Pre-and post-tsunami coastal planning and land-use policies and issues in the Maldives

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The Maldives archipelago is the historical archetype of an atoll-type coral reef province. The coral reefs of the Maldives have been formally explored and studied since 1840 and they represent the most diverse and best known reefs in the Indian Ocean. The reef system contains about 2 000 distinct coral reefs with a total coral reef area of about 4 500 square kilometres. Conventional definitions of coastal area as applied to continental land areas do not apply to the Maldives due to the nature and structure of its coral atolls and reefs. Effectively, all reefs in the Maldives can be considered as coastal for the purposes of tropical coastal area management. This notion of coastal lands for the Maldives can be explained by the fact that only five percent of the total reef area of the Maldives is land. The islands are extremely small (size ranges from 0.1 to 5 square kilometres). In fact, most of the reefs are landless with vast expanses of shallow reef flats. Two hundred of the 1 200 islands are thinly inhabited. About 120 islands are assigned exclusively for tourism development. The remaining 880 uninhabited islands are used for agriculture and other commercial developments. All land (consisting of individual small islands) belongs to the state with very few exceptions. Fisheries and tourism are the main industries. Fisheries can conveniently be categorized into offshore tuna fishing and coastal reef fishing — both depending on healthy reefs for their sustenance. The Maldives has successfully created a unique tourism product over 30 years of tourism development. Tourist resorts are developed on small islands with a one-island one-resort concept. The December 2004 tsunami displaced 10 530 people in the Maldives. Three islands were totally evacuated and will not be inhabited again. The tsunami caused extensive damage to the island coastlines and infrastructure. The smallness of the islands presents great challenges to socio-economic development. The government has formulated a population consolidation plan whereby the country will be divided into five regions for development. Larger and safer islands will be developed under the plan within these regions.

1. Background

1.1 Coral atolls and reefs of the Maldives

The Maldivian atolls extend 900 kilometres from 7° 06’ north to 00° 45’ south latitude and 130 kilometres from 72°33’ east to 73° 47’ east longitude in the north central Indian Ocean. They comprise 16 complex atolls, five oceanic *faros* (ring-shaped reefs exposed to the open ocean) and four oceanic platform reefs (reefs lacking deep lagoons that are exposed to the open ocean, Figure 1). Water depths outside the atolls drop steeply to hundreds of metres in the Maldives Inner Sea, and to thousands of metres in the surrounding ocean. The atolls and their associated rim reefs, lagoons and lagoon reefs vary tremendously in their formation, size and physical setting (Purdy and Bertram, 1993; Naseer and Hatcher, 2001). The depths of the atoll lagoons range from 30 to 80 metres.

The Maldives archipelago is the historical archetype of a coral reef province. Sparsely populated by humans since at least 500 BC and formally studied since 1840, it represents the

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most diverse and best known reefs in the Indian Ocean (Darwin, 1889; Daly, 1915; Gardiner, 1902; Agassiz, 1903; Sewell, 1932; Stoddart, 1966; Woodroffe, 1992; Purdy and Bertram, 1993; Naseer and Hatcher, 2003). The earliest survey of the Maldives' coral reefs was the pioneering cartography of Moresby from 1834 to 1836, which resulted in the popular British Admiralty charts (Spray, 1966)

