problem in some areas. More recently concerns have been raised over the discharge of sewage and wastewater its consequences on the reef environment at some resorts. Sewage pollution needs to be looked into urgently.

## **2.2 Reef Fisheries**

Maldives is a large tuna-fishing nation and hence its people are very dependent on tuna fish for food. Reef fish are not widely used for consumption by the local people. Reef resources have been little used in the past and was limited to live baitfish for the pole and line tuna fishery. Major baitfish types caught are: sprats, juvenile fusiliers, cardinal fishes and anchovies. Live bait catches has increased dramatically over the last two decades. Over 10,000 tonnes of bait were collected from reefs around the country in 1994.

With the introduction of tourism in the 70's and rapid socio economic developments in recent years, a growing reef fishery has developed in the Maldives over the last two decades. The

reef fishery is now expanding rapidly. In the late eighties and early nineties new reef fisheries activities have developed. These are mainly export oriented and include giant clam, sea cucumber, groupers and aquarium fish.

The giant clam fishery, which started in 1990, was short lived. Two species were exploited (*Tridacna squamosa* and *Tridacna maxima*). Within six months of the fishery, stocks were exhausted and the fishery is now banned as a result.

The sea cucumber fishery began in 1985 in the Maldives and increased rapidly. Main species collected are: Prickly Red Fish (*Theilonota ananas*), White Teatfish (*Microthele nobilis*) *Holothuria atra*. The fishery reached a peak in 1990 and has fallen since then. The government has brought in restrictions on the fishery as a result of over exploitation. -SCUBA gear cannot be used to collect sea cucumbers by government regulations now in the Maldives.

The grouper fishery, which started in 1993, has increased dramatically. Due to high prices paid for groupers the fishery has expanded in a short period of time and its wide spread. There are already signs of over exploitation. Groupers are exported live and frozen.

The export oriented aquarium fishery began in 1980. The fishery increased steadily since then.-Concerns have been raised over the exploitation of rare species and several species are now banned from export. A quota system has also been introduced.

Reef fishing in general can be carried out virtually anywhere by the local fishermen. There are few restrictions as to where fishermen can fish except only around resorts and Marine Protected Areas. Concerns have been raised on the sustainable exploitation of reef fish resources and plans are underway to demarcate zones for reef fishing. Reef resources that are under pressure from over exploitation include giant clams, sea cucumbers, groupers, certain reef sharks, turtles, and corals. Management measures are being implemented to alleviate the pressure on these populations and reef resources in general.

### **2.3 Coral Mining**

Coral reefs in Maldives represent strategic natural offshore sea-defence. They are also important as habitat for baitfish and primary source of building material. Coral blocks have been historically mined and used for buildings and road construction. The coral blocks are extracted from shallow reef flats at 1-2 meters depth, with help of iron bars to break up the living coral. The lumps are break in smaller sizes, available to transport.

The biological and physical impacts of coral mining on reefs in Male" Atoll, Maldives were investigated by Brown and Dunne, (1986;1988). They reported that live coral cover on reefs subject to coral mining was very low compared to unmined reefs. Response of reef associated fish to coral mining was reported by Shepherd *et al.* (1992) and Brown *et al* (1990). Fish community structure was compared on mined and non mined reef flats and their adjacent slopes. Abundance of reef fish was found to be low on mined reefs compared to non-mined reefs.

The use of concrete blocks as an alternative to corals is now wide spread in the country as a result of the awareness programmes and due to regulations which came into effect recently. It must also be said that people are finding it increasing difficult to obtain corals for building purposes as a result of higher costs and regulations.

Corals are not used to any extent at Male, the capital island, and at resorts now for building purposes. Concrete blocks are manufactured in large quantities by the public and private sectors in Male to cater for the building industry. Of special interest is that the Ministry of Construction and Public Works now produce concrete blocks at low prices in large quantities

and sell them to the public at any quantity required.

### **3. CORAL REEF MANA CEMENT AND RESEARCH IN THE MALDIVES**

#### **3.1 Legislation relating to coral reefs**

The Ministry of Fisheries and Agriculture is legally responsible for the management of all issues and activities relating to marine living resources in the Maldives.

