

1

NATIONAL CIRCUMSTANCE

1.1 Geography

The Republic of Maldives is a chain of coral atolls stretching 860 km from latitude 7°6'35"N, crossing the Equator to 0°42'24"S, and lying between 72°32'19"E and 73°46'13"E longitude in the Indian Ocean. Its nearest neighbours are India, Sri Lanka and Chagos Islands, lying approximately 600 and 750 km to the north and north-east, and immediately south respectively (MPHRE, 1998). The width of the chain varies from 80 to 120 km at some locations. The total land area of the Maldives is estimated at around 300 km². The maritime area of the Exclusive Economic Zone (EEZ) amounts to more than 859, 000 km² (MPND, 2000).



Map 1-1: Location of the Republic of Maldives in the Indian Ocean

The chain of the atolls of the Republic of Maldives stand on the Chagos-Laccadive Plateau. It is believed that the Maldives and other features of the Indian Ocean bottom were formed about 65 to 225 million years ago in the Mesozoic Era (Maniku, 1990). There are several theories on the formation of the Maldivian atolls. One such theory is that the basin of the Indian Ocean was formed due to subsidence and oceanisation of the continental crust. "The compound atoll reefs of the Indian Ocean, of which Maldives forms the larger part, are believed to have been grown above the foundered continental (rather than oceanic) crustal segments" (Maniku, 1990). According to Gardiner (1902, 1903), the main Maldives

plateau was formed by current erosion, and the atolls were subsequently formed by the growth of deep; and later shoal water; organisms on this formation (Maniku, 1990).

The Maldives archipelago contains 26 geographic atolls, which vary in shape and size. The word “atoll” is derived from “atolhu,” a native name in the Maldivian language. The sizes of the atolls vary from 1.4 to 2,800 km². It is estimated that the atolls of the Maldives are over 10,000 years old (Woodroffe, 1989). These atolls are grouped into 20 administrative regions. The capital, Malé forms a separate administrative unit and is centrally located. The distance between different atolls vary from 1.5 km in the channel between Kuda Kanduolhi and Kudarikilu Kandu in Baa Atoll and 96 km in the Huvadho Kandu (one and half degree channel).



Figure 1-1: The standard theory of atoll formation states that a volcanic island forms in deep tropical waters, giving coral polyps a foundation to grow on (left). In time, the volcano becomes dormant and the island begins to subside. Coral reefs, originally, fringing the edges of the island, becoming a barrier reef outlining the contour of the original coastline (middle). After the original island slips entirely beneath the waves, all that is left is a coral atoll (right). (NASA, 2001).