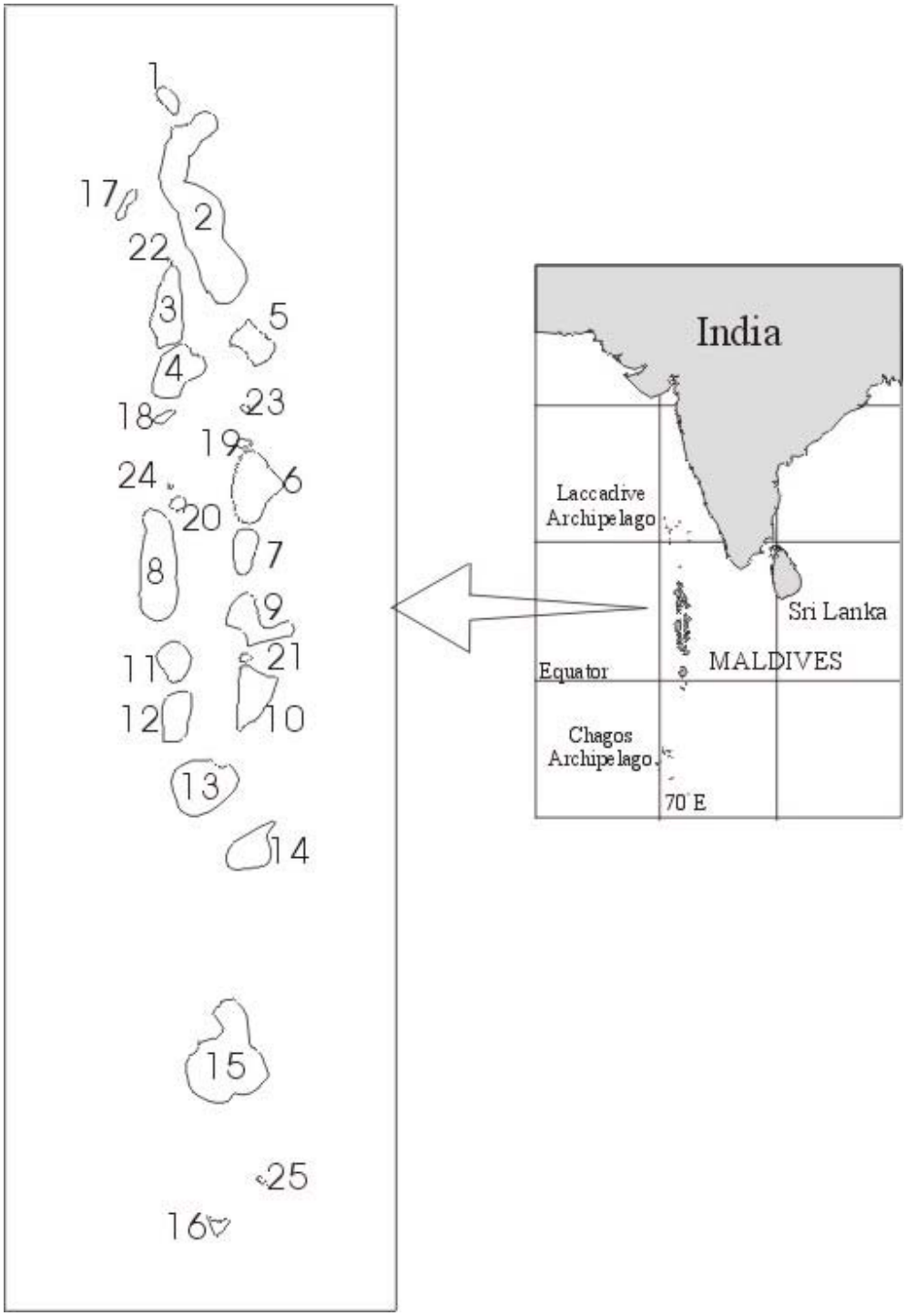

Figure 1. The Maldives' coral reef system with a diagrammatic outline of major coral reef structures. Items 1–16 = complex atolls; 17–21 = simple atolls or oceanic *faros*; 22–25 = oceanic platform reefs. See Table 1 for corresponding names of reef structures and statistics

Naseer and Hatcher (2004) quantified the coral reefs of the Maldives using satellite imagery and provided the most detailed quantifications of the Maldives' reefs to date. This study determined that the Maldives archipelago contains about 2 000 distinct coral reefs greater than one hectare in area (Plate 1, Table 1). Of these, about 529 reefs are located on the rims of the 16 complex atolls, five form the rims of the five ocean *faros* and four form oceanic platform reefs, also rising from deep water but lacking a lagoon. The remaining reefs (about 1 500) are lagoon patch reefs scattered throughout the lagoons of the atoll. The total number of reefs varies greatly among atolls, ranging from only seven in Seenu Atoll to 268 in Ari atoll. About 1 200 coral islands are scattered over these reefs.

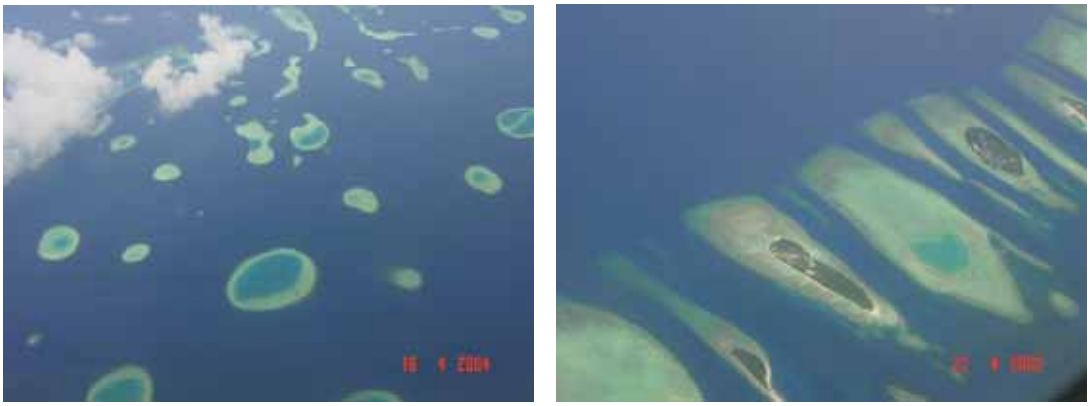

Plate 1. Aerial views of individual coral reefs of the Maldives. Atoll rim reefs (right) and atoll lagoon reefs (left) are depicted