The Fisheries Law of Maldives (Law No. 5/87, 24-08-87) governs the management of all fisheries activities in the Maldives. Fisheries Regulations (1997) drawn under the Fisheries Law of Maldives and gives details and updates relating to fisheries regulations in the form of notifications and written regulations.

Specific destructive fishing practices are banned in the Maldives. The following are banned methods of fishing:

- Use of dynamite or explosives
- Use of guns and such devises to catch fish
- Use of any chemical to collect or catch fish
- Use of scuba gear to collect sea cucumber and lobsters

Under the Fisheries Law of Maldives special areas or species can be protected from exploitation or export if the need arises. The Fisheries Regulation gives details of protected marine species in the Maldives from exploitation and/or export. This is part of the steps taken by the government to conserve and manage coral reefs and the marine environment in a sustainable manner.

*Marine species banned from export (as of December 1996) in the Maldives include:*

- |  |                            |
|--|----------------------------|
| 1. Black corals                                | 9. Eels                    |
| 2. Trochus shells                              | 10. Bigeye scad under 6"   |
| 3. Triton shells                               | 11. Skates and rays        |
| 4. Pearl Oysters                               | 12. Dolphins               |
| 5. Lobsters and lobster meat-                  | 13. Whales                 |
| 6. All types of corals except organ pipe coral | 14. Parrot fish            |
| 7. Turtles                                     | 15. All types of bait fish |
| 8. Puffer fish                                 |                            |

*Marine species totally prohibited from collection or exploitation (As of December 1996) in the Maldives include:*

- |                  |   |
|------------------|---|
| 1. Dolphins      | 6. Napoleon Wrasse  |
| 2. Whales        | 7. Berried female lobsters and those less than 25cm in total length |
| 3. Whale shark   | 8. Black coral  |
| 4. Turtles       | 9. Giant clams  |
| 5. Triton shells |   |

Much effort have been put recently into the development of mariculture activities in the Maldives. Pilot projects have been carried out on the culture of seaweeds. Other projects in the pipeline include sea cucumber, lobsters, aquarium fish, giant clam and pearl oysters. Currently there is no aquaculture specific legislation designed to manage aquaculture ventures in the Maldives. Aquaculture activities are known to have adverse effects on coral reefs. Although there are no aquaculture establishments yet in the Maldives, temporary cages or



holding facilities are maintained for reef fish before they are exported live. Under the fisheries regulation government issued permits are required to set up floating or other cages to hold and rear reef fish species.

### **3.2 Regulations relating to Coral Mining**

The government is concerned about the environmental implications of coral mining. Prior to 1992 there were very few regulations as to where people could or could not mine corals. It was then simply a matter of protecting properties such as islands belonging to individual owners.

In 1992 new regulations were introduced to combat uncontrolled mining activities. The following regulations are now in effect in the country. These Regulations are now under revision.

- *Mining is not to be carried out on island house reefs.*
- *Mining cannot be carried out on atoll rim reefs and common bait fishing reefs.*
- *Applications are required to be submitted to the atoll offices through island offices by any one needing corals to build any structures and permissions need to be granted by the atoll office before any mining can be carried out.*
- *The island office is required to estimate the quantity of corals required for the applied construction work and hence should ensure that only the required amount is granted.*
- *Every island is required to keep a log book of the amount of corals mined.*

### **3.3 Environmental Legislation and Marine protected areas**

Government realises the urgency in its commitment to stewardship of the environments contained in the Agenda 21. In 1993, the Parliament enacted the Environment Protection and Preservation Act of the Maldives (law No. 4/93). Key elements in the Environment Law include the submission of an Environmental Impact Assessment report to Ministry of Planning Human Resources and Environment prior to implementation of any developmental project that may potentially impact the environment. Hence EIA's are mandatory for all projects relating to coral reefs. The law prohibits disposal of wastes, oil, poisonous chemicals or environmentally harmful substances within the territory of Maldives. Fines of up to Maldivian Rufiyaa 100 million may incur depending on the offence for environmental damage.