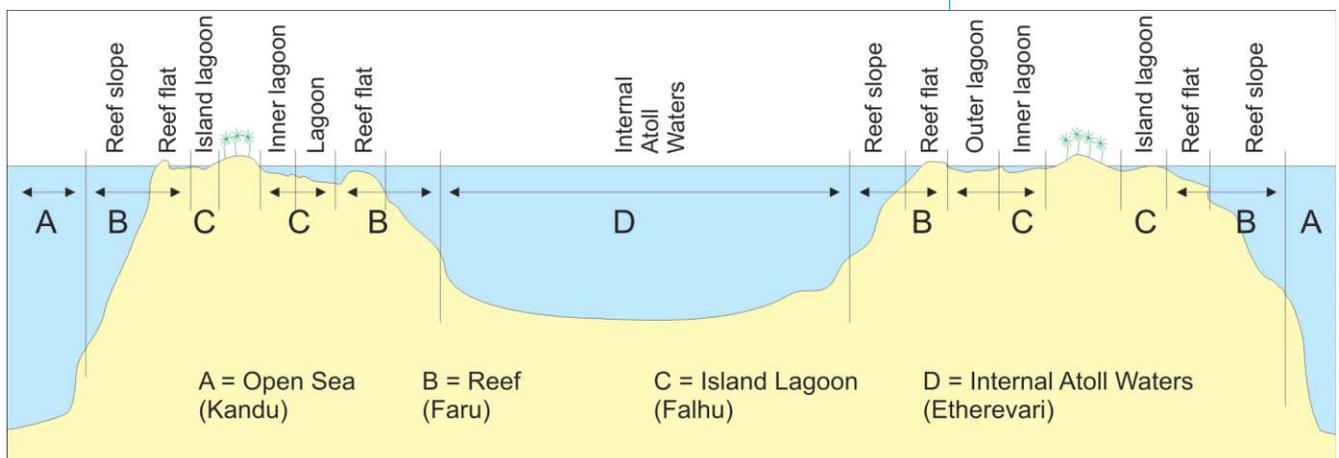
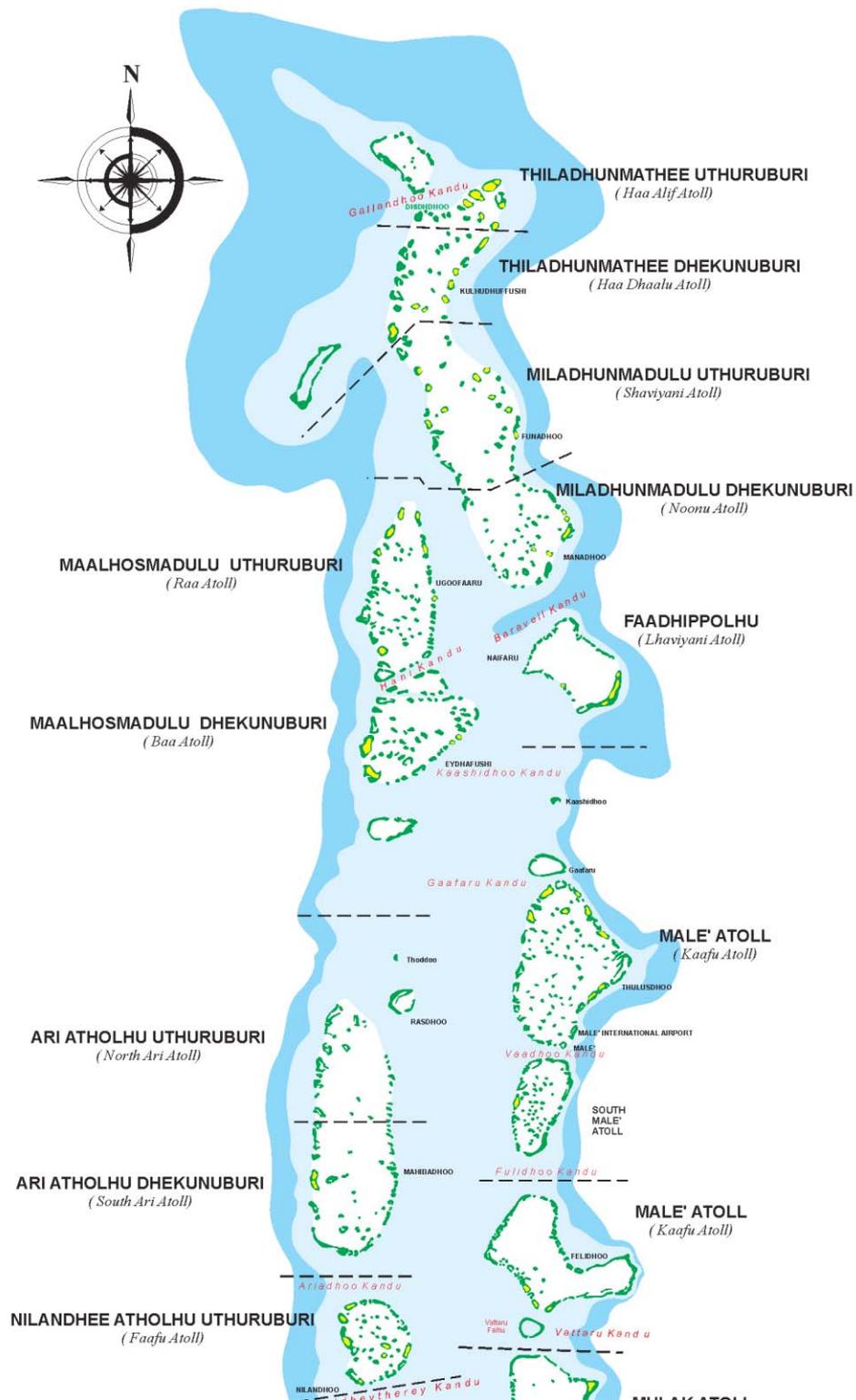
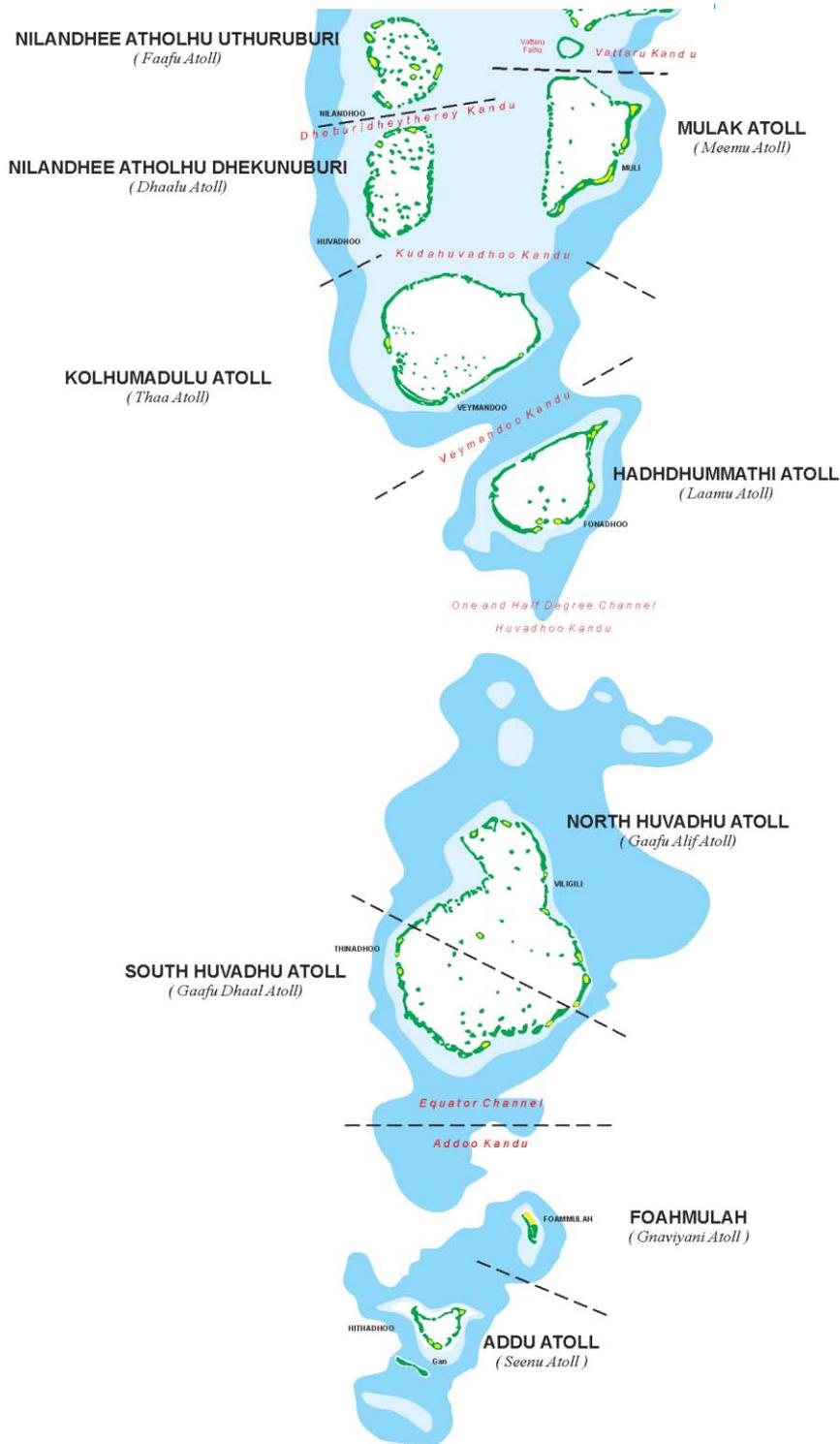


Figure 1-2: Cross section through a typical Maldivian Atoll (adapted from BoBP, 1994)





Atoll	Island Name	Area (km ²)	Population (2000)
1. Laamu	Gan	5.166	2244
2. Seenu	Hithadhoo	4.673	9461
3. Gnaviyani	Fuvahmulah	4.200	7528
4. Laamu	Isdhoo	2.937	1432
5. Kaafu	Kaashidhoo	2.765	1572
6. Seenu	Gan *	2.649	-
7. Gaafu Dhaalu	Gan **	2.636	-
8. Haa Dhaalu	Hanimaadhoo	2.595	1009
9. Haa Alifu	Baarah	2.488	1270
10. Haa Alifu	Filladhoo	2.256	659

* - industrial/airport ** - uninhabited

Table 1-1: Ten largest islands of the Maldives

The characteristics of reefs and coral islands of the Maldives vary considerably from north to south. The atolls to the north are broad banks discontinuously fringed by reefs with small coral islands and with numerous patch reefs and faroes (derived from the Maldivian word “faru”) in the lagoon. To the south the depth of atoll lagoon increases, faroes and patch reefs are rare in the lagoon, the continuity of the atoll rim is greater and a large of the perimeter of the atolls is occupied by islands (Woodroffe, 1989).

The atolls of the Maldives contain a total of 1,192 islands, of which only 199 are inhabited. Over the past 12 years, 86 islands have been developed into tourist resorts (MoT, 2001). All of these islands are made up of coral and coral sand. The islands are entirely built and sustained by the continuous ecological and physical processes in the coral reef ecosystem of which the existence of the islands are based upon. The shapes of the islands depend largely upon the wave action on the shore. Islands vary in shape from small sandbanks with sparse vegetation in the centre to elongated strips and also to relatively circular islands with a large cover of vegetation.