Table 1. Reef area statistics for the Maldives. Total surface area of the major reef structures includes all reef area plus atoll lagoons (from Naseer and Hatcher, 2004). See Figure 1 for corresponding structures

Major coral reef structures	Total surface area (km^2)	No. of reefs	Reef area (km^2)	Reef island area (km^2)
Complex atolls (16)				
Ihavandhippolhu	289.81	30	119.50	5.70
Haa	3 788.71	164	500.70	68.70
Raa	1 184.31	155	223.50	12.90
Baa	1 126.95	105	262.90	5.50
Lhaviyani	701.42	84	158.00	7.20
North Malé	1 568.18	189	349.00	9.40
South Malé	536.33	112	175.60	2.00
Ari	2 271.75	268	489.40	8.30
Faafu	597.15	86	151.30	2.20
Dhaalu	736.46	98	179.40	4.40
Vaavu	1 090.97	203	251.10	0.92
Meemu	983.92	111	197.30	4.20
Thaa	1 695.79	154	243.70	9.30
Laamu	884.63	56	203.70	23.10
Gaafu	3 278.59	210	437.90	34.30
Seenu	157.22	7	70.32	15.00
Simple atolls or oceanic *Faros* (5)				
Makunudhoo	142.48	1	142.48	0.96

Major coral reef structures	Total surface area (km^2)	No. of reefs	Reef area (km^2)	Reef island area (km^2)
Goidhoo	112.61	1	112.61	2.20
Gaafaru	88.05	1	88.05	0.19
Rasdhoo	61.84	1	61.84	0.62
Vattaru	46.72	1	46.72	0.01
Oceanic platform reefs (4)				
Alifushi	4.38	1	4.38	0.71
Kaashidhoo	9.54	1	9.54	2.89
Thoddoo	4.75	1	4.75	1.62
Foahmulah	10.18	1	10.18	5.13
Maldives total	**21 372.72**	**2 041**	**4 493.85**	**227.45**

The total surface area of the major reef structures of the Maldives (all coral reef and lagoon habitats of atolls) is 21 000 km^2. This value includes the vast areas of the world's largest atoll lagoons, much of which are too deep to support coral growth. The total reef area of the Maldives is close to 4 500 km^2 (Naseer and Hatcher, 2004). This represents only 20 percent of the total surface area of atolls. Atoll rim reefs comprise the greatest area of reef platform (3 221.4 km^2), while the ocean *faros* occupy 451.70 km^2 and the ocean platform reefs only 28.85 km^2. The remaining 791.92 km^2 of reef area forms patch reefs in the 16 atoll lagoons.

1.2 Concept of coastal areas for the Maldives

Conventional definitions of coastal area as applied to continental land areas do not apply to the Maldives due to the nature and structure of its coral atolls and reefs. The system comprises over 2 000 individual coral reefs, sometimes with islands developed on them (Plate 2).

Plate 2. Reef housing an island. Note the lush growth of coconut palms which signifies the maturity of the island

Effectively, all reefs in the Maldives can be considered as coastal for the purposes of tropical coastal area management. This notion can be explained by the fact that only five percent of the total reef area of the Maldives is islands (Table 1). The islands are extremely small (0.1 to 5 square kilometres). In fact, most of the reefs are landless with vast expanses of shallow reef flats.

So for the purposes of this report, coastal areas will be defined as individual coral reefs. A quick glance at a definition of coastal area shows that for atoll-type coral reef systems the whole system should be treated as coastal area. Coastal areas are usually defined as "an entity

of land and water affected by the biological and physical processes of both the sea and land and defined broadly for the purpose of managing the use of natural resources." As reef islands in atoll systems are products of marine biological and physical processes, coral reefs should be technically treated as coastal systems.
In many coastal studies coral reefs are commonly treated as "coastal living habitats". A coral reef is defined as a biological structure that rises from the ocean depths. Habitats on a coral reef consist of coral islands, lagoons, mangroves, seagrass beds, coral reef flats and many other types.

Islands on coral reefs are products of marine biological processes. All the islands in the Maldives are products of marine biogenic processes. Therefore, whole islands irrespective of their sizes can be conveniently referred to as coastal areas.

If we look at important issues inherent in coastal areas such as the salinization of groundwater aquifers by seawater intrusion, for example, for coral reef countries the problem is directly related to the sea and the affected areas are the whole islands, not just part of the coastal areas. This emphasizes the need to identify whole reef islands as part of the coastal areas for coral reef island countries.

1.3 Land/island use: Uninhabited islands

Land is a scarce commodity in the Maldives. In many atolls and islands there are active land reclamation programmes initiated by the government to provide land and housing for local communities.

Two hundred of the 1 200 islands are inhabited. The sizes of inhabited islands vary from 0.1 to 5 square kilometres (Table 2).

