State of the Environment Maldives 2011

Ministry of Environment and Energy

Republic of Maldives

STATE OF THE ENVIRONMENT 2011

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Foreword

Dr Mariyam Shakeela

Minister of Environment and Energy

The first SOE report of the Maldives was produced for the UN Global Conference on the Sustainable Development of Small Island States held in Barbados in 1994. Today it is with great pleasure I am presenting the SOE 2011, the fifth report of SOE series. The report addresses the objective of providing an analytical overview of state of the environment focusing on 10 key environmental challenges confronting today. New issues including energy, chemical and toxicology, and environmental governance have been included in this issue widening the information and data, and addressing emerging issues.

Maldives has changed socially, economically and environmentally since SOE 2004, the last publication. With the first democratic election held in November 2008 the country is going through a political transition. With the passing of the Decentralization Act in October 2010 island councils and atolls councils have been formed paving way for growth to be distributed equally between the atolls and the capital. With this change the importance of integrating environment protection and conservation into development decision making has become more important today. The report highlights changing drivers, such as population growth, economic activities and consumption patterns have placed increasing pressure on the environment. Serious and persistent barriers to sustainable development continue to persist.

SOE 2011 highlights landmark developments. In March 2009 Maldives unveiled plans of becoming carbon neutral by 2020. Today use of renewable energy is encouraged with a number of programs being implemented at the country level. The most recent decisions to encourage use of renewable energy includes waiving import duties on electric and renewable energy powered vehicles. Significant efforts towards biodiversity conservation have also been made of which declaration of Baa Atoll as a UNESCO Biosphere Reserve in 29 June 2011 being a major milestone. The Baa Atoll Conservation Project initiated in 2003 is formulated to design, test and demonstrate a management system that will secure and sustain the rich biodiversity and ecological processes of the Atoll for the benefit of the future generation.

SOE 2011 is the fifth of the series of reports. The objective is to create and broaden awareness and environmental issues and to provide decision makers and planners with meaningful data and information to make necessary decisions. The process of publication of SOE also highlights and identifies several issues in relation to availability, accessibility and management of environmental information in the Maldives. Although considerable efforts had been made to improve issues related to collection, management and access to environmental information, lack of a centralized environmental information system makes access to environmental information difficult. The complete absence of some environmental information pertaining to issues such as chemical and toxicology presents a major challenge, not only in evaluating issues and their state but also in assessing risks. A coordinated effort is required among the different sectors to strengthen the information base.

It is my sincere hope that this analytical overview will stimulate innovative thinking and increase knowledge of the stakeholders of the environment. And it is also my hope that a coordinated effort would take place to establish a centralized environmental information system where scientific and technical literature on environmental topics such as global warming, climate change, biodiversity and coastal zone management would be available. Establishment of an environment information system that provides access to such material, among others, is a pressing issue for the Maldives at present.

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Abbreviations

BACP	Baa Atoll Conservation Project
CBD	Convention of Biological Diversity
CCA	Climate Change Adaptation
CCAC	Climate Change Advisory Committee
CCHDC	Centre for Community Health and Disease Control
CFC	Chlorofluoro carbon
COP	Conference of Parties
DOM	Department of Meteorology
DPH	Department of Public Health
DRR	Disaster Risk Reduction
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
ENSO	El Nino Southern Oscillation
EPA	Environment Protection Agency
ERC	Environment Research Centre
FISIM	Financial Intermediation Services Indirectly Measured
FRESA	Fund for Renewable Energy System Application
HCFC	Hydro chlorofluro carbons
HDPE	High-density polyethylene
GHG	Green House Gas
GIS	Geographic Information System
ICZM	Integrated Coastal Zone Management
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for
IWMC	Island Waste Management Centres
LPG	Liquid Petroleum Gas
MCS	Maldives Custom Services

MED	Ministry of Economic Development
MEMP	Maldives Environment Management Project
MDG	Millennium Development Goals
MOFA	Ministry of Fisheries and Agriculture
MFDA	Maldives Food and Drug Authority
MFF	Mangroves for the Future
MHAE	Ministry of Housing and Environment
MODNS	Ministry of Defense and National Security
MOHAF	Ministry of Health and Family
MOT	Ministry of Transport
MRC	Marine Research Centre
MSI	Mauritius Strategy Implementation
MSL	Mean Sea Level
MTC	Something related to transport
MTAC	Ministry of Tourism, Arts and Culture
MWSC	Maldives Water and Sewerage Company
NAP	National Action Plan
NAPA	National Adaptation Plan of Action
NBF	National Biosafety Framework
NBSAP	National Biodiversity Strategy and Action Plan
NC	National Communication
NCHLR	National Centre for Historic and Linguistic Research
NDMC	National Disaster Management Centre
NGO	Non Governmental Organisation
ODS	Ozone Depleting Substances
OIEP	Outer island electrification project
PPP	Public –Private Partnership
REDTAP	Renewable Energy Technology Development and Application Project

REIO	Renewable Energy Investment Office
RET	Renewable Energy Technologies
RWMF	Regional Waste Management Facility
SACEP	South Asia Co-operative for Environment Program
SAICM	Strategic Approach to International Chemicals Management
SASP	South Asian Seas Program
SIDS	Small Island Developing States
SLM	Sustainable Land Management
SLR	Sea Level Rise
SME	Small and Medium Enterprises
SNAP	Strategic National Action Plan
SRES	Special Report on Emissions Scenarios
SST	Sea Surface Temperature
STELCO	State Electric Limited Company
TRA	Transport Regulating Authority
TPMP	Terminal Phase-out Management Plan
UNEP	United Nations Environment Program
UNESCO	United Nations Education, Scientific and Cultural Organisation
UNCCD	United Nations Convention to Combat Desertification
UNISDR	United Nations International Strategy for Disaster Reduction
UV	Ultraviolet
WCCM	Wetland Conservation and Coral Reef Monitoring For Adaptaton To Climate Change
WRM	Water Resource Management
WHO	World Health Organization

Overview

The MHE initiated the publication of the SOE in 1994 to assess the issues and development of the environment. The aim is to make the environment information easily accessible to all the stakeholders of our environment. The publication is a precise reference pertaining to the environment within the scenario of information available in the country. SOE highlights the changes that have occurred, socially economically and environmentally.SOE 2011 addresses Energy, Environmental governance, Chemical and toxicology and Tsunami recovery in addition to the 5 key environmental issues identified in SOE 2004. These 5 areas are Climate change and sea level rise, Water and sanitation, Waste management, Pollution and Biodiversity conservation. SOE also highlights the socio-economic status of the country which emphasizes the interlink between environment, economic and social issues.

Socio-economic Development

In the Maldives, where only less than 1% of the total area is land suitable for human habitation, population growth has far more serious consequences than many other countries worldwide. Population of Maldives grows about 1.76 % per annum and had alarmingly increased inward migration to the capital city for better livelihood causing major environmental implications. The Maldives population reached 319,740 by 2010 in which 56% is comprised of children and youth. One third of the population lives in the capital, Male', which has an area of less than 2 sq. km. The rest of the population is scattered over approximately 193 islands. The average population size of these islands is 900 and the average household size is 6.5. With regard to human development trends, the country ranks high among the Asia-Pacific countries. However there is growing youth unemployment against the background of generally low rates of labor force participation especially for women.

The ecologically fragile coral atolls with a population of over 300,000 people scattered over 194 islands is economically dependent on fishing and tourism; both sectors are fragile and vulnerable to external factors as well as natural disasters. The Maldives' economic base is extremely narrow and dominated by tourism accounting over 27 percent of GDP in the recent years. Following the tourism sector, fisheries, construction and commerce play a significant role in the Maldivian economy by contributing between 5 – 10 percent of the GDP each. The Asian tsunami of 2004 severely affected the Maldivian economy, causing major destruction of infrastructure and assets, especially those in the tourism and fisheries sector. Changing drivers such as population activities and consumption patterns places increasing pressures on the environment and serious persistent barriers to sustainable development remains.

Climate Change

Two decades on the scientific evidence of climate change is overwhelming to Maldives where 80% of the islands are less than a meter above sea level. National indicators and forecasts show that extreme events in terms of sea level rise, precipitations temperature and storm events have the probability of occurring more often in the future. Major adaptation related initiative include replicating locally appropriate coastal protection measures throughout the country. SLM and WRM are initiated as part of the strategy to mainstream risk planning and climate change adaptation into the policy and planning framework across all sectors. Achieving carbon neutrality by year 2020 is the priority and as such promoting renewable energy, energy efficiency and phasing of HCFC are major mitigation related initiatives.

Though at the institution and technical level knowledge with regard to climate change risk and different option to manage may have increased over the years, at the local level understanding is poor and weak. This has contributed to local development choices and individual actions that have unwittingly increased the vulnerability of the population and economic assets to current and future climate change risks. The SAP 2009-2013, NEAP 3 and NSDS 2009 of the government provides the contextual background for environment management, which highlights climate change as an extraordinary environmental challenge focusing on adaptation and disaster risk mitigation as priority areas.

Maldives continue to highlight the special vulnerability of the low lying small developing island states to the predicted climate change and in getting attention to this issue in the international arena. To call attention to climate and its impact to the country had the world's first underwater Cabinet meeting in October 2009. A documentary feature film which highlights the Maldives efforts to combat climate change and rising sea levels is premiered at an international film festival in 2011. A CCAC representing all stakeholders including government, business and civil society was formed in recognition that climate change is everyone's concern and responsibility.

Water and Sanitation

The shallow ground water aquifers have been extracted for years and in many islands the aquifers are depleted because the extraction of water exceeds natural recharge through rainfall and also due to intrusion of salt and waste water into the aquifer. Waste water includes sewage water, waste water from industrial activities (including hazardous wastewater) and waste water from poor agricultural practices. In Male', desalinated water has been used for household consumption since 1985. Currently each household and commercial establishment in Male' have

access to desalinated water. In the islands, the situation is different relying on rain water to a great extent. Rain water harvesting is a traditional practice and currently almost each house in the islands will have a HDPE tank donated by the government after the Tsunami of 2004. Rainwater is the primary source of drinking water in 90% of the outer islands with groundwater being used for washing, and for other domestic uses. At present government is encouraging private sector to participate and invest in the provision of water supply and sanitation services. At the same time, utilities companies have been set up in 6 provinces to manage the delivery of these services in the islands.

Waste Management

Waste disposal is an activity that compounds the vulnerability of the islands in Maldives. The primary landfill in Maldives, Thilafushi, lies in the middle of the ocean and 90% of the islands in Maldives have their waste disposal sites within 100m of coastline and on the ocean-ward side of the island. There are two collection yards in Male' and one in Villingili.There is no municipal collection system for household waste. In Male' waste collection is carried out by individuals on bicycle, by individuals using hand cart and by two private operators. Segregation of waste is mostly done at the collection yards at Thilafushi. It is unclear to what extent hazardous waste is identified as such in Maldives. Waste disposal practices vary among islands depending on access to disposal facilities, local custom and government/municipal intervention. Households usually carry their waste to collection sites. These sites can range from a designated waste collection site, seaside (beachside), land reclamation site, bushes, and back/front yard. In addition, waste is often burnt regularly at the collection site in some islands.

The Environment Protection and Preservation Act (Law 4/93) is the primary legal instrument for environmental management in the Maldives and EPA is the custodian of the law. A Draft Solid Waste Management Regulations were also released August 2009 and is yet to be finalized. Tourism waste is addressed through a separate regulation, the Regulation on the Protection and Conservation of Environment in the Tourism Industry, Law 2/99 (2008).The regulation outlines stringent waste management requirements for resorts, including source separation. The Decentralisation Law transferred the responsibility of the waste management of islands to island councils, who were elected in February 2011. Male' city council is responsible for the management of waste in Greater Male' Area.

Pollution

Pollution in terms of air quality is more pronounced in Male' while in the islands in can be generally termed good, as islands are small with sea breeze flushing the air masses over the island. In Male', the capital pollution is often stated as an emerging health hazard. The capacity to study the air pollution is limited and air quality standards are yet to be established with regular monitoring activities. The deteriorating status of air quality is evident through increasing trend in land transport, imports of fuel, and construction related activities.

Ground water pollution is common throughout the country. Ground water aquifer varies from island to island and is highly vulnerable to contamination from inadequate sanitation facilities and other human activities, solid waste run-off, over exploitation and saline intrusion through soil erosion and flooding. The regulatory authorities EPA and TRA develop technical and financial guidelines and standards for assessment and monitoring procedures. The enforcement of the standards and guidelines are targeted towards controlling pollution.

Conservation of Biological Diversity

The biodiversity or the degree of variation of life within the marine ecosystem is rich and diverse while the terrestrial biodiversity is limited characterized by the geomorphic structure of the islands. The pressures and threats on biodiversity have been in existence over long periods of time and will continue for decades to come. The challenge is the difficult tradeoffs in finding a balance between economic growth, social equity and conservation of environment. Extraction of branched coral and sand, over fishing of reef species and reoccurring of coral bleaching events are the major threats to marine biodiversity.Pressures to terrestrial biodiversity are caused mainly by removal of vegetation, diseases to plants caused by pests, and use of fertilizers and chemicals. The negative effects of these pressures are continuously monitored and minimized through enforcement of regulations and awareness programs which are set up under the policies and strategies of MHE and MOFA. Under this legal protected status have been given to different areas and species in the Maldives to negate the pressures and threats to biodiversity and one major outcome was the declaration of, Baa Atoll as a biosphere reserve in 29 June 2011. The Environment Protection and Preservation Act 1993 provide the legal justification for the protection of the biodiversity with MHE, MOFA, and MOTAC playing major roles towards conservation of biodiversity.

Chemicals and Toxicology

The capacity to study and analysis the situation in chemical usage is limited with no baseline information established, to determine whether chemical usage within the country is an emerging health issue. Statistics pertaining to the chemicals imported into the country is unavailable, although prior permission from the MODNS is required before importing chemicals into the country. Rapid developments and urbanization of the country have resulted in an increase in the import and use of chemicals and related components. Data on imports reveal that the in Maldives use of pesticides for agricultural purposes is common and increasing in rural islands which is a cause for concern.

Control and regulation of chemicals is split between different organizations. Pesticides are regulated through the MOFA which process the request of imports of chemicals. MFDA also play an important role in approval of public health pesticides. The MDNS is mandated by Law 4/75, Law on Importation of Prohibited Items to the Maldives to regulate, among others, the import of dangerous chemicals into the country. Planned efforts towards strengthening the foundations of chemical management includes a draft bill on pesticides which is currently open for public consultation. This National Pesticide Act will be the major legal instrument to regulate import, use and dispose all types of pesticide in the country. The Environment and Protection and Preservation of Act (Law no 4/93) of MHE has its provisions on environmentally sound management of hazardous waste, chemicals and oil.

Energy

In March 2009 the government unveiled plans to make the country carbon neutral. These measures were announced in the face of stark warnings from scientists that rising sea levels even by one meter could engulf the Maldives and other low lying nations rendering the islands almost entirely uninhabitable.

Carbon neutrality is planned to be achieved in 2020. With an estimated forecast of energy demand of 85 % increase in the Male region and 77% in the provinces by 2020 (Audit report 2010), the need for undertaking urgent measures becomes all more the important. For Maldives to become carbon neutral by the year 2020 the increasing demand for energy need to be reduced. The government appointed a task force to deliberate on the various pre-requisites and requirements for reducing energy sector carbon emissions in line with overall objective of carbon neutrality. A roadmap in the energy sector to reduce dependence on fossil fuels was developed which was build on 5 interventions. They are promoting use of renewable energy,

becoming more energy efficient, cleaner transportation system,, waste management and carbon sequestration and offsetting. Today use of renewable energy is encouraged with a number of national level initiatives being implemented. To encourage use of renewable energy import duties on electric and renewable energy powered vehicles are waived. At the same time import duties on solar panels and solar panel batteries used in marine vessels is also waived. Regional utilities companies are planned to purchase electricity produced by renewable energy companies to the grid at the rate Rf3.50 per unit of electricity. To promoted and implement the renewable energy policy REIO was also established. The SAP 2009-2013, the National Energy Policy 2009-2013 and National Energy Action Plan 2009-2013 of the government provides the contextual background for energy policy of the country.

Pre Tsunami Status

Maldives is highly vulnerable to climate change and its consequences, which was proven by the Asian Tsunami of 26 December 2004 in which 35% of the 198 inhabited islands were categorized as high or very high impacted islands. The Tsunami caused damage and destruction on a nationwide scale in the Maldives. Eighty two people died and 26 are still missing or presumed dead. Over one-third of the population was directly affected by the Tsunami, and some 29,000 people had to leave their homes. All but nine inhabited islands were either partially or wholly flooded. Sea walls were breached on most islands, causing severe flooding, and in some cases islands were submerged and remained so for few days. The economic damage and losses were the equivalent of 62 percent of the country's GDP. Fifty three islands experienced severe damage to infrastructure and environment. Flooding wiped out power plants, communication equipments, contaminated water supplies, irrevocably damaged jetties, harbors, causeways, agricultural land and equipments, and fishing vessels and equipment. The Tsunami of 26December 2004, thus, represented the worst natural disaster in the country's history. Almost 7 years after the Tsunami, recovery work has been almost finished for some of the sectors. Communities impacted have revived their livelihoods. Reconstruction of houses and settlements including redevelopment of public infrastructure are nearly completed. Both education and health sector have recovered from the impacts.

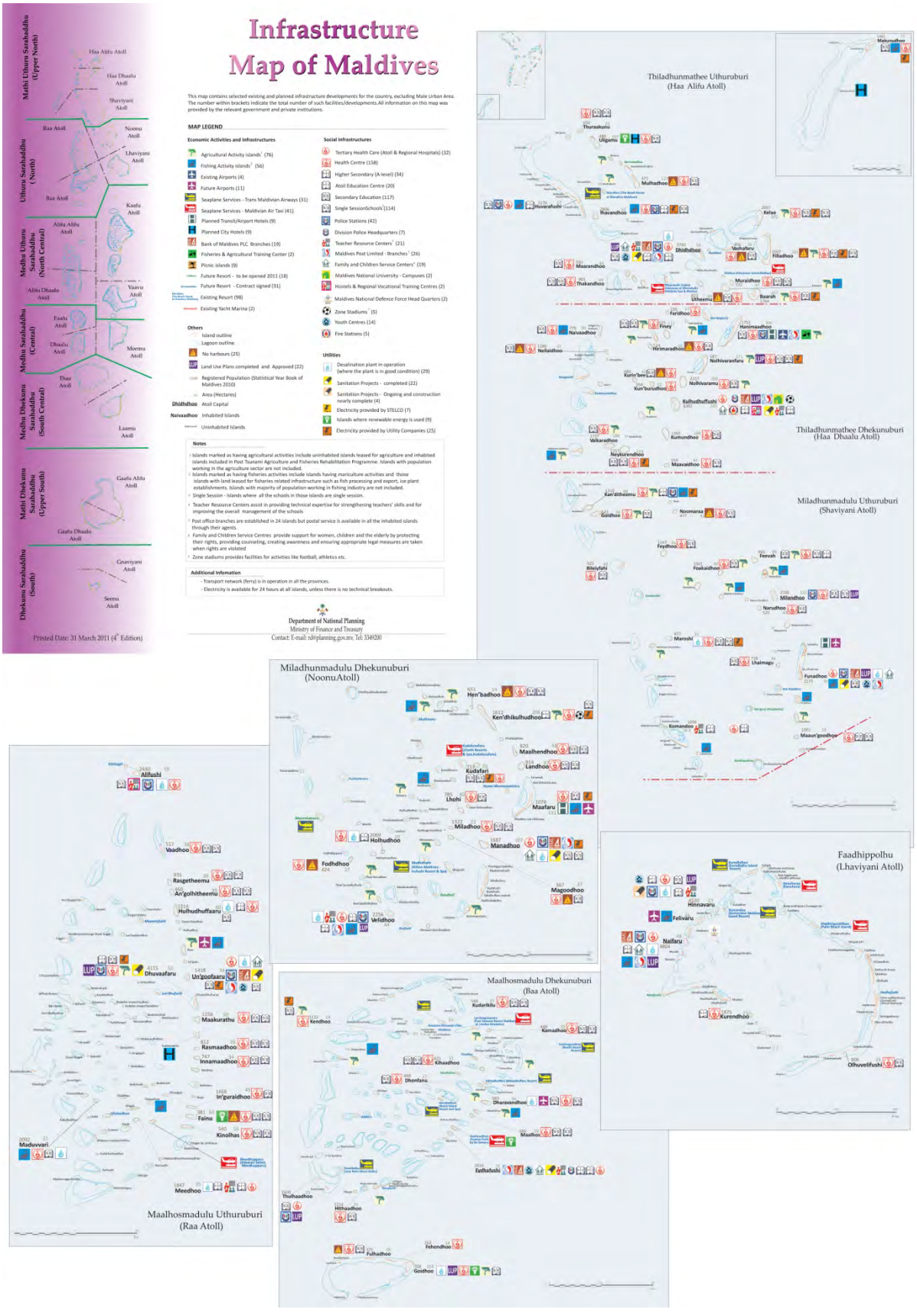
Environmental Governance

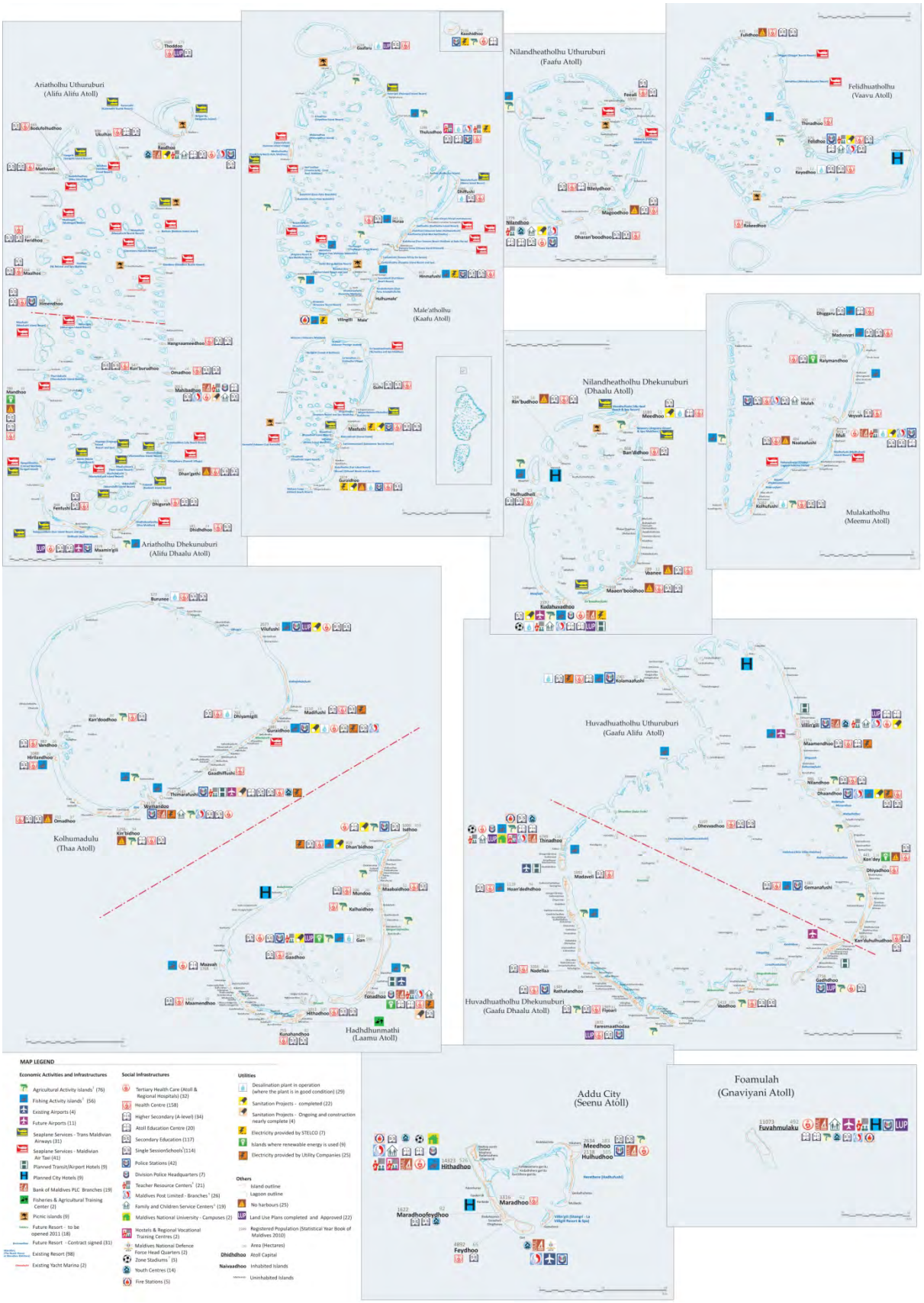
Conservation and protection of the environment is essential for survival for the Maldives as the challenges facing the country directly impacts the people, economy and the society. Under environmental governance the role and functions of international organization, state and civil society has becomes ever more important today as the country is highly susceptible to the

effects of climate change with rising sea levels and coastal erosion. Article 22 of the Constitution of the Maldives states that it is a fundamental duty to protect and preserve the natural environment of the country for the benefit of present and future generations. The State is to undertake and promote desirable economic and social goals through ecologically balanced sustainable development. Hence environmental related issues have been featured high on the SAP 2009 -2013 and sector policy documents such as the NEAP 3 and NSDS 2009-2013. Similarly over the years the NGO community has also progressed with 700 new NGOs registered in the Maldives though comparatively few are regularly active. The challenge for the government and the civil society is finding a balance between economic growth and social equity and the conservation and protection of the environment.

A critical opportunity for support was the donor conference held in 2010. The forum was one of the most opportune moments for international donors to assist the country in underscoring its commitments and fulfilling its peoples' expectations. Of the five priorities CCA was a key area. Funding needs for climate change and adaptation was estimated at US $ 175,890,345million and was highlighted in the Maldives Donor Conference of 2010.

Maps


Infrastructure
Map of Maldives
This map contains selected existing and planned infrastructure developments for the country, excluding Male Urban Area. The number within brackets indicate the total number of such facilities/developments.All information on this map was provided by the relevant government and private institutions.
MAP LEGEND
Economic Activities and Infrastructures
Social Infrastructures
Utilities
Others
Notes
Additional Infomation
Department of National Planning
Ministry of Finance and Treasury
Printed Date: 31 March 2011 (4th Edition)
Thiladhunmathee Uthuruburi
(Haa Alifu Atoll)
Thiladhunmathee Dhekunuburi
(Haa Dhaalu Atoll)
Miladhunmadulu Uthuruburi
(Shaviyani Atoll)
Miladhunmadulu Dhekunuburi
(NoonuAtoll)
Faadhippolhu
(Lhaviyani Atoll)
Maalhosmadulu Dhekunuburi
(Baa Atoll)
Maalhosmadulu Uthuruburi
(Raa Atoll)



Source: Department of National Planning

1. The Maldivian Setting

1.1 Geography and Land

The Republic of Maldives comprises 1,190 small, low- lying islands grouped into 26 atolls that together form a chain over 820 kilometers in length, over an area of more than 90,000 square kilometers in the Indian Ocean. These islands stretch from latitude 7° 6'35''N, crossing the equator and extending up to 0° 42'24''S and between longitudes 72° 33'19''E and 73° 46' 13'' E. The islands are flat, with very low elevation of hardly 1.5 meters above the sea level. Located on the 600km long Laccadives Chagos submarine ridge, these coral atolls extend into the central Indian Ocean from the south-west coast of the Indian sub-continent. The Exclusive Economic Zone (EEZ), boundaries of the Maldives are shared with Sri Lanka and India on the northeast and the Chagos Islands on the south.

It is believed that the Maldives was formed about 65-225 million years ago in the Mesozoic Era (Maniku, 1990). There is more than a single theory on how the Maldives was formed, and one of them suggests that the Maldives grew above foundered continental crustal segments (Maniku 1990). Gardiner (1902, 1903) suggests that current erosion and subsequently formed atolls by the growth of organisms formed the main Maldives plateau.