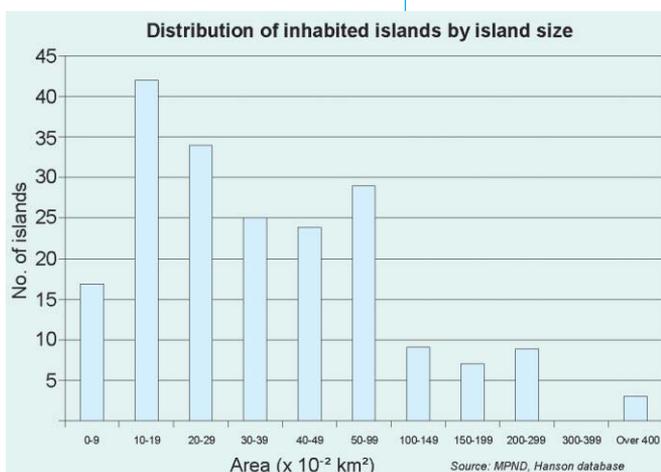


Figure 1-3: Distribution of inhabited islands by island size

The average islands vary in size from 0.5 to 2 km². Only 33 islands have a land area in excess of one square kilometre. According to Figure 1-3 below more than 85% of the inhabited islands are less than 1 km² in size and only 3 inhabited islands have an area exceeding 4 km².

All islands of the Maldives are very low lying and none exceeds the elevation of 3 m. More than 80% of the land area is less than 1 m above mean sea level (MHAHE, 1999). Combined with the small size of the islands, this means that accelerated sea level rise will have devastating effects on the islands and can threaten the very existence of all the islands of Maldives.

1.2 Climate

The Maldives has a warm and humid tropical climate. The weather is dominated by two monsoon periods: the dry northeast monsoon is from January to March and the wet southwest prevails from May to November. The southwest monsoon is the wetter of the two monsoons and is typically the period when most severe weather events occur. The annual average relative humidity is about 80% (DoM, 2000).

Although the Maldives is not located in a region of cyclone or other severe weather activities, historic evidence shows that the northern part of Maldives is affected by storms generated from cyclone activity in other regions of the world (Maniku, 1990 & Woodroffe, 1989). A listing of some of the storms is included further down the chapter, in the section on climate extremes.

Climate Trends

The following section gives the trends in the general climate for the Maldives. The data for the meteorological stations in Seenu Gan are used wherever possible. As the island of Hulhulé is very close to Malé the dataset for Hulhulé is often referred to as data for Malé.

Temperature

Daily temperatures vary little throughout the year with a mean annual temperature of 28 °C. Analysis of long-term annual maximum and minimum temperatures (1969-1999) show a rising trend (Figure 1-4). Based on the analysis, the annual maximum temperatures increase by 0.17 °C every 10 years, whilst annual minimum temperatures show an increase of 0.07 °C every 10 years.

	Temperature (°C)		Wind speed (Kts)	Rainfall (mm)
	Max	Min		
Jan	30.0	25.6	11	85.7
Feb	30.4	25.8	9	44.8
Mar	31.1	26.2	7	70.7
Apr	31.5	26.6	7	125.8
May	31.0	26.3	11	232.3
Jun	30.6	26.0	11	165.6
Jul	30.5	25.7	10	166.8
Aug	30.2	25.5	10	184.2
Sep	30.2	25.3	11	215.3
Oct	30.1	25.3	10	226.9
Nov	30.0	25.3	9	211.2
Dec	29.9	25.3	10	218.1
Mean	30.5	25.7	10	162.3

Table 1-2: 33-year monthly means (1967-1999) for Hulhulé station

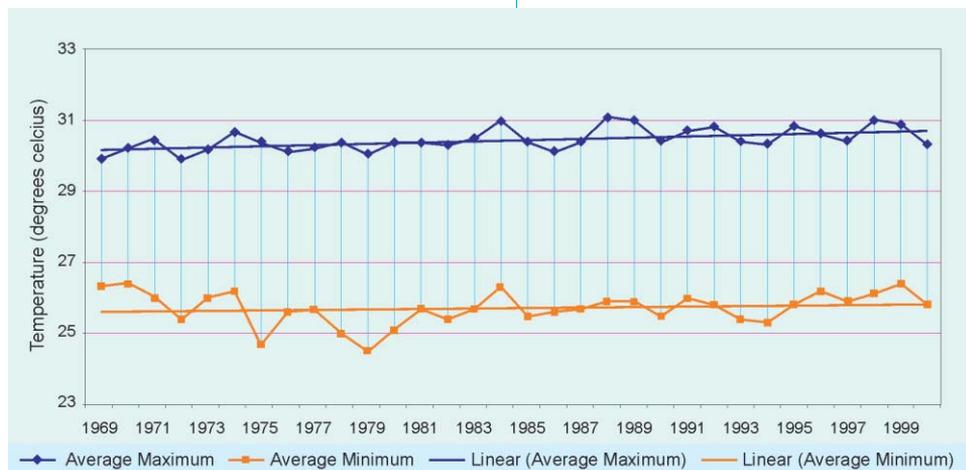


Figure 1-4: Average annual temperature variation for Malé

Table 1-3: Measured temperature extremes for Malé (DoM, 2001)

Highest maximum daily temperature	16th and 28th of April 1973	34.1°C
Highest monthly average maximum temperature	April 1975	32.7°C
Lowest monthly average minimum temperature	March 1974	21.7°C

Rainfall

Rainfall in Maldives varies from north to south with the amount of rainfall increasing towards the south. This difference in rainfall patterns is primarily due to the northeast monsoon period and April being much drier in the north than in the south (Edwards, 1989).

Based on the analysis, the annual maximum temperatures increase by 0.17 degrees every 10 years whilst annual minimum temperatures show an increase of 0.07 degrees every 10 years.

Based on the analysis, a decrease of 2.7 mm in the total annual rainfall for every year for the central region of the Maldives has been observed.

A decrease of 7.6 mm in the total annual rainfall for every year for the southern part of Maldives has also been observed.



Figure 1-5: Annual variations of total rainfall for Malé and Gan

Wettest year recorded	1978	2707mm
Driest year recorded	1995	1407mm
Wettest month recorded	October 1994	588mm
Heaviest daily rainfall recorded	11 October 1998	200mm

Table 1-4: Rainfall extremes for Malé (DoM, 2001)

Analysis of long-term total annual rainfall data for Malé shows a decrease in rainfall. The trend shows a decrease in 2.7 mm of rainfall every year (Figure 1-5). Total annual rainfall for the station in Gan in the south shows a decrease of 7.6 mm of rainfall every year.

Wind

The wind pattern is dominated by winds from the west and northwest and winds from the northeast and east-northeast. Slightly stronger winds are associated with winds from the west typical of the southwest monsoon season. On average wind speeds vary between 7-12 knots. The sever monsoon months are typically May, June and July during the early

part of the southwest monsoon, and September and October at the latter half. Squally gusty winds of 50-60 knots have been recorded at Malé (DoM, 2000). Figure 1-7 below, shows the variation in average seasonal wind speeds over the last 30 years.