The Environment Act also paved the way for the establishment of marine protected areas and nature reserves. As a first step, 15 coral reef dive sites have already been declared as Marine Protected Areas on June 5 1995 (Table. 1).

These sites are protected under the Environment Act of Maldives and come under the jurisdiction of the Ministry of Environment. In addition a number of islands of ecological significance, for example as seabird roosting and nesting sites, are under active consideration for protection.

Recognising the difficulty of effectively managing multispecies reef fishery, the Ministry of Fisheries and Agriculture of Fisheries and Agriculture has recently proposed to declare two large areas as strict reserves, mainly to assist recruitment of the fisheries.

### **3.4. Organisations Involved in Coral Reef Management and Research**

Many sectors of the government are involved in the management of coral reefs and their

resources. The Ministry of Fisheries and Agriculture (MOFA) represents a focal point for many marine activities. The Ministry of Fisheries & Agriculture is responsible for the management of living resources in the Maldives. The ministry manages coral reefs and associated species. Law and regulations concerning the management of coral reefs are formulated by MOFA.

### *Marine Research Section*

The Marine Research Section (MRS) is the research arm of the Ministry of Fisheries and Agriculture. Its main fields of activity include biological sciences, coral reef ecology, marine fisheries, resource management and information services.

MRS was established with a mandate to undertake research in marine biology and fisheries, particularly the study of population dynamics of commercial fish, with an emphasis on management of the fishery. Fisheries research in coastal marine waters and reef conservation are the two main functions carried out at present. It had played a central role in coral reef research and management during the last 10 years. Many research projects both local and foreign funded have been carried out on reefs. It represents the major institution in the country responsible for managing and carrying out coral reef research work.

**Table 1. Established marine protected areas in the Maldives**

	Atoll	MPA	Location	Special features	Area
1	Lh.	Fushivaru thila	Channel south of Lh. Fushivaru	Superb hard corals Abundant reef fish; pelagic fishes. Manta Rays	100m
2	N. Male'	Makunudho o kandu	Channel to west of Makunudhoo	Corals; reef fishes; sharks.	100 x 2000m
3	N. Male	Rasfari	Outer reef of Rasfari Island	Grey reef Sharks, Manta rays	5000 x 1700m
4	N. Male'	H.P. Reef	Thila in channel between Girifushi & Himmafushi	Soft corals and gorgonians; reef and pelagic fishes; sharks.	100 m radius
5	N. Male	Banana Reef	Between Kurumba Club Med & Full Moon Resorts	Fish and corals	100m radius
6	N. Male	Giraavaru Kuda Haa	Inside south end of North Male Atoll	Corals abundant fish and stone fish	100m radius
7	N. Male'	Lions Head	Centre of Thila Falhu facing Vadho Channel	Sharks.	500m radius
8	N. Male'	Hans Hass Place (Kikki Reef)	West end of Galhu Falhu facing Vadho Channel	Corals; caves; reef fishes.	500m radius
9	S. Male'	Embudu Channel	Entire Embudu kanduolhi	Sharks; pelagic fishes.	Entire Channel
10	S. Male'	Guraidhoo Channel	Entire Guraidhoo kanduolhi	Corals; reef and pelagic fishes; sharks.	Entire Channel
11	Ari	Maaya thila	Thila to west of Maayafushi	Abundant fish life; sharks. Manta rays	500m radius
12	Ari	Fish Head	Mushimasingili thila	Sharks.	500m radius
13	Ari	Orimas thila	Thiia in channel south of Orimas faru	Corals; soft corals; reef fishes.	100m radius
14	Ari	Kuda Rah thila	Thila east of Kuda Rah	Corals; reef fishes; sharks.	100m radius
15	Vaavu	Devana Kandu	West side of Vaavu Atoll	Soft corals, fish and grey reef sharks	Entire Channel

Major research activities relating to coral reefs carried out by the MRS are out line below. A number of reports and publications are available on these research topics at MRS.