Geographically the Maldives is made up of 26 natural atolls which vary enormously both in shape and size. The largest atoll is Huvadhu Atoll with an area of approximately 2800 square km (MPND 2000) and the smallest atoll Thoddoo Atoll has an area in the order of 5.4 square km (MHAHE, 2001). The characteristics of the atolls, reefs and reef islands vary considerably from north to south. The northern atolls are broad banks, discontinuously fringed by reefs with small reef islands and with numerous patch reefs and faros in the lagoon (Woodroffe, 1989). In the southern atolls, faros and patch reefs are rarer in the lagoon, the continuity of the atoll rim is greater, and larger proportion of the perimeter of the atolls is occupied by islands.

The islands differ depending on location, form and topography (Woodroffe 1989). The variance of size among the islands is from 0.5 square km to around 5.0 square km and in shape from small sandbanks with sparse vegetation to elongated strip islands. While storm ridges are found at the seaward edges of many islands, few have swampy depression

centre. The largest island is Gan in Laamu Atoll with an area of 5.16 square km (MPND 2000). Although a detailed land survey of the entire Maldives has not been conducted yet, the total land area of the Maldives is estimated at 300 square km. The distribution of inhabited islands by island size is shown in Fig 1.1 and the ten largest islands in the Maldives are given in table 1.1.

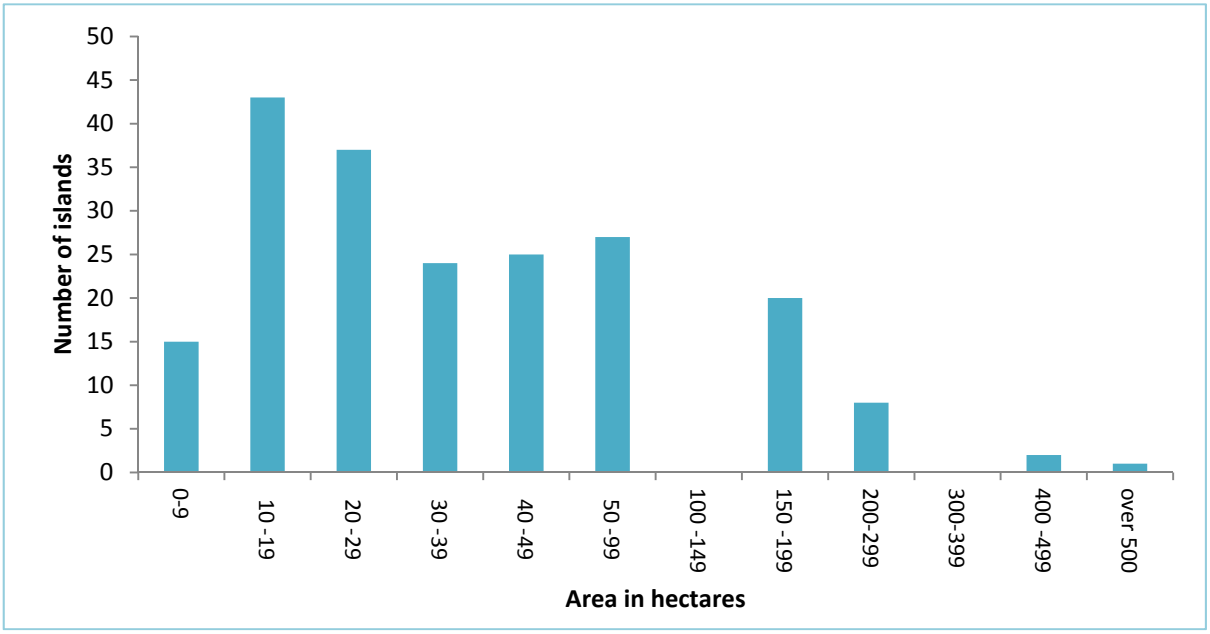


Fig 1.1 The distribution of inhabited island by islands size

Source: Department of National Planning 2011

Atoll	Island Name	Area (km)	Population (2006)
1. Laamu	Gan	5.166	2502
2. Seenu	Hithadhoo	4.673	9465
3. Gnaviyani	Fuvah Mulah	4.200	7636
4. Laamu	Isdhoo	2.937	1559
5. Kaafu	Kaashidhoo	2.765	1696
6. Seenu	Gan *	2.649	
7. Gaafu Dhaalu	Gan**	2.636	
8. Haa Dhaalu	Hanimaadhoo	2.595	1184
9. Haa Alifu	Baarah	2.488	1203
10. Haa Alifu	Filladhoo	2.259	548

Table1.1:-Ten largest islands in the Maldives

Source: Department of National Planning 2011

1.2 Climate

The Maldives has a warm and humid climate. The weather is dominated by 2 monsoon periods: the south west (rainy) monsoon which occurs from May to November and the north east (dry) monsoon which occurs from January to march when winds blow predominantly from either of these two directions. The relative humidity ranges from 71% to 84%.

The daily temperature of the country varies little throughout the year with a mean annual temperature of 28. During 2009, the mean daily minimum temperature recorded for Male' was 26.3^{0}C and the mean daily maximum temperature recorded for Male' is 31.1^{0}C. On May 1991, a temperature of 36.8^{0}C was recorded at Gadhdhoo meteorological office which is the highest temperature ever recorded in the Maldives while the minimum temperature ever recorded in the Maldives was 17.2^{0}C which was recorded at the National Meteorological Centre on 11th April 1978.

Eight rainfall stations measure the rainfall patterns throughout the country and it is evident that there are variations in rainfall from north to south through the atoll chain with the south being wetter and the north being drier. In 2010 average monthly and annual rainfall for Male' are 183.4mm and 2201.5mm respectively. During this year July, August and November are the wettest months while the driest is January, February and March. There has been considerable inter annual variation in rainfall from 1407mm to 2711mm over the last 14 years. Figure 1.2 shows average annual rainfall and total duration of sunshine for Male' for this period.

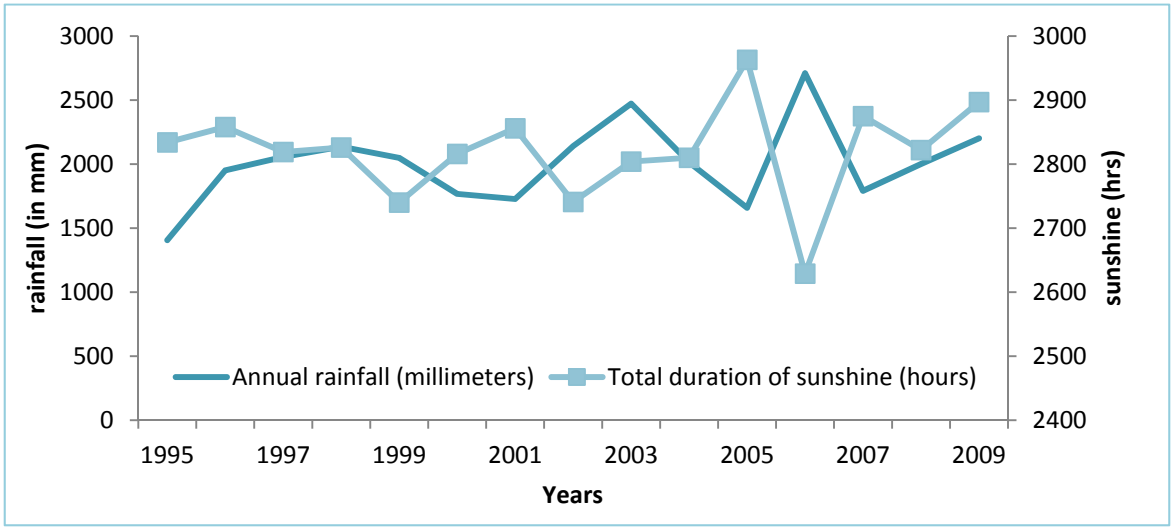


Fig 1.2: Annual rainfall and total duration of sunshine 1995-2009

Source: Department of National Planning, 2010

On 9th July 2002 Kaadedhdhoo meteorological office recorded a rainfall of 219.8mm which is the highest rainfall ever recorded in the Maldives within a 24 hour period.

The current regime in the Indian Ocean is strongly influenced by the monsoon climate. In the region of the Maldives during the North East monsoon period the currents flow westward, and they flow eastward during the South West monsoon period. The ocean currents flowing through the channels between the atolls are driven by the monsoon winds. Generally the tidal currents are eastward in flood and westward in ebb.

The swells and waves experienced by the Maldives are conditioned by the prevailing bi-annual monsoon wind directions and are normally strongest during April-July in the South West monsoon period. During this season, swells generated north of the Equator with heights of 2-3m with periods of 18-20s have been reported in the region. However, the Maldives also experiences swells originating from cyclones and storms occurring well south of the Equator. It is reported that strong storms in the southern hemisphere in the area of West Australia with direction towards the Maldives occurs due to swell waves from south east. The swell waves the reached male and Hulhule in 1987 had significant wave heights in the order of 3m (JICA, 1987). Local waves periods are generally in the range 2-4s and are easily distinguished form the swell waves.

Hydrographically the Maldives is characterized by a seasonal fluctuating mixed layer of relatively saline water from the Arabian Sea (360/00) and less saline water from the Bay of Bengal (340/00). A rapid downward decrease in temperature to below 20^0C occurs at 90 to 100m depth. The sea surface temperatures (SST) do not vary much throughout the year. Generally the average months SST ranged between 28-29^0C with maximum temperatures rarely over 30^0C. The mean monthly SST rises from low in December/January to high usually in April/May. The average seasonal rise is about 1.3^0C in the central atolls. However during May 1998 the mean monthly SST was 1.1^0C above the highest mean monthly SST (30.3^0C) expected in any 20 year period (Edwards et al 2001).

1.3 Marine and Coastal Areas

The dominant natural environment of the Maldives is the marine environment. Outside the atolls the deep ocean covers a large area and the EEZ and the territorial waters of the Maldives cover an area of 859000 square km and 115000 square km respectively. The marine environment inside the atolls is made up of lagoons and reefs making up about 21300 square km (MPHRE, 1998).

The water depth varies considerably within the Maldivian waters. The lagoon waters within the atolls have depths ranging from 30-80m with the depth increasing from northern to southern atolls. Most lagoons of the atolls open into the Indian Ocean, and in some instances the channels through the atoll margin are as deep as the lagoon itself. The ocean floor falls abruptly to great depths measuring up to 2000m or more at the outer margin of the two atoll chains. However, at the inner side of the two atoll chains the ocean floor has less depth. The main channel dividing the eastern and western chain of atolls is between 250 and 300m deep. The east-west channels that divide the atolls are deeper with depths of more than 1000.

Atoll lagoons enclose a variety of reef structures including faros, micro-atolls, patch-reefs and knolls. Faros are ring shaped reefs emerging during tidal low water with their own sandy lagoon and a rim of living coral consisting of branched and massive corals. Deep channels that surround these reefs and faros are unique to the atolls of Maldives. Patches rise to 30m above the lagoon floor the top of which have robust wave braking corals. Knolls do not reach the surface and often support profuse coral growth (Naseer, 1997).

The island itself is sand, and changes to coral rubble as the reef edge is approached. The outer slopes are very steep and area down to about 15m is covered lush coral on a healthy reef. The outer reef slope is characterized a series of reef terraces at depths of 3-6m, 13-30m, and a deeper on at 15m representing past sea level skill strands. The modern coral growth veneer over older reef rock but the existing community is constructional down to a depth of at least 15m. In the upper levels reef building is by Zooxanthellate corals. In deeper zones reef building is sometimes by a Azooxanthellate branching corals. Several species Lithophaga, various Polychaete worms and several species of boring sponges are some of the boring organisms found in Maldivian corals. Cliona Schmidtii, the blue boring sponge is very common in the Maldives.

A geo-chemical analysis of the reefs emphasized the relatively pristine nature of the Maldives marine environment. Analysis of coral skeletons for common heavy metals showed values that were below detection limits in all cases. Values of extraneous organics in coral tissues were found to be typically low except for hydrocarbon residues found in corals near an island which stores fuel (Risk and Sluka, 2000). The white sandy beaches and the vegetation found on the island periphery are highly important in the Maldives island ecosystem. They form an important protection for the housing and infrastructure near to the shore and are the main source of income for the tourism industry. 70% of the tourists who visit the Maldives has been identified as tourists who visit primarily for beach holidaying.

One of the most serious environmental issues the Maldives islands face is beach erosion. The sand at the beach and the shore line are being washed off at a greater rate than it is accreted on many islands. The process of coastal erosion and accretion is extremely complex with the inter-relations to oceanographic, climatic, geological, biological and terrestrial processes with human intervention affecting the growth and the stability of the reefs and island structures. The prevailing seasonal conditions may gradually shift the shape as well as the position of the island by strong beach erosion and accretion on either side of the island as the beach systems are highly dynamic in nature.

1.4 Population

Of the total 1192 islands, only 194 are inhabited. The islands are small in size, 33 inhabited islands have a land area of more than one square kilometers. The registered population as of December 2009 is 332,992 of which 56% are comprised of children and youth. Percent of female population remains more or less equal to that of men. One third of the population lives in the capital, Male', which has an area of less than 2 square km. The rest of the population is scattered over approximately 193 islands. The average population size of these islands is 900. Maldives has a relatively young population with almost 41 percent under 15 years of age and around 3 percent over 65 years of age. With regard to human development trends, the country ranks high among the Asia-Pacific countries. The current demographic transition poses a key concern to young people, their families, and to the Government. There is growing youth unemployment against the background of generally low rates of labor force participation especially for women. The remoteness and inaccessibility of the islands presents a challenge in delivery of basic services. The concentration of the population on the capital island has also led to problems of overcrowding, the rising cost of living and other social problems such as narcotics abuse and gang violence.

1.5 Administration

Since State of the Environment (SOE) 2004, there have been significant changes in legislative and administrative structure with the change of government on 11 November 2008 through the first multiparty election. The Government embarked on establishing a local governance system with the aim of strengthening local democracy and addressing economic and social development issues arising from highly centralized government. Based on the principles of decentralized administration laid out in Chapter Eight of the 2008 Constitution, government has aimed to achieve this through the implementation of a two-fold Program of Regionalization and Decentralization. Regionalization was planned through dividing the country into seven regions with the aim of achieving efficient and effective service delivery at local levels. Clustering two or more atolls to form a region or province can provide effective and efficient planning, co-ordination and management as a means to facilitate effective administrative decentralization and accelerate development in the islands. This would in turn, reduce the social, economic and developmental disparities between the capital island Male' and the rest of the country.

With passing of Decentralization Act, 184 administrative island divided among 19 atolls are listed declaring Seenu atoll as a city under the name of Addu City. Following this the country's first ever local council elections were held to elect 188 island councils, 19 atoll councils and 2 city councils. Fuvahmulah Island elected 8 ward councils. A ward council is at the same rank of an island council. This was done since Fuvahmulah was also an atoll, having an atoll council.

The government's objective is to facilitate people oriented development by empowering citizens and promoting democracy at local levels through Decentralization.

The strategies identified to achieve this objective are as follows:

1. Developing representative local institutions at island/atoll level, whereby the people living in the islands and atolls will take part in deciding their own affairs.
2. Bringing the Government closer to the people by delegating and devolving centrally controlled functions including service delivery functions to the island, atoll/ province levels through elected Island Councils and Atoll Councils in each province, and an elected City Council in the capital island Male'.
3. Creating an enabling environment and a vibrant civil society to strengthen governance at local level.
4. Introducing new strategies for financing and sustaining development at all levels through community empowerment.

5. Developing local administrations and strengthening links between local functionaries and national authorities as a way to seek coordinated national development throughout the seven regions.
6. Developing an operational framework and a process for planning and managing local development, based on the inspirations of the people in the localities.
7. Bringing economies of scale which would facilitate market decentralization.

To implement regionalization and decentralization the President appointed State Ministers to all seven regions. Community consultation workshops to familiarize the public with the concept of regionalization and decentralization are being conducted in all seven provinces. With implementation of administrative decentralization, the Government envisions the establishment of a three-tier sub-national governance structure, with the sector ministries at the national level, the Province Offices and Atoll Council Office at the regional level and the Island Council Office at the Island level (Fig 1.3).

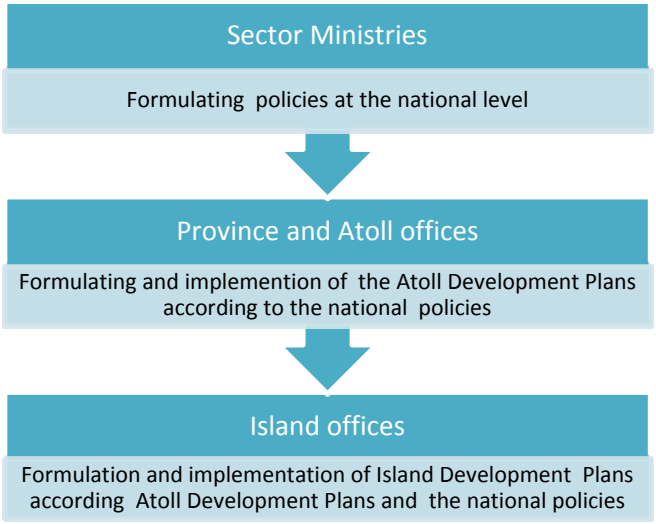


Fig 1.3: The administrative structure

Province Offices established in each administrative province act as the government representatives in their respective region. The Province Offices will be responsible for formulating and coordinating regional development program in accordance with the laws and national level policies and establishing a mechanism for efficient delivery of services at regional, atoll and island levels in co-ordination with sector ministries at the national level. The Province Office will be headed by a State Minister in consolidation with the Ministry of Home Affairs and the newly established Local Government Authority supported by the appointed deputies to the

State Minister. The functions of line Ministries will be carried out by Civil Servants under Ministers.

The decentralization program has been planned with the vision that people will migrate by choice to regions where more prosperity and better services are available. The Government has put in place a national transportation system as a means to overcome the transportation barrier throughout the nation. Thus, instead of measures for resettlement in other localities through incentive benefits, measures assisting voluntary migration will, in time, facilitate the achievement of the policy of population consolidation. Table 1.2 outlines the administrative regions by province and population and Table 1.3 outlines the administrative atolls by islands.

Province local Name	Province	Atolls	Capital	Population of Province as of December 2009
Mathi Uthuru	Upper North Province	Haa Alifu , Haa Dhaalu, Shaviyani	HDh Kulhudhufushi	59768
Uthuru	North Province	Noonu, Raa, Baa, Lhaviyani	Lh Naifaru	59568
Male'	Male'	Male'	Male'	56917
Medhu Uthuru	North Central Province	Kaafu, Alifu Alifu, Alifu Dhaalu, Vaavu	Maafushi	29824
Medhu	Central Province	Meemu, Faafu, Dhaalu	Dh. Kudahuvadhoo	18709
Mathi Dhekuni	Upper South	Thaa, Laamu	L. Gan	28120
Medhu Dhekunu	South Central	Gaafu Alifu, Gaafu Dhaalu	GDh Thinadhoo	32108
Dhekunu	South	Gnaviyani, Seenu	S. Hithadhoo	39978

Table 1.2: Administrative Regions by Province

Source: Ministry of Home Affairs , 2011

Atoll Name	Alternative Atoll Name	Inhabited Islands	Industrial Islands	Airports	Resorts 2010
Thiladhunmathi Uthuru Buri	Haa Alifu	14	2	1	7
Thiladhunmathi Dhekunu Buri	Haa Dhaalu	13	7		6
Miladhunmadulu Uthuru Buri	Shaviyani	14	5		6
Miladhunmadulu Dhekunu Buri	Noonu	13	4		8
Maalhosmadulu Uthuru Buri	Raa	15			6
Maalhosmadulu Dhekunu Buri	Baa	13	4		10
Faadhihpolhu	Lhaviyani	5	8		6
Male'	Kaafu	9		1	60
Ari Atholhu Uthuru Buri	Alifu Alifu	8			12
Ari Atholhu Dhekunu Buri	Alifu Dhalu	10	1		16
Felidhe Atholhu	Vaavu	5			3
Mulaku Atholhu	Meemu	8	1		3
Nilandhi Atholhu Uthuru Buri	Faafu	5	1		1
Nilandhi Atholhu Dhekunu Buri	Dhaalu	7	1		6
Kolhumadulu	Thaa	13	5		5
Hahdhunmathi	Laamu	11	7	1	4
Huvadhu Atholhu Uthuru Buri	Gaafu Alifu	9	1		11
Huvadhu Atholhu Dhekunu Buri	Gaafu Dhaalu	9	2	1	9
Fuvahmulah	Gnaviyani	1			1
Addu City	Seenu	1		1	5
Male' (capital)		1			
MALDIVES		184	49	5	185

Note: Resorts include existing and upcoming resorts

Table 1.3: Administrative regions, by Atolls and Islands

Source: Department of National Planning, Ministry of Tourism Arts and Culture. Government Gazette, www.gazzette.com.mv,2011

1.6 Natural and Cultural Heritage

Natural heritage is an important component, encompassing the natural environment, including terrestrial and marine environment with flora and fauna scientifically known as biodiversity. The marine environment is rich with 248 different species of corals over 1100 species of fishes, 285 species of algae being recorded. (MRC 2009) The country has declared 39 protected areas of which 25 are marine protected sites, 9 marines species are protected from fishing or collecting and 23 birds are also protected (MHE 2011). These natural heritages serve as an important component in the country's tourism industry attracting many visitors from abroad. Thousands of divers go diving in these designated marine protected sites. Law number 4/93 is formulated for the protection and preservation of the environment. The law states that environment of the Maldives is a valuable heritage that has to be preserved for the coming generations. Under the law protected areas are identified by the Ministry of Housing and Environment (MHE) and the necessary rule and regulations are formulated for their protection and preservation.

Protected areas in the Maldives lack the necessary elements for effective management. The sites are protected through legislation with no real funding for outreach and education and enforcement to protect them. Also during the last few years, a rapid human encroachment on the terrestrial vegetation, reef and wetland ecosystems of uninhabited islands and inhabited islands in the Maldives have occurred. Impacts on these islands in the Maldives are unprecedented, their scale and speed alarming. Harbor dredging, channel blasting with dynamite and massive reclamation projects modifying the coast and the topography of the island. The places and values are under threat through detrimental waste management places with a lack of understanding, skills or resources.

Today with the implementation of Baa Atoll Ecosystem Project some promising approaches for protected area management is emerging. The project is being implemented with support of the UNDP and the Global Environment Facility with the purpose of designing and demonstrating an effective management system for atoll ecosystem conservation and sustainable development of Baa atoll which could then be replicated throughout the Maldives. Baa Atoll Ecosystem project is being implemented integrating cultural values and community participation into natural resource management programs. Baa atoll was selected as the demonstrative atoll on account of its globally significant biodiversity. Taking into account the commitment and capacity of the local community on 29 June 2011 the area was declared as Biosphere Reserve.

The Maldives is also rich in cultural heritage, but the task of discovering and preserving the rich heritage of the Maldives is challenging. No official inventory of Maldivian cultural heritage sites and statement of significance exist although it is recognized that a systematic inventory of Maldivian heritage sites are necessary for its preservation. Limited funding, the cost of transportation and the lack of qualified people are the constraints confronting the sector.

The framework on protection and conservation of heritage is split between different organizations. By law much of the responsibility for the cultural heritage management rest on the Department of Heritage within the Ministry of Tourism, Art and Culture (MTAC). The National Centre for Linguistic and Historical Research (NCLHR), which functioned under the President office from 1979 was abolished in 2010 and the functions of the Centre related to culture, tradition and conservation of historic monuments were assigned to the MTAC. The objectives of reassigning the functions of the Centre include expanding these functions in a sustainable manner.

Since 2008 Male' Hukuru Miskiy/enclosing cemetery and Minaret is part of the Tentative List in order to qualify for inclusion in the World Heritage List. Generally cultural heritage sites are under threat through range of pressures including environmental decline, shifts in land use pattern, demographic change with lack of understanding and skills and resources to manage the site.

2. Socio-Economic Development

Key findings

- Population of Maldives grows at about 1.76 % per annum and the government gives high priority for housing development to alleviate social and environmental challenges.
- Maldives has a narrow economy base driven by tourism which is vulnerable to external shocks.
- Abject poverty do not exist in the Maldives however, significant disparity exist
- Maldives face challenges in addressing unemployment, especially for women and youth.

2.1 Introduction

Population, consumption of natural resources and climate change are considered the broad factors or pressures of environment changes. Collective increase in human requirements had lead to over use of natural resources forcing climate change. The world's population doubled during the past 50 years and reached 6.2 billion by mid 2010. During this exuberating growth period, humans had degraded the Earth's ecosystem to an alarming level. The global ecological footprint is currently estimated to exceed the Earth's carrying capacity by 20% (Millennium Ecosystem Assessment, 2005). This means that we are living beyond our planet's means and that some renewable natural resources are being harvested at rates higher than they can be replenished.

In the Maldives, where only less than 1% of the total area is suitable for human habitation, population growth has far more serious consequences than many other countries worldwide. Nevertheless, population of Maldives grows about 1.76 % per annum, and internal migration in search of better livelihoods, education and health services, has lead to an alarmingly increase in settlement in the capital resulting in major environmental implications.

The population policy of the Maldives highlights the need for sustainable development providing direct relationship to health, education, gender and environmental issues. The policy promotes a healthy generation of people who have equitable access to natural resources, employment and income, housing and infrastructure, education and health services.

. Maldives has a relatively young population with almost a third below 15 years of age and around 3 percent over 65 years of age. With regard to human development trends, the country ranks high among the Asia-Pacific countries. The current demographic transition poses a key

concern to young people, their families, and the government. There is growing youth unemployment against the background of generally low rates of labor force participation especially for women.

2.2 Social Development

2.2.1 Demographic scenario

Maldives population has grown steadily during the past 25 years and reached 319,740 in 2010. This represents a 57% increase in population size over the 25 year period (Fig 2.1).

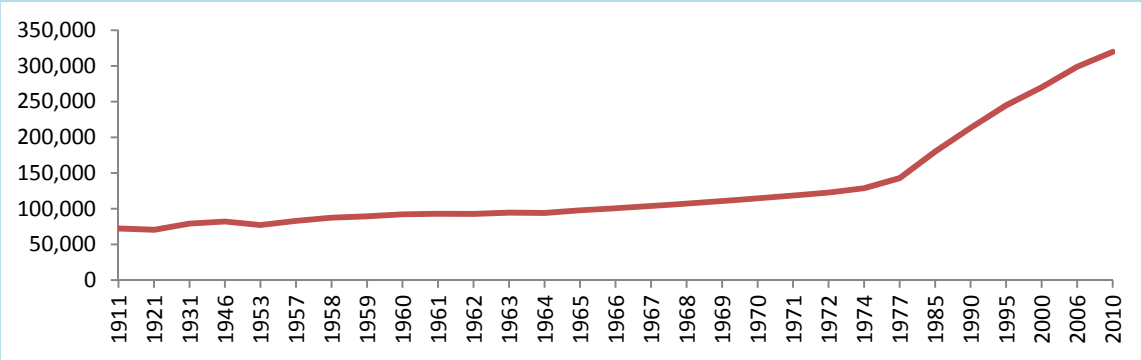


Fig 2.1:-Population 1911-2010

Source: Department of National Planning 2011

Most environmental problems tend to be aggravated by population size as well as the population growth. However, the impact of population size and population growth is not direct or linear since distinct population groups impinge on the environment in different ways. Analysis of the existing population records of the Maldives during 1911-2010, depicts four significant peaks over the years. The highest peak was 5.28% in 1958, followed by 3.95% in 1965, 3.72% in 1972 and 3.43% in 1990 (Fig 2.2).

Population analysts estimate a 4% growth rate to double the population in 18 years. Recent statistics compiled by the United Nations, World Population Report (2007), Maldives had an average population growth rate of 1.76% (world average 1.17%), ranking 70th fastest growing population in the world. Since 1990, demographic statistics indicates a decline in growth rate which can be attributed to the introduction of modern public health care services and adopting modest birth control programs mostly among the more urbanized segment of the population.