Table 2. Ten largest islands and their populations in the Maldives (State of the Environment Report, 2002)

Atoll	Island	Area (sq. km)	Population (2000)
Laamu	Gan	5.1	2 244
Seenu	Hithadhoo	4.7	9 461
Gnaviyani	Foah Mulah	4.2	7 528
Laamu	Isdhoo	2.9	1 432
Kaafu	Kaadhidhoo	2.8	1 572
Seenu	Gan	2.6	-
Gaafu Dhaalu	Gan	2.6	-
Haa Dhaalu	Hanimaadhoo	2.6	1 009
Haa Alifu	Baarah	2.5	1 270
Haa Alifu	Filladhoo	2.3	659

About 85 islands are developed exclusively as tourist resorts and 35 more islands have recently been leased out for the development of new resorts. The remaining 880 uninhabited islands are used for fisheries, agriculture, airport development and other light industrial purposes. Selected large islands are exclusively assigned for the development of commercial agriculture. These are leased to private individuals or companies. A few are also leased out exclusively for the development of land-based infrastructure for fisheries development and other economic activities such as the development of airports (Plate 3).

Plate 3. An uninhabited island developed as a fishery complex in the Maldives

Most of such islands are leased out on a long-term basis from 20 to 35 years, based on the proposed investments. There are active plans to lease out more islands for industrial activities. Islands with special ecological characteristics have been identified, protected and conserved as no-take zones under relevant laws (Law No. 4/93). While the total number of islands allocated for various activities is clear, this is not so for the total areas of such islands because these figures have not been determined accurately.

A large proportion of the 880 uninhabited islands (after human habitation, tourism, fisheries, agriculture, and airport development, etc.) are managed under a traditional system called *Varuvaa*. Under a written law and associated regulations (Law No. 20/98), these uninhabited islands are leased out by the government to private individuals or companies. They are mostly covered by coconut and timber tree species. The law regulating the lease of these uninhabited islands states that, "……..the lessee must rehabilitate woodlots, improve and maintain the island according to this law and the regulations drawn under this law." It includes a condition that two trees must be planted to replace every coconut palm or timber tree felled. A timber permit from the Ministry of Fisheries Agriculture and Marine Resources (MFAMR) is required for cutting trees on uninhabited islands.

It is important to note that uninhabited islands under the *Varuvaa system* are leased out to individuals not to undertake major economic activities, but to obtain benefits from the island in terms of *the coconuts* they generate from the islands. However, lessees undertake annual crop cultivation on islands where cleared agricultural land is available. The rents of *Varuvaa* islands are fixed by the number of mature coconut palms on the island. It should be emphasized that some of these islands may not even have any coconut palms and as such may not generate any effective income (Plate 4). Consequently islands with no coconut palms may carry a very small rent sometimes as low as MVR100.

Plate 4. On islands leased out under *Varuvaa*, coconut palms determine the rent

Table 3. Distribution of uninhabited islands by their lease amount (Statistical Year Book of Maldives, 2004)

Amount of lease in MVR (US$1.00 = MVR12.85)	No. of islands	Percentage share
100–499	487	53.8
500–999	97	10.7
1 000–4 999	235	26
5 000–9 999	56	6.2
>10 000	30	3.3
Total	**905**	**100.0**

1.4 Land/island use: inhabited islands

The land tenure systems on inhabited islands are complex. Land on an inhabited island is categorized into: a) homestead plot; b) *goi* land; and c) *faalabba* land.
Homestead plots are given free of charge. Plot sizes depend on the availability of land, with an average size of 50 x 100 feet. Trees grown on homestead plots belong to the owner and the homestead allotment is inheritable.

Goi land refers to a particular area of the inhabited island with special vegetative characteristics. Coconut palms and tree species grown on *goi* land belong to the government. *Goi* land is rented to the highest bidder by the Ministry of Atolls Development. The lessee rents smaller plots for farming. In general, the lessee gets 12.5 percent of the income generated by farmers.

Faalabba is a land area generally located close to residential areas. Islanders grow coconut palms and tree species with the permission of the Island Office. Half of the trees grown belong to the person who planted them and the other half is the property of the state.
Most islands have communal land for the cultivation of annual crops. No rent is charged for cultivation on this land and no standard regulation exists for its use. On some islands plots change hand every year, whereas on other islands farmers can hold the plots as long as they continue cultivation. The complexity of land tenure systems on inhabited islands has serious implications for the development of agriculture.

Some of the 200 inhabited islands are completely developed as urban areas and there is no room for agriculture or land-based industrial activities. Land reclamation programmes are necessary as populations increase on these islands.

1.5 Fisheries

Fisheries in the Maldives can conveniently be categorized into offshore tuna fishing and coastal reef fishing. Offshore tuna fishing is the key industrial and commercial fishery. For the purposes of this report, only reef fishery activities are described as they represent fishery activities within the outlined coastal concept. All parts of the reef are considered as coastal areas.