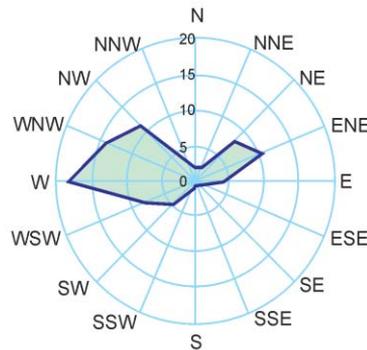
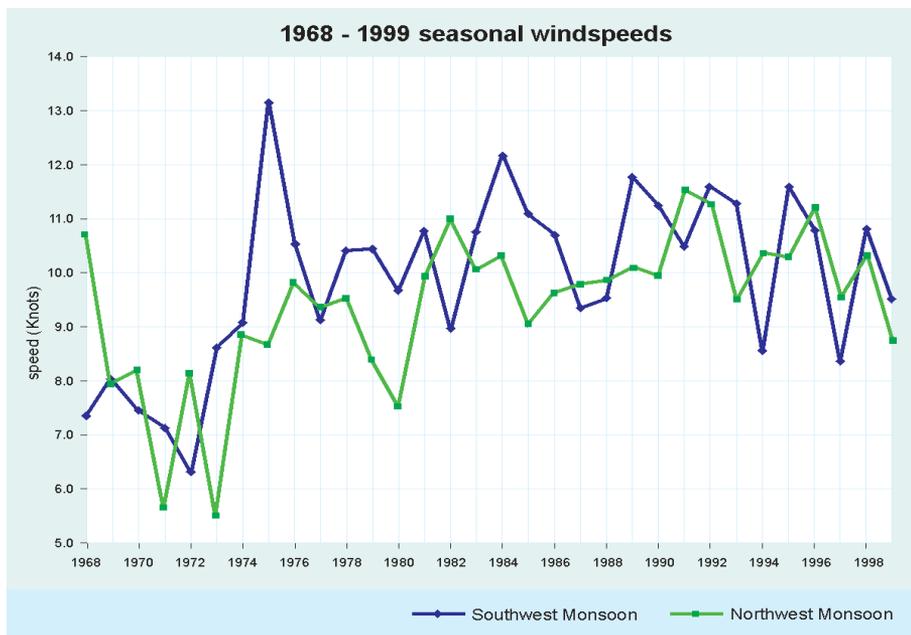


Figure 1-6: Percentage of wind direction for Malé (1980 - 1999)

Current, tides and waves



Month	Wind speed (Kts)
Jan	11.2
Feb	9.2
Mar	7.1
Apr	7.5
May	10.8
Jun	11.0
Jul	10.0
Aug	9.7
Sep	11.0
Oct	10.5
Nov	8.9
Dec	10.0

Table 1-5: Average monthly wind speeds for central atolls of Maldives (1968 - 1999)

Figure 1-7: Average seasonal variations of wind speeds for Malé (DM, 2000)

The Indian Ocean current regime is strongly influenced by the monsoon climate. The swells and wind waves experienced by the Maldives are conditioned by the prevailing biannual monsoon wind directions, and are typically strongest during April – July in the southwest monsoon period.

The Maldives experiences mixed semi-diurnal/diurnal type tides. Comparison of the tide records for Gan (south), Hanimaadhoo (north) and Malé (mid) indicated that the tidal range increases slightly from north to the south of the country. The tide at Hanimadhoo is about 20 cm lower than that at Gan. The tide records also indicate that there is a phase lag from north to south.

Tide level	Referred to Mean Sea Level
Highest Astronomical Tide (HAT)	0.64
Mean Higher High Water (MHHW)	0.34
Mean Lower High Water (MLHW)	0.14
Mean Sea Level (MSL)	0.00
Mean Higher Low Water (MHLW)	-0.16
Mean Lower Low Water (MLLW)	-0.36
Lowest Astronomical Tide (LAT)	-0.56

Table 1-6: Tidal recordings for Hulhulé station

Storm	No. of islands affected
7 May 1812	33
29 Dec 1819	18
8 Dec 1821	27
9 Jan 1955	25
30 May 1991	13 (atolls)

Table 1-7: Historic storms driven by cyclone (Maniku, 1990 & SAARC 1992)



Photo: K.D. Ahmed Manik

Extreme episodic events

- Historical records show that the northern part of Maldives experiences the fury of cyclones. There have been several cases of islands even being uninhabited due to damage caused by such cyclone driven storms. Historical records show that about 18 islands from the northern atolls were abandoned after being devastated by the storm events (Maniku, 1990).

- Inundation of parts of islands, usually accompanied by high waves or heavy rainfall is experienced in the islands of Maldives. These events occur mainly in the southern region and mostly in April and December which is the interim period between the northeast and the southwest monsoon. The island of Fuvahmulah had experienced 9 such events between 1977 and 1989 (Maniku, 1990).

- According to Maniku (1990) storm events that are very localised to sometimes even one island (freak storms) occur in the Maldives. The resort island of Bolifushi was hit by such a freak storm in 2000. This storm lasted about 12 hours and caused US\$ 1.2 million worth of damages.

- The central part of Maldives experienced a strong tidal wave in April 1987. This caused extreme damage to the capital and the international airport.

- It is commonplace to see tide coming ashore in many islands throughout the country at high spring tide. There have been various incidents where houses, roads and trees, especially those nearer to the coastline, have been affected by floods during such tide.

- The most recent storm to affect Maldives was on 30th of May 1991. This is the most severe recorded storm event so far in which the atmospheric pressure fell down to 997 hpa and the maximum squally winds reached 90 kts per hour (DoM, 2001; WMO, 1993). Even though the severe weather system occurred at the southern most atoll, most parts of the country was affected, as 4,081 houses in 13 atolls were damaged (SAARC, 1992).

1.3 Biodiversity in the Maldives

The islands of the Maldives are very small, low lying and isolated. This fact very much limits the richness of the terrestrial biodiversity. As the islands are located purely in a marine ecosystem, the Maldives is very rich and diverse in terms of its marine biodiversity.

Limited studies have been done to study the biodiversity of Maldives. From Tables 1-8 and 1-9, it can be seen that the recorded species of terrestrial flora is more diverse compared to terrestrial fauna. Because of the coastal ecosystem, Maldives has a wide variety of mangrove species.

Given the small island ecosystem, Maldives is home for many species of seabirds. Five sub-species of seabirds have been identified as endemic to the Maldives (Table 1-10). Endemicity and the frequency of unique sub-species are high in the southern part of Maldives compared to the north. From a biodiversity prospect, it is very important to protect all islands from the effects of climate change and sea level rise, especially the uninhabited islands, which are hotspots of biodiversity.

Maldives is very rich in its marine flora and fauna. Over 1200 species of fish, 250 species of hermatypic corals and 285 species of algae have been identified in the Maldives (Table 1-9). These marine ecosystems are very vulnerable to climate change and sea level rise.

As mentioned earlier few studies have been undertaken to study the biodiversity in Maldives. No studies have been undertaken to study the freshwater environment. There might still be many species that have not been identified. Therefore, it is important to do more studies to compile a complete listing of flora and fauna found in the Maldives.