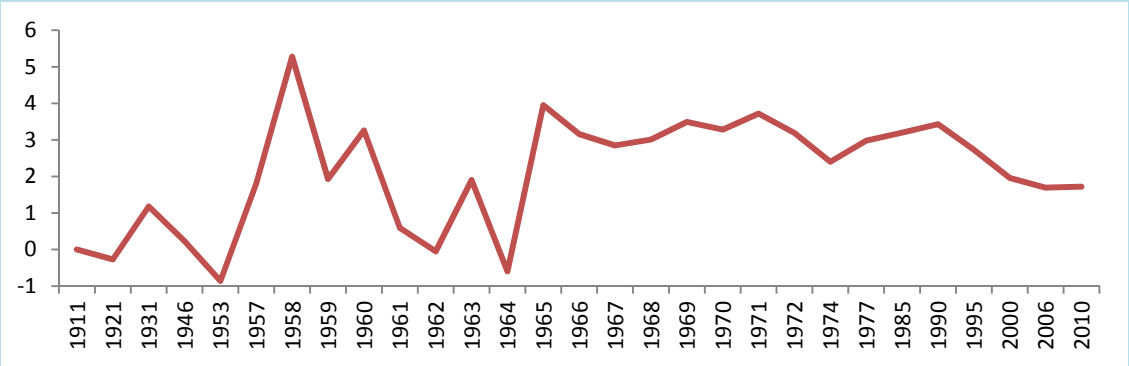


Fig 2.2: Population growth rate 1911-2010

Source: Census 2006& Department of National Planning

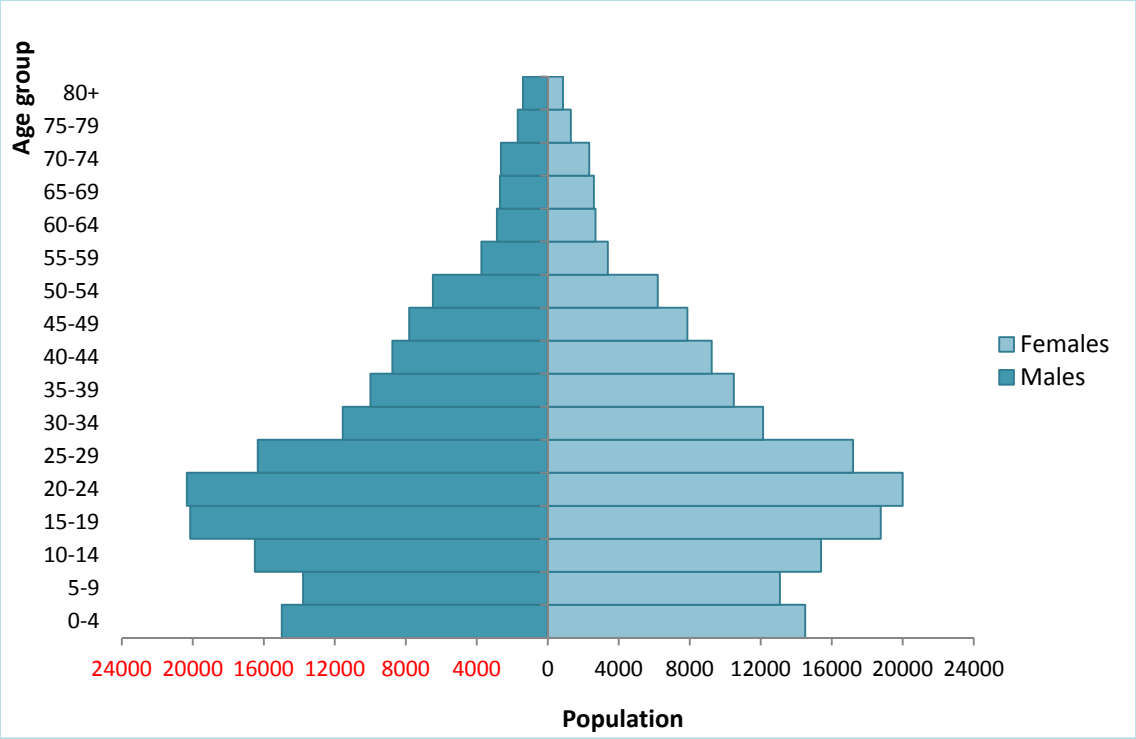


Fig 2.3: Population pyramid 2010

Source: Department of National Planning 2011

Since 1990, infant mortality rates have fallen significantly and the country has maintained almost universal coverage for all vaccines for preventable childhood diseases for over two decades. Government expenditures on health and education have increased significantly over the last two decades. Health expenditures increased from US$24 million in 2000 to almost US$70 million by 2009.

In 2006, over thirty percent of the population was under 15 years of age. This figure remains similar in 2010 by decreasing only one percentage point (Table 2.1). The projected mid-year population estimates for 2010 shows no significant difference among the two gender categories in the different age groups having an average sex ratio 103 (Fig 2.3). In both gender, 15-25 age groups have the highest population size reaching almost 40,000 each.

Age group	Population 2006		Population 2010	
	Size	Percentage	Size	Percentage
Under 15	93,037	31.1	97,408	30.5
16 - 64	186,904	62.5	215237	67.3
65 and over	16,027	6.4	7,095	2.2
Total	295,968	100.0	319,740	100.0

Table2.1:-Maldivian age structure 2006 -2010

Source:-Census 2006 & Department of National Planning, 2011

Over sixty seven percent of the population falls under the working age group which is placing extra demand on infrastructure and natural resources. Ensuring food and nutrition security, housing, employment and educational to the growing population can negatively impact the country's environment health.

Population distribution is the major concern in the Maldives. It is a driver of many environmental pressures in the country, including loss of biodiversity, congestion, pollution and excessive waste generation. A significant amount of people migrates each year to the capital city for better livelihood options. Since 2006, over a third of the population (Fig 3) lives in the capital city making it one of the highest densely populated cities in the World. The total area of Male' is less than 2 sq. km. The rest of the population is scattered over approximately 193 islands disbursed in the archipelago.

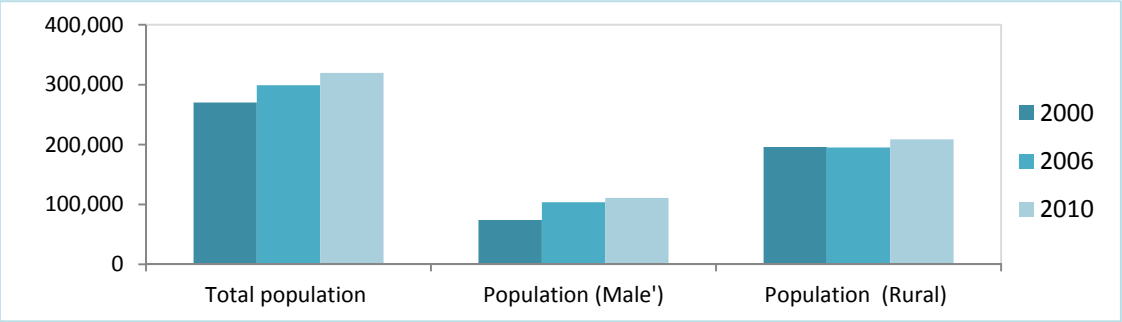


Fig 2.4: Population distribution (2000-2006)

Source: Census 2006 &Department of National Planning, 2011

No. of inhabited islands by size of population

Size class	No of islands	
	2006	2010
Total for Republic	194	194
Less than 100	5	7
100-199	11	8
200-299	18	18
300-399	18	15
400-499	20	20
500-599	18	21
600-699	12	9
700-799	11	14
800-899	12	10
900-999	6	11
1000-2000	47	22
2000-4999	12	36
5000-9999	3	2
10000 and over	1	1

10 most populated islands in the Maldives

Island	Population size
Male'	110,897
Hithadhoo	10,123
Fuvammulah	8,167
Kulhudhuffushi	7,484
Thinadhoo	4,751
Naifaru	3,943
Hinnavaru	3,227
Ugoofaaru	3,196
Feydhoo	2,913
Dhidhdhoo	2,687

Table 2.2: No. of inhabited islands by size of population and the 10 most populated islands

Source: Department of National Planning, 2011

The average population size of these islands is 900. Out of the 194 inhabited islands, 128 have a population less than a 1000. Besides Male' only 2 islands have a population more than 5000 (table 2.2). Migration within the islands is near to non-existing. High cost of providing and maintaining infrastructure and services for a widely dispersed population is not consistent with

the promotion of development that is economically sustainable. Population consolidation and developing alternative destinations to the migrants is a key requirement for sustainability and reducing environmental degradation from human activities.

2.2.2 Infrastructure development

In the past Maldives have invested into social infrastructure while the services and utilities infrastructure, especially the transportation had been lagging behind. To address this shortfall the new Government in its election manifesto pledges identified developing a transportation network as a priority. The primary aim is to establish a new maritime/land based public transportation network to increase accessibility and mobility of people and goods by incorporating existing networks of private and public transportation networks. The network has partially established intra atoll, inter regional or national level ferry services. The combined terminals which include harbors, jetties and other commercial infrastructure are in the process of establishment.

There are five operational airports in the Maldives; two international and three domestic airports; where scheduled flights operate daily from Male' to all the four airports. Eleven more domestic airports are under current development plan and expansion and modernization of Ibrahim Nasir International Airport is underway. The total of two way international passenger traffic has hit over 1.6 million in the Maldives. More than 80 per cent of this traffic is tourists and holiday makers visiting the country. These tourists are transported to their destination by seaplanes operated from the airport and by speed boats. Two sea plane companies, operate 72 planes which covers a significant proportion of the transportation requirement of the tourism industry.

At present, Maldives has three international ports, one at the capital Male' (Male' Commercial Harbor), one at North (Kulhuduffishi Regional Port) and one at South (Hithadhoo Regional Port). At present, one in every four foreign ships that call to Maldivian ports are subject to port state control inspections. The management of ports also give high priority for preventing environmental pollution by adopting strict policies to stop any vessel dumping or discharging into any harbor, lagoon, or into any part of the waters of the Republic of Maldives any type of refuse, bunker oil, sewage and noxious substances or any material.

The provision of adequate and affordable housing across the country is a key pledge of the new administration. In this regard, the government is seeking private sector participation in building 10,000 new housing units across the Maldives. By the provision of 7000 housing units

and related social infrastructure in the seven provinces, the Government aims to ease the congestion in the capital city Male'. The housing units is developed using the neighborhood concept with major social infrastructure like mosques, parks and green areas, schools etc at walking distance.

Social infrastructure in terms of health and education are well distributed in numbers within the country. More than 195 health and 310 education institutions are in existence however, quality and level of service are not up to the expectation. At island level most children have access only to primary level education. Poor quality teachers, lack of supporting materials and facilities, poor quality classrooms, and poor child nutrition hamper the delivery of quality education in outer islands. At the same time, over 10,000 students who complete secondary education every year, require postsecondary and vocational education. Unemployment in the country is near 4.4 percent with women and youth representing the largest share. Providing suitable skills training is essential to replace expatriate labor which, at present, accounts for nearly a quarter of the labor force. Recently the government has embarked on a vocational training program to provide skills for 8600 people covering the major sectors to replace at least 20% of the expatriate labor force. Upgrading quality, scope and relevance of postsecondary and tertiary education including vocational education are main human resource development challenges facing the Maldives.

Similarly, the existing health infrastructure suffers from weak support services due to acute shortage of human resource capacity. Corporatizing the health services to provide quality health to all citizens is a major policy change that the new government had adopted however, its impact will be felt in the medium term.

Harbor development is a major intervention in the new developmental agenda of the current government. The program is expected to contribute to further diversification of the economy and improve the resilience of island and atoll economies. Currently 68 harbors are developed, out of which 78 percent is completed by the new government administration. Harbor infrastructure development in the islands also aims to promote commercial activities surrounding the harbors in an effort to generate economic activities at island and regional level to provide meaningful employment opportunities, particularly to the youth, at island level, and thereby create means for income generation by promoting SMEs, trade and entrepreneurship.
A detail list of existing infrastructure is provided in appendix 1.1 of which the most significant is the existing hotel infrastructure in the Maldives.

2.2.3 Poverty

Maldives has achieved the Millennium Development Goal (MDG) 1 to eradicate extreme poverty and hunger. Considering the MDG income level of one dollar per person per day as reference, very low levels of absolute and relative poverty can be observed in the Maldives. Therefore, many characteristics of poverty found in the rest of South Asia are not evident in the Maldives.

Despite achieving the MDG goals, the concentration of poverty among particular population groups is of considerable concern. It requires public interventions aimed at greater equity and redistribution of the gains of economic growth. There is a need to have more relevant and appropriate strategies for poverty reduction, because poverty in the Maldivian context differs from that of many other countries, with poverty issues which is often related to hardship or remoteness of the islands and lack of services in the atolls.

Goal and target	Indication	Baseline 1990	Population (%)
Target 1.A Have between 1990 and 2015 the proportion of people whose income is less than one dollar a day	1.1 Proportion of people below $1 PPP per day	24	1
	- Proportion of population below MRF 7.5 per day	49	3
	- Proportion of population below MRF 10 per day	59	8
	- Proportion of population below MRF 15 per day	74	21
	1.2 Poverty gap ratio		
	- Proportion of population below MRF 7.5 per day	NA	1
	- Proportion of population below MRF 10 per day	NA	2
	- Proportion of population below MRF 15 per day	NA	6
	1.3 Share of poorest quintile in national consumption	NA	6

MDG.1:- ERADICATE EXTREME POVERTY AND HUNGER

Source: Statistical year book 2010

The preliminary results of a recent survey conducted by the Department of National Planning (DNP) reveals that the overall poverty has declined in the Republic compared to the status in 2003. The analysis used 8 income poverty lines to calculate headcount ratio and the poverty gap ratio. Table 2.3 provides the poverty lines and the percentage headcount ratio which indicates the proportion of the population that lives below the poverty line.

Poverty line	Headcount ratio (%)					
	Republic		Male' (Capital)		Atoll (Rural)	
	2003	2010	2003	2010	2003	2010
MRF 4.34	0.16	0.39	0	0.1	0.22	0.53
MRF 7.5	2.75	1.23	0	1.63	3.76	1.04
MRF 8.13	3.2	1.63	0	2.14	4.38	1.38
MRF 10	5.02	2.31	0.11	2.67	6.83	2.14
MRF 15	18.93	7.05	0.42	6.45	25.73	7.33
MRF 18	24.86	9.94	1.41	9.01	33.47	10.39
MRF 21	32.56	12.86	4.19	10.24	42.98	14.13
MRF 22.83	40.01	14.96	10.72	11.37	50.77	16.69

Table 2.3: Headcount ratio for poverty lines 2003 -2010

Source: Department of National Planning, 2010

The results indicate that people living below the poverty lines in 2010 (in comparison to 2003) in the capital is increasing within all poverty lines while that in the rural islands has significantly reduced. The significant improvement of headcount ratio in the atolls is attributed to the overall enhancement of poverty status in the country. A detail breakdown of the poverty situation in 2010 at regional level indicates that people living under the poverty line; MRF 22.83 (poverty line at half the median of expenditure) is the highest in the North followed by Central South and Upper South province. Central and North Central provinces closer to the capital in the dynamic tourism zone reported the highest improvement in the headcount study.

Poverty gap indicator was used to identify the incidence and depth of poverty. Comparison of the results of 2003 and 2010 indicates that overall poverty gap reduced in the country. There is a significant reduction in the poverty gap in the Atolls while the opposite is observed in the capital where poverty gap is slowly increasing in all poverty lines (Table 2.4). Breakdown of the poverty gap results regionally in 2010 shows that the gap is highest in the North Province followed by South Central and South Province.

Poverty Lines	Poverty gap ratio (percentage)					
	Maldives		Male' (Capital)		Atolls (rural)	
	2003	2010	2003	2010	2003	2010
Rf 4.34	0.020	0.002	0.000	0.001	0.000	0.002
Rf 7.5	0.005	0.004	0.000	0.002	0.006	0.005
Rf 8.13	0.007	0.005	0.000	0.004	0.009	0.005
Rf 10	0.013	0.007	0.000	0.007	0.018	0.008
Rf 15	0.044	0.020	0.001	0.020	0.060	0.020
Rf 18	0.074	0.031	0.002	0.030	0.100	0.032
Rf 21	0.104	0.043	0.005	0.039	0.140	0.044
Rf 22.83	0.125	0.050	0.010	0.045	0.167	0.053

Table 2.4: Poverty gap ratio 2003-2010

Source: Department of National Planning, 2010

The study shows that the income inequality is rising in the country (Gini 2003 = 0.38 and 2010 = 0.44). Both in the capital Male' and in the islands poverty gap is increasing. Gini coefficient increased from 0.35 in 2003 to 0.45 in 2010 for Male'. Similar pattern is observed for the islands with Gini rising from 0.32 to 0.41. Inequality is slightly higher in the capital in both 2003 and 2010. However inequality between Male' and Atolls has decreased during 2003 & 2010.

The Government introduced new policies for poverty reduction by introducing social assistance. Their mode of assistance / service delivery still leaves sections of the population vulnerable to poverty. Considerable percent of the Maldivian population is still struggling to recover from the impacts of the 2004 tsunami that caused large-scale loss of incomes and assets. Environmental risks of global warming leading to a rise in sea levels and increasing fiscal deficits are among other risks that may be concerns in the Maldives. At an individual level, health risks and joblessness is reported to be of great concern leading to poverty. Health shocks are reported to cause the largest and most frequent shocks to household incomes. Special focus on social assistance to child and youth populations is needed, given their increasing vulnerability and risks with regard to unemployment and disaffection, as well as the issues of drug abuse, and growing violence and abuse.

2.3 Economic Development

2.3.1 Growth

The Maldives economic base is extremely narrow and dominated by tourism accounting over 27 percent of GDP in the recent year. Following the tourism sector, fisheries, construction and commerce play a significant role in the Maldivian economy each sector contributing between 5 – 10 percent of the GDP. Despite the risky narrow economic base, during the past decades, impressive economic growth rates were recorded in the Maldives except in the times of exogenous shocks. The Maldives is now one of the wealthiest countries in the region in income per capita terms. Real per capita GDP stood at approximately US$2,800 in 2009.

The Asian Tsunami of 2004 severely affected the Maldivian economy, by causing major destruction of infrastructure and assets, especially those in the tourism and fisheries sector. The impact of the tsunami disaster reduced real GDP growth by -4.6% in 2005.

Investments for tsunami recovery and rapid revival of the tertiary sector particularly the tourism which grew by over 42% in 2006 ensured strong GDP growth. Real GDP growth rates rose from -4.6 in 2005 to reach a record high of 18% in 2006 before slowing to more conventional rates of under 5% in 2009. The GDP growth rate continued to plunge in 2010, however is expected to stabilize at 2009 rate in 2011.

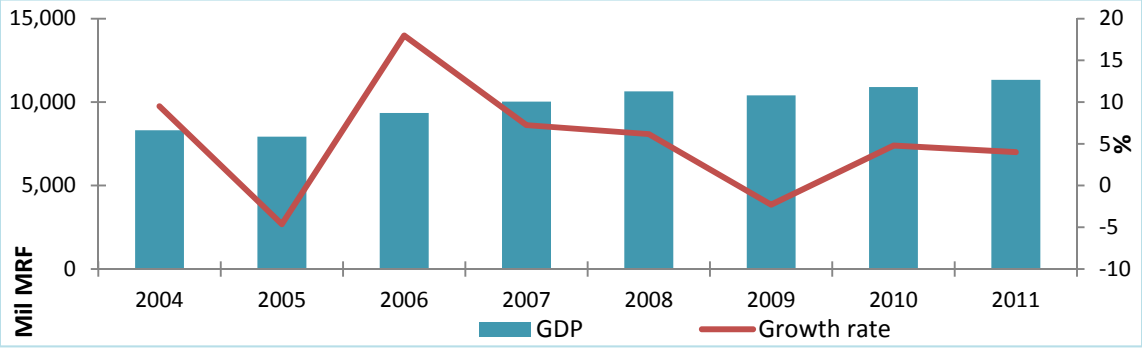


Fig 2.5: GDP and growth rate (2004 -2011)

Source: MMA April 2011 statistics (at 1995 constant prices)

In 2009, due to the global crisis, GDP growth was reduced more than the expected of 1.3%. This was mainly due to the turbulences in the tourism sector which reduced its growth rate to 0.5 %. In addition, the construction sector growth rates decreased to 24.2 in 2009 from earlier high ranging from 20%. Similarly, the transport and communication and government administration

experienced a decline in real growth rates in 2009, compared to earlier years, growing in real terms only by 1.1 and 12.5% respectively (United Nations, 2007) . However, the latest GDP estimates of November 2010, real GDP is estimated to have grown by 4.8 percent in 2010, due to stronger than expected performance of the tourism sector. Meanwhile, the pace of growth is projected to be moderate at 4.0 percent in 2011 supported by continued buoyant growth in tourism and related sectors such as construction, transport and communications.

GDP contribution by sector is provided in appendix 2.2. The primary industry represents agriculture, fisheries and coral and sand mining of which fishing is the major economic activity. The primary sector depicts an unstable trend during the period 2004 -2010, which experienced negative growth rates since 2006. The secondary sector includes manufacturing, electricity and water supply and construction. In 2009, the secondary sector showed negative growth mainly due to the short falls in the construction industry. Major players of the tertiary industry are tourism followed by, transport and communication, wholesale and retail trade and government administration. In 2006, the tertiary sector growth rate peaked reaching 21.3% and plunged to -0.6 in 2009.

Tourism sector's contribution to GDP remains the strongest with 26 percent at the end of 2009. In 2010 the sector grew by 9.2 percent rebounding from the negative growth of -5.2 in 2009. Transport and communication sector contributed to GDP modestly at around 20 percent in 2010 and its growth remained positive at 2.5 although it declined to 1.1 percent in 2009. Wholesale and retail trade representing the distribution sector continued to grow and expanded during the period. This sector is closely linked to major sectors of the economy such as tourism and construction and their economic activities drove the sectors growth. The sector continues to contribute about 3.8 percent of GDP since 2004 to date.

The expansionary fiscal and monetary policies of the past Government, inherited huge fiscal debts to the current Government since its election in October, 2008. Efforts to reign in this deficit and the associated costs to the economy are currently being exacerbated and made more difficult by the world economic and financial crisis.

As a percent of GDP, public debt levels have almost doubled from 55 percent in 2004 to an estimated 97 percent in 2010. Public debt service as a percent of government revenues are projected to more than double between 2006 and 2010 from under 15 percent to over 30 percent. The IMF recently classified the country as ‘at high risk’ of debt distress.

Inflation in Maldives is on the rise, mainly due to the monetized fiscal deficit in 2008. According to the estimates of the annual percentage change in the moving average of the Consumer Price Index, inflation stands at 12.3 percent as at end of December 2008 (MMA website). Major categories contributing to inflation include soaring food, transportation, and housing prices.

Despite the impressive growth of the past, the mounting fiscal deficit and the concomitant resource gap, the crisis from double digit levels of inflation hurting the poor and the impact of the global recession is currently having a knock on effect on the government revenues. The gross reserve for 2009 was calculated to be at US$386.1 million, which is equivalent to 4.3 months of import (MMA website). The adverse economic conditions have also impacted upon employment and household incomes due to lesser pay, enforced leave and some layoffs.

2.3.2 Construction

The construction sector continued to remain robust during 2004 - 2008 owing to the increase in developmental activities by the tourism sector as well as public sector infrastructure development projects. As a result, the value added to the sector rose by 16 percent by the end of 2008. The industry was hard hit during the year 2009 and growth rate fell to -29.2.

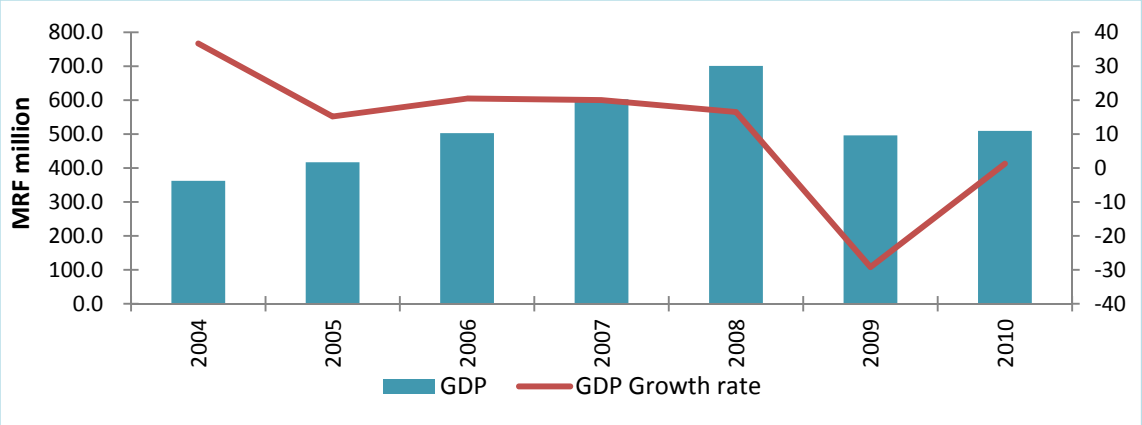


Fig 2.6: Construction sector contribution to GDP (2004 – 2010)

Source: Statistical year book, 2010, Department of National Planning, 2010

The construction sector's performance, as measured through the share of commercial bank's credit to the sector, registered a twelve month improvement of 54 percent at the end of 2008 compared to an annual improvement of 107 percent in 2007. As for construction related imports, the total value of imports of construction materials increased by 13 percent from

$172.3 million in 2007 to $194.9 million in 2008, compared to 42 percent annual growth in 2007 (MMA website).

2.3.3 Tourism

Tourism sector is the main sector of the economy which contributes over a third of the GDP. Tourism sector is vulnerable to exogenous shocks and the aftermath of the 2004 Asian tsunami which hit the sector hard by reducing its contribution to the GDP by about one-third. However, the sector recovered remarkably with growth rebounding strongly in 2006. Similarly, tourism sector was increasingly affected by the volatile global economy during the past few years. Followed by an outstanding performance of double-digit growth, during the year 2006 and a more moderate growth in 2007, the sector observed a steady decline in 2009 (graph 2.7).

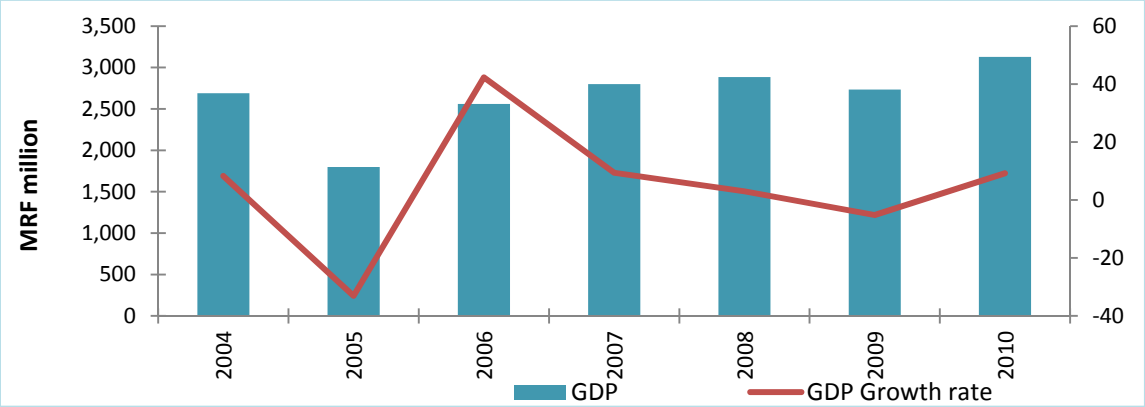


Fig 2.7: Tourism sector contribution to GDP (2004 – 2010)

Source: Statistical year book, 2010, Department of National Planning, 2010

The tourist arrivals registered a significant growth in 2006 while it slowed down in 2008, mainly due to a fall in arrivals from main source markets in Europe. A similar trend was observed in the growth trend. The tourist bed nights, which is directly related to arrivals, was somewhat better than arrivals growth trend partly reflecting the increase in the average stay of a tourist visit from 8.3 days in 2007 to 8.6 days in 2009.

During the period the number of tourist resorts increased from 87 to 97. Similarly, the number of city hotels increased from 8 to 14 while the number of yacht marinas remained unchanged. A declining trend was experienced in number of guest houses (28 in 2005, and 22 in 2009) while safari vessels increased from 113 to 145 from 2005. The average occupancy rate increased by 5.8 percent from 2005 – 2009, which peaked during the 2007 showing an increase of 18.4 percent compared to that of 2005. The occupancy rate increased by 0.3 percent from 2005 –

2009, depicting the highest in 2009. With the increasing trend in the total number of registered resorts, hotels and safari vessels in the country at the end of 2009, the total bed capacity rose by 4480 beds by the end of 2009.