Commercially exploited reef species include small baitfish, groupers, snappers, sea cucumbers, lobsters, big eye scads and a variety of other minor species. Reef fish and invertebrates are not reported as separate species in official statistics, but as a reef species group (Figure 2 and Table 4). What is interesting is that only a small proportion of the total catch composition signifies reef-associated species.

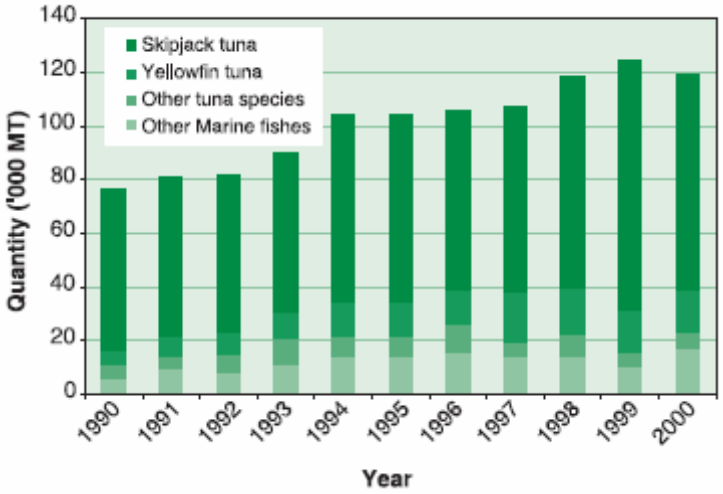

Figure 2. Reef fish reported as other marine species in fish catch composition from 1990 to 2000 (from State of the Environment Report, 2002)

The most important widespread reef fishery is tuna bait, which has been carried out effectively for hundreds of years. Maldivians use the pole-and-line method for tuna fishing, which requires large amounts of live bait. Commonly caught bait fish varieties include silver and blue sprats, fusiliers, cardinal fish and anchovies. Live bait fish are collected from shallow reef areas and kept alive for the duration of the tuna fishing activity. Virtually all types of reefs are used for bait fishing in the Maldives, making it the most widespread reef associated activity. An estimated 15 000 tonnes of bait fish were taken from shallow reefs in 2003 (Adam, 2004).

Table 4. Detailed composition of fish landings for 2003 (from Adam, 2004)

Recent fish landings in Maldivian waters (tonnes)

Species	Scientific Name	2003 catch	Percent of total catches
Skipjack tuna	*Katsuwonus pelamis*	108 329	70
Yellowfin tuna	*Thunnus albacares*	21 767	14
Frigate tuna	*Auxis thazard*	4 356	3
Kawakawa	*Euthynnus affinis*	2 406	2
Dogtooth tuna	*Gymnosarda unicolor*	746	0
Bigeye tuna*	*Thunnus obesus*	1 147	1
Subtotal tuna		138 751	89
Other fish†	Reef fish varieties	16 664	11
TOTAL		**155 415**	**100**

Notes: *Estimated catch; †Excludes bait fish catch.
Source: Ministry of Fisheries, Agriculture, and Marine Resources.

Maldivians traditionally do not consume large amounts of reef fish, hence, most of the reef fish and invertebrates are targeted for export markets and the local tourism markets.

Coral mining for building purposes used to be a major activity until recently. This destructive activity was phased out under a major environmental awareness programme and the introduction of a viable alternative for coral mining in the 1990s. Concrete blocks were introduced successfully in all of the islands to combat coral mining. Only coral sand mining is required for the construction of concrete blocks, which has far less impact on the reef environment.

Coral sand is the only form of construction aggregate available locally. This is not a preferred aggregate for professional concrete mixing for concrete frameworks for buildings. But large amounts of locally mined coral sand are used for the construction of hollow concrete blocks used for filling walls of concrete frameworks of buildings. Coral sand is mined from shallow sand flats on coral reefs (Plate 5). In the early days sand was commonly mined from island beaches, which is environmentally very destructive for islands. Sand mining from island beaches is now banned.

Plate 5. Shallow sand flats on coral reefs generate large amounts of renewable biogenic sand that is mined for construction purposes

1.6 Tourism and picnic islands

The Maldives has successfully created a unique tourism product over 30 years of tourism development. Tourist resorts in the Maldives are developed on whole islands with a concept of one-island one-resort (Plate 6). When an island is developed as a resort, effectively the whole reef on which the island is a subset falls under the jurisdiction of the resort's management, sometimes unofficially.

Plate 6. Tourist resorts are developed on single islands in the Maldives

The use of coral reefs for diving and snorkelling is the most significant economic activity on coral reefs of the Maldives. At any given time there maybe thousands of divers admiring their underwater beauty. Apart from diving and snorkelling there are many other reef-associated activities such as windsurfing, wave surfing, safari boat operations and big game fishing, all of which are related to the tourism industry.

Recent developmental extensions to tourism are “picnic islands”. These are small uninhabited islands with characteristics that make them more natural and pristine (Plate 7).