1.4 Population

Maldives has a population of 270,101 and an annual growth rate of 1.96% according to the figures of the latest census in March 2000 and

Terrestrial Biodiversity
583 species of plants
Over 300 species of medicinal plants
Over 24 families of Fruit plants
Over 23 families of vegetable plants
Over 35 families of flowering plants
130 species of insects including spiders, flies, beetles, arachnids and ants
180-200 bird species of which 70 are shore birds
2 species of native fruit bats
2 species of Snakes, 2 species of Ghekoes and 2 species of Garden lizards
1 species of Frog
1 species of Toad

Table 1-8: Terrestrial biodiversity of the Maldives (ERC, 2001)

Marine Biodiversity
1200 species of Fish
Over 9 species of Whales
15-20 species of Sharks
Over 7 species of Dolphins
5 species of Turtles
250 species of hermatypic corals
285 species of algae (21 blue-green algae, 163 red, 83 green and brown algae)

Table 1-9: Marine biodiversity of the Maldives (ERC, 2001)

English name	Maldivian name	Scientific name
Maldivian Pond Heron	Huvadho Raabondhi	<i>Ardeola grail phillipsi</i>
Maldivian Little Heron	Dhivehi Raabondhi	<i>Butorides striatus albidulus</i>
Central Maldivian Little Heron	Medhu Raajjetherey Raabondhi	<i>Butorides striatus didii phillipsii</i>
Maldivian Water Hen	Dhivehi Kan'bili	<i>Amouronis phoenicurus maldivus</i>
Asian Koel	Dhivehi Kovei	<i>eudynamus scolopacea scolpacea</i>

Table 1-10: Endemic bird sub-species of Maldives (MHAHE, 2001)

the population was counted as 244,814 in the 1995 population census. The population pyramid for the 1995 census in Figure 1-8 shows that a large proportion of the population is below twenty years of age. Maldives is a very young population living on very vulnerable low-lying islands (MPND, 2001).

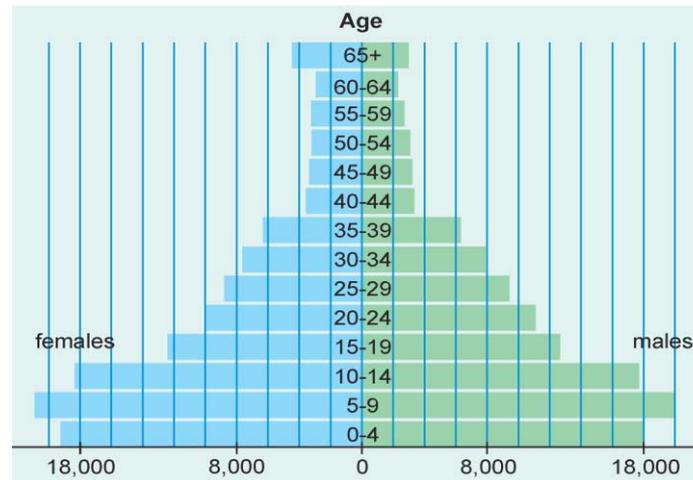


Figure 1-8: Distribution of Maldivian population by age (1995)

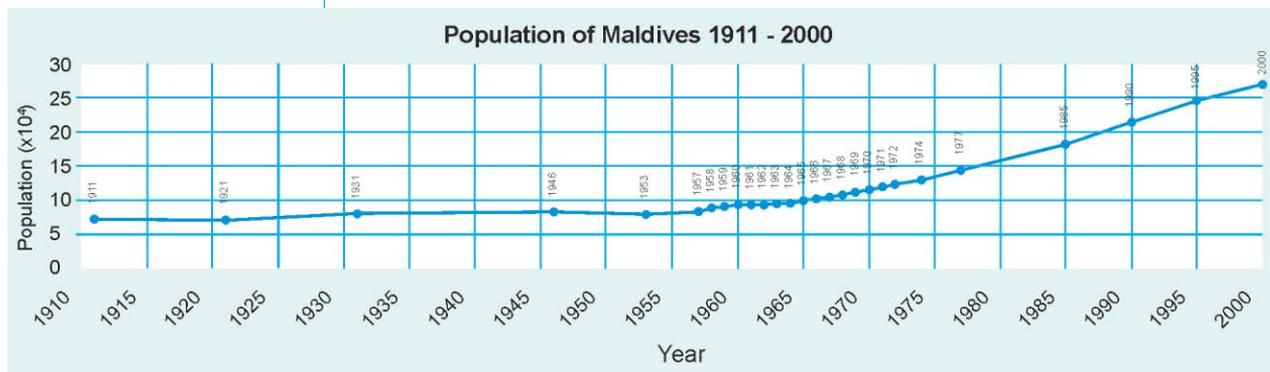


Figure 1-9: Population of Maldives (1911-2000)

Malé is the only urban centre with, a population of 74,069 (MPND, 2001). The need for education and employment is the main reason for the huge tendency for the population to move to Malé. With more job opportunities in the tourism industry, there is a tendency for a lot of the young people from outer islands to move to nearby resort islands.

The government is looking into solutions to urbanise other regions of Maldives. Currently there are islands in the southern and northern atolls of Maldives that are being developed as growth centres.

The population density on some islands is very high. Nearly half the inhabited islands have population densities over 2,000 persons/km². There

are three other islands with higher population density than Malé with the most densely populated island being, *Kandholhudhoo* in Raa Atoll with density over 744 persons/Ha (MPHRE, 1998). The distribution of the population in the Maldivian islands is given in Figure 1-10.

1.5 Socio-cultural character

Archaeological evidence indicates that the islands have been inhabited for up to 2,500 years (Woodroffe, 1989). According to historic writers the early settlers were from the Indus valley civilisations and linguistic evidence suggests a common ancestry with the Sinhalese who settled in Sri Lanka. The people originally appear to have been sun-worshippers, then later became Buddhists and were converted to Islam in the year 1153. Maldivians belong to the Sunni sect.

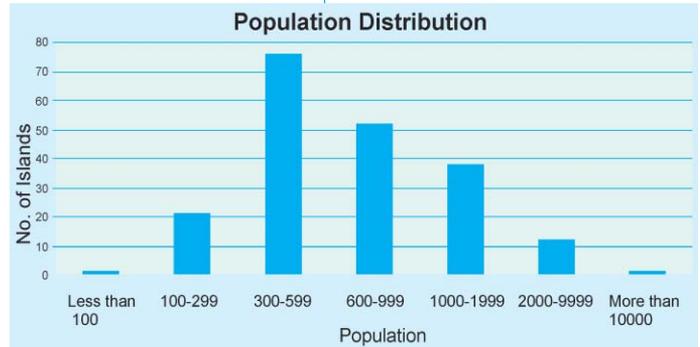


Figure 1-10: Spatial population distribution for Maldives (1995)

The distinctive Maldivian language, Dhivehi, was written down as early as the 12th century and originally written from left to right. The modern script, Thaana, was invented in the 16th century, is based on variants of 9 Arabic numerals, and is written from right to left. The Maldives thus has an ancient culture, own language and script. A whole unique culture and way of life is thus at risk from climate change and sea level rise.

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“Thaana”: A script used exclusively in Maldives.

1.6 Transportation system in the Maldives

The isolated populated islands and resort islands are linked by the air and sea transportation system existing in the Maldives. An air transportation system is developed with the four regional airports and the seaplane networks, which is being operated in the central region of the country. In 1994, 151,217 domestic passengers travelled between the regional airports in 15,738 flights. In 1994, the seaplane network carried 69,279 passengers and operated 8,636 flights (MPND, 1995). The domestic air transportation sector is developing and in 1999, the total domestic passenger movements increased to 466,551 (MPND, 2000).