With regards to the utilization of bed capacity while the total number of registered bed capacity of the industry expanded, while the number of beds in operation increased by 7.1 percent to 20,137 in 2009. This indicated on average, registering an annual increment of about 1000 beds during the period. However, the capacity utilization increased from 69 to 82 percent from 2005 to 2008 despite the slow growth in tourist arrivals (fig 2.8).

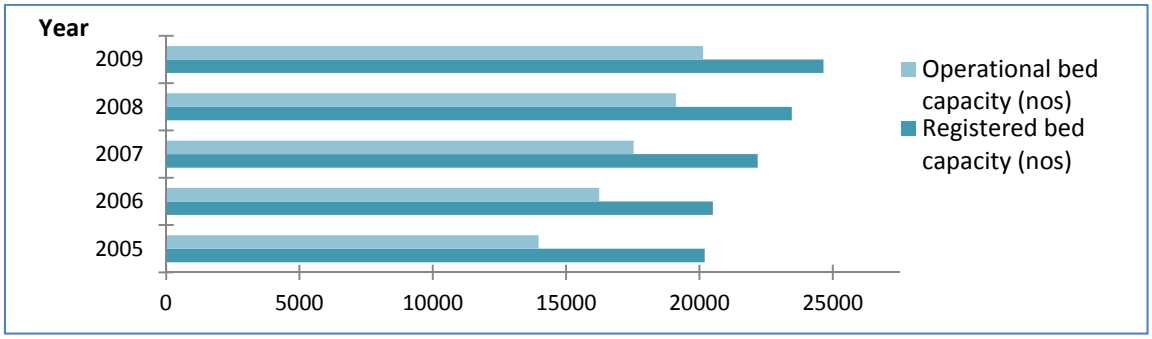


Fig 2.8: Tourist bed capacity utilization (2005 – 2009)

Source: Ministry of Tourism, 2010

Maldives is a popular long-haul destination for European travelers contributing near three quarters of the total arrivals. With the rise in global fuel prices to record levels in 2008 and reflecting the slowing of most European economies, the growth performance of European market decreased to -0.4 in 2009 compared to 2007. The growth rate was exceptionally sluggish by countries such as UK and Italy which were among the hardest hit countries by the global financial crisis and were officially in recession by the end of 2008. However, other major markets from Europe like Russia, recorded a robust growth, followed by moderate performance by Switzerland and France. The Asian market contributes about 23% of the total arrivals. Growth of the Asian market remains moderate at 6.9 percent at the end of 2009 due to the strong performance of the fast growing Chinese market, although the scenario for the Asian market remained sluggish in 2008. New and emerging markets in the Maldives includes America and the Middle East in which the growth was recorded as 4.7 and 3.5 respectively at the end of 2009 (Fig 2.9).

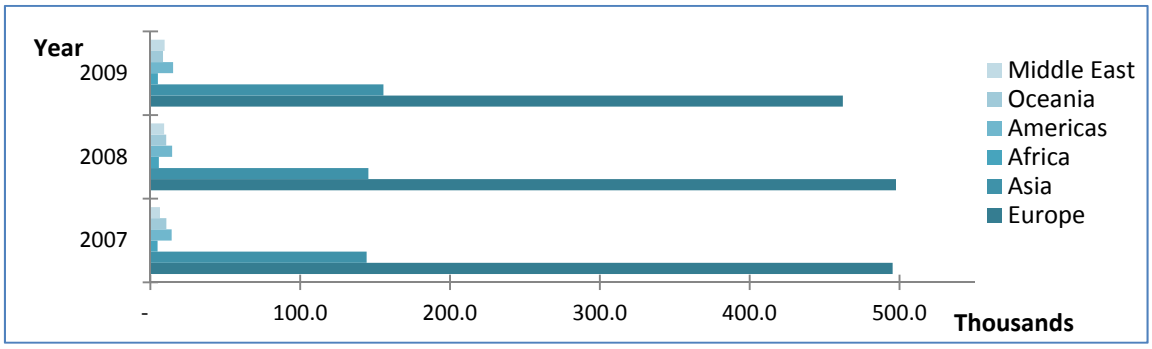


Fig 2.9: Tourist arrival by nationality (2007 – 2009)

Source: Ministry of Tourism

2.3.4 Fisheries

The fisheries sector continues to remain imperative to the Maldivian economy. It is an important sector in terms of foreign exchange earnings as fish and fish products account for almost 98 percent of total domestic exports. The sector provides a key source of employment, both directly and indirectly, averaging about 15 percent. Despite its importance to the Maldivian economy fisheries sector has been experiencing a prolonged set back since 2006 and its contribution to GDP had been declining steadily. The fisheries sector growth rate was worsened in the year 2007 and 2009 due to the continued decline in fish catch and rising fuel prices (Fig 2.10).

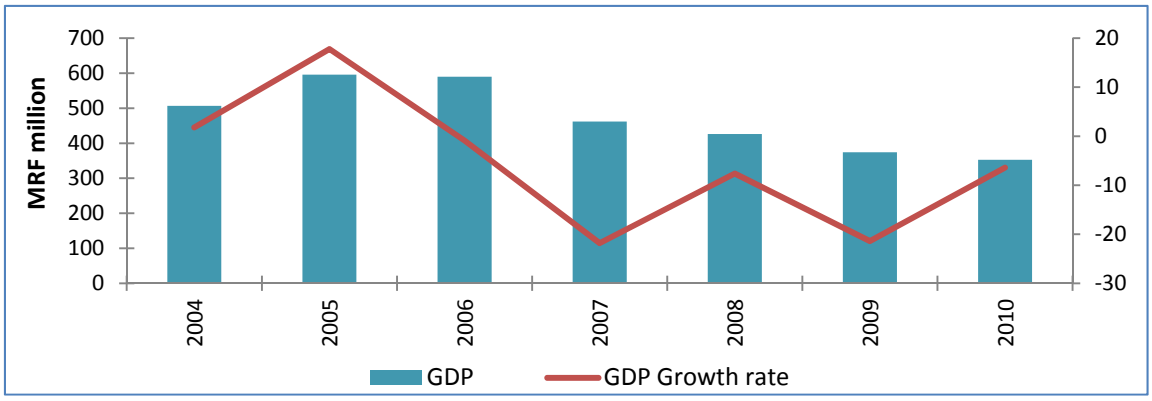


Fig 2.10: Fisheries sector contribution to GDP (2004 -2010)

Source: Statistical year book, 2011, Department of National Planning 2011

Fig 2.11 depicts the distribution of fishermen and the fishing vessels within the country. According to the 2010 statistics, Maldives has 14,423 fisherman and 610 vessels are licensed for fishing.

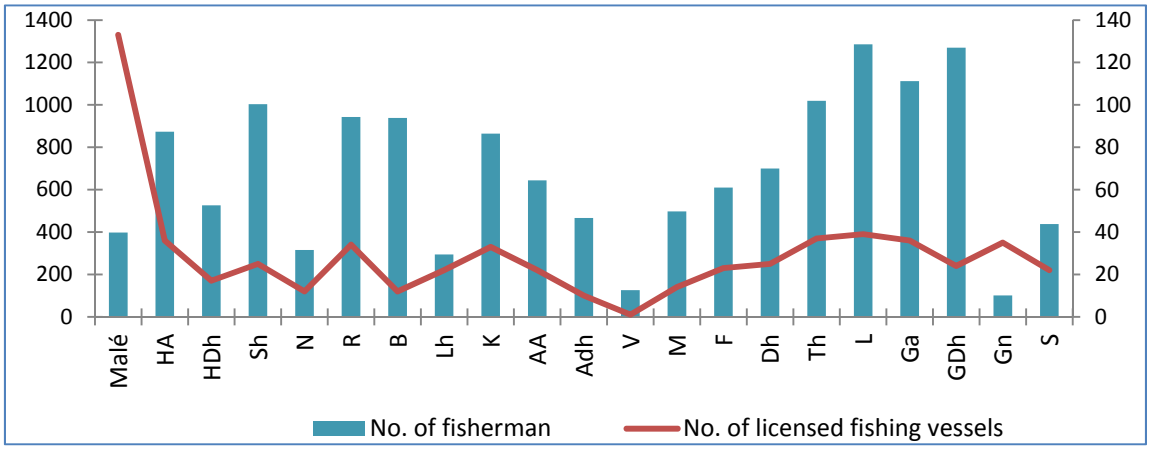


Fig 2.11: No. of fisherman and fishing vessels - 2010

Source: Ministry of Fisheries and Agriculture 2011

Fisheries sector experienced a declining in trend in total fish landing since 2005. Total fish landing decreased by 26 percent in 2009 from 158 thousand Metric tons in 2005, to 117 Metric tons. Decreased fish landings are attributed to economical and environmental factors. Maldivian fisherman still goes out fishing on single day trips returning back to the island by dusk. Majority of the fishing vessels are large in size with high powered engines which is not cost effective due to high fuel prices and other operational costs involved. Thus, the fishing effort was reduced over the years. More recently Maldives has raised concerns over the increased activities in the Indian Ocean which is claimed to have contributed to the reduced the fish stock and hence poor catch. Furthermore , the recent climate change phenomenon's which caused warmer sea temperatures is believed to have pushed the fish deeper than the fisherman can catch by using pole and line catching systems.

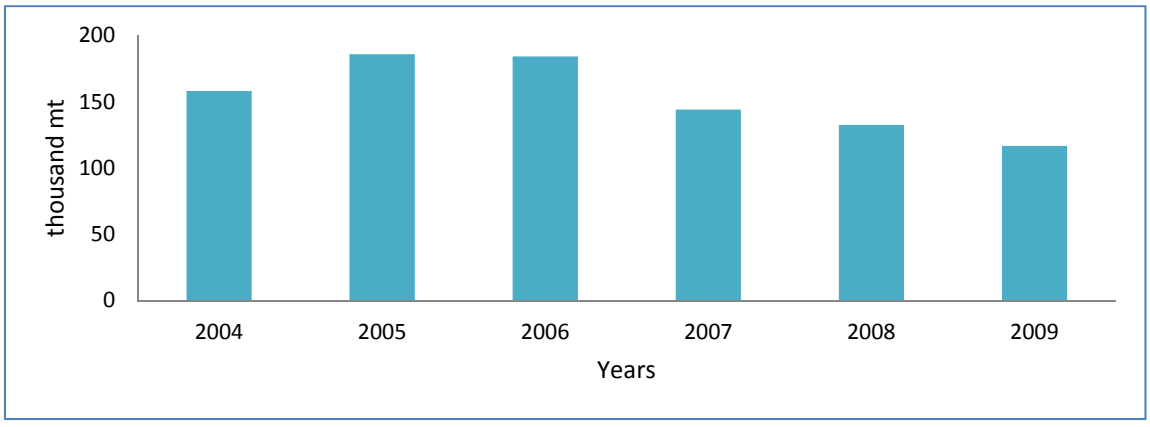


Fig 2.12: Fish landing (2004 -2009)

Source: Ministry of Fisheries and Agriculture 2010

The total volume of fish export and its earnings in table 2.7 indicate an overall reduction in earnings except for the reef fish. Total earnings from exports of fish and fish products estimated MRF 17.1 billion in 2006, 13.5 billion in 2007 and 15.9 billion in 2008. The overall earnings reduced by 20 and 7 percent in 2007 and 2008, respectively compared to that of 2006. Similarly, during the same period the earnings from fresh or chilled tuna fell by 11 and 5 percent. Volume of tuna export fell by 33 percent in 2008 compared to that of 2006. However, due to the favorable global tuna prices during 2008, tuna export earnings reduced by only 1 percent. Reef fish landing and export trend was positive though the quantity is very minimal. Volume of reef fish export increased by 6.76 percent, the earnings by 18.6 percent from 2006 to 2008. The canned fish sector performed the poorest during 2006 – 2008. Volume and earnings from canned fish export fell by 59 and 39 percent respectively (table 2.5). Export earnings do not reflect the value of total national fish production as the value of fish locally consumed is not taken into account. The policies to address the issue of low economic benefit is directed towards facilitating business development trade and export promotions, regulating the market to ensure changes in buying prices of fish at international market and enhancing regulatory framework.

Fish and fish product	Quantity (Metric Tons)			Value (F.O.B MRF '000)		
	2006	2007	2008	2006	2007	2008
Fresh or chilled tuna	8,992.17	7,535.70	6,919.56	440,207.29	392,992.23	417,829.11
Fresh or chilled reef fish	317.00	318.01	340.10	16,424.12	18,768.18	20,178.86
Frozen Fish	86,103.21	46,342.31	49,351.76	856,996.14	628,545.75	875,466.77
Canned fish	4,727.14	3,684.51	1,940.21	146,263.39	137,920.80	88,726.35
Salted dried fish	2,914.73	2,389.24	2,269.96	31,893.93	20,880.12	18,199.66
Dried Fish	5,699.30	5,095.43	3,711.83	112,946.92	98,514.52	92,852.15
Tuna (in brine)	-	0.53	0.01	-	6.38	0.12
Live Reef Fish	436,485.00	425,739.00	408,767.00	18,895.87	13,823.74	18,442.56
Sea Cucumber (Dried)	87.87	112.95	84.01	12,707.46	10,945.97	7,891.33
Sea Cucumber (Live)	-	50.00	-	-	0.32	-
Fish Meal	2,946.93	2,248.74	1,490.28	20,244.42	13,431.57	13,204.79
Other Marine Products	1,483.27	435.24	592.93	53,079.36	21,315.47	38,727.55
Other Marine Products (litres)	9,580.50	3,469.00	14,801.20	330.53	77.13	419.95
			Total	**1,709,989.44**	**1,357,222.19**	**1,591,939.20**

Table 2.5: Export and earnings from fish and fish products (2006-2008)

Source: Maldives Customs, 2009

2.3.5 Agriculture

The share of agriculture in the national economy has always been recorded as low and stagnant (fig 2.13). However, recent anecdotal evidences support the fact that the sector is strengthening as production efforts and output delivered to the market are increasing. Agriculture is still the principal preoccupation and source of livelihood for a large number of people particularly those who live in the islands. Agriculture sector had a major impact of the 2004 Asian tsunami and the sectors growth fell from 4.3 percent in 2005 to -0.5 percent in 2005. Since, then the sector's recovery is steady and as of 2010 growth had reached 1.7 percent. Partly, agriculture sector's contributions to GDP are depicted low due to the rapid growth of other sectors. Moreover, agricultural statistics are poorly covered as, the landings in Male' market is only used as the production figures. Direct sale to resorts and trade between islands are not included in the agricultural statistics. It is estimated that a third of the production is represented by the direct trade and it is not included in the current data collection system. Unreliable data distort the macro as well as the micro-economic scenario of the agriculture sector.

Agriculture is recognized as a supplementary source of cash and food in more than 76 inhabited islands and commercial farming is carried out extensively throughout the country. The sector is crucial to address MDG goal of poverty alleviation and the national problem of high malnutrition and food insecurity.

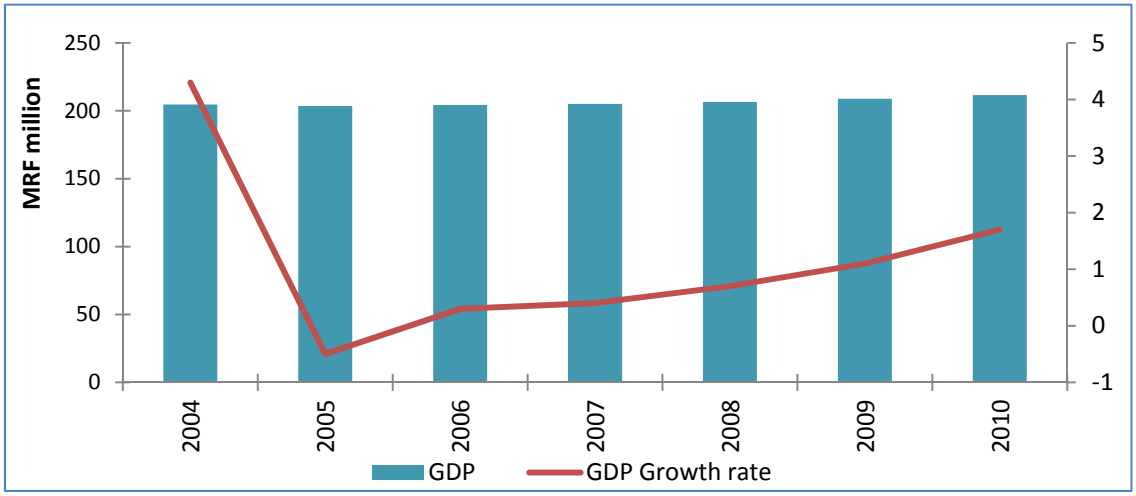


Fig 2.13: Agriculture sector contribution to GDP (2004 – 2010)

Source: Statistical year book, 2010, Department of National Planning 2011

Farming is currently practiced 76 inhabited islands and 600 uninhabited islands leased as 'varuva' (traditional leasing system) whereby the lease holders go into semi commercial type of

farming ventures and 60 islands leased for 21 years for commercial farming. In the 76 inhabited islands over 7500 are registered as farmers of which most of them are marginal producing in an area less than a hectare. A total area of 1025 hectares is leased for commercial farming; however few farmers use the full potential of the available resources.

Developments in local productions in terms of earnings from agricultural commodities traded to the Male' market and value of import bills is compared in fig 2.16.

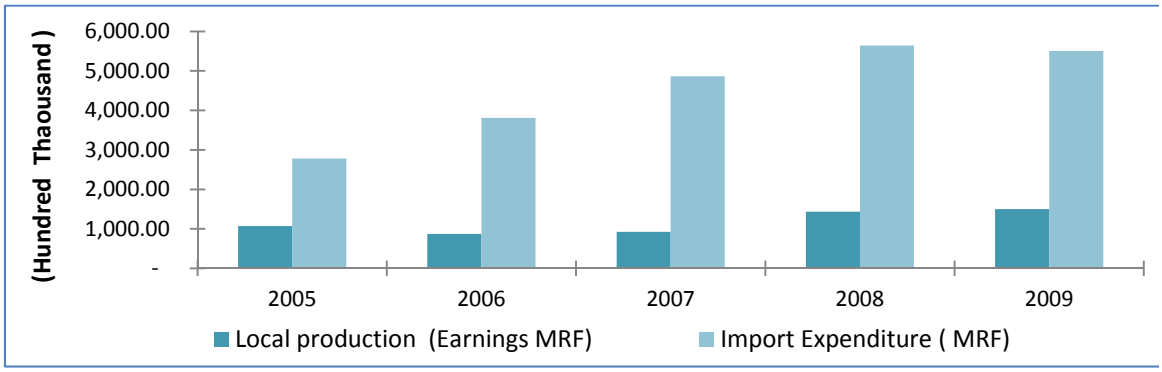


Fig 2.14: Import expenditure and earnings from agriculture commodities

Source: Statistical year book, 2010

As depicted in fig 2.14, the earnings from 15 agricultural crops increased by 32% in 2009 compared to that of 2004. Farmers compete with imports from neighboring countries and struggle to fetch good price for the local crops. Hence, as depicted in fig 2.17, comparison of 2009 imports and local production data for 15 major crops indicates that local production exceeds import by 23% nevertheless, the earnings are 3% less than the value of imports. The scenario is worst in 2010 in which production increased by 13 percent and the earnings was 40 percent less than the import. This may be due the competitiveness in cost of production and also due to the absence of a well-organized and regulated supply chain.

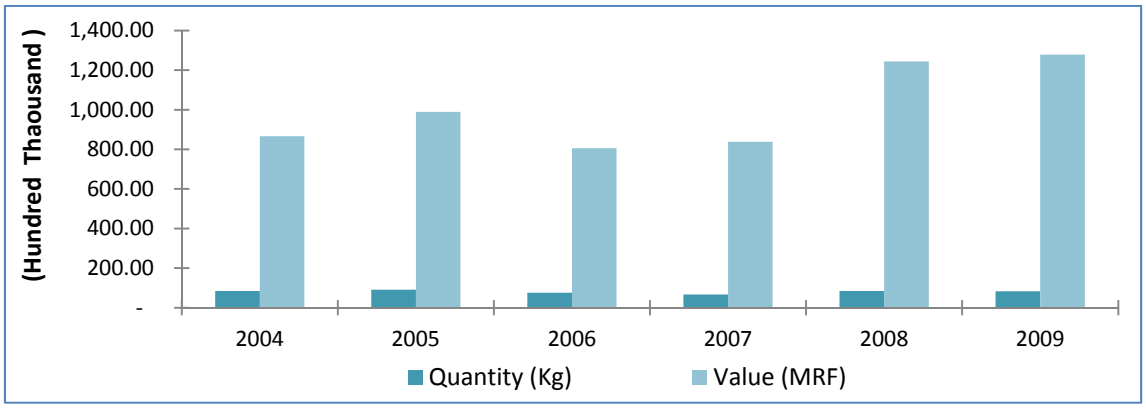


Fig 2.15: Quantity and Earnings of horticultural crops grown in the Maldives

Source: Ministry of Fisheries and Agriculture, 2010

To address the issue of value chain and marketing system for the agriculture sector, empowering the private sector, enabling and facilitative business environment, public-private partnership and promoting micro-enterprises and SME's are considered as policy directives for the Ministry of Fisheries and Agriculture.

Appendices

Economic Infrastructures	Number
Existing Airports	4
Future Airports	11
Fishing Activity islands	56
Agricultural Activity islands	76
Existing Airports	4
Future Airports	11
Seaplane Services - Trans MaldivianAirways	31
Seaplane Services – Maldivian Air Taxi	41
Planned Transit/Airport Hotels	9
Planned City Hotels	9
Bank of Maldives PLC Branches	19
Agricultural Activity islands	76
Fishing Activity islands	56
Fisheries & Agricultural Training Center	2
Picnic islands	9
Future Resort - to be opened 2011	18
Existing Resort	98
Future Resort - Contract signed	31
Harbors and jetties	68
Health and Social Infrastructure	
Tertiary Health Care (Atoll & Regional Hospitals)	32
Health Centre	158
Higher Secondary (A-level)	34
Atoll Education Centre	20
Secondary Education	117
Single Session Schools	114
Division Police Headquarters	7
Police Stations	42
Teacher Resource Centers	21
Family and Children Service Centers	19
Maldives Post Limited - Branches	26
Maldives National University - Campuses	02
Hostels & Regional Vocational Training Centres	02
Zone Stadiums	05
Defense Force Head Quarters	02
Youth Centres	14
Fire Stations	05
Utilities and services	
Desalination plant in operation	29
Sanitation Projects - completed	22
Sanitation Projects – under construction	04
Electricity provided by STELCO	07
Islands where renewable energy is used	09
Electricity provided by Utility Companies	25

Appendix 2.1: Infrastructure in the Maldives

Source: Department of National Planning website, Infrastructure map of Maldive March 2011

Industry/Economic activity	2005	2006	2007	2008	2009	2010	2011
Primary							
Agriculture	203.6	204.3	205.1	206.6	208.9	211.6	214.9
Fisheries	595.8	590.1	461.7	426.5	374.1	352.5	336.5
Coral and sand mining	49.5	52.1	53.4	54.5	52.5	52.7	53.3
Secondary							
Manufacturing	593.6	680.2	703.2	722.8	694.2	703.0	708.9
Electricity and water supply	363.4	409.0	446.5	476.5	497.1	515.7	541.0
Construction	417.3	502.8	603.2	701.3	496.4	509.6	559.0
Tertiary							
Wholesale & retail trade	336.0	357.1	387.3	403.5	392.1	410.9	425.9
Tourism	1798.5	2559.7	2800.0	2883.9	2733.2	3127.8	3371.7
Transport & communications	1456.5	1725.4	1868.8	2043.8	2082.0	2163.1	2255.5
Financial services	261.9	286.5	298.8	306.8	301.4	312.2	320.0
Real estate	574.5	594.8	610.0	623.9	623.6	643.2	660.8
Business services	222.4	233.3	238.9	243.5	240.4	246.6	250.9
Government administration	1212.7	1380.3	1596.3	1814.5	1943.2	1909.9	1912.5
Education, health & social services	148.5	151.7	154.5	157.4	160.3	163.5	166.9
FISIM	-308.0	-376.2	-399.4	-418.9	-397.8	-423.6	-442.6
Memorandum items							
Nominal GDP (MRF million)	6357.0	6935.0	7348.0	7650.8	8201.0	8863.2	9938.7
Nominal GDP (US$ million)	540.1	589.2	624.3	625.1	640.7	690.8	776.5
GDP per capita (in US$ at cp)	1840.2	1933.8	1986.4	2020.9	2117.7	2262.1	2439.3
GDP deflator (percent change)	2.0	1.7	1.1	0.6	0.6	-0.4	2.4
CPI Inflation	-1.4	3.0	-1.2	0.7	1.5	-2.5	3.9

Appendix 2.2: GDP at basic price (in Millions of MRF, at 1995 constant prices)

Source: Department of National Planning website, Infrastructure map of Maldive March 2011

3. Climate Change

Key findings:

- National indicators and forecasts show that extreme events in terms of SLR, precipitations temperature and storm events have the probability of occurring more often in the future.
- Major adaptation related initiative include replicating locally appropriate coastal protection measures throughout the country. SLM and WRM are initiated as part of the strategy to mainstreaming risk planning and climate change adaptation into the policy and planning framework across all sectors.
- It is estimated that Maldivians emitted 1.3 million tons of carbon dioxide in 2009 (Becitizen 2010). Achieving carbon neutrality by year 2020 is the priority and as such promoting renewable energy, energy efficiency and phasing of HCFC are major mitigation related initiatives.

3.1 Introduction

Maldives is low lying archipelago with more sea than land with less than 1% of the total area is land suitable for human habitation. More than half of the population of the country lives within 100 meters of the coast line making the entire nation highly vulnerable to Sea Level Rise (SLR) due to climate change.

Climate change, driven by the increasing concentration of Green House Gases (GHG) in the atmosphere, poses serious, wide-ranging threats to Maldives. Intergovernmental Panel on Climate Change (IPCC), Fourth Assessment Report (2007) states that temperature rises of about 0.2 °C per decade is projected for the next two decades under all Emission Scenarios. It is estimated that SLR will be 18 to 38 cm (7 to 15 inches) in a low scenario and 26 to 59 cm (10-23 inches) in a high scenario.

Climate change is overwhelming to Maldives where 80% of the islands are less than a meter above sea level. National predications and forecasts of climate change indicators in terms of SLR, precipitation, temperature and extreme events are reviewed to understand the current status the predictions and the severity of the climate change (table 3.1). The forecast shows increasing trends with the probability of the extreme events occurring more frequently in the future.

3.2 Climate Change Impacts

3.2.1 Sea level rise

Global sea level is projected to rise under all scenarios of IPCC Special Report on Emission Scenarios (IPCC 2001) with an average rate of increase of 5mm/year within a range of 2 to 9 mm/year. During the 20th century the global mean sea level rose 10 to 20 mm at the rate of 1 to 2 mm /year. Between 1990 to 2100 sea levels rise is projected to rise within the range of 9 to 88 cm.

The national projections reveal that that the maximum hourly SLR of 7mm/year is a rate far in excess of the observed local and global trends in mean sea level. A long term trend of an increase of 1.7 mm/year is observed with forecasts predicting that the probability of events such as hourly sea level of 70 cm above mean sea level are to occur more frequently in the future.