**Plate 7. A picnic island developed for tourism in the Maldives.
Tourists pay to visit such islands where they spend the day relaxing**

1.7 Changes in the use patterns of land and fisheries

Island and fisheries resource use in the Maldives have changed little over the past decade. The most visible changes may be those occurring as a result of land reclamation from the sea. Tens of square kilometres of land may have been reclaimed in the Maldives in the last ten years. The most dramatic of such land reclamation projects is Hulhumale Island, which is a totally reclaimed island developed for housing needs for the growing population of Malé, the capital island (Plate 8). According to the most recent estimates the population of Malé has reached 100 000. Some agricultural land has been lost and given away to human encroachment on inhabited islands.

Plate 8. Land reclamation is almost an essential activity for economic well-being in the Maldives. Hulhumale Island has been developed in the vicinity of the capital island, Malé

Fishery patterns have witnessed changes over the last decade. A major activity that commenced in 2000 was the large yellowfin fishery, which requires larger sizes of live bait than skipjack tuna. This led to the expansion of the big eye scad fishery, which was formerly a subsistence activity. This has now become a major commercial fishery in the Maldives.

The expansion of the tourism industry necessitated the allocation of more islands for its development. Thirty-five extra islands have been allocated for tourism development in recent years.

Leasing islands for agriculture on a long-term basis is a key policy developed in the early 1990s. Selected large islands with potential for agriculture have been set aside exclusively for agricultural development. Such island developments are expected to increase in the near future in response to the recently developed commercialization plan for agriculture.
The development of agriculture has taken a major turn in recent years, primarily due to focused efforts by the government. Agricultural centres set up in the north and south of the country play a key role in sector development.

Notable changes have occurred in the way reefs are exploited, mainly due to external market pressures. A key development has been the introduction of a live food fish trade. Groupers, snappers and many other high value reef fish are caught and kept live in cages until specially designed vessels collect them for export. This has been a major development in reef fisheries in the past decade. Other reef fishery activities also developed at the same time.

Reef resources are by nature diverse, but not abundant. Hence, they are easily overexploited, as evidenced worldwide. The Maldives has seen a decline in grouper numbers in recent years – less than ten years since the fishery started. Some species of sharks are also diminishing.

2. Issues

2.1 Post-tsunami land tenure

All land in the Maldives belongs to the state with very few exceptions. There is no “tribal land”. A few plots of land on inhabited islands are owned privately, but most lands/islands are owned by the state. By law, all reefs and their associated habitats are owned by the state.

The ownership of reefs and islands, their use and management responsibilities are clearly laid out in relevant laws. Consequently, most development on islands (especially those that are uninhabited) proceeds at the discretion of the government.

The government does not trade land under normal circumstances. It would rather lease islands for commercial activities under various economic development plans. Plots of land on inhabited islands are leased for industrial activities from which the government earns rent. An exception is the recently formed state-owned enterprise which has acquired reclaimed land for commercial property development.

Registered plots of land for housing can be obtained free by any citizen, on demand, on formally inhabited islands where government infrastructures are established. No such land may be obtained from uninhabited islands or industrial islands. No fees of any sort are levied on land plots allocated for housing purposes. Technically, any citizen over the age of 18 can obtain a plot of land freely in the Maldives for housing purposes.

Ownership of land for industrial or commercial activities is different and set rents are levied on such plots of land or islands. Resorts and industrial islands are leased out for the long term, sometimes as long as 35 years, but more commonly for 20 years.

2.2 Displaced populations and their management

The December 2004 tsunami displaced 10 530 people. Three islands were totally evacuated and will not be inhabited again. Of the displaced people, 5 785 are living in temporary shelters on various islands and the remaining 2 883 are housed by friends, relatives and other benefactors. In most cases, the displaced populations will be resettled on their own islands, with some exceptions. But for others, resettlement is planned on larger, safer and economically more appropriate islands. The long-term plans are to provide permanent housing for all displaced populations.

The 200 islands of the Maldives are populated very unevenly (Figure 3). Some of the islands contain only 300 persons. Nevertheless, basic infrastructure has to be provided to all islands irrespective of size. This is a major hindrance to the total development of communities. In order to overcome this issue the government devised a population consolidation and resettlement plan under which selected regions of the country were to be developed as urban centres. This plan was in place even before the tsunami strike, but it was accelerated in response to the tsunami. Currently, under the tsunami rehabilitation programme, a few islands are being developed completely with all the necessary infrastructure and services.