Sea transportation is a popular mode of transportation in the country. In 1994, more than 750 vessels were registered and operated in the Maldives (MPND, 2000). As the services and facilities are located in the regional growth centres, the major transportation is between islands and

Malé and between Malé and the growth centres in the atolls. It was found on average 18 boats travelled to the atoll capital at least three times in a month and 29 boats travelled once or twice to Malé from the atolls (MPND & UNDP, 1998).

The smallness of the islands and infancy of the transportation sector has limited the land transport system to Malé and other regional growth centres. Though motorcycles are found in all islands, the bulk of the cars are found in Malé. In 1994, 128 new cars were registered and this grew to 245 in 1999 (MPND, 2000). The bulk of these cars would add on to the already existing traffic congestion and pollution in Malé.

1.7 Energy production and usage

Energy is mainly used for electricity generation and in the transportation sector.

Year	Percentage of population without electricity
1990	33
1995	13
1998	7

Table 1-11: Percentage of population without access to electricity (MPND & UNDP, 1998)

Diesel is the main source of fossil fuel for generation of electricity in the Maldives. The total population of the Maldives does not have access to 24 hour electricity. In 1998, more than 60 islands had electricity for 24 hours, accounting for 55% of the population (MPND & UNDP, 1998).

There is an imbalance in the usage of electricity between Malé (urban) and atolls (rural areas) of the Maldives. In 1994, 2.57 million gallons of diesel was consumed to produce 42 MWh of electricity in Malé, while in atolls 4.5 MWh of electricity was generated (MPHRE, 1995). The usage of electricity is on the rise as in 1998, 68.6 MWh of electricity was produced and 3.96 million gallons of diesel was consumed in Malé (MPND, 1999).

The transportation sector is another major area where energy is consumed. The land and sea transportation system mainly uses diesel and to some extent gasoline, while the air transportation system mainly consumes jet kerosene.

Firewood, liquid petroleum and kerosene are the main sources of energy used for cooking in the country. In 1990, 94% of the population in

the atolls used firewood for cooking while in 1998, the figure dropped to 66%. However the use of kerosene for cooking increased from 6% to 40% in the same period (MPND & UNDP, 1998). Liquid petroleum is mainly used in Malé and in 1994, 3.4 Kt of Liquid Petroleum Gas (LPG) was used in the Maldives (Customs, 1994).

1.8 Water resources, usage and supply

The water resources of the Maldives comprise of fresh groundwater that occurs in the porous coral sediments on many islands of the Maldives. The population of Maldives has traditionally been dependent on groundwater from shallow wells dug in the ground. It has been estimated that currently 25% of the population depends on groundwater for drinking while the rest of the population uses rainwater and desalinated water for drinking and groundwater for other purposes (MPND & UNDP, 1998).

The quality of groundwater varies seasonally and across the islands. The amount and temporal pattern of rainfall and the size and shape of an island determines the amount of fresh groundwater that accumulates. The fresh groundwater is found as a “freshwater lens” that comprises of a freshwater zone underlying by a transition zone of a few meters thickness between the freshwater and underlying seawater. The top of each freshwater lens found in the islands of Maldives is generally 1.5 to 2 m below the land surface and changes continuously with the tide. At present mapping of the groundwater resources is not generally available for the islands of Maldives.

In general the groundwater found in the islands have very low salinity. The quality of the water in terms of bacterial content needs to be assessed further. In many of the islands where studies have been done, it was found that bacterial content is very high. The source is generally discharge and leakage from septic tanks.

For drinking purposes, rainwater is the traditional source for the Maldivians. Rainwater is harvested by individuals from roofs of houses during rain showers. The harvested rainwater is stored in tanks and other vessels. In almost all inhabited islands there are public rainwater storage

facilities. Before harvesting rainwater, the roofs and storage vessels are allowed to be cleaned by the initial burst of rain.

Presently, more than a quarter of the population depends on desalinated water for drinking and other uses. Desalinated water is used only in two inhabited islands, including Malé. Desalinated water has been available in Malé for more than a decade and all households in Malé now have access to piped desalinated water. However, rainwater is still harvested in Malé during the rainy season. In the resorts, mostly bottled water is used for drinking while desalinated water is used for other purposes.

1.9 Agriculture and food security

Primarily because of the limited area of arable land with generally poor soil and limited supplies of freshwater, agriculture is a comparatively small sector in the Maldivian economy. Share of agriculture sector of GDP declined from 5.5% in 1986 to 3.6% in 1995 (MPND, 2001). The sector's importance to the economy however, is greater than its contribution to GDP, considering its impact on generating employment and income opportunities in the outer atolls, attaining food security and greater self-reliance in part through import substitution of certain agricultural products.

The sector has always been the employer of the majority of the female labour force of the island population. About 3.4% of the Maldives labour force is engaged in agriculture and related activities (MPHRE, 1995).

A wide range of crops are grown, with a heavier concentration of root crops in the south and more field and grain crops in the north. Coconut is the most common 'plantation' crop in all the atolls, as well as the most popular home garden tree. Coconut is an integral part of the Maldivian diet and its supply is sufficient for local use. The production of banana, papaya, watermelon, chilli, pumpkin, eggplant and leaf cabbage has been increasing and they constitute a significant percentage of the grower's income. The production of root crops such as taro, cassava and sweet potato and grains is decreasing with increased consumption of imported rice and wheat flour at administered prices. Today,

such root crops are more of a delicacy than an everyday staple food.

Recently, there has also been an increasing trend in farming in resorts islands. A total of about 26 resorts have been recorded for producing a significant part of their tropical vegetables and fruits (MoT, 2001). In addition, timber forest management through traditional tenure agreements is an important component of agriculture. Livestock production is limited to goat husbandry and poultry production. The latter takes place primarily in rural islands.

The agricultural crops mainly grown are rain-fed, however, many high value cash crops like chillies and watermelon are being irrigated with water extracted from the water table.

1.9.1 Food storage and distribution

The imported rice and other food items are stored in Malé. The local small business entrepreneurs then distribute these throughout the country.

The country's traditional food distribution system is largely via *dhoni*, small boats, from the storage facilities in Malé to islands through the *ad hoc* transport system, which operates in the country. It normally takes about two to three days travel by *dhoni* from Malé to the most northern and southern islands respectively.

Storage in the islands is limited to local households and warehouses of small retail shops. The frequency of food supplies depends largely on the available transport and storage facilities.

1.9.2 Heavy import dependency

At present almost all food requirements, except fresh fish and coconut, are imported. Rice is the staple food of the Maldivians and it is mostly imported from South and South East Asia. According to statistics from Maldives Customs Services, 66% of rice and 90% of wheat flour is imported from India (MCS, 2001). Maldives also imports a lot of its fresh fruits and vegetables from India, Australia and Sri Lanka.

1.10 Health

Maldivians are a healthy people and according to statistical records, the health of Maldivians has improved dramatically over the past 20 years (Figure 1-11). These improved health conditions are due to the increase in health facilities provided to the public and also awareness among the public.