3.2.2 Precipitation

Global average water vapor concentration and precipitation are project to increase (IPCC, 2001), while a marginal decline in precipitation is projected for the Indian Ocean Region. (Nurse and Sem, 2001)

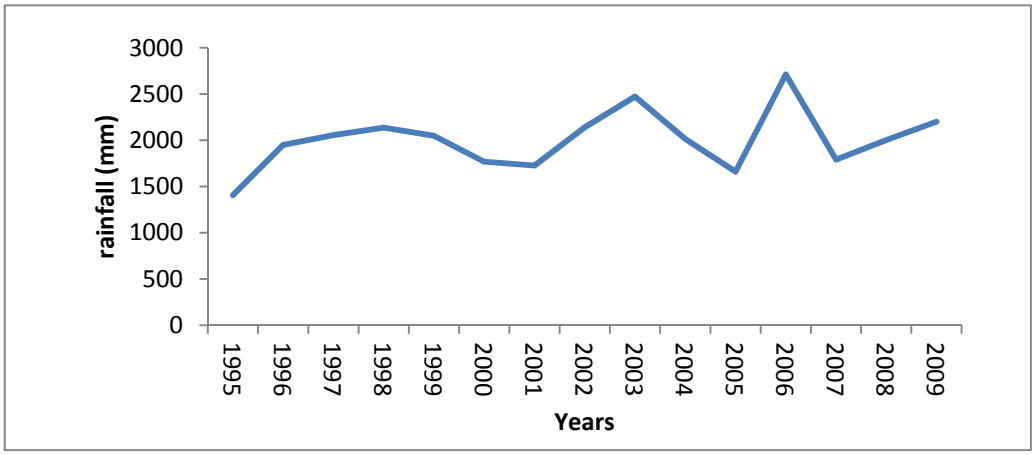


Fig 3.1:-Annual rainfall 1995-2009

Source: Department of National Planning, 2011

In line with this projection in Maldives no significant long term trends are observed daily, monthly, annual or maximum daily rainfall. Figure 3.1 outlines the available data on annual rainfall for the period 1995-2009 which shows that annual rainfall has ranged from 1407 millimeters in 1905 to 2711 millimeters in 2006. Similar to other indicators rainfall projections in terms of extremely high daily rainfalls occurring more often is predicted for the future.

3.2.3 Temperature

Eleven of the twelve years between 1995-2007 ranked among the twelve warmest year in the record of global surface temperature since 1850(IPCC 2007). An increasing trend from 1.4 to 5.8 percent is predicted for the period 1990-2100 (IPCC, 2001), while for the Indian Ocean the average increase is predicted at 2.1 percent for 2050 and 3.2 for the 2080 (Nurse and Sem, 2001). Figure 3.2 outlines the annual average of daily maximum and minimum temperature between 1995-2009. According to the data the temperature ranges from 25.8 to 31.1 degrees Celcius.

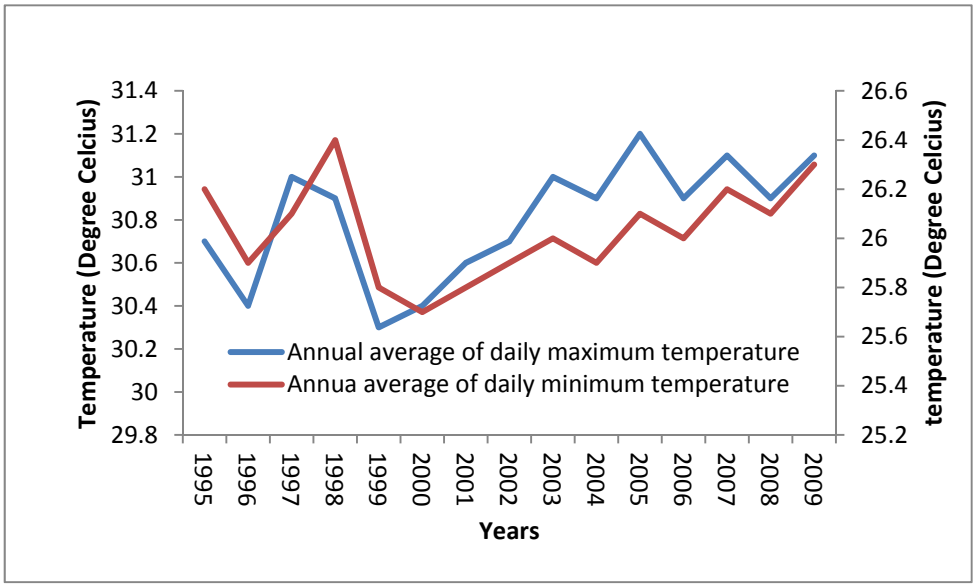


Fig 3.2:-Annual average of daily maximum and minimum temperature 1995-2009

Source: Department of National Planning, 2011

Indicator	Status
Sea level	• Increasing at 1.7 mm/year • Maximum hourly sea level rise 7 mm /year • An hourly sea level of 70cm above MSL is currently a 100-year event and will likely be at least an annual event by 2050
Precipitation	• No significant long term trends are evident in the observed rainfall pattern • Daily rainfall of 160 cm is rare with a return period of 17 years • An extreme daily rainfall of 180 cm is currently a 100 year event and will occur twice as often by 2050 • An extreme three hourly 100 mm rainfall is rare and is 25 year event but will be twice as common by 2050
Temperature Annual maximum daily temperature	• Projected to increase 1.5 C by 2100 • Maximum temperature of 33.5 is currently a 20 year event and has a return period of 3 years by 2025
Sea Surface temperature	• An increasing trend in Sea Surface Temperature (SST) observed • The annual mean SST trends at Hulhule' and Gan are 0.2±°C and 1.1 to

	1.6°C/decade respectively • During May 1998 mean monthly SST was 1.1C above the highest mean monthly SST expected in any 20 year return period
Extreme events – storm surge	• Maximum storm surge height is reported at 1.32m with a return period of 500 years. If coupled with high tide, it could generate a storm tide of 2.30m • Island in the northeast could face storm tides of 2.3 m • Sea level rise would cause regular tidal inundations in most islands even at the medium prediction. The high prediction could cause inundations in almost all islands. A storm surge at high prediction could cause a 3.18m wave that could inundate even the largest of islands.
Extreme event – wind gusts	• Wind gust of 60 knots has return period of 16 years and will reduce to 9 years by 2025 • Category 3 cyclone for the Northern Maldives with a 500 year return period
Erosion	• 41 island have reported severe beach erosion in year 2009

Table 3.1: Summary of national indicators of climate change

Source: National Adaptation Plan of Action, 2007, Statistical Yearbook , 2010

National Adaptation Plan of Action (NAPA), reports that for Maldives there is a relatively high confidence in projections of maximum temperature. The annual maximum daily temperature is projected to increase by 1.5 percent by the year 2100. According to Sing et al, 2001; Khan et al, 2002, increasing trend in SST has been observed in Maldives. Noteworthy is the fact that during May 1998 means monthly SST was 1.1 degrees C above the highest mean monthly SST expected in any 20 year return period (Clark et al, 2001)

3.2.4 Extreme events

In addition to regular monsoonal wind generated flooding, extreme events such as storm surges and cyclonic storms are also predicted events. In a country where 90% of the islands are at an average height of 1.5 meters above Mean Sea Level (MSL) forecasts of storm tides for predicted Sea Level Rise (SLR) shows many islands can be submerged. Islands in the north east of Maldives are predicted as more vulnerable for such disasters. The probable maximum storm surge tide by region for the northeastern islands storm tides of 2.30 meters is predicted. The high prediction forecasts waves of 2.41 –meters 3.18 meters with a possibility of inundating all islands in the Maldives. With medium SLR predictions storm tides of 1.86-2.78 meters can be

generated submerging most islands of the country. Cyclonic storms have also occurred in the past and probability of such events happening exists. Predicted return periods of wind gust of 60 knots have increased from 16 years to 9 years by 2025. Category 3 cyclonic events have a return period of 500 years for the Northern Maldives.

STRONG TIDAL WAVES HIT MALDIVES: On 15th May, 2007 and for four subsequent days, powerful swells hit many islands throughout the Maldives. According to the Department of Meteorology, the swells were generated by waves between 10 - 15 feet from a dissipated polar storm 3,500 miles south west of Maldives, off the coast of South Africa. This climatic phenomenon occurs each year throughout the Maldives. The tides were higher than usual and the degree of flooding almost unprecedented. While there is no scientific evidence yet that the phenomenon is due to global warming such evidence seems to suggest that it might be. A total of 88 island on 18 atolls were affected .The five island most severely affected were Fares Maathoda, Rathafandhoo, Nadalla, Madavelli and Fiyori. Fortunately there were no fatalities but 1649 were evacuated from their homes to community facilities, families and friends on the island in the immediate after math. Six sectors were assessed: infrastructure, health, water and sanitation, livelihood, environment, and emergency relief needs. Observations on the five islands documented substantial flooding and erosion. Damage to the harbors and quay walls of the islands has also been observed. The maximum inundation measured was in excess of 5 feet on the island of Fares-Maathoda and the minimum flooded island visited was about less than a foot. All basic services have been impacted such as electricity, water and sewerage systems. The ground water quality assessments show that the water has been contaminated in all the five islands. The total coliform count as well as the faecal coliform count is higher than the reference range of the guidelines. A number of houses were observed to have been damaged by flooding. Longer term consequences are likely to be structural damage to walls and floors; but more extensive damage caused by infiltration of saline water is likely to have weakened foundations, leading to the need for repair and reconstruction. The salt water intrusion has damaged crops and trees, visible immediately and it is foreseen that further damage will become apparent Home gardens and other means of livelihood such as fish processing are certain to require longer term recovery intervention. It was evident from the observation from all the islands that livelihoods of the communities in the long term will be affected.

Source: National Disaster Management Centre, 2007

3.3 Vulnerability to Climate Change

With about three-quarters of the land area of Maldives being less than a meter above MSL, the slightest rise in sea level will prove extremely threatening. NAPA identifies the high risk sectors and associated vulnerabilities which are reviewed in table3.2 .

High risk vulnerable sectors	Sectoral Vulnerabilities
Land, Beach and Human Settlement	• Infrastructure, human settlements and facilities located on or near the beach affected • Habitability threatened due to reduction in island size or complete inundation
Critical Infrastructure	• Airport, ports,harbours, power, water and sewerage systems located at an elevation of about 1.5 meters above sea level and in close proximity to the coast line at high risk • Over water structures threatened by complete inundation
Tourism	• Accelerated beach erosion, degradation of coral reefs, and bleaching will all have impacts on incomes from tourism. • Salt water intrusion will affect the vegetation
Fisheries	• Live bait fishery, tuna fishery and reef fishery coral reefs affecting food security • Changes in fish production affects tourism sector
Human Health	• Salinization of fresh water supplies • Sewage and water systems affecting human health • Heat stress with occurrence of disease
Water resources	• Salinization affect quality of life, soil and vegetation • Rain water storing facilities affected • Changes in rainfall and increased evaporisation
Agriculture and Food Security	• Limited agricultural land, with poor soil vulnerable to heat stress on plants, changes on soil moisture and temperature loss
Coral Reef Biodiversity	• Coral reefs which are highly sensitive to change in temperature • Reefs may not be able to keep pace with the predicted sea level rise

Table 3.2: High risk sectors and associated vulnerability to climate change

Source: National Adaptation Plan of Action, 2007

3.3.1 Land beach and human settlement.

The low elevation with over 80% less than 1m above MSL and small size of the islands are inherent characters of the country making Maldives highly vulnerable to climate change and sea level rise. Land is scarce in the country which is made up of over 1192 coral islands of which 96% of the islands are less than 1 square km. The total land area is 235 square kilometers and 176 square kilometer is utilized for human settlement and associate uses. The coral islands that make up the Maldives are morphologically unstable with beaches dynamic with substantial seasonal changes. Settlement footprints lie close to the sea with 44% of the settlement footprints of all islands within 100 m of coastline. In terms of population and housing 42% and 47% are within 100 m of the coastline respectively placing the people at high risk to climate change and sea level rise. In the absence of scientific data observed evidence on severe weather events and storm surge consolidate this fact. Table 3.3 outlines the recent recorded events.

Year	Details
2000-2005	90 inhabited islands have been flooded at least once a year
2000-2005	30 inhabited island have flooded regularly
15-18 May 2007	Swells of 10-15 feet affected 88 islands damaging 500 houses affecting 1600 people
Aug 2011	Flooding in Huvadhoo Atoll and Addu Atoll

Table 3.3: Available recent recorded evidence of severe weather events

Source: Ministry of Housing and Environment 2011, Disaster Management Centre 2011

The vulnerability and the high risk associated with climate change and SLR exacerbates when coupled with other pressures such as use of unsuitable designing structure and housing material. Coastal erosion is very frequent. Moreover population is increasing and overcrowding is significant with 34 island have reached their carrying capacity while 17 islands will exhaust the existing land by 2015 (Shaig, 2006). Analysis of the cause and effect of vulnerability to climate change reveals that with population increase demand for housing justifies land reclamation. Land reclamation requires suitable coastal infrastructure and harbors (Fig 3.1) Land reclamation is also associated with removal of coastal vegetation and sand mining, reef blasting dredging. Poorly designed coastal infrastructure with sewage disposal and solid waste disposal affects the health of the reefs results in the imbalance of reefs which has the critical function of protecting the coast. As such the vulnerability increased as the causes and effects multiplies.

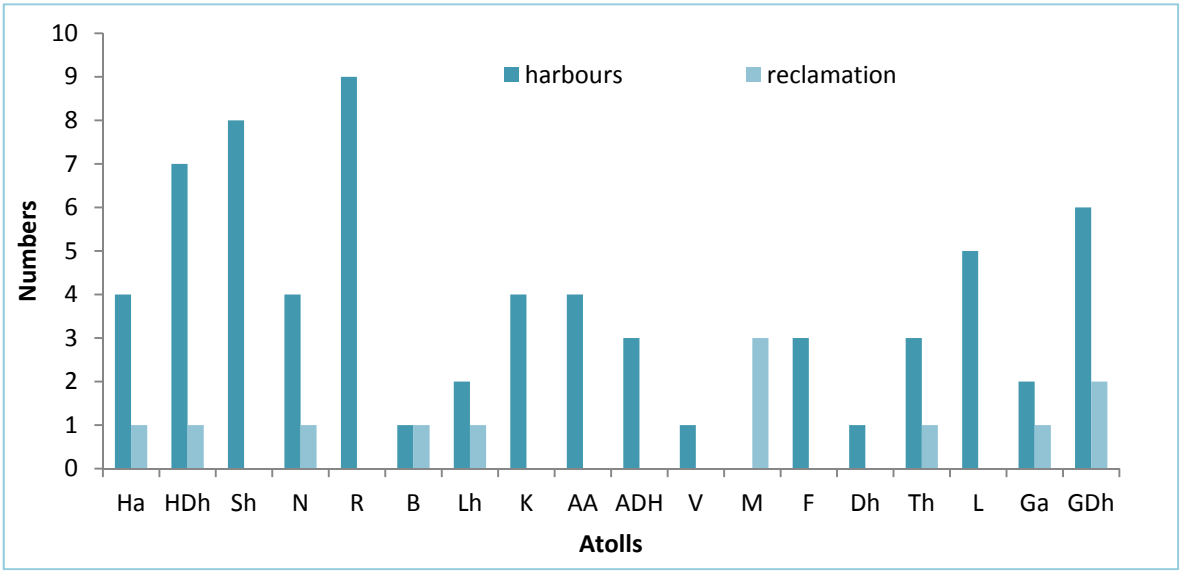


Fig 3.3:-Harbor and reclamation projects completed from 2006-2010

Source: Ministry of Housing and Environment, 2011

3.3.2 Critical infrastructure

Scarcity of land forces critical infrastructure such as airports, ports, harbors, resort, and associate infrastructure such as power generation, water production and sewerage system, environmental services and utilities to be located close to the coastline. Due to the natural geography of the island all infrastructure are at a low elevation at 1.5 m above MSL and some are over water structures. The average height of the causeways and bridges is 1.6 meters above MSL. Generally adaptation and mitigation has not been incorporated into deciding the location, design and construction of infrastructure. Vulnerability increases in terms of frequent inundation which can virtually obliterate the critical infrastructure damaging the economy, threatening the safety and security of the people.

The effects of climate change and its impacts on critical infrastructure are already felt as revealed from the past experiences (table 3.4).

year	Details
1987	Damage worth US$ 4.5 million to Male International Airport
2004	Damage worth US$ 230 million to Male International Airport
2004	Damage worth US $ 20.3 million to transport and communication infrastructure

Table 3.4: Available recent recorded evidence of damage to critical infrastructure

Source: Ministry of Housing and Environment 2011, Disaster Management Centre 2011

3.3.3 Tourism

Tourism is the main economic sector with forward and backward linkages to construction, transport, communication, agriculture, transport and other local economic sectors. The vulnerability to the sector lies in the small size, low elevation and geographical dispersion of the islands while the attraction of the resorts lies in the marine biological diversity, tropical climate and small island environment. The resorts are located in uninhabited island based on the concept of one resort one island. The increasing frequency and severity of extreme weather, sea-level rise and accelerated beach erosion, degradation of coral reefs (including bleaching), leading to inundation and flooding are likely to reduce the attractiveness of tourism sector.

More than 90% of all resorts infrastructure and 99% of all tourist accommodation are within 100 m of coastline. The average width of a tourist resort is 190 m while 6.3% of resort islands have width less than 200m and 88% have less than 300 m (Shaig 2006). These figures illustrate direct risks to the tourism sector. Indirect impact detrimental to the tourism sector includes damage to other critical infrastructure such as airports, ports, harbors and other utilities infrastructure. Likewise negative effect to the fisheries sector, agriculture sector, water resources and human health will also affect the tourism sector. Over 99 percent of the tourists arrive by air and most of the products are imported through air cargo or ships through ports and harbors. Certain reef fish species such as lobsters and other reef fishes are exclusively fished to meet the demands of the tourism sector. The impact to the tourism sector will occur to individuals, communities, enterprises and sectors dependent on the tourism sector. Adverse affects will impact on the tourist experience, health, safety and the tourist destination.

Statistics and other information recorded reveal that the effects of climate change and its impacts on the tourism sector are already felt (Table 3.5).

Type of impact	Details
Beach erosion	45 per cent of the resorts reports beach erosion
Salt water intrusion	Often reported
Coral bleaching	Occurred in 1977,1983,1987,1991,1995,1997,1998 Live coral cover reduced to 5% after the event
Damage to coral reef of popular shark diving spot	1995-1996 loss of revenue of US 500,000
Damages from Tsunami of 2004	Excess of US $ 300 million

Table 3.5: Available recent recorded evidence of damage to the tourism sector

Source: Ministry of Housing and Environment 2011, Disaster Management Centre 2011

3.3.4 Fisheries

The fisheries sector is highly vulnerable as tuna is attuned to biophysical conditions of the pelagic environment particularly El Nino Southern Oscillation (ENSO) and associated changes in SST. Also as tuna fishery is part of the wider Indian Ocean tuna fisheries climate induced changes will affect the tuna fishing industry of Maldives. Moreover the tuna fishing industry depends on live bait which depends on a healthy coral reef for survival. These habitats are highly vulnerable to changes in SST and other climate changes. Reef fishery is also an important industry supplying fresh reef fishes to the tourist resorts and exporting some species to overseas market. Already the fisheries sector has reported decline in fish catch with climate change and its associated impacts as one of its reasons. Specific impacts recorded are outlined in table 3.6.

Type of impact	Details
1998	Coral bleaching caused decline of live bait
1998	Coral bleaching caused the disappearance of two reef fish species

Table 3.6: Available recent recorded evidence of damage to the fisheries sector

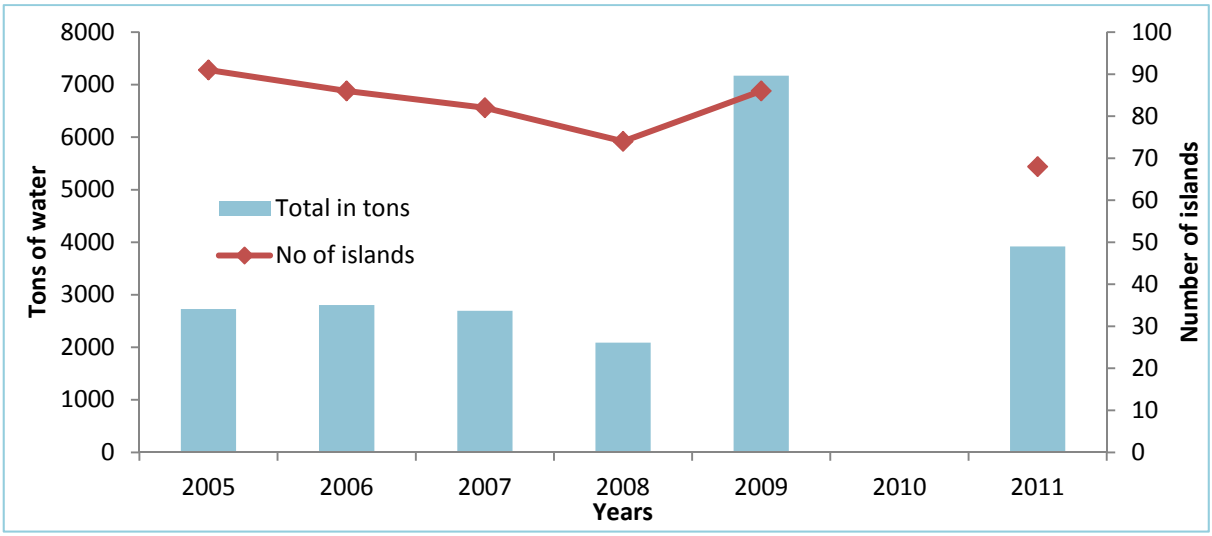
Source: Ministry of Housing and Environment, 2011

3.3.5 Water

Water shortages from the islands are reported during recent years. Between 2004-2010, each year on average, 81 islands have reported water shortages and over 3000 tons of water are provided each year costing over Rf 2 million(Fig 3.2). Water supply is likely to be exacerbated by future climate change. Surface freshwater is lacking throughout the country and the traditional practice of relying on shallow wells for drinking water does not exist today. Freshwater supplies are also threatened by saltwater intrusion due to storm surge and sea level rise. This affect the quality of life as people of the atolls depend on ground water for bathing, and washing. Salt water intrusion also affects the soil and vegetation causing impacts to agricultural and terrestrial vegetation. The fresh water aquifer is already stressed due to increased in demand for water and faces the risk of total depletion if dry period extends.

Rain water is the main source of drinking water in the islands. A marginal decline in precipitation is projected for the Indian Ocean region which has the potential to impact on rainwater harvesting across all islands. Today 90% of the drinking water is rainwater while in

Male 100 percent of the population have access to piped desalination water while in 38 islands following the tsunami desalination water is supplied by the Government.



Note: Data for 2010 not available

Fig 3.4:-Number of islands with water shortages with the quantity of water provided 2005- 2011

Source: Disaster Management Centre, 2011

3.3.6 Agriculture

Agriculture sector is already constrained in terms of limited cultivable land, poor quality of soil. With these limitation and high import dependency contribution to GDP is low and declining. With such a scenario at the forefront food security in Maldives is vulnerable to climate change impacts on agriculture sector of other countries as well. The critical impact path ways include heat stress on plant, changes in soil moisture, and temperature loss of fertility of soil through erosion of fertile top soil, less water availability for crop production, changes in height of water table, salinization of fresh water aquifer and loss of land through sea level rise.

Recent recorded incidences which indicate the vulnerability to sector are outlined in table 3.7.

Type of impact	Details
2003	7% of the population experiences food crisis and for half of this population it lasted for 10 days
2004	Damage to field crops, trees, agriculture tools, infrastructure land and water resources, timber and forestry. Damage estimated at Rf 84 million
2007	Sea induced flooding caused salt water intrusion to 33 islands causing significant damage to agriculture sector

Table 3.7: Available recent recorded evidence of damage to the agriculture sector

Source: Ministry of Housing and Environment 2011, Ministry of Fisheries, Agriculture and Marine Resources, 2011

High incidences of water and vector borne diseases have been attributed to climate change. Vector borne diseases reported in Maldives include out breaks of dengue fever, scrub typhus, and Chikungunya. Morbidity due to diarrhea and acute respiratory diseases caused by inadequate access to safe water and sanitation are also reported. Evidence also shows that people in the atolls are more vulnerable to diarrheal diseases in the atolls than Male' and the disparity is more pronounced in children under five years. The number of cases of acute gastroenteritis cases can also be attributed to climate change related water borne diseases. Climate related communicable diseases such increase in the conditions of the skin, subcutaneous tissue and eye has close linkages with climate change caused by increase in exposure to Ultraviolet (UV) radiation.

The health sector is confronted with a lot of constraints even without the vulnerability to climate change risks. This includes high level of malnutrition in children, accessibility and quality of health care high population and low levels of income. Extreme weather and effects of climate change will exacerbate the already overburdened sector. In such a situation medical evacuation is almost impossible. The climate change impacts on fisheries and agriculture will affect the food security affecting the nutritional status of the population. Increase in flooding and storm surges causing sea induced flooding, are likely to exacerbate the short and long-term effects on human health.

The recorded incidences of the dengue outbreak associated with ENSO events indicates the vulnerability of the health sector to climate change impacts.

Type of impact	Details
1979	Dengue outbreak occurred
1983	Dengue out break
1988	Dengue outbreak with 2054 cases and 9 deaths of children under 10
1998	Dengue outbreak with 1750 cases
2005	Dengue outbreak, increase in gastro enteritis by 50% from 10000 to 15000

Table 3.8: Available recent recorded incidences of vulnerability to health sector

Source: Ministry of Housing and Environment, 2011, Disaster Management Centre, 2011

3.3.8 Coral Reef Biodiversity

Two major economic activities tourism and fishing are reef based. Corals are highly sensitive to changes in temperature, with bleaching incidences forecasted to increase with the rise in temperature. Table 3.6 outlines the available recorded coral bleaching events.

3.4 Adaptation and mitigation to Climate change

3.4.1 Needs and priorities

In response, to climate change and its impacts, strategic priorities of the country are to mitigate the causes and adapt to the consequences of climate change (Fig3.3).

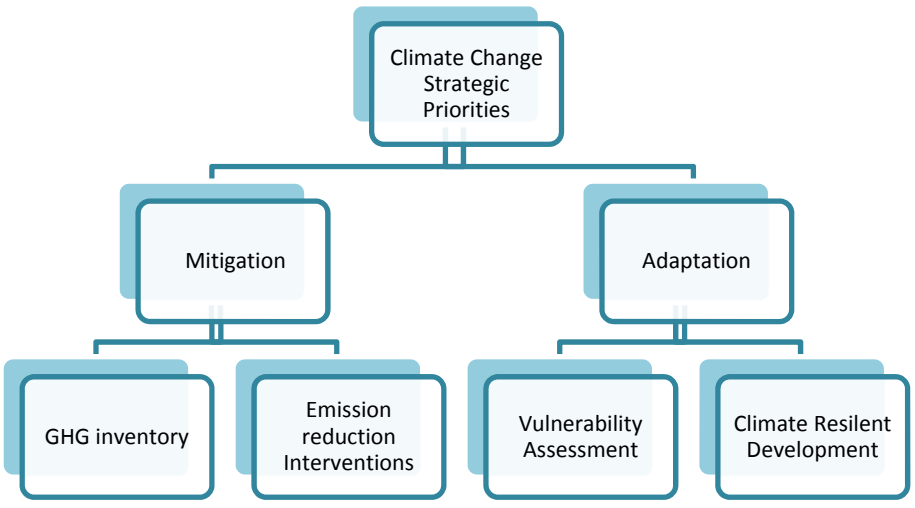


Fig 3.5: Strategic Priorities for Climate Change and its Impacts

3.4.2 Adaptation to Climate Change

Priority is given to integrating climate risk considerations into island land use planning, coastal protection and coastal development given the high degree of physical exposure of island populations and economic assets to climate-change induced wind and wave damage and short- and long-term flooding. Bench mark for adaptation and resilience building to climate change are provided through a number of vulnerability and risk assessments. Disaster risk profiles and detailed island risk assessment to high risk hazards, such as tsunamis, swell waves, and rainfall flooding was prepared for different islands. Report on Gaafu Dhal Atoll Thinadhoo, Gaafu Alif Atoll Viligili, and Thaa Atoll Vilufushi prepared in 2009 emphasized that SLR is the greatest threat to the Maldives, with the recommendations stressing the need to explore "softer" options such as improved settlement planning and early-warning systems that would allow adjusting approach based on events, while reducing the impact of natural hazards. The studies revealed the cost of adaptation is high and recommended a "wait and see" approach for the physical protection measures, particularly in light of the great expense required to protect against sea level. In the shorter term, a 'no regrets' approach is required to establish best practices in high impact coastal and terrestrial developments, better land use planning and building socially resilient settlements, while time is used to its maximum advantage to allow for greater analysis and understanding of the likely impacts of SLR, as well as technological advances and development of innovative approaches to protect the islands.