- Baitfish research
- Collection and identification of economically important reef fish species
- Reef fish stock assessment
- Reef fish resources surveys
- Coral and reef fish taxonomy
- Effects of reef degradation on local reef fisheries
- Impact of crown-of-thorns starfish on coral reefs
- Impacts of coral mining
- Reef monitoring
- Rehabilitation of reefs subject to coral mining activities
- Biology and ecology of corals and reef fish

### *Environment Research Unit*

The Environment Section of the Ministry of Planning Human Resources and Environment is responsible for co-ordination of all environmental activities in the country. It plays a central role in all marine environmental management as well as setting environmental standards and guidelines.

The Environmental Research Unit (ERU) is entrusted with carrying out all research work relating to the environment, and making available all relevant data for programming, planning, enforcing and regulating environmental matters.

The aims and objectives of the ERU are:

- to establish environment research capability within the country.
- Carry out research in all environment related fields in the country.
- make available all relevant data and information to provide for sound environmental management in the country.
- Develop and strengthen the technical know-how and manpower in the field of environmental research and management.
- Create sound environmental awareness and knowledge within the public and government administration.

### *Ministry of Construction and Public Works*

The Ministry of Construction and Public Works (MCPW) undertakes major locally managed government projects; most significantly, dredging and harbour construction projects. There are many ongoing dredging projects throughout the country for which it is responsible. MCPW is also responsible for the management of all solid wastes in Male'. It also therefore has a role to play in the management of reefs in terms of solid waste disposal and sedimentation. Therefore this ministry is an integral part in the management process.

### *Ministry of Tourism*

All aspects of tourism in the country are the responsibility of the Ministry of Tourism including the management of the marine environment of tourist islands. For most purposes it has its own

regulations. Permission for activities such as dredging and the construction of artificial maritime structures at resorts will need to be cleared by the Ministry of Tourism. It is also responsible for tourism regulations in the country.

The Government of Maldives commissioned the second Tourism Master Plan in 1994 and was completed in 1996. The plan clearly spells out the policies, strategies, targets and details of tourism expansion in the country for the period 1996-2005.

The Tourism Master Plan 1996-2005 spells out the future strategy for balanced regional tourism development. Under the plan the tourism zone was expanded recently to include atolls North and South of Male and Ari Atolls. The estimated targets for visitor arrivals for the year 2005 is 650,000 and the resort beds to be increased to 20,500. The plan proposes the following actions for environmental management in tourism development:

- Integrating Tourism with coastal resources management;
- Tourism and marine research;
- Developing marine protected areas;
- Environmental public awareness programmes;
- Resort environmental improvement measures;
- Resort infrastructure standards.

The tourism regulations are drawn under the Law on Tourism in the Maldives (Law No: 15/79). There is a written regulation available at the Ministry of Tourism for the general public. However there are also many regulations in the form of circulars or notification that aren't necessarily compiled. Given below are some of the circulars that have been issued in relation to environment protection at resorts.

Disposal of garbage	MoT Circular 06/84
Disposal of garbage	MoT Circular 03/85
Waver of customs duty on incinerators	MoT Circular 19/85
Incinerators and compactors	MoT Circular 19/86
Incinerators on credit	MoT circular 01/90
Blockage of jetties	MoT Circular 21/90
Catching and sale juvenile and berried lobsters	MoT Circular 22/90
Keep the environment clean	MoT Circular 13/91
Mining of Coral	MoT Circular 25/91
Dredging an reclaiming of land	MoT Circular 07/92
Rubbish collection	MoT Circular 24/92
Crown of Thorns Starfish programme	MoT Circular 62/92
Incinerators and compactors	MoT Circular 27/92
Waste minimising project by LTU	MoT Circular 27/93
Supply of incinerators through Norwegian grant loan facilities	MoT Circular 5/94

#### **4. POLICY AND STRATEGIES ON CORAL REEF MANAGEMENT**

A number of activities have been initiated by MOFA and various sectoral agencies of the government to manage and conserve coral reefs. A National Environment Action Plan was drawn up by the government in 1989 with the objective of integrated environmental management in the country. Under the Environment Action Plan, the following issues relating to coral reefs were designated for immediate consideration:

- Coral mining;
- Sewage contamination of coastal waters;

- Sea level rise;
- Solid waste management;
- Dredging.