Figure 1-11: Infant Mortality Rate 1980-1999 (MoH, 2001)

Other indicators like the Maternal Mortality Rate (MMR) and Still Birth Rate (SBR) are also used in the health sector. Both these indicators reflect improvements in the health of the

population (MoH, 2000).

1.10.1 Health care facilities and services

Table 1-12 give the types of health care facilities and services available in Maldives.

Tertiary curative care (available in Malé)		
	1 Public hospital	Experienced Maldivian doctors and expatriates, wide range of specialists
	1 Privately owned hospital	Assisted by nursing, paramedical and technical staff
	About 16 Private clinics	Wide range of investigative facilities also available
Secondary curative care (Regional Level)		
	5 Regional hospitals Located in Raa Atoll, Meemu Atoll Haa Dhaal Atoll, Seenu Atoll and Malé	Wide range of preventive and curative services including certain investigative services available
Primary curative care (Atolls and Island Level)		
Atolls	27 Atoll Health Centres	Staffed by a team consisting of: <ul style="list-style-type: none"> • a doctor and nurse aides • a community health worker (CHW) • a family health worker (FHW) • traditional birth attendant (TBA)
Islands	No set health centre established	Simple preventive and curative services provided by a local FHW and TBA
	In some islands a health post is set up	In islands with a large population, the government provides the services of a doctor

Table 1-12: Health care facilities and services available in Maldives (MoH, 1998)

1.10.2 Burden of diseases

Table 1-13 below gives an overall status of major communicable diseases in Maldives.

Disease	Status
Acute Respiratory Infection (ARI)	Estimated 18% of deaths aged between 0-4 years of age due to pneumonia In some regions, an estimated 60% of children attending hospitals affected with ARI
Diarrhoea	In the past a significant number of infants and children dying from the disease No decrease in morbidity as expected with increased accessibility to safe drinking water and sanitation facilities
Worm Infestations	Study done in Laamu Atoll (1992), 60% of children under the age of 3 suffering from worm infestations Recent estimates show 50-75% of children below 5 years infected with intestinal parasites
Malaria	A major public health problem till the early 1970s In the early 1960s a WHO assisted vector-borne disease control programme, specifically malaria control, was initiated Since 1984, the Maldives has remained malaria free
Filaria	The implementation of mosquito control activities for malaria control had a positive impact on the filarial situation Filaria cases still continue to show up but there have been no cases that have progressed to advanced stages
Dengue fever	The first cases identified in 1979 Endemic in the country No clear-cut epidemic pattern has been observed with respect to dengue hemorrhagic fever and the last epidemic occurred in 1988

Table 1-13: Status of most common diseases in the Maldives (MoH, 1998)

GDP (at 1985 constant prices)	
Year	GDP (in Million US\$)
1995	115.5
1996	124.6
1997	136.0
1998	148.3
1999	161.0

Table 1-14: GDP for Maldives
1995 -1999 (MMA, 2001)

1.11 Economy

The Maldivian economy shows a strong economic growth as registered in the GNP growth rate of 8.5% in 1999. This is however a slight decline from the GDP growth rate of 9.1% in 1998 (MMA, 2001).

The main contributing sectors to the GDP are tourism, fisheries, construction and the commercial sector, with the tourism sector contributing to 33.1% of the GDP and the fisheries sector contributing to 6.5% in 1999 (MPND, 2001).

1.11.1 Primary imports and exports

Due to the growth in the commercial sector, imports and export has been increasing steadily. Table 1-15 and 1-16 shows a breakdown of the imports and exports for the Maldives. The consumer goods imported include food products such as rice, wheat flour, sugar, dairy products, etc., tobacco and beverages, and other manufactured goods. The petroleum products imported are aviation gas, kerosene, diesel, gasoline and lubricating oil. Intermediate and capital goods are inclusive of machinery, transport equipment, construction material and timber.

Cost including freight in millions of US\$	1995	1996	1997	1998	1999
Total imports	267.9	301.7	348.8	354.0	402.2
Consumer goods	127	142.8	168.9	N.A	N.A
Petroleum products	30.5	27.3	38.7	N.A	N.A
Intermediate and capital goods	110.4	131.6	141.2	N.A	N.A

Table 1-15: Composition of main imports
by year, 1995-1999 (MMA, 2001)

The exports constitute chiefly of marine exports and garments. Fish export is the major component of the marine exports. The fish exports are frozen tuna, frozen reef fish, canned fish, dried fish, salted fish, salted reef fish and live tropical fish, out of which canned fish is the biggest contributor to marine exports.

Composition of exports in millions of US\$	1995	1996	1997	1998	1999
Total merchandise exports	85	79.9	92.9	95.6	91.5
Domestic exports	49.6	59.2	73.2	74.3	63.7
Total marine exports	37	48.7	58.2	56.5	38.8
Garments	12.5	10.3	14.9	17.8	24.8
Others	0.1	0.1	0.1	0.1	0.1
Re-exports	35.4	20.8	19.6	21.3	27.8

Table 1-16: Composition of main
exports from Maldives (MMA, 2001)

1.11.2 Tourism

Tourism is the leading economic sector in the Maldives. The annual number of long staying visitors in the Maldives far exceeds the size of the resident population, contributing to about one third of GDP of the country (Table 1-17). Tourism is also the largest single foreign currency earner and a significant source of employment in these islands. Since Maldivian tourism industry is almost entirely dependent on physical and geographic factors, such as good weather and activities associated with sea and coral reefs, climate change will have very serious implications on the nation's main economic sector.

Annual tourist arrivals have increased from 1,097 in 1972 to 467,155 in 2000. Tourist bed capacity has also increased to over 17,500 beds in 1999 (MoT, 2001). Over 85% of these beds are developed on resort islands within a 145 km radius around Malé International Airport.

Year	Tourism revenue (Million Rufiyaa)	Tourism receipts (Million US\$)	Percentage share of GDP
1990	141.7	88.7	18.1
1991	159.7	95.3	17.4
1992	191.1	138.0	17.7
1993	217.1	146.4	17.1
1994	307.8	180.7	17.8
1995	372.0	210.7	18.4
1996	408.9	265.6	19.1
1997	480.8	286.0	18.7
1998	527.2	303.0	18.3
1999	628.5	334.1	18.5

Table 1-17: Tourism contribution to economy, 1990-1999 (MoT, 1999)

According to tourism legislation, resort islands need to be developed on uninhabited islands, which are kept separate from the other islands where the locals dwell. Such regulations are primarily to protect the local culture and religion from external influences.

The Ministry of Tourism has specified several regulations and standards to ensure maximum protection of the island environment. Some of these include:

- *Maximum island area to be occupied by buildings is 20%*
- *For building purposes a minimum setback limit of 5m from the vegetation line of the island.*

All resort islands are self sufficient in terms of the electricity, water and other essential items needed for efficient running of the resort. The electricity demand is met by the electricity generation facilities on the island itself and the resorts have their own water desalination systems to cater to the water requirements.

The staff working at the resort are accommodated on the resort island during the weeks or months of their work-shift. Building up of an island as a resort has to comply with guidelines set by the Ministry of Tourism. Standards that are set include that coral from the reefs of Maldives shall not be used for any construction on a tourist resort and that not more than 20% of an island may be cleared of bushes and vegetation for construction.