3.4.3 Adaptation related initiatives

Building on the assessments main initiatives that are being implemented includes

1. Use of locally appropriate adaptation measures
2. Sustainable Land Management (SLM)
3. Sustainable Water Management (SWM)
4. Strengthening the information base

a) Use of locally appropriate adaptation measures

Demonstrating locally appropriated adaptation measures for flooding and erosion control is to be demonstrated initially in 4 islands in 4 different atolls, which have a total population of 14,200 and 42,000, respectively. By the end of the program, at least 50% of households in the 4 islands and 10% of the population in each of the 4 atolls will be better protected from climate change impacts as a result of the adaptation measures. This is planned to be replicated throughout the country.

Under this program baseline information on adaptation activities and adaptation options that are currently being used and which maybe suitable for replication is identified by surveying 40 islands including 25 residential islands 12 resort islands and 2 infrastructure islands. Useful baseline information pertaining to relative effectiveness and cost of adaptation measures and the factors that might affect performance and the potential implementation of soft adaptation measures and major barriers and constraints and opportunities at the island level were revealed from the study providing the way forward. Table 3.9 provides a summary of the findings.

Categories	Hard Measures	Soft Measures
Usage	Widely used in inhabited islands	Explicitly Used in Resort
Types	Sea wall, breakwaters, Groynes	Beach replenishment, artificial reef temporary sea walls and groins, coastal vegetation restoration
Impacts	Generally effect but have caused unwarranted effects on beach system	Highly successful
Key issues	Poor design, poor construction, unsuitable to site condition and over design	Lack of awareness, limitation in mitigating immediate severe erosion and perception of ineffectiveness
Opportunities	Short term solutions	Low cost. Familiarity with method, benefits over the long term
Requirement	Design faults need to avoided and corrected Training program and demonstration projects Existing guidelines reviewed and new guidelines formed	Awareness building. Soft measure need to introduced, Training program and demonstration projects Existing guidelines reviewed and new guideline formed

Table 3.9: Comparison of adaptation techniques used in Maldives

Source: Compiled from Survey of Climate Change Adaptation Measures in Maldives, Ministry of Housing and Environment, 2011

The survey has revealed that hard techniques such as building sea walls, breakwaters and groynes widely used in inhabited islands are poor in design and unsuitable for site conditions. Though it does provide short term solutions design faults need to be corrected and training program and demonstration projects and new guild lines need to be formulated to maximize the benefits.Perception regarding the effectiveness of the soft methods such as beach replenishment, groynes and sea walls with low costs need to be changed through increased awareness as a long term solution. Noteworthy is that in terms of the effectiveness against controlling the causes of erosion artificial reefs is the only effective option used in the study islands. Other measures are mainly used to address the consequences of erosion (MHE 2011). The finding of the study will contribute to appropriate cost-effective coastal management under the broad umbrella of adaptation to climate change

b) Sustainable Land Management

The Government's goal also include mainstreaming climate risk planning and climate change adaptation into the country's development policy and planning frameworks across all sectors. Specific areas targeted at present include land use planning for coastal protection and coastal development. The key policy is to overcome the intersectoral coordination gaps, by strengthening and providing an enabling environment for future decentralized planning, by integrating climate risk reduction measures into key national policies on environment, land use, decentralization, privatization and disaster risk reduction. This work is to be done in tandem with detailed technical guidelines on climate resilient coastal protection, coastal development and land-use planning relevant to the Maldivian context to assist planners, decision-makers and technical specialists to evaluate climate risks when making development and investment decisions.

The SLM program includes technical capacity building in the form of training to staff at national, atoll and island level and farms and local community in practical aspects of land management and agricultural best practices and workshops and consultation with communities to increase the understanding and awareness of land degradation and implication and the value of SLM.

To strengthen the policies and regulatory framework status reports on land use and land degradation with a development of national land use plan with a computerized geographic information GIS including a cadastral land use database and registry and a program to monitor and evaluate land usage is planned. The development of a legal and regulatory frame work for land use management is a priority as such the draft recommendation to revise the land law and

the regulatory framework has been formulated. Targets to be achieved include integration of SLM into macro-economic policies and appropriate sector policies and action plans.

c) Sustainable Water Management

Plans are underway to develop an integrated water resource management program developing a national water and sanitation policy, Water Act and regulation and monitoring framework. The final outcome is formulating of a strategy and mechanism for implementing. Part of the intervention includes initiative to increase the resilience through integrated freshwater resources.At the onset Mahibadhoo (Alifu Dhaalu Atoll), Ihavandhoo (Haa Alifu Atoll) and Gadhdhoo (Gaaf Dhaal Atoll) representing different geographical locations across the country, which are densely populated and have a flat topography varying between 0-0.5m MSL have been selected.

d) Strengthening the information base

Finding opportunities for strengthening the scientific information base with regard to climate change is an ongoing process. Strategies have been formulated to address knowledge gaps on climate change effect on the Maldives. A climate risk information system linked to National GIS is to be established with plans to allow universal access to different datasets needed to adaptation planning. Also information and the lessons learnt from the demonstration of prioritized adaptation options for flooding and erosion control is also planned to be analyzed and disseminated. A direction is also on the way to enhance knowledge which quantifies climate change impacts, and adopts a clear and logical structure, with climate and impacts modeling, vulnerabilities, risks and economic costs, as well as potential responses. The plan is to provide updated tools for decision-making under uncertainty, especially for vulnerable regions.

3.4.4 Adaptative Capacity

The capacity of the country to adapt to climate change and SLR depends on the ability in terms of decision making taking into consideration the institutional, technical and human resources capacity and the available financial resources. Specifically NAPA and Technical Need Assessment (TNA) highlights that lack of technical capacity, financial and human resources and lack of common understanding and mechanism to coordinate climate change issues as major constraints. Such issues continue to persist over the years.

From historical perspective Maldives has not been prone to major natural disasters and as a result the need to develop expertise in disaster reduction became a priority at later stage. One

of the major constraints confronted is the limited knowledge and technical know-how about climate risk management and climate adaptation generally across all sectors. Oceanographic meteorological information is still inadequate with 3 stations to measure SLR and 5 meteorological stations to measure only the basic parameters required for weather forecasting. Consequently the information generation is minimal with recorded and published information ranging from rainfall, sun shine, temperature (minimum and maximum temperature), humidity and wind direction. With rainfall pattern varying over different locations the need to establish more stations to study rainfall patterns and their spatial pattern continues.

There is a shortage of skilled and professional staff within the environment sector. The Climate Change Department of the MHE and the National Disaster Management Centre (NDMC) is weak in terms of limited staff and the limited information within these organizations. Over the years efforts towards limiting such constraints have been ongoing. Mapping of the Maldives was initiated in 2010 using a survey aircraft to do the aerial photography. In addition, local bathymetry and reef parameters are being collected with help of divers. Work is ongoing to strengthen the scientific information base involving training and installation of GIS.

Though knowledge at the institution and technical level with regard to climate change risk and options to manage may have increased over the years, at the local level understanding is poor and weak. This has contributed to local development choices and individual actions that have unwittingly increased the vulnerability of the population and economic assets to current and future climate risks. Over the years the natural island resilience and the local adaptive capacity are being reduced unintentionally due to unsustainable practices in the areas of land use, coastal protection and development increasing the physical vulnerability to climate changes. Due to lack of capacity these practices have not been systematically addressed in the development planning process multiplying the vulnerability. Unsuitable design of the houses, land reclamation, clearing of coastal vegetation and inland wetland, unsuitable drainage system are all altering island topography and the pattern of coastal erosion and accretion. Moreover, methods of controlling erosion and flooding rely on coastal engineering and hard physical structure such as sea walls and groins are expensive and difficult to maintain are perceived to be better than the soft methods. (MHE, 2011) .As such ,the lack of capacity to adapt continues in terms of financial and technical competence.

The challenges of administering, financing and distributing public services, critical infrastructure and other development benefits equitably across nearly 200 geographically dispersed, inhabited islands continues. Decentralization introduced in 2010 through the new

constitution of the Maldives requires the government to devolve many of its planning and decision-making functions to the atolls and islands. With decentralization, atoll and island councils formed, atoll and island development plans need to be formed in accordance with the sector polices. Yet technical, professional and administrative capacity constraints, constitute a serious barrier to effective implementation.

The underlying weakness in the policy framework and weak intersectoral coordination continues along with limited institution and individual capacity with gaps in technical knowledge and knowhow and major financial constraints. With such constraints at the forefront adapting to climate change and increasing resilience of the vulnerable systems against climate hazards and risk is extremely challenging.

3.5 Mitigation related initiatives

Climate change mitigation or action to decrease or reduce the potential effects of global warming involves reducing the GHG or their sources. The Audit Report of Becitizen estimated that Maldivians emitted 1.3 million tons of carbon dioxide in 2009 via electricity generation, transport, waste and fishing. The total works out at 4.1 tons per Maldivian compared to 23.5 tons per person per year in the United States. In March 2009 Maldives unveiled plans to make the country carbon neutral .At the institutional level efforts are made to implement the endeavor of becoming carbon neutral 2020 (Fig. 3.6)

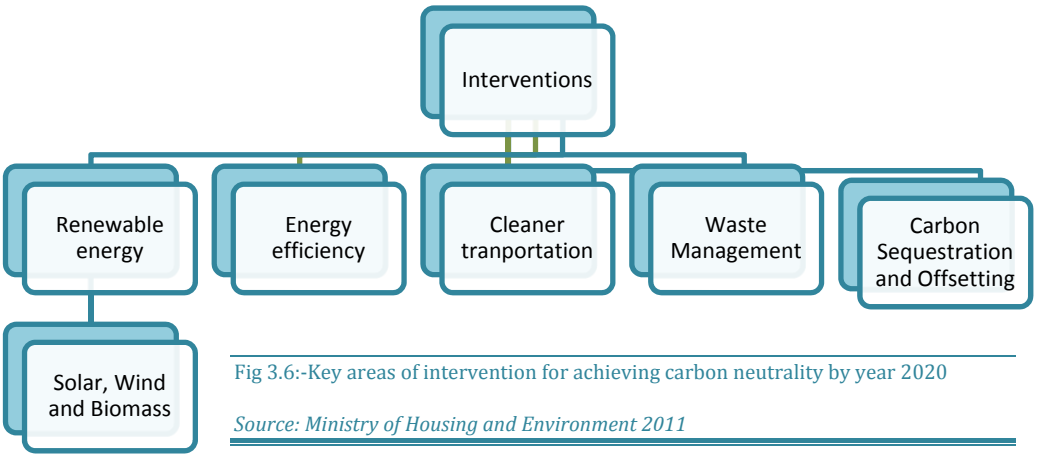


Fig 3.6:-Key areas of intervention for achieving carbon neutrality by year 2020

Source: Ministry of Housing and Environment 2011

3.5.1 Use of Renewable Energy

Under renewable energy use of wind solar and biomass energy is to be encouraged. The details of the use of renewable energy are given chapter 9.

3.6 Policies and Strategies

The Strategic Action Plan (SAP) 2009-2013, National Environmental Action Plan (NEAP) 3 and National Sustainable Development Strategy (NSDS) 2009 of the government provides the contextual background for environment management, which highlights climate change as an extraordinary environmental challenge focusing on adaptation and disaster risk mitigation as a priority areas. The policies and strategies of adaptation and disaster risk mitigation are being mainstreamed into policy making and programming in all areas.

The principal planning document of the government SAP 2009-2013 has outline the government pledges in terms of policies and strategies within the plan period. NEAP 3 outlines the principles of environment management with an emphasis on coordination and cooperation from all sectors towards the goal of integrating environmental aspects into the goals of and actions of all sectors. The NAPA lays the ground work to mitigate and adapts to its impact in an effort to make Maldives resilient and adaptable to the impact of climate change. Implementation of the priority program depends on the capacity to implement and on the support from international community to a great extent.

At the centre of efforts to address climate change on the international stage is the United Nations Framework Convention for Climate Change (UNFCCC). Maldives ratified the UNFCCC in November 1992. Maldives gives high importance to climate change and was one the first country to sign the Kyoto Protocol which is the international agreement linked to the Convention. The protocol was ratified by the Maldives in December 1998. Under UNFCCC the first National Communication was submitted in 2001. To understand the vulnerability of the Maldives to this challenge, a vulnerability assessment was undertaken in 2001 and was presented in the First National Communication of the Maldives to the UNFCCC. Based on the finding of the First National Communication of the Maldives, NAPA, TNA, National Capacity and Self Assessment have been formulated. The target is to submit the second National Communication at Conference of the Parties (COP) 18 and is listed as a program area in the national agenda which is currently in its initial stage. As a follow up of the second National Communication NAPA will be reviewed and is also listed as upcoming program areas at the national level.

A Climate Change Advisory Committee (CCAC) representing all stakeholders including government, business and civil society was formed in recognition that climate change is everyone's concern and responsibility. CCAC functions through mutual respect and consensus building among all stakeholders to develop integrated policy and programs.

At present the government is measuring the progress of the policies and strategies outlined in the SAP 2009-2012. The current program areas in relation to adaptation and mitigation initiatives are outlined in table 3.11 and 3.12.

Strategy/Objective	Actions/Program/Activities	Current Status
Increase community resilient to climate change	1.Locally appropriate coastal protection and flood measures developed for implementation in inhabited islands	Final Report outlining the locally appropriate coastal protection measures formulated
	2.National adaptation strategies and programs reviewed and NAPA implemented	Project launched
	3.Current Resilient Islands Programme (RIP) reviewed and revised	Project launched
	Civil society engagement in combating climate risks increased	Some workshop conducted
	Islands in which coastal protection measures are implemented to protect human settlements, increased	
	Locations where appropriate waste water treatment processes are implemented to avoid climate change related risks to fresh water availability	Project to be submitted to National Planning Council

Adaptation and Mitigation response to beach erosion strengthened and a system developed to assist communities where livelihood and property are affected by beach erosion	**1Develop guidelines for settlement planning and coastal modification to prevent erosion** **2.Identify viable alternatives (more cost efficient softer measures for prevention of coastal erosion and guidelines for settlement planning and coastal modification to prevent erosion)** **3.Settlements protected against coastal erosion, increased** **4. National coverage under early warning system, increased**	**Survey of existing soft coastal adaptation measures conducted and report formulated**

Table 3.11: Policies programs and status adaptation 2009-2012

Source: Ministry of Housing and Environment. 2011

In terms of mitigation initiative and particularly in relations to Carbon Neutral Policy the action area and the current status is illustrated in table 3.12

Objective/Strategy	Actions/Programs/Activities	Current Status
Establish legal Framework and Action Plan targeting carbon neutrality by 2020 establish	1.National Energy demand and supply studies 2009 2.Carbon Audit 3.Enact Energy Bill 4.Implementation of the Investment Plan	Completed Completed Bill drafted
Develop incentive scheme to encourage businesses offering renewable sources of energy	1.Publish a Dhivehi Version of Energy Policy 2.Implementation of the Energy Policy 3.Prepare a scheme to provide incentives	Translation drafted
Businesses engaged in	1.Prepare an action plan to engage the public	

establishing and servicing alternate renewable energy system increased	and private partners in renewable energy sector	
Adopt and increase appropriate waste management practices,		
Advocate climate change issues and importance and advantages of becoming carbon neutral	1.Provincial level Awareness Programme Provincial level Awareness Programme Environmental Camp	3 workshop completed
Obligations Under UNFCC	1.Second National Communication	Developing preparatory project document to seek funding

Table 3.12: Policies Programs and Status - mitigation 2009-2012

Source: Ministry of Housing and Environment. 2011, Department of National Planning 2011

4. Water and Sanitation

Key Findings

- A large part of the Maldivian population depends on desalinated water for drinking purposes
- Currently 51 islands have desalination plants with a capacity of 10 litres per day. However, 28 are operational
- Since 2005, government has been providing drinking water to islands. By May 2011, 68 islands had been provided drinking water
- Energy for desalination may represent the highest increase in electricity generation in the future.
- Adequate sanitation systems are installed in greater Male' area and a few islands only

4.1 Introduction

In Maldives, fresh water comes from two main sources; the shallow ground water aquifers and rainwater. The shallow ground water aquifers have been extracted for years. In many islands the aquifers are depleted because the extraction of water exceeds natural recharge through rainfall and also due to intrusion of salt and waste water into the aquifer. Waste water includes sewage water, waste water from industrial activities (including hazardous wastewater) and from poor agricultural practices.

In Male', desalinated water has been used for household consumption since 1985. Currently each household and commercial establishment in Male' have access to desalinated water. In the islands, the situation is different. In the islands, reliance on rain water is great and rain water harvesting is a traditional practice. Currently almost each house in the islands will have a High Density Polyethylene Tank (HDPE) donated by the government after the Tsunami of 2004 .Rainwater is the primary source of drinking water in 90% of the outer islands with groundwater used for washing, other domestic uses and agriculture (MHE, 2011).

4.2 Rain water

Maldives has two distinct seasons; the dry season and the wet season. The dry season, also known as the northeast monsoon extends from January to March and the wet season, also known as the southwest monsoon falls on mid-May to December. During wet season, Maldives

experiences torrential rain. Central, Southern and Northern parts of the Maldives receive annual average rainfall of 1924.7mm, 2277.8mm, and 1786.4mm, respectively. The highest rainfall ever recorded in the Maldives within 24 hour period was 219.8mm, recorded on 9th July 2002 at Kaadedhdhoo Meteorological Office.

The graph below shows the total rainfall for the years 2005 to 2010. During these five years the highest rainfall was recorded in 2006 and lowest in 2008. Among the meteorological stations, the highest rainfall recorded varies from year to year. However, rainfall for S. Gan shows the least variation and for L.Kadhoo shows the most variation.

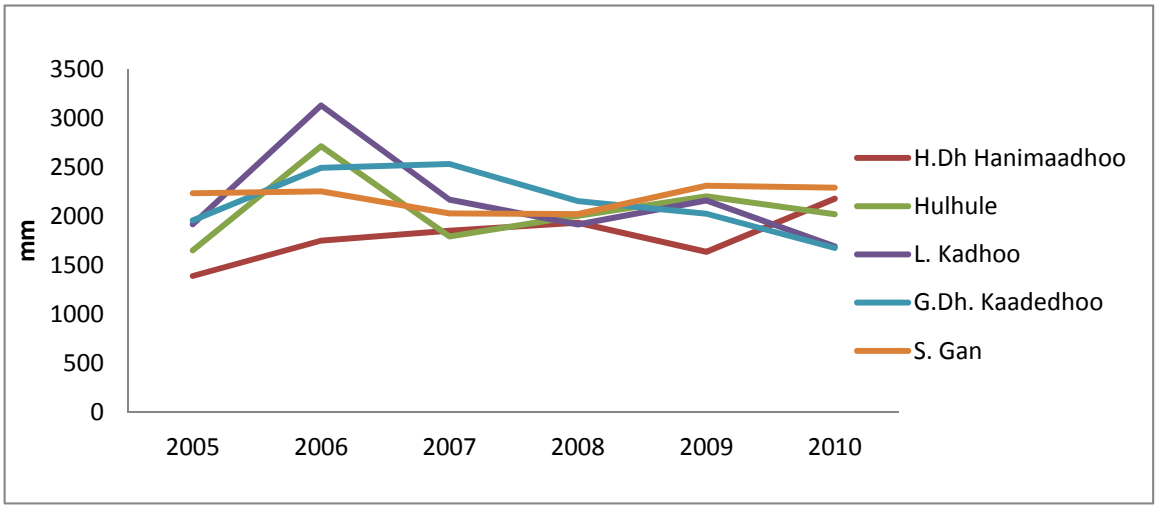


Fig 4.1:-Total Rainfall, 2005 – 2010

Source: Department of Meteorology, 2011

4.2.1 Rain water harvesting

While rainwater is the main source of drinking water in the islands, the fact that Maldives do not experience rain throughout the year necessitated the practice of rain water harvesting. In the islands roof of the house or other establishments are retrofitted to collect water through a simple pipe system, into household or communal storage tanks. A study conducted by UNEP in 2005 estimated that almost 75% of the population used water from these rainwater storage tanks. As seen in the aftermath of the Indian Ocean Tsunami of 2004, the rainwater storage facilities at the

time were very vulnerable to flooding and high wave incidences. Tsunami damage assessments by the Maldives Water and Sanitation Authority revealed that a high percentage of rainwater storage tanks and/or catchment areas were damaged on the worst impacted islands.

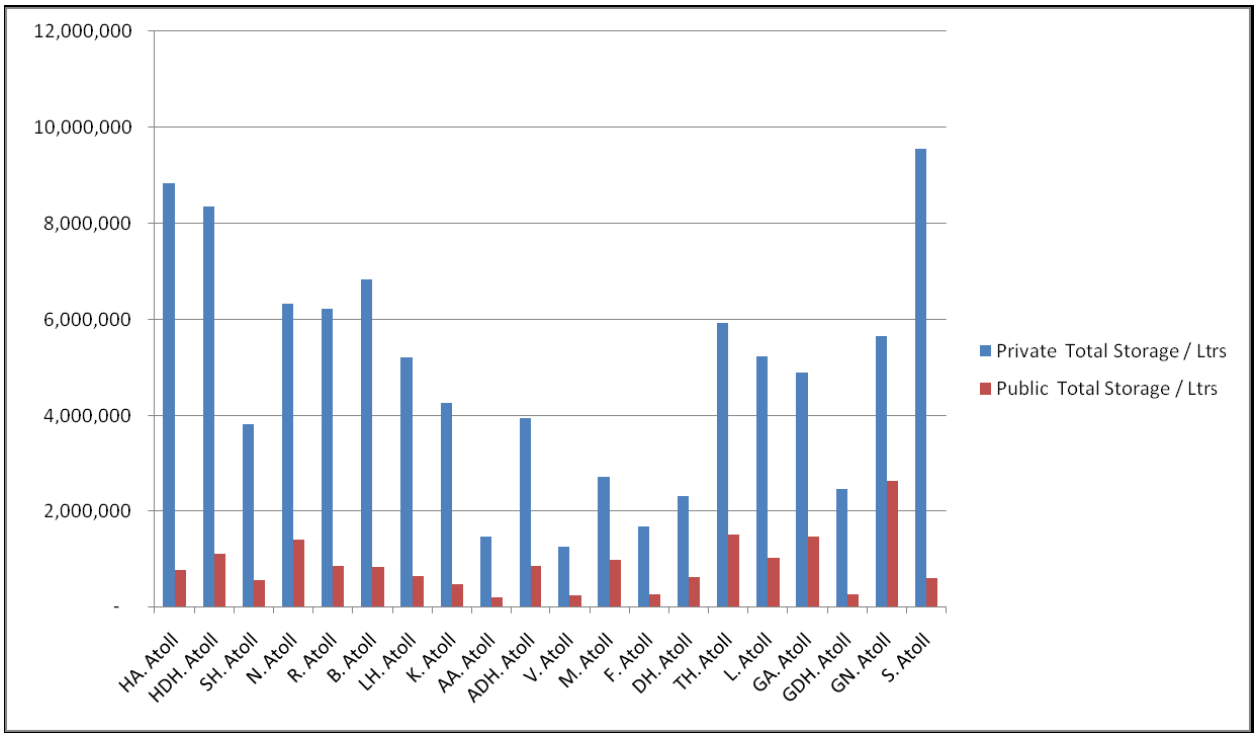


Fig 4.2:-Public and Private Rainwater Storage Capacity, 2011

Source: Reproduced from: An Assessment of Rainwater Catchment and Storage Capacity in the Maldives, MHE, 2011

Even with rain water harvesting, drinking water shortage is a common occurrence in the recent history. For example, water shortages were reported by 30% of the population in the 2004 Vulnerability and Poverty Assessment (MPND, 2004). As recently as 2011(by May) 68 islands had reported drinking water scarcity and government supplied drinking water up to 3919.5 tons. Table1 shows the government expenditure on drinking water since 2005.

Year	No of islands	Total (tons)	Total expenses (MRF)
2005	91	2728	2455200
2006	86	2805	2244000
2007	82	2694	2020500
2008	74	2088	1566000
2009	86	7469	7280472.3
2010	Not Available		
2011	68	3919.5	2192390

Note: Expenses include cost of purchasing water as well as land and sea transport

Table 4.1: Supply of drinking water to islands, 2005 – 2011 (May)

Source: National Disaster Management Centre, 2011

The chart below shows water supplied to islands and total rainfall by year and indicates that water provisions to islands do not relate to the total rainfall during a particular year.

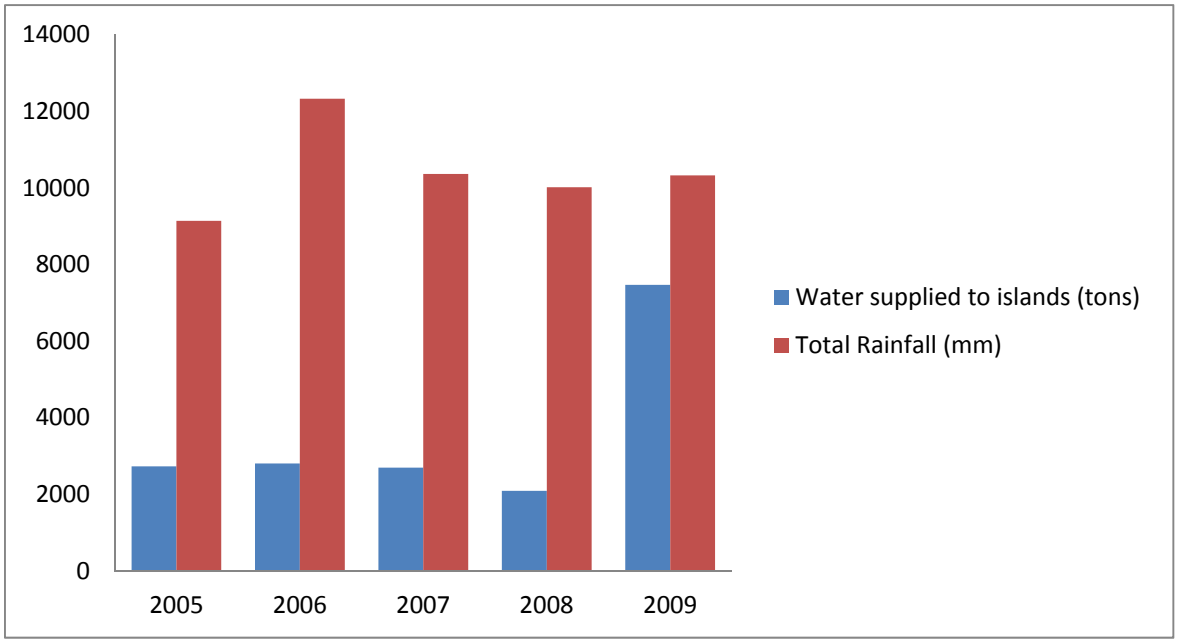


Fig 4.3:-Water supplied to islands and total rainfall by year, 2005 – 2009

Source: Department of Meteorology; MHE 2011

4.3 Ground water

In Male', after desalinated water was introduced, people do not drink groundwater, as groundwater is not fit for consumption. But a certain percentage use ground water for other domestic purposes such as washing. However, in some islands ground water is used for drinking as well as for all other domestic purposes. In the islands, groundwater is also used for irrigation in agriculture.

Fresh ground water is a scarce resource because the freshwater aquifer lies a mere 1 to 1.5m below the surface and is no more than a few meters thick. Where ground water is used for household or other consumption purposes, for instance in the islands, water is extracted from shallow wells.

Thickness of the groundwater aquifer in the islands is determined by net rainfall recharge, size of the island and permeability of the soil column (NAPA 2007). As a result, long dry periods will lead to depletion of the freshwater aquifers. Global warming and the predicted consequent sea level rise will further exacerbate the situation with the possibility of salt water intrusion. For

instance, Climate Risk Profile of Maldives (2006) stated that the mean sea level rise from 1990 -2005 was unexceptionally high and that 'such exceptionally high sea levels are associated with short-term flooding, accelerated coastal erosion and salt water intrusion into groundwater' (p 4). Saltwater intrusion will not only impact the supply of freshwater but also affecting the tropical vegetation due to its impact on the soil. This will have negative impacts on the fledgling agriculture industry.