#### **4.1 Awareness and Education Programmes**

Regular awareness programmes are carried out by MOFA and MRS to increase awareness on coral reefs amongst school children and the public. Poster, magazines and leaflets are produced and distributed. In addition to this, lectures, video and slide presentations are organised for schools on coral reefs. Such programmes are incorporated into the work schedules of the Marine Research Section.

With financial and technical assistance from the Bay of Bengal Programme (BOBP) a major awareness programme on reef resources was conducted in Vaavu and Meemu Atolls during the period 1992-1993. This was essentially a pilot activity to investigate and monitor the levels of community participation and involvement in marine resources management. Many workshops, seminars and surveys were carried out in both atolls under the programme. Committees at various levels of organisation in the atolls participated in these workshops.

An informative colouring book on reefs (Life on our Reefs - A colouring book, BOBP/MAG/20) was produced under this programme. It contained basic information on coral biology, ecology and associated fauna. Ways in which coral reefs could be destroyed and how to conduct preventive actions were also given. The books were meant for grades 5 to 8 in the schools it was well received and used in the atolls by students and teachers.

#### **4.2 Data for the Management of Reef Resources**

It is widely believed that the Maldives has a relatively efficient system of resource data collection. The Fisheries Law states that resource data should be submitted to MOFA on a regular basis. Regulations and mechanisms are in place to gather data from all the inhabited islands in the country. The government offices in all the inhabited collect data and submit to MOFA on a regular basis. A relatively accurate picture of the status of reef resources can be derived from these data.

Resource data collected for management purposes are maintained in databases at the Economic Planning and Co-ordination Section of MOFA. Data on catch, landings, exports and socio economic data relating to reefs are available on databases.

#### **4.3 Integrated Reef Resources Management Programme**

The Ministry of Fisheries and Agriculture (MOFA) is the key sectoral agency for coral reef protection and management. However it cannot undertake this function with out the assistance of line ministries and stakeholders. An integrated approach to resource management was felt necessary and MOFA embarked on an Integrated Reef Resources Management Programme in 1995 with the assistance of the Bay of Bengal Programme (BOBP).

The IRRM programme seeks to identify the key issues for reef resource management in selected atolls and tackle these in an integrated manner. The following key issues were identified:

- Coral mining
- Bait fishing
- Grouper fishing
- Aquarium fishing
- Mariculture activities

- User conflicts - Tourism vs. Fishing

The IRRM concepts are consultative and participatory. The management approaches are community based and efforts have been made to practice this in the target atolls. A workshop was convened in 1995, which brought together stakeholders from the atolls, private sector and the public sector parties. The concepts of integrated reef resource management and its approaches were discussed in the workshop and recommendations were made on key issues.

The community based approach in the implementation of the IRRM programme will be pursued in the coming years and if successful will be introduced to other atolls in the country.

#### **4.4 Participation in International and Regional Efforts to Manage Coral Reefs**

The Maldives has participated and played a central role in regional and international coral reef initiatives. It is an active partner of the International Coral Reef Initiative (ICRI) established in 1994. The Maldives hosted the ICRI South Asia regional meeting in 1995. A major output of this meeting was to identify options for regional policy and action framework. The Maldives is committed to fulfill the outcomes of this meeting and continues to be an active partner of ICRI.

The Maldives is also an active member of the Global Coral Reef Monitoring Network for which a regional network work was established recently in the South Asia Region. It will participate in the training and pilot monitoring programmes under the network and hopes to contribute fully to understand the status and health of coral reefs in the South Asia Region.

Maldives has also participated in regional coral reef activities organised by the South Asia Cooperative Environment Programme (SACEP). SACEP plays a central role in the coordination of environmental issues including coral reef issues in the region.