Box 1-1: A Typical Resort Setting in the Maldives

1.11.3 Fisheries

The main types of fishery in the Maldives are tuna, reef, grouper, aquarium, sea cucumber, shark and giant clam. The fisheries sector contribution to the GDP has shown a declining trend compared to the tourism sector. In 1978, the fisheries contribution to the GDP was estimated at about 22% (MPD, 1983) and by 1999 this figure had decreased to 6.5% (MPND, 2001).

Maldivians rely heavily on tuna resources as a source of protein. It is assumed that a constant per capita consumption rate of 85 kg/yr was consumed during the mid 1980's (Doulman, 1992). However, not all the tuna catch are used for home consumption. Frozen round tuna is exported to Thailand and Japan while the traditionally processed products of smoked tuna, dried tuna and salt dried tuna are exported to Sri Lanka.

The Felivaru Tuna Processing Plant produces canned tuna in the Maldives. Tuna is packed in brine and oil as chunks and steak and exported to

countries such as the UK, Germany, Netherlands and Greece. Export of canned tunas stagnated during the past five years due to the fall in the world market prices. The unit price for a metric ton of canned tuna has decreased from Rf 24,000 to Rf 16,000 (US\$ 2031-US\$ 1356) over the past six years.

The livelihood of the communities in the atolls depends on the income generated from the fisheries sector. The total percentage of people engaged in the fishing industry consists of about 25% of the total population (MPHRE, 1998). This also includes employment sought in fishery related areas such as Felivaru Tuna Processing Plant, export of various fish products and land based freezer facilities at Koodoo in Gaaf Alif Atoll and Maandhoo in Laamu Atoll.

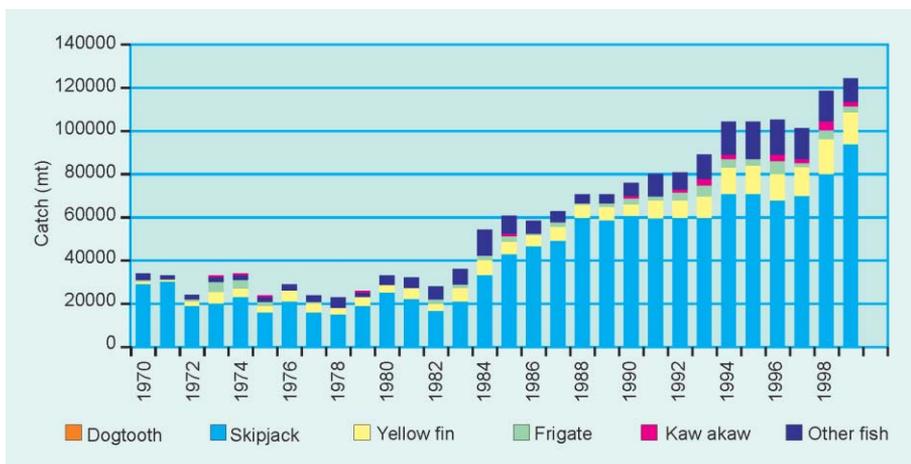


Figure 1 - 12: Tuna catch in Maldives (MOFAMR, 2001)

1.11.4 The International Airport

All economic sectors rely heavily on the international airport. Malé International Airport on the island of Hulhulé about two kilometres from Malé is the gateway to the Maldives for tourists and the world. The airport handled 49,726 flights, 1,497,559 passengers, and 25,326 tonnes of freight in 1999 (MPND, 2000). The airport is a key installation as far as the economy is concerned. The revenue from the tourism sector, which contributes 33% to the government revenue (MPND 2001), is dependent on the continued operation of the airport.



Maldives has been involved in some of the global programmes of research and systematic observation. Maldives continues to take part in such programmes. Below are some of the programmes that Maldives is involved in:

Coral reef monitoring

- International Coral Reef Initiative (ICRI).
- Global Coral Reef Monitoring Network (GCRMN).

Impacts of aerosols on climate change

- Indian Ocean Experiment (INDOEX)

Box 1-2: Some of the global programmes of research and systematic observations participated by the Maldives

1.12 Research and systematic observation

All climatic data in the Maldives is being measured by Department of Meteorology (DoM). Climatological measurements are limited to tide levels, rainfall, wind speeds and direction, and temperature measurements. Such measurements over a period of approximately 30 years are available for Gan in Addu atoll and the island of Hulhulé, the international airport that is in northeast of Malé. Since the two islands are so close, this data is often referred to as measurements for Malé. In addition to these two stations, the National Meteorological Centre now relies on data from three other stations. The Department of Meteorology relies on eight rain gauges to measure rainfall patterns throughout the country. (DoM, 2000).

Due to the absence of basic measurement instruments and the lack of human resources necessary to carry out such research, there have been no measurements taken for radiation levels, evaporation rates and, upper atmospheric measurements on the atmospheric side.

For measurements related to the ocean, there is no recording of sea surface temperatures, current patterns and speeds, salinity, wave observations and actual sea levels. The latter is with the exception to measurements of tide levels being taken at three meteorological stations in the northern, middle and southern parts of Maldives (DoM, 2000).

There is a low-resolution satellite recovery system in place in the meteorological observatory at the international airport island of Hulhulé. Satellite imagery of the region is available at a very low resolution.

1.13 Maldives in the international arena

The Maldives gives high importance to taking part in the international agenda. Maldives is a member of many international organisations. Some of these organisations include the United Nations (UN), World Meteorological Organisation (WMO), World Health organisation (WHO), South Asia Co-operative Environment Programme (SACEP), International Maritime Organisation (IMO), International Civil Aviation Organisation (ICAO) and South Asian Association for Regional Cooperation (SAARC).

The Maldives is also party to a number of international agreements and treaties. Being a small island state, Maldives has been very actively voicing the concerns of climate change and sea level rise. Maldives is a party to the UNFCCC and was the first country to sign the Kyoto Protocol and has been actively participating since its inception and throughout the IPCC processes. Other environmental conventions signed and ratified by the Maldives include:

Treaty / Convention / Agreement	Signature	Ratification (R) Accession (A)
1954 International Convention for the Prevention of Pollution of the Sea by Oil	-	10 April 1982
1982 United Nations Convention on the Law of the Sea	10 Dec 1982	7 Sep 2000 (R)
1985 Vienna Convention for the Protection of the Ozone Layer	-	26 Apr 1988 (A)
1987 Montreal Protocol on Substances that Deplete the Ozone Layer	12 July 1988	16 May 1989 (R)
1989 Basel Convention on the Control of Transboundary Movements of hazardous Wastes and their Disposals	-	28 April 1992 (A)
1990 The London Amendment to the Montreal Protocol on Substances that Deplete the Ozone layer	-	31 July 1991 (R)
1992 The Copenhagen Amendment to the Montreal Protocol on Substances that Deplete the Ozone layer	-	27 Sep 2000 (R)
1992 Convention on Biological Diversity	12 June 1992	9 Nov 1992 (R)
1997 The Montreal Amendment to the Montreal Protocol on Substances that Deplete the Ozone layer	-	27 Sep 2000 (R)

Table 1-18: Some of the environmental conventions signed and ratified by the Maldives