Sometimes, as stated above, in the islands people extract fresh ground water for drinking. This has been found to increase the vulnerability of the population to water borne diseases because most islands have septic tanks not too far from the ground water well. Sometimes septic tanks and associated parts in the system are broken or damaged due to sludge buildup or other processes. For example, tsunami caused septic tanks in many islands to become damaged. This leads to the leakage of sewage and wastewater to the ground and ultimately the water lens.

4.4 Desalinated water

With increasing population in Male', the city's freshwater aquifer was over extracted to the extent that an alternate freshwater supply was provided in 1985. The government began the service free of charge with public water pipes. Presently, every domestic and commercial establishment have access to desalinated water through piped desalinated water supplied on a metered basis.

Census 2006 reported that a total of 35 % of the Maldivian population has access to desalinated water. This includes every household in greater Male' region (including Villingilli and Hulhumale') which have piped desalinated water supplied on a metered basis, through a city wide distribution pipe system. This service is provided by Male' Water Sewerage Company (MWSC). In Male' area, water consumption has steadily increased as can be seen by the table below.

	2004	2005	2006	2007	2008	2009
Male'	1,669.70	1,969.40	2,147.40	2,444.50	2,880.60	3,275.10
Villingilli			87.61	94.46	132.75	153.44
Hulhumale'			63.95	63.95	79.81	138.17

Table 4.2: Desalinated water distribution in Male' area, 2004 - 2009 (In '000 metric tons)

Source: Statistical Yearbook 2010, DNPirs

MWSC has completed the installation of water supply network in three other islands, namely K. Thilafushi, K. Maafushi, Hdh.Kulhudhufushi and Gdh.Thinadhoo (MHE 2011). Other islands that have access to desalinated water as early as 2004 include, Sh. Komandoo and R. Kandholhudhoo (SOE 2004). Currently 51 islands have desalination plants with a capacity of 10 litres per day. However, 28 are operational. While 68 islands had requested for water by May 2011, of those islands which had operational desalination plants, only the following islands requested for drinking water in 2011. Subsequently, water was transported to these islands by sea.

Atoll	Island	Population (2006)	Plant Capacity(daily)	Water supplied (tons)
R	Alifushi	2450	10 Ton	127.5
B	Hithaadhoo	1221	10 Ton	47.5
L	Isdhoo-Kalaidhoo	1559	10 Ton	75
GA	Villingili	3180	30 Ton	111
GA	Maamendhoo	1373	10 Ton	97.5
GA	Kolamaafushi	2568	10 Ton	60
GDh	Gadhdhoo	1439	10 Ton	35

Table 4.3: Islands with operational Desalination plants who requested for water in 2011 (May)

Source: National Disaster Management Centre and MHE

This may indicate that islands with operational desalination plants may not require water provisions. However, more information such as cost benefit analysis of water provision versus cost of operating a desalination plant needs to be collected to be able to form policy responses.

4.5 Water production and carbon neutrality

Demand for desalinated water supply in Male' has increased tremendously and at present more than 10,000m3 per day is produced for distribution. Carbon Audit Report 2009, report that under growing population and growing per capita water consumption, energy for desalination represents the highest increase in electricity generation in the future. The report further states that energy requirements for desalination will increase by 441 %, from 4,307 toe of diesel in 2009 to 22,259 toe in 2020. This rise comes from both a higher population and a higher consumption per capita, notably in Male Greater Area (Carbon Audit 2009).

The MWSC, the only company who provides desalinated water in Male' Greater Area, have developed energy recovery systems for new desalination plants which will provide 50 % energy savings. In addition, in the State Electric Company (STELCO), water for the power station is produced from the exhaust heat from the power station. The exhaust heat is fed into an ME desalination plant with a daily production capacity of 150 tons per day (STELCO 2011).

Year	Quantity (Ltr)
2005	3,156,309.58
2006	2,839,478.98
2007	3,383,826.95
2008	3,176,168.31
2009	2,407,541.69
2010	2,009,558.00

Table 4.4: Imports of Mineral Water

Source: Maldives Customs Services, 2011

Mineral water imports show a declining trend. This may be due to the fact that water production locally has increased (waiting for stats).

4.6 Waste water and Sanitation

Male' Greater Area (Villingilli and Hulhumale') has 100% sanitation coverage while the percentage is less than 1 for the rest of the country (MHE, 20111).

The prevailing systems of sewerage disposal in most islands are onsite sanitation systems using septic tanks and soak-pits (See Box A for further information).These systems are causing various environmental health problems and contamination of groundwater due to unsafe disposal of sewage and waste water. The post tsunami environment assessment conducted by UNEP in 2005 found that microbial contamination of groundwater supplies was a serious chronic problem that pre-existed the tsunami.

Government of Maldives with assistance from external agencies and the private sector is working to improve the sanitation facilities in the islands. Sewerage systems have been installed in 27 islands from 2005 -2011 (May 2011). During the period, 2009 – 2011 (May 2011) 13 sewerage systems have been completed in different islands[2]. The new systems consist of

[1] This information is obtained form the Evaluation Framework submitted to the Department of National Planning during the process of preparing the M&E framework for the Strategic Action Plan

[2] See foot note 1

sewerage network for the whole island, with pump stations, sewage treatment facilities and sea outfalls.

Sanitation systems in Maldives

On most islands, sanitation depends on pour-flush latrines and cistern flush toilets connected to septic tanks and, to a lesser extent, holes in backyards. The septic tanks are typically a combination of small scale pre-sedimentation tanks and soak pits from which sewage migrates freely through the highly porous island soil and contaminates groundwater supplies. These units are often poorly constructed and maintained due to the unavailability of material and skilled labour. Most have also been located too close(less than one metre) from groundwater wells, thus providing additional sources of water supply contamination. The remaining septic systems are connected to small-bore sea outfalls. These systems are generally not well designed and maintenance is often deferred. As a result, they often malfunction and convey raw sewage directly into the marine environment.

Although Male' has an adequate sanitation system, a sewage treatment system is non-existent. Sewage treatment in the islands is limited to the sedimentation tanks, which can hold 1 m3, provide an average family with suitable capacity for approximately 200 days, after which they require maintenance and sludge disposal. Most tanks are sealed with concrete and are located under topsoil, making regular maintenance nearly impossible. In addition, the surfaces of the tanks are too small to provide adequate retention time and settling. As a result, most of the untreated sludge discharges directly into soak pits and, from there, into groundwater resources. Further, when de-sludging is done, the sludge is disposed of in the open sea or buried somewhere in the island.

Reproduced from UNEP 2005

4.6.1 Resorts

Several legal instruments provide for environmental protection in tourist resort developments and operations. The most pertinent of which is the Regulation on the Protection and Conservation of the Environment in the Tourism Industry passed in 2006. The Regulation essentially prohibits use of ground water in resorts, for drinking or any other purposes. This Regulation also prohibits discharge of any chemicals to the ground.

More specifically, Section 6 of the Regulation on the Protection and Conservation of the Environment in the Tourism Industry, every resort is required to have a desalination plant registered with the Environmental Protection Agency (EPA). It further requires that daily logs of water quality are recorded and maintained. Under this regulation, resorts also need to have storage of water supply sufficient for 5 days.

According to the Regulation on Protection and Conservation of Environment in the Tourism Industry, sewage from resorts, hotels and guesthouses have to be disposed in a manner that is least harmful to the environment. Data on desalination plants and sanitation systems in the resorts are not accessible at this point, thus this section is limited in the information provided.

4.7 Major policy responses and initiatives

Sector policies and strategies are outlined in the SAP, which is the operational plan for the Government's Manifesto. As is the policy of the current government, the sector development is undertaken under a heavy privatization effort. Thus, government is encouraging private sector to participate and invest in the provision of water supply and sanitation services. At the same time, utilities companies have been set up in 6 provinces who will manage the delivery of these services in the islands. At present, 11 water supply projects and 38 sewerage projects have been tendered through Ministry of Finance under contractor finance scheme. These projects are not yet implemented. In addition a water purchase agreement has been signed between Southern Utilities Limited with an international company which will deliver installation of desalination plants with water supply network and sewerage system will in Addu City and Fuahmulah (MHE 2011). The table below gives detailed information on the status of policy and strategies.

Objectives/ Strategy	Programmes/ Activities	Current Status	Future Plans
Access to safe drinking water improved, including vulnerable groups	1.1. Water network developed	7 islands	All islands
	1.2. Rainwater storage capacity on islands improved	All islands have 2500 litres provided to each household	-
	1.3. Tsunami affected Islands on which desalination plants installed and functioning	85% of all islands have desalination plants installed	All Tsunami affected islands
Drinking water safety measures improved	2.1. A drinking water safety plan developed	Plan drafted	Implement
	2.2. Water quality testing facilities increased in outer atolls	none	10% in 2011
Emergency water supply response improved	3.1. Outer atolls where facilities developed with water stocks for use during emergencies / disasters increased	35% of inhabited islands	Utility companies now mandated
	3.2. Establishment of water stocks in the designated 7 regions of the country	-	-
Access to sanitation facilities improved	4.1. Islands with improved sewerage facilities increased	27 islands	All islands
Effective operation and maintenance procedures established for water supply and sanitation system	5.1. Local councils and utilities engagement in operation, maintenance and management of water supply and sewerage increased	Local councils in place	
	5.2. Water supply and sanitation projects operationalised with renewable energy sources, increased	-	-
Private Sector Investment in the water and sanitation sector increased	6.1. An incentive scheme established for promoting private sector investment	-	Contractor Finance scheme developed
Institutional Capacity covering technical, legal financial and human resource needs strengthened to enhance sector performance	1.1 Regulatory Capacities in legal, technical, financial and human resources strengthened	7 professionals working now	15
	1.2 Structures, systems and functions of responsible agencies and capacity of staff strengthened		Review and revises institutional systems/structures to mainstream GESI Build capacity of staff on GESI mainstreaming
	1.3 Development of research facilities specialized in water and sanitation field	20(Bach. Of Environmental Management, MEMP, initiated in 2010)	20 (Bach. Of Environmental Management, MEMP, expected to end in 2010)

	1.4 Alternative water supply schemes for Agricultural and Industrial activities made available	none	5
Community and Civil Society participation in the water and sanitation sector enhanced	1.5 Islands and atolls where private sector/civil society engaged with water and sewerage increased	none	20(Awareness programs on water and sanitation management (focused on aspects of skills and knowledge for women))
Water resource management improved	9.1 An inventory of natural water catchment areas	No data	Collect data
	9.2 Assess fresh groundwater quantity in all islands	Inadequate data	Carry out hydrological surveys
	9.3 Mechanism to monitor the water resource quality in the islands developed	No mechanism	Mechanism developed
Enforcement of Water and Sanitation Act of Maldives	10.1 Water Act or Water Legislation drafted	Water Act Drafted (MoU signed with MWS&D, Sri Lanka and GoM for technical assistance	The Act implemented
	10.2 Drinking water quality standards developed	Draft standards available	
	10.3 Water tariff system developed for islands	-	Tariff system developed

Table 4.5: Policy programs and Status, 2011

Source: Department of National Planning, 2011

5. Waste Management

Key Findings

- Waste volume has been increasing with increasing population and development activities
- There is some recycling done at waste collection facilities in Male' and Thilafushi, some of the recycled waste, mostly iron and and PET Plastics, are exported by private exporters
- There are Island Waste Management Centres in 134 islands but most are not operational
- Emissions from wastes are estimated to represent 15% of GHG emissions.

5.1 Introduction

It was estimated that 298Kton of waste was generated in Maldives in 2009. Data on solid waste are limited and possibly underreported, Statistics on solid waste indicate that in Maldives solid waste comprise of domestic waste, industrial waste, construction debris, plastic, glass, scrap iron, saw dust and wood. Liquid waste generated in the Maldives also includes hazardous wastes such as asbestos, oil/fuel, fertilizers, pesticides and healthcare waste.

Waste disposal, whether solid or otherwise, pose different problems for Male' region and the rest of the inhabited islands in the country. Solid waste generated in Male', Vilingili, Hulhumale', Ibrahim Nasir International Airport, most of the wastes generated in resorts of Male' atoll, few resorts in other atolls and some inhabited islands, assisted by resorts are transported to Thilafushi dumpsite. Other inhabited islands either dump or burn their waste somewhere in their own islands or periphery whether at a designated waste management centre, the beach or own backyard. On some inhabited islands solid waste is discarded on a designated (occasionally enclosed) area on the beach, while on others most of the trash is burned. However, some

inhabited islands continue to have problems of littering and dumping in non-demarcated areas. Although this practice is less now since many islands have waste management centers established, a process expedited after the Tsunami of 2004. Additionally after the decentralization process each Island or City Council is mandated to manage solid waste in their jurisdictions.

5.2 Situation Analysis

Waste disposal is an activity that compounds the vulnerability of the islands in Maldives. The only designated primary landfill in Maldives, Thilafushi- which was initially just an open dumpsite, lies in the middle of the ocean. Currently, the island (formed of waste) has other industrial activities going on such as cement packing etc and only part of the island is designated a dumpsite. In addition, 90% of the islands in Maldives have their waste disposal sites within 100m of coastline and on the ocean-ward side of the island (MHTE, 2009).

5.2.1 Male'

Major sources of waste in Male' are domestic waste, industrial waste, construction and demolition waste, organic and non-organic waste. Solid wastes generated in Male' also include hazardous wastes such as asbestos, oil/fuel, and healthcare waste.

The waste generated in Male' are first taken to the collection yards. There are two collection yards in Male' and one in Villingili: two yards in Male' are one for construction and demolition waste and one for municipal solid waste (SOE, 2004). There is no municipal collection of waste. Waste collection is carried out by private parties and is transported by bicycle, by hand cart and also by two private operators providing collection and transport to collection yards. In each case, collection from households is predominantly by expatriate laborers, who work after hours in this sector. In that sense, majority of the households and commercial establishments in Male' pay for waste disposal explicitly.

From the collection yards, waste is transported in dump trucks which take the waste to the municipal waste dump site at Thilafushi on a barge. Municipal waste is transported by large static composter units while commercial and demolition waste is transported by tipper trucks. In 2009, approximately 123,549 tonnes of waste was transported to Thilafushi from Male' region. This represents about 20 percent increase from 2004. Carbon Audit (2009) estimated that 79% of the waste generated in Maldives is transported to Thilafushi.

Table 5.1 shows some statistics that indicate that waste generated in Male' has not consistently increased, which is surprising given that anecdotal evidence suggests that resident population and construction activities has increased in Male'.

Type of waste	2003	2004	2005	2006	2007	2008	2009
Total	103,548	100,298	110,281	109,400	111,955	134,722	123,549
Industrial	42,944	33,055	38,901	43,648	40,179	52,791	47,881
Construction debris	38,880	28,390	34,160	40,070	32,702	50,600	45,210
Domestic	60,604	67,243	71,380	65,752	71,776	81,931	75,668
Non-organic	31,703	42,651	53,060	34,853	41,097	46,788	39,249
Organic	28,679	24,240	18,176	30,366	30,583	34,482	35,609
Plastic	7	222	119	533	75	640	412
Glass	215	130	25	-	21	21	398
Scrap Iron	1,062	789	438	726	1,193	70	22
Oil & Fuel	4	78	-	-	-	-	-
Saw Dust	2,354	3,078	246	662	2,522	-	479
Wood	645	720	4,057	2,190	3,762	2,121	2,170

Table 5.1: Waste transported to Thilafushi from Male', 2003 – 2009 (tonnes)

Source: Statistical Yearbook 2010, Department of National Planning 2010

Waste is not formally segregated at any originating site, whether households or commercial sites. However, at the collection yards, waste is segregated to some extent. Reusable waste is kept aside, which are then taken away by middle men representing exporters. Mostly segregation of waste is done at the collection yards in Thilafushi. Segregated categories include paper, plastic, boxes, tins, aluminum, electronic materials, High-density polyethylene (HDPE) plastic, vegetable baskets, wooden boxes, fibre, used oil, dry batteries, coconut husks, furniture and tiles.

Most of the waste is burnt openly and the residual ash and unburnt waste is dumped in to an area of the lagoon with bund walls and land filling is done. While the inevitable odour and smoke fill the atmosphere, the resulting litter, such as plastic bags, packaging and paper are filling the marine environment and leads to leaching of environmentally damaging substances.

The potential of risk to human health and the impending risk to the natural environment of the area, especially underwater, from the improperly disposed waste is immense.

5.2.2 In the atolls

Solid waste generated in the atolls varies from atoll to atoll from time to time. For instance, where there is a lot of construction activity going on, construction debris would be high. In islands like R. Alifushi, wood and saw dust would be high because lot of boat building activities would be going on throughout the year. Additionally, in islands practicing commercial agriculture such as Thoddu in Alif Atoll, a lot of agricultural waste is generated. Nevertheless, generally in all islands domestic waste would be highest. Household level waste segregation is done so far as backyard composting is demanded by individual households. Some communities that depend on firewood may segregate wood, coconuts and other combustible waste. In such cases, organic waste does not end up with municipal waste.

Waste disposal practices vary among islands depending on access to disposal facilities, local custom and government/council intervention. Households usually carry their waste to collection sites and usually women are responsible for the task, who push a wheelbarrow to the site. These sites can range from a designated waste collection site, seaside (beachside), land reclamation site, bushes, and back/front yard (living area). Table 5.2 suggests some burning in the household and use of a waste disposal machine. In addition, waste is often burnt regularly at the collection site in some islands.

Table 5.2 show that almost 61 percent of the atoll households dump garbage into the designated site (garbage compound). Almost equal number of households dump their solid waste into the bushes or burns it in the living area. In some atolls, a significant percentage dumps the waste into the seaside, which has implications for impact on the marine environment. Further, the said garbage disposal site would usually be located in close proximity to the seaside/ beach compounding the problem.

	Total households	Garbage compound	Sea side	Land Reclamation site	Throwing it into the bushes	Bury in the living area	Burn in the living area	Use a waste disposal machine	Not stated
Atolls	32087	60.8	10.2	0.6	12.5	0.6	12.5	0.4	2.4
HA	2425	63.3	10.0	0.0	20.2	0.6	4.6	-	1.2
HDh	2988	55.4	0.3	0.8	39.3	0.6	3.3	-	0.4
Sh	2099	32.8	10.2	2.7	51.7	0.4	1.8	0.0	0.4
N	1811	61.6	8.9	1.8	19.2	0.4	7.2	-	0.9
R	2538	92.8	1.0	-	0.1	-	5.7	0.0	0.4
B	1552	93.1	0.5	-	1.3	0.1	3.3	0.2	1.5
Lh	1449	73.6	21.0	0.2	-	0.1	3.6	0.3	1.2
K	1526	84.0	0.1	-	9.4	0.2	1.2	0.5	4.5
AA	774	77.6	0.3	0.1	0.1	0.9	18.7	0.1	2.1
ADh	1060	74.9	-	-	-	0.3	6.9	8.1	9.8
V	260	82.3	-	-	-	-	12.3	0.4	5.0
M	793	84.5	3.0	0.1	8.2	0.1	2.1	0.1	1.8
F	567	90.8	0.2	-	-	0.4	5.8	0.2	2.6
Dh	768	80.2	0.1	-	-	0.3	1.4	0.3	17.7
Th	1454	75.0	17.2	0.1	0.4	0.3	2.8	0.2	4.1
L	1970	19.5	52.5	0.7	18.9	0.5	4.0	-	4.0
GA	1472	34.4	45.0	0.3	2.6	1.8	13.4	0.1	2.3
GDh	2145	45.5	14.0	0.1	6.7	1.5	30.5	0.0	1.7
Gn	1332	40.0	0.3	1.6	2.8	1.4	51.0	0.1	2.9
S	3104	47.5	1.3	0.7	2.5	0.7	45.8	0.2	1.3

Table 5.2: Ways of Disposal of Waste in the islands, 2006

Source: Census 2006, Department of National Planning 2007

After the tsunami of 2004, the Australian Red Cross and Canadian Red Cross undertook a range of reconstruction and development activities and 79 Island Waste Management Centres (IWMC) were constructed throughout the Maldives, Some of the IWMCs are still functional. However some were never used or ceased being used in a short time once the centres were full of waste. The establishment of IWMCs had a direct impact on overall island cleanliness in most cases, and was instrumental in placing waste management on the agenda at an Island level. The current

situation as to the establishment of IWMCs are shown in table 5.3. There are now 134 IWMC s in the Maldives, coverage of approximately 66% of islands, although the percentage of population able to access a waste facility would be much higher given population distributions (UNOPS 2010).

5.2.3 Existing situation in the resorts

In general, waste practices on resort islands are decidedly better than those on inhabited islands. The resort islands, as a result, appear clean. Combustible waste is incinerated and kitchen waste is dumped offshore into the open sea in accordance with the regulations of MOT on deep-sea disposal of waste. Waste that cannot be reused or incinerated is transported by boat to the country's central dumpsite at Thilafushi.

A waste survey was conducted in 21 resorts in North and South Ari Atoll in 2009 and found that all the resorts in North and South Ari Atoll transport their waste to Thilafushi for final disposal. A tourism source of waste that is often overlooked is the waste from safari boats. Resort in Ari atoll reported that they clean up wastes from safari boats from their beaches.

5.3 Health care and hazardous waste management

It is unclear to what extent hazardous waste is identified as such in Maldives. The main sources of hazardous waste on the islands are power stations, oil/fuel supply storage areas, fertilizer and pesticide storage areas, farming activities, and hospital waste. Hazardous waste is handled and disposed no differently than other forms of solid waste except some healthcare waste. The resort islands transport hazardous components to the landfill site at Thilafushi, which stores oil, batteries, accumulators and other hazardous waste.

Health care waste generated in Maldives comes from healthcare facilities set up in Male', the islands and the resorts. In Male', there are two facilities operated by the government, Indhira Gandhi Memorial Hospital and a health centre. There is one private hospital and several private clinics. In addition, there are government operated (from 2008 operated by health corporations) 6 regional hospitals, 13 atoll hospitals, 60 health centres and 26 health posts. All registered hospitals are required to incinerate the waste they produce. However, this is not practiced in many hospitals and waste other than sharps and infectious materials are disposed of along with other waste. In all health care facilities in the islands, sharps and infectious wastes are burned and buried which is an environmentally unfriendly practice as well as being a health hazard.

5.4 Waste and the Maldivian economy

Waste is the by-product of economic activity. Waste can be generated at different times during the material life cycle: when raw natural resources are extracted or harvested; when goods are manufactured or services provided; and when goods are packaged, transported, and consumed.

Some waste reflects the economic activities going on in a society. The volume of the certain waste may also indicate the extent of these activities. So for example a high volume of construction debris in a given year means that construction sector was more productive in that year. In this regard, the graph below shows that construction activities have increased in the country with industrial waste shows a similar trend.

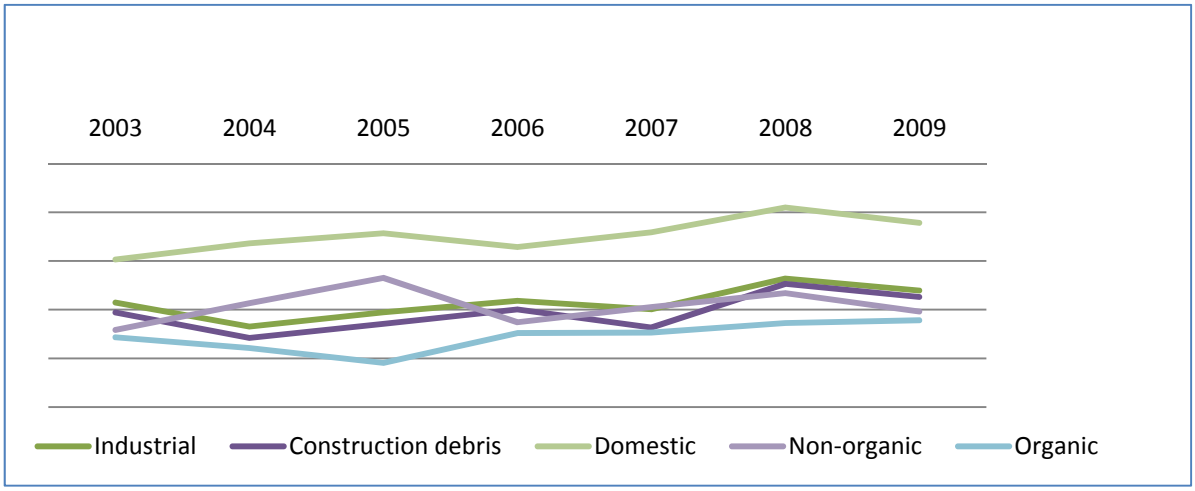


Fig 5.1:- Trends in high volume waste, in Male', 2003 – 2009

Source: Statistical yearbook, 2010, Department of National Planning

In Thilafushi island, where 60 % of the country's waste is stored, but also in other inhabited islands, some of the waste still goes directly to sea and threatens the quality of the local environment (water and marine resources). In adequate solid waste disposal have implications for affecting the health of the vulnerable reef system of Maldives. MHE (2011) states that solid waste disposal into the coastal vegetation is a major contributor to the degradation of the vegetation belt in some islands namely, Dh. Kudahuvadhoo,Ga. Kolamaafushi, Sh. Funadhoo and N. Velidhoo. This maybe the case in many islands.Similarly, poor solid waste disposal increases the risk of vector borne diseases, because vector breeding sites are created.

5.5 Waste and carbon neutrality

Waste is a source of greenhouse gas emission (through methane emissions resulting from decomposition of waste) . Carbon Audit Report (2009) report of two sources of emissions to assess the greenhouse gases emitted from waste in the Maldives: open-burning (as is the case in Thilafushi or in some islands) and solid waste disposal. No emissions for waste dumping into sea were taken into account. In 2009, 90 % of the GHG were emitted from Thilafushi and other landfills. Total GHG emissions from waste open-burning and disposal amounted to 217 ktCO2eq, out of which 75 % are CH4 emissions, 21 % CO2 emissions and 4 % N2O emissions. In total 15 percent of the 1.3MT of carbondioxide emitted were from waste in 2009. (Carbon Audit 2009). 15% is a considerable percentage of GHG emission, especially since that rapid growth of both the population and development activities (such as construction) are expected in future as well.

In search of options to reduce waste and its by products, a waste to energy (WtoE) study was conducted by Environment Research Center (ERC) in 2007. The study revealed that while quantities of waste generated in individual islands were inadequate to support potential WtoE solutions, WtoE options maybe financially viable, if waste from neighboring islands are integrated. So for example, according to this study, sufficient waste quantities are generated in Southern Atolls of Addu and Fuhamulah.

The same study also found that there were several potential applications/products that could be addressed through WtoE solutions such as electricity generation to displace use of fossil fuels; conversion to alternate fuels such as gas (Syngas) or charcoal (pellets), which can displace the use of firewood or other fuels used for cooking, diesel fuel used for industrial processes; use of the generated energy to produce potable water, ice, etc; use of ash (a by-product of the combustion process) to produce concrete blocks and slabs which can be used in construction, etc. However, based on stakeholder feedbacks, the most relevant and appropriate needs have been identified as electricity generation and desalination of water to make it potable. In general, the WtoE study reported, there is potential of generating 91% fuel from the waste available in Maldives. The financial analysis in the study showed that costs associated with WtoE solutions are justified for reasonably large quantities of waste (greater than 15 tonnes per day). For smaller quantities it may be more suitable to simply incinerate the waste.

Subsequently, the ERC conducted a detailed study in 2008 to assess the viability of waste incineration in Maldives. The report stated that given the lack of revenue streams expected from incineration, operating an incinerator can prove to be a huge financial burden over a period of

time. Unless, the heat produced by the incinerator are used for other useful purposes like electricity generation or sea water desalination to make it viable from economic point of view (1 kg of waste can generate upto 0.5 kwh of electricity + 0.5 litres of water or 1 litres of fresh water). WtoE solutions will help in reducing dependence on fossil fuels, help in providing adequate drinking water and will also reduce the GHG emissions.