The International Year of the Reef 1997 (IYOR) has been marked in the Maldives with many activities. Many awareness-raising activities were organised to mark the year of the reef. The IYOR was launched in the Maldives on 5<sup>th</sup> June, the World Environment Day. Leaflets were produced on how to care for the reefs and information about the IYOR. A Reef Day was held in November as a major awareness raising campaign. Posters, leaflets, magazines, were displayed on Reef Day. Slide shows and videos were shown on coral reefs. A special reef poster displaying common reef animals was launched in December with assistance from the BOBP. This poster will be distributed widely to all schools in the country so that a poster is displayed in every classroom of all the schools in the Maldives.

#### **5. SUMMARY AND CONCLUSIONS**

The Maldives consists entirely of coral reefs the most diverse of all marine ecosystems. The reefs of Maldives consist of atolls and associated reef structures. A total of over 1000 species of fish have so far been catalogued from the reefs of Maldives. The total number of coral species recorded from the Maldives to date is about 200, representing over 60 genera. 51 species of echinoderms, 5 species of sea grasses and 285 species of alga have also been identified.

It is widely believed that coral reefs in the Maldives are in a relatively pristine state, and of high aesthetic quality. Apart from supporting a growing tourism and recreation industry, coral reefs also play a vital role in fisheries, and in the culture and life style of people in Maldives. Tourism, reef fishing, coral mining, dredging, reclamation and the construction of maritime structures and pollution represent some of the impacts on coral reefs.

With the introduction of tourism in the Maldives, coral reefs gained a major economic significance. Tourism in the Maldives is centered around coral reefs and relies on these rich and healthy reefs for the well being of the industry. It is evident that there are few serious

environmental concerns in the tourism sector in the Maldives.

The reef fishery in the Maldives is expanding rapidly. These are mainly export oriented and include giant clam, sea cucumber, groupers and aquarium fish. Concerns have been raised on the sustainable exploitation of reef fish resources and plans are underway to demarcate zones for reef fishing. Reef resources that are under pressure from over exploitation include giant clams, sea cucumbers, groupers, certain reef sharks, turtles, and corals.

Corals are mined and used for construction purposes in the Maldives. Coral blocks are extracted from shallow reef flats at 1-2 meters depth, with help of iron bars to break up the living coral.

The Fisheries Law of Maldives (Law No. 5/87, 24-08-87) governs the management of all fisheries activities in the Maldives. Fisheries Regulations (1997) drawn under the Fisheries Law of Maldives and gives details and updates relating to fisheries regulations in the form of notifications and written regulations. Several coral reef species are protected under the Fisheries Regulation.

In 1993, the Parliament enacted the Environment Protection and Preservation Act of the Maldives (law No. 4/93). Key elements in the Environment Law include the submission of an Environmental Impact Assessment report to Ministry of Planning Human Resources and Environment prior to implementation of any developmental project that may potentially impact the environment. 15 Marine Protected Areas have been established under the Environment Act.

The Ministry of Fisheries and Agriculture (MOFA) represents a focal point for many marine activities. The Marine Research Section (MRS) is the research arm of the Ministry of Fisheries and Agriculture. Its main fields of activity include biological sciences, coral reef ecology, marine fisheries, resource management and information services.

The Environment Section of the Ministry of Planning Human Resources and Environment is responsible for co-ordination of all environmental activities in the country. It plays a central role in all marine environmental management as well as setting environmental standards and guidelines.

All aspects of tourism in the country are the responsibility of the Ministry of Tourism including the management of the marine environment of tourist islands. It is also responsible for tourism regulations in the country.

Programme are carried out by MOFA and MRS to increase awareness on coral reefs amongst school children and the public. An informative colouring book on reefs (Life on our Reefs - A colouring book, BOBP/MAG/20) was produced under this programme.

Regulations and mechanisms are in place to gather resource data from all the inhabited islands in the country. Data on catch, landings, exports and socio economic data relating to reefs are available on databases at the Ministry of Fisheries and Agriculture.

MOFA embarked on an Integrated Reef Resources Management Programme in 1995 with the assistance of the Bay of Bengal Programme (BOBP). The IRRM programme seeks to identify the key issues for reef resource management in selected atolls and tackle these in an integrated manner.

The Maldives is a partner in many international and regional initiatives on coral reef conservation and management.

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