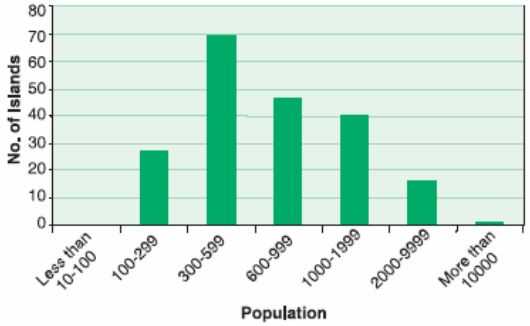

Figure 3. Population distribution on inhabited islands (reproduced from SOE 2002)

Managing tsunami-displaced populations has not been an easy task, although most temporarily housed people are functioning well. Social conflicts have taken place in some islands where displaced populations have been relocated temporarily or otherwise. Most of these problems stemmed from differences in social structures, combined with the lack of proper facilities in temporary dwellings. For some people settlement on another island is out of question and they totally reject the initiative. Maldivians have lived on islands separated by sea for so long that they have a deep sense of belonging to their islands. Island communities exhibit a closely knit social structure, so resettlement on an island with another community is a very unattractive option. The government has always encouraged small communities to resettle on larger islands. In some instances expensive initiatives have been undertaken for resettlement.

For some of the tsunami-displaced people, disruption to economic activities such as fisheries has been a major problem. Land-based fish processing and other small economic activities have been hindered by the loss of land.

Altogether three islands were totally evacuated following the tsunami and so rendered ownerless. People from these islands will be relocated on other islands and there are no plans to redevelop them for settlement. In accordance with existing regulatory mechanisms, these islands will eventually be handed over to the MFAMR as uninhabited areas, but some are currently being used by the evacuees for small-scale income-generating activities related to fisheries and agriculture. Islands that are rendered ownerless (for any reason) are automatically taken over by the government and handed over to the concerned government authority (currently the MFAMR) to be dealt with accordingly. The MFAMR keeps a register of all uninhabited islands in the country. As soon as an island becomes uninhabited (as in the aftermath of the tsunami) it is registered formally as such.

There have been no incidences of land capture by power players for any of the land affected by the tsunami in the Maldives. This is due to the firm legal and regulatory frameworks in place for land management, and also due to the nature of the small islands. Orderly land ownership has no scope for mishaps as found in other tsunami-affected countries. For the tsunami-affected islands, the whole island was affected, not the coastline *per se*.

2.3 Post-tsunami coastal environment issues

An assessment of the geomorphology of reef flats, shorelines and islands undertaken in 19 islands just after the tsunami reported the scale of damage to islands and their beachlines (AUSAID Report, 2005). The report concluded that despite significant damage to buildings, the tsunami had less impact otherwise than was expected:

- Reef flats outside atolls were impacted minimally.
- Beaches exposed to the tsunami experienced limited erosion and some toppling of vegetation that may increase the likelihood of further seasonal erosion.
- The ends of islands suffered more extensive erosion.
- The island surface and soil structures remained relatively intact and there were no major accumulations of reef sand or shingle.
- On the beaches on the lagoon side of the atolls, scour pit formation caused significant erosion and deposition of sediment on the adjacent reef flats, except on islands where the water flowed right across the island.
- One case of an island breaching was documented.

The importance of shoreline vegetation for erosion prevention was significant in all environments. Much of the building damage was caused by scour under and around structures, and by physical damage by debris. On coral walls without rendering, water entering cracks led to rapid collapse of walls. Increased groundwater pressures probably caused some lifting of solid floors.

Coral islands are geomorphologically dynamic structures. The sandy beaches around islands are the most active areas of an island and they undergo natural erosion in response to reversing monsoons. The tsunami caused damage to island beach lines and coastal vegetation (Plate 9).

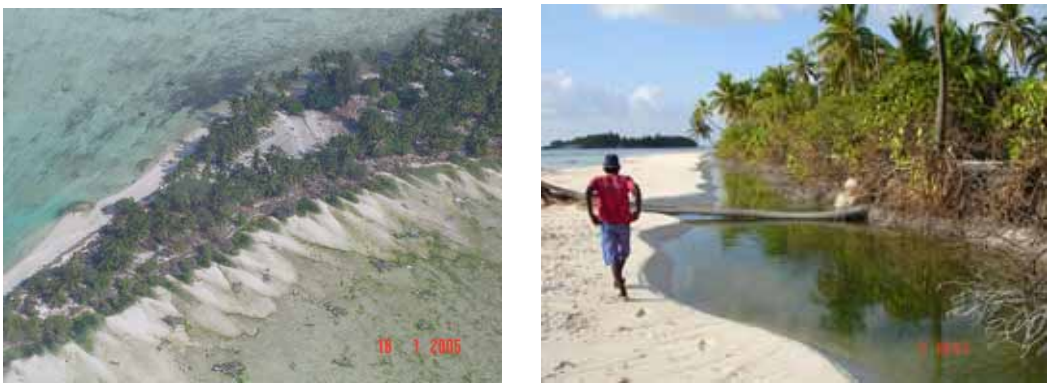

Plate 9. Tsunami damage to coastal stabilization areas and beach environments

It is widely recognized that salt-tolerant beach vegetation protects an island from erosion and wave action. Natural protection of islands is also afforded by raised beach berms on the windward sides of some islands. The tsunami also destroyed many coastal structures built on islands such as artificial seawalls, jetties, causeways and artificial harbours (Plate 10).

Plate 10. Tsunami damage to harbours and keywalls

The destruction of critical coastal infrastructure generated hardships to the affected island communities. Of particular significance was damage caused to breakwaters and harbor walls. Many harbors on inhabited islands were completely or partly damaged. Some are now under construction, while most remain as they are.

Harbors are essential shelters on remote islands for fisherfolk and travellers. Depending on reversing monsoons, prevailing sea conditions may present great challenges for island

communities lacking proper harbor facilities. Fishing and other vessels are vulnerable to severe weather under natural conditions. The rehabilitation and socio-economic development of tsunami-affected islands are directly related to the reconstruction of damaged harbours.

Coastal habitats such as mangroves and seagrass beds are considered protective belts for most coral reef coastlines. In the Maldives, however, island mangroves do not play any part in coastal or beach stabilization. The mangroves are depression types usually found inside islands. They are essential ecological entities with minimal roles in coastal stabilization. There are no records of extensive mangrove damage by the tsunami.

3. Policies and institutions

3.1 Institutional structures for coastal land management

Island management in the Maldives is under the jurisdiction of four ministries:

1. Ministry of Fisheries Agriculture and Marine Resources (MFAMR)
2. Ministry of Atolls Development (MAD)
3. Ministry of Housing and Urban Development (MHUD)
4. Ministry of Planning and National Development (MPND)

All uninhabited islands and the management of their resources are legally mandated to the MFAMR. The ministry keeps records of all uninhabited islands along with details of their lessees. The ministry also keeps known records of ecological characteristics and land cover on such islands. Contracts are drawn up between lessees and are monitored and maintained by the MFAMR. The ministry has written laws, rules and regulations on uninhabited island management (Law No. 20/98: Uninhabited Management Law).

When uninhabited islands are earmarked for industrial development such as tourism, fisheries and transport, such islands are formally handed over to the concerned sectoral ministries. For example, when islands are selected by the government for the development of resorts, they are formally handed over to the Ministry of Tourism for management. Contracts are then drawn up between lessees and the concerned sectoral ministries.

Land management on inhabited islands (apart from the capital island, Malé) come under the Ministry of Atolls Development. Land-use planning of inhabited islands is guided by the MPND and MHUD, while overall planning is carried out by the MPND and MHUD; land allocations and registrations are finalized by the MAD with consultations and necessary approval from both the MPND and the MHUD and sometimes also from line ministries. There are no traditional governance structures in the Maldives for coastal land and resource use. Local island and atoll offices play a major role, however, in the planning stages of land allocation and management on their respective islands. Locally formed and selected Island Development Committees and Atoll Development Committees play a critical advisory role in land management on inhabited islands.

Coral reef and coastal marine resources are managed by the MFAMR. The ministry formulates laws and regulations for the management of reef resources. All types of fisheries and marine activities are permitted and regulated by the MFAMR. Fisheries and coral reef resources are managed under the Fisheries Law No. 5/87 (Law on Fisheries).

3.2 Policies and regulations governing coastal land/resource management and use: conflicts and gaps

For a nation entirely formed of coral reefs, and where most economic sectors are dependent on coral reef resources, environmental management plays a key role in natural resource management. Under the current regulatory set up, natural resource management and regulation falls under the MFAMR. However, the Ministry of Environment also has related and sometimes overlapping mandates for the regulation of issues relating to the protection of natural resources. Consequently, notable regulatory conflicts in the management of natural resources exist between the two ministries. Such matters are solved by mutual agreements and consensus between the ministries. The Environment Commission set up within the Ministry of Environment is represented by the MFAMR. Similarly the Fisheries and Agriculture Advisory Boards have representatives from the Ministry of Environment. Such interministerial representations in commissions, boards and committees provide practical platforms to solve conflicting intersectoral issues.

4. Lessons learned and solutions identified

In small island nations such as the Maldives, the thinly distributed population over a large number of small islands, separated by sea, is a major hindrance to socio-economic development. Following the tsunami, the government has formulated a population consolidation plan whereby the country will be divided into five regions for development. Larger and safer islands will be developed under the plan within these regions.

Studies carried out just after the tsunami concluded the importance of shoreline vegetation for the prevention of erosion on affected islands. Tsunami impacts were reduced on islands with intact beach vegetation. It is important to ensure that shoreline vegetation belts are preserved in all development activities in the future. Conservation of shoreline vegetation is more profound on ocean windward sides of islands where hydrodynamic energy is at its peak during monsoonal changes.

The biodiversity and resilience of coral reefs and their associated habitats and resources need to be safeguarded through a network of representative protected areas covering all habitats within a coral reef system. The current system of isolated protected islands and “nice reef spots” needs to be developed in integrated protected areas.
Coastal monitoring programmes need to be designed and implemented for better understanding of seasonal and long-term trends on coastlines and for the introduction of set-backs for coastal developments.

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