Other examples of waste being used in a similar way was reported by MHE, in 2011, on their report, Survey of Climate Change Adaptation Measures in Maldives. The report states that waste had been used in ad hoc reclamation measures in islands such as Sh. Funadhoo and AA Bodufolhudhoo. The survey also revealed that 'the use of construction debris to permanently reclaim erosion hotspots is wide spread practice in the inhabited islands surveyed'. In this regard, of 26 inhabited islands that were eroding, 19 islands had some section of the island protected by construction waste and occasionally green waste. In fact, among these 19 islands, this method is used as a solution to construction waste disposal rather than as true adaptation measure (MHE, 2011)

There are some companies who export recycled waste.

Material	Quantity Exported 2009(tons)	Quantity Exported 2010(tons)
Ferrous Metals	6237.23	9,675.94
Cast Iron	388.5	0
Copper	134.62	273.11
Aluminium	87.4	131.86
Zinc	0	0
Plastics	0	35.00
Cardboard	0	0
Waste Oil	195	57.20

Table 5.3: Recycling exports by material, 2008 and 2009

Source: Maldives Customs Service 2011

The Economic and Technical Feasibility Study for a National Recycling Strategy (Medina, 2008) produced a table of materials that were potentially recoverable on a daily basis and stated that in general terms a Material Recovery Facility (MRF) would be a feasible option as a central

processing and export operation. Table 5.4 calculates the full resource streams in each category (100% recovery) to give a general overview of resource quantities.

Material	Quantity (T/day)	Quantity (T/A)
Organic	45.4	16,571
Paper	1.7	620.5
Cardboard	1.41	514.65
PET	3.3	1204.50
Mixed Plastics	2.27	828.55
Aluminium Cans	1.36	496.4
Steel Cans	2.13	777.45
Glass	1.24	452.6

Table 5.4: Estimated Waste Generation of Recoverable In Maldives

Source: The Technical Feasibility Study for a National Recycling Strategy(Medina,2008)

However, Medina (2008) also stated that Male's municipal waste does not appear to contain enough recyclable material to attract and support public-private partnerships (PPPs) for individual recyclable commodities based on an export market scenario.

5.6 Regulatory framework

The Environment Protection and Preservation Act (Law 4/93) is the primary legal instrument for environmental management in the Maldives and EPA is the custodian of the law. The following sections specifically address waste management:

Section 37 - Standards, Classification and identification of hazardous waste and materials
Section 38 - Classification of hazardous Waste
Section 39 - Solid Waste Management Standards

The MHE has responsibility for the preservation and protection of the environment. A Draft Solid Waste Management Regulations were also released August 2009 and is yet to be finalized. One of the most important provisions in the draft regulations is the emphasis on licensing of waste management activities such as collection, transport, storage and disposal.

Tourism waste is addressed through a separate regulation, the Regulation on the Protection and Conservation of Environment in the Tourism Industry, Law 2/99 (2008*).* This outlines stringent waste management requirements for resorts, including source separation. Each resort must have an incinerator, compactor and bottle crusher. Food waste is permitted for sea dumping provided waste does not wash onto any shoreline. Incinerators can not be used to burn plastics, and all waste must be disposed off in a manner that is least harmful to the environment.

The Decentralisation Law transferred the responsibility of the waste management of islands to island councils, who were elected in February 2011. Male' city council is responsible for the management of waste in Greater Male' Area.

5.7 Policies and strategies

Management of solid waste has remained one of the most pressing environmental issues in the Maldives. The National Solid Waste Management Policy for the Republic of the Maldives published in 2008 focused on establishing and activating waste management governance, creating waste producers' duties, establishment of waste management infrastructure, activating the waste management system; and influencing consumer choices and waste management practices. Subsequently, the *National Framework for Solid Waste Management in the Maldives* adopted by the Government in 2008, is the overarching framework for all waste initiatives and directions.

The Waste Management Corporation is a newly formed Government Enterprise with the mandate of waste management operation throughout the nation. In terms of waste management the action area and the current status is illustrated in table 5.5.

Objectives/ Strategy	Programmes/ Activities	Current Status
A solid waste management system to prevent adverse impact on human health and environment through economically viable and locally appropriate approaches, implemented	1.1. A Waste Management Act enacted 1.2. Development of first draft of waste management Regulatory framework,	Regulatory framework drafted
	1.3 Stakeholder consultation and reviewing the draft frame work	Completed
	1.4 Finalization of waste management act	To be finalized
Policy and Regulatory Framework for PPP in Waste Management, developed	2.1 Development of waste management Regulatory framework	PPP in cooperated in the reg. framework
Facilitation for island communities to manage their waste management	3.1 Trainings for island communities	Completed in some islands
	3.2 Trainings for island communities/ Handover of WM equipments	Completed in some islands
Island waste management centres managed by island communities increased	4.1 All islands having waste management facilities	114 completed
Provincial Solid Waste Management facilities established for recovery and recycling, facilitated	5.1 Selection of sites	North province selected under MEMP project
	5.2 Surveying and developing site	Surveying conducted Design of the site developed
	5.3 Establishment of site in North Province	Preparatory work going on
	5.4 Build a waste management facility in Thilafushi with an engineered land fill and Gassification plant as well as	Contract between Male' City Council and Tatva Global Renewable

	invessel composters.	Energy Maldives Limited signed
Provincial waste management centres functional	6.1 All centres functional	Thilafushi only functional
People and the environment protected from hazardous waste and chemicals	7.1 A National Chemicals Regulation Framework, guidelines and information system developed	
	7.2 Including chemicals management in the Env act	Draft prepared
	7.3 Developing a Chemical profile of Maldives	SAICM proposal prepared for funding the project
	7.4 NAP of conventions developed	
	7.5 Guide line of chemical handling prepared	
A communication system for timely updated notification of movement of hazardous waste, meeting international standards developed	8.1 Reporting of international conventions strengthened	Annual reporting
	8.2 Annual Reporting of international conventions strengthened	Annual reporting done
	8.3 Guideline for trans boundary movement of hazardous waste prepared	
	8.4 Updated notification to conventions	

Table 5.5: Policies, Programs and status -managing waste 2009-2012

Source: Ministry of Housing and Environment. 2011, Department of National Planning 2011

6. Pollution

Key findings:

- Indicators of local air pollution shows increasing trend in terms of vehicles in operation, construction of building, imports of fuel and recorded cases of respiratory diseases.
- Quality of the ground water aquifer varies from island to island and is highly vulnerable to contamination from inadequate sanitation facilities and other human activities, solid waste run-off, over exploitation and saline intrusion through soil erosion and flooding. Ground water pollution is common throughout the country.
- Waiving import duties from renewable energy powered vehicles is a noteworthy development which has the potential of contributing towards a cleaner environment.

6.1 Introduction

Pollution in terms of air quality is more pronounced in Male' while in the islands in can be generally termed good, as islands are small with sea breeze flushing the air masses over the island. In Male', the capital pollution is often stated as an emerging health hazard. The capacity to study the air pollution is limited with no regular monitoring activities until 24 December 2011. On 24 December 2011 EPA began publishing air quality monitoring data. The parameter of major concern currently is particulate matter(PM10)With limited data on the measures of the level of pollution indicators of pollution are used to determine the level of pollution. The deteriorating status is evident through review of certain indicators of pollution such trend in land transport, imports of fuel, and construction related activities. These activities generates particulates of soot and dust which are circulated into the atmosphere creating pollutants in the form of solid particles, liquid droplets, or gases which create a range of health issues.

In terms of water pollution, contamination occurs when groundwater accumulated in rainwater recharged aquifers which lie at a depth of 1-1.5 meters below the surface gets contaminated. Quality of the ground water aquifer varies from island to island and is highly vulnerable to contamination from inadequate sanitation facilities and other human activities, solid waste run-off over exploitation; and saline intrusion through soil erosion and flooding. Marine pollution is mainly linked to the waste management practices of the country.

6.2 Air Pollution

6.2.1 Indicators of air pollution

Male' the capital of Maldives is approximately 2 square Km and is the most populated island of the country with a population of 103693. (Department of National Planning, 2010). Due to the prominence as the capital city with opportunities of economic activity has encouraged an inward migration to the capital city. The population is increasing at the rate of 5.8 percent per annum.

According to the survey conducted in Male' by EPA (2011) perceptions of participants of the survey on exposure to air pollution are high with 78% stating that highest exposure is during walking while about 14% also felt that they are exposed to pollution while riding motorcycles. Indicators of air pollution reviewed includes trend in vehicles, construction of building, respiratory diseases, imports of fuel

6.2.1.1 Vehicles

Among the sources of pollution, Male' transport sector is contributing a significant amount as inhabitants of Male' are using more and more motor cycles and cars replacing bicycles used a few years ago. Public road passenger transport in Maldives was only through taxis operated by taxi centers until June 2011. On 23 June 2011 bus service introduced as a trail service and the impacts of it is yet to be determined. Taxi services were initiated in 70's and by mid 80s formed taxi centers were formed and started to give taxi services through these taxi centers. Ministry of Transport (MOT) started to register taxi centers from 1989 and taxi drivers from 1997 and by year 2000 taxi services were totally regulated. The increasing trend of motor cars and motor bikes are illustrated in graphs 6.1. The carbon monoxide gas from a motor vehicle exhaust is a primary air pollutant as it is directly emitted from the vehicles in operation.

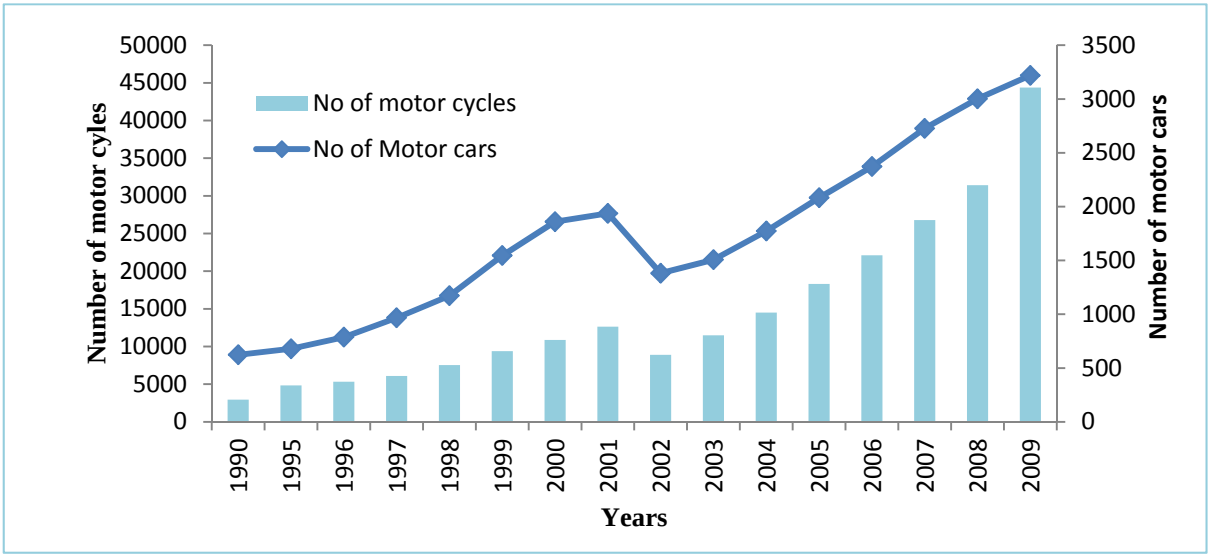


Fig 2.2: Increasing trend of cars and motor cycles 1990-2009

Source: Department of National Planning 2010

Over the years an increasing trend is observed and by 2009, there were 44380 vehicles registered and most (80%) vehicles are motorbikes while cars account for 7% of the total vehicles. Between 2004 and 2009 an average of 3245 motor bikes and 230 cars were registered per year. Vehicles are primary source of air pollution and vehicles that are powered by petrol, diesel natural gas or any other petroleum product emit or give out pollutants.

The increasing pressure and impacts are revealed when taking into consideration the estimates of number of return trips by cars and the personal travel cost estimates. In 2009 it is estimated that 12500 return trips are made while it is widely held that this estimate will increase further during school times. It is estimated that personal travel cost at 108 million dollars which is one percent of GDP (MTC 2007).Vehicle ownership is increasing at an alarming rate and it is expected to grow by 200 percent in the next 15 years with the only impediment for the growth is the lack of physical parking space. (MEEW, 2007)

The situation gets aggravated with obstructions in commercial areas. Obstructions are temporary and is caused when construction sites uses the foot paths to store their materials and equipments. Sometimes the whole street may be closed during construction causing nuisance to all road users with traffic congestion occurring on the next available road. Also many small retail shops and cafes as well as tea shops are seen using the foot path to keep their goods, blocking the movement of pedestrians. In addition, many vehicle repair and maintenance workshops keep the damaged vehicles on foot paths and their activities such as painting and washing often creates discomfort to pedestrians. (p 10, EPA, 2011)

6.2.1.2 Construction of Buildings

The growth of the construction industry also denotes the increasing trend of air and noise pollution. Construction activities that contribute to pollution include land clearing, operation of diesel engines, demolition of buildings and building activities undertaken within the site. All construction sites generate high levels of dust typically from concrete and cement which can be carried over a large area for a long period. Due to lack of space and increase congestion construction work on high rise building in Male' is on the increase. Table 6.1 outlines the number of building authorized to be constructed over the period 2004-2009 which shows that on average 47 buildings are authorized on a monthly basis and 13 building are completed per month. Fig 6.2 illustrates the floor area in construction building in terms of authorized and completed buildings which again emphasizes the amount of construction activity that are going on in Male'. The dust from the cement and coral blocks used in the construction is circulated within the surrounding area of the construction site and throughout 2 square km Male'.

Type	2004	2005	2006	2007	2008	2009
Authorized Building	843	513	593	506	504	485
Completed Buildings	166	170	153	153	167	175

Table 6.1: Building authorized for construction and completed.2004-2009

Source: Department of National Planning 2010

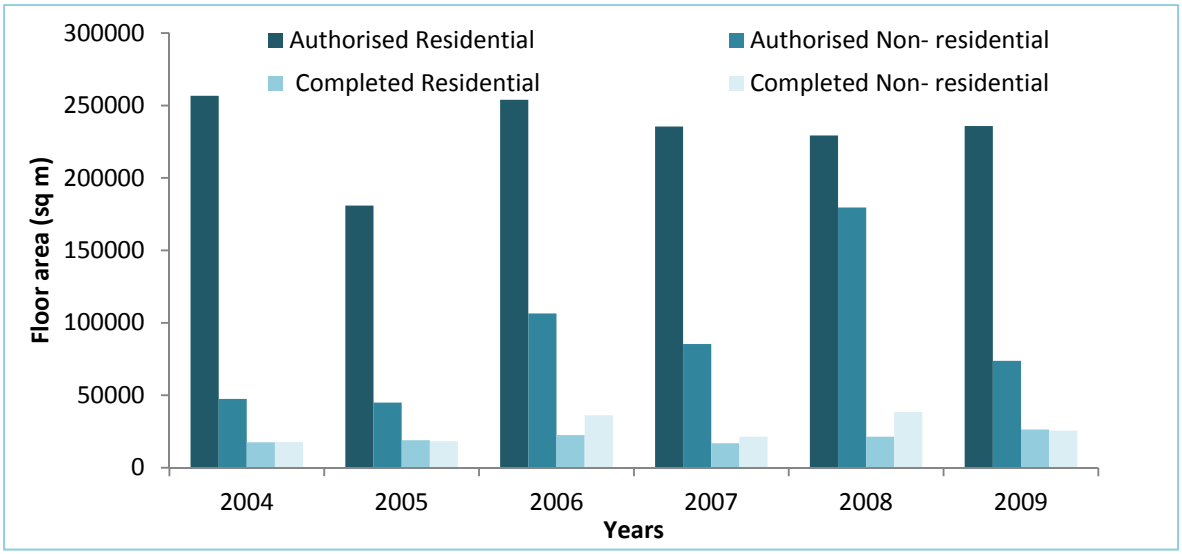


Fig 6.2:-Floor areas in terms of authorized and completed buildings 2004-2009

Source: Department of National Planning 2010

6.2.1.3 Respiratory Diseases

Urban air pollution is a growing concern with construction dust invisible to naked eye which penetrates deeply into the lungs and cause wide range of health problems including respiratory illness, asthma and bronchitis. Congestion within the households is also on the increase creating indoor air pollution another concern within the capital Male'. On 24 December 2011, EPA, started monitoring the particular matter of size 10 (PM10) at one station in Male', Friday Mosque station. As highlighted in table 6.2, in December the average for 10 days were 20 micrograms per meter cube which is below the 150 micrograms per cubic meter on a daily average of 24 hours. The United States EPA standards for PM state that PM10 should be lower than 150 micrograms per cubic meter on a daily average of 24 hours.

Pollutant	Averaging time	US EPA national Ambient Air Quality Standards	Level of Pollutant monitored from Friday Mosque Station
PM10	Annual mean 24 hour	150 µg/m^3	20 µg/m^3 (December 10-15 2011) average for 5 days

Table 6.2:-Level of pollutant monitored from Friday Mosque Station

Source: Environment Protection Agency, 2011 (http://epa.gov.mv)

PM or particulate matter is solid or liquid particles which remain suspended in the air for long periods of time. The particulate matter of size 10 micron diameter are termed as PM10, and are of greatest health concern as they can penetrate in to sensitive regions of the human lungs. The source of PM is stated as windblown dust from roads and from construction sites. Finer particles are from vehicle exhausts with oxides of sulfur and nitrogen released from vehicle emissions transformed by chemical processes in to PM. Health effects of PM includes premature death, increased hospital admissions increased respiratory illnesses, alterations in lung tissues and lowering of respiratory tract defense mechanisms. Most sensitive are elderly, children and people with cardio pulmonary diseases such as asthma. (EPA, 2011, http://epa.gov.mv)

Increased respiratory illnesses are one of the effects of particulate matter. Acute respiratory diseases are recorded by Department of Public Health (DPH) and are used here as an indicator of air pollution. According to the statistics published by the DPH reveals that over the years the cases of respiratory disease has increased. (Fig 6.3) and is one of the leading causes of death.

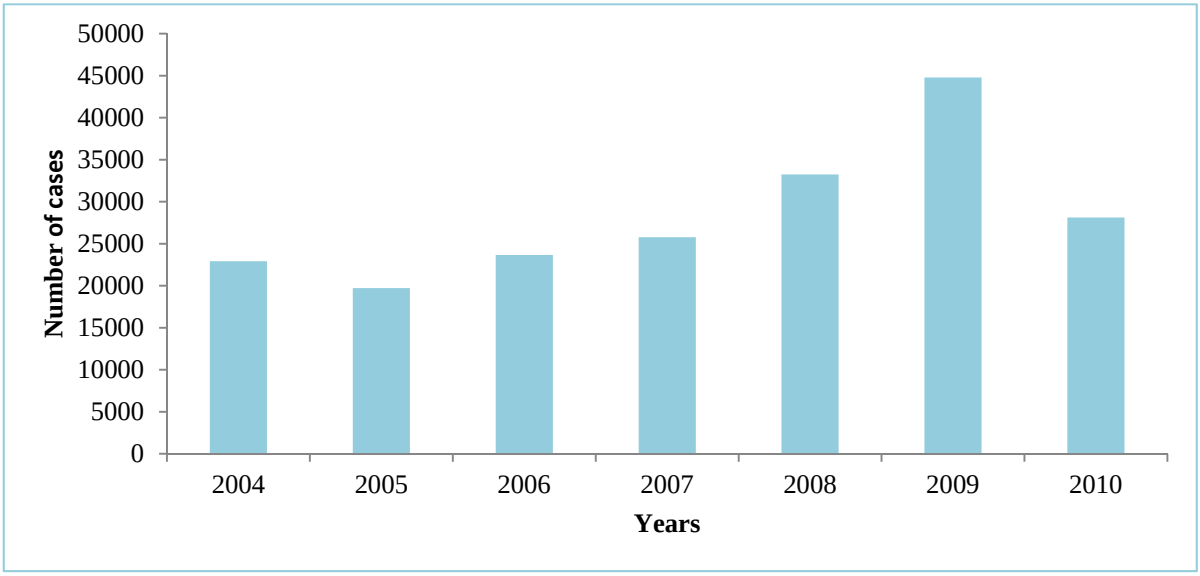


Fig 6.3: Cases of Respiratory Disease 2004-2010

Source: Department of Public Health, 2011

6.2.1.4 Import of Fuel

Maldives has no conventional energy resources that it can utilize to meet its energy needs and depends on imports for its energy needs. Bulk of these fuel imports is marine gas oil, aviation gas, lamp fuel. Diesel fuel is mainly used for power generation both by the utility companies and other electricity generators in the outer islands. Petroleum products are also used in land transport (gasoline, high-speed diesel), including aviation (jet fuel), industries, and households (kerosene, Liquid Petroleum Gas (LPG)). Nowadays, more outer island households are using kerosene and LPG for cooking instead of biomass materials such as shrubs and coconut husks. Table 6.3 outlines the imports of fuel from 2004-2010 which shows that large quantities of marine gas, lamp fuel and diesel are imported to the country indicating that pollution levels are on an increasing trend.

Description	unit	2004	2005	2006	2007	2008	2009	2010
Marine Gas Oil (Diesel)	M/T	202,530	187,668	238,981	250,866	267,183	280,257	286,900
Aviation Gas	M/T	15,830	13,037	16,951	13,383	23,460	25,495	21,351
Kerosene Oil	M/T	8,383	1,059	4,259	743	664	936	
Lamp Fuel	Ltr	226,743	141,775	174,227	217,119	197,367	150,095	219,819
Petroleum Ether	Ltr	9	83	4	11	19	47	51

Liquid Fluid	Ltr	464	358	827	1,923	1,728	435	4,461
Butane	M/T	6,488	7,150	6,403	6,048	10,317	11,538	11,780
Propane Liquefied	M/T	2	0	1	3			
Propylene Liquefied	Ltr	41	18	71	694	662	160	45
Petrol	M/T	18,461	19,209	23,051	28,116	26,477	28,323	29,865

Table 6.3: Imports of Fuel 2004-2009

Source: Maldives Custom, 2011

6.2.2 Transboundary air pollution

Efforts towards controlling and prevention of transboundary air pollution is undertaken as collaborative activities with regional partners. Transboundary air pollution first became apparent in 1997 when large parts of the country were affected by a haze caused by forest fires in Indonesia. The effects were significant from October to December 1997 as a result the Indian Ocean Experiment of 1999 was initiated with two air pollution measuring stations established to measure the long range transport of pollutants from Asia to the Indian Ocean. The cloud is caused mainly by domestic wood and dung fires plus smoke from the burning of forests and fields for agriculture. In addition ,vehicle exhausts, power plants and factory chimneys add to the mix. Under the Male' Declaration of Control and Prevention of Air Pollution and its likely Transboundary Effects in South Asia ,significant efforts were made towards controlling and prevention of transboundary air pollution in 1998. Under the program additional monitoring station was established in Hanimadhoo. The program emphasized the need for countries to carry forward, or initiate, studies and programs on air pollution in each country of South Asia. The Male' Declaration on Control and Prevention of Air Pollution and Its Likely Transboundary Effects for South Asia is the first regional environment agreement in South Asia to tackle transboundary air pollution through regional cooperation. The participating countries in the Male' Declaration are Bangladesh, Bhutan, India, Iran, Maldives, Nepal, Pakistan, and Sri Lanka.

The objective of the Decleration is to aid the process of providing a clean environment through clean air. The Declaration calls for regional cooperation to address shared local air quality problems and the increasing threat of transboundary air pollution and its possible impacts. The implementation has been done in a phase wise manner with the fourth phase ongoing from March 2010- to March 2012. The focus of fourth phase is on sustainable financing mechanisms and selection of regional centers on air quality and impact assessment studies. Under the

project pollutants NO_2 and SO_2 and O_3 were monitored in Hanimadhoo monitoring station in 2008.

6.3 Noise Pollution

Increasing vehicles for road transport in Male' not only raises the issue of air pollution but also raises serious concern of noise pollution. The transport sector has evolved in an ad hoc basis without a comprehensive plan. Without an organized public transport system in Male' the motor cycles and cars are increasing at an alarming rate of 18% per annum creating lot of traffic congestion and associated issues. The paved network of roads of varying length and width is often concentrated with vehicles creating traffic blockage within the small alleyways creating excessive noise with lorries, cars and motor bikes sounding their horns without any concern of noise pollution. Loading and unloading of lorries in front of rented godowns in small streets causes traffic blockages and vehicles which are comes behind the lorries constantly sounds their horns. The situation gets aggravated when over 70% of the car owners do not have a parking space with many office building and commercial building coming up without a fraction of the parking space required.

Construction sites also producelots of noise from demolitions, concrete mixing, also from vehicles, heavy equipment and machinery with movement of trucks loads of construction material within small alley ways

6.4 Water pollution

6.4.1 Fresh water pollution

Ground water aquifers formed by the accumulation of the recharged rainwater on top of the salt water are found in all the islands. The aquifer is normally at a depth of 1-1.5 meters below the surface. The thickness of the aquifer is normally dictated by several factors including net rainfall recharge size of the island and permeability of the water through the soil. Quality of the aquifer varies from island to island and is highly vulnerable to contamination from inadequate sanitation facilities and other human activities, solid waste run-off over exploitation; and saline intrusion through soil erosion and flooding.

A survey of 70 islands in 2010 reported that in most of the islands ground water is contaminated with the water not suitable for drinking. As fig 6.4 illustrates 49% of the islands reported that ground water is not used at all, while only 17 % uses ground water often. Most

islands reported that ground water is saline and that the quality is bad in terms of color smell and taste. Of the islands reported, 55 percent has stated that water is saline while 28-65% stated that the water quality is bad in terms of color smell and taste.

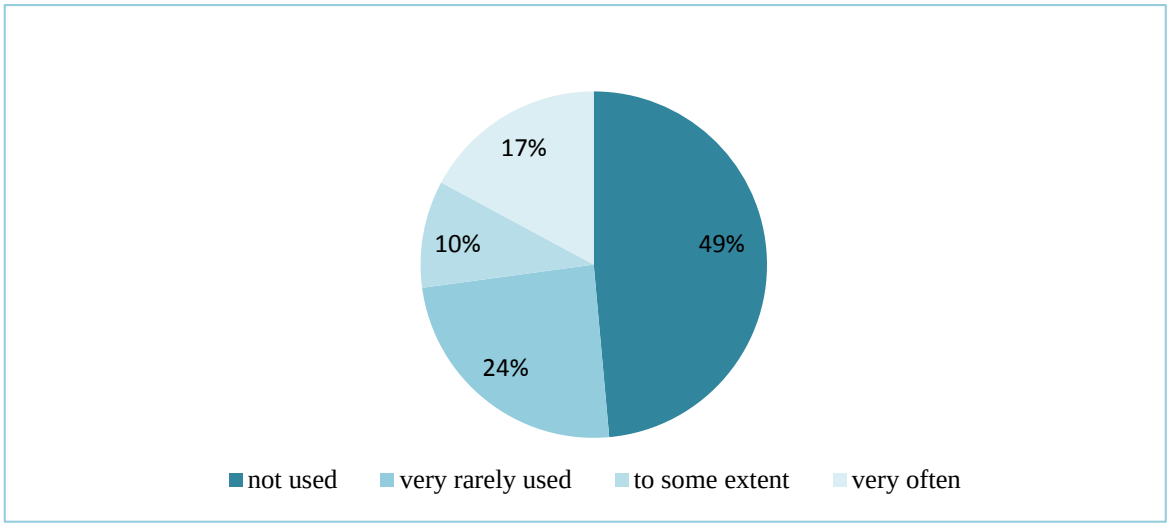


Fig 6.4: Use of ground water -2011

Source: Island Offices, 2011

The use of septic tanks and the primitive sewage systems in these islands are some of the causes for deteriorating ground water quality with sinking of effluent causing ground water contamination. Unlike Male', the capital in the rural islands the people use groundwater for washing clothes, dishes and for bathing more often, as piped desalinated water is not available and in some islands rain water gets depleted during dry spells.

In Male' the ground water has been contaminated and desalinated water is being provided by the government for a number of years. In 1995 the Maldives Water and Sewerage company (MWSC) was formed which provided the desalinated water for Male'. Since then the use of ground water has been steadily increasing as revealed from Fig 6.5 which shows that use desalinated water has increase over 11 folds over the 14 year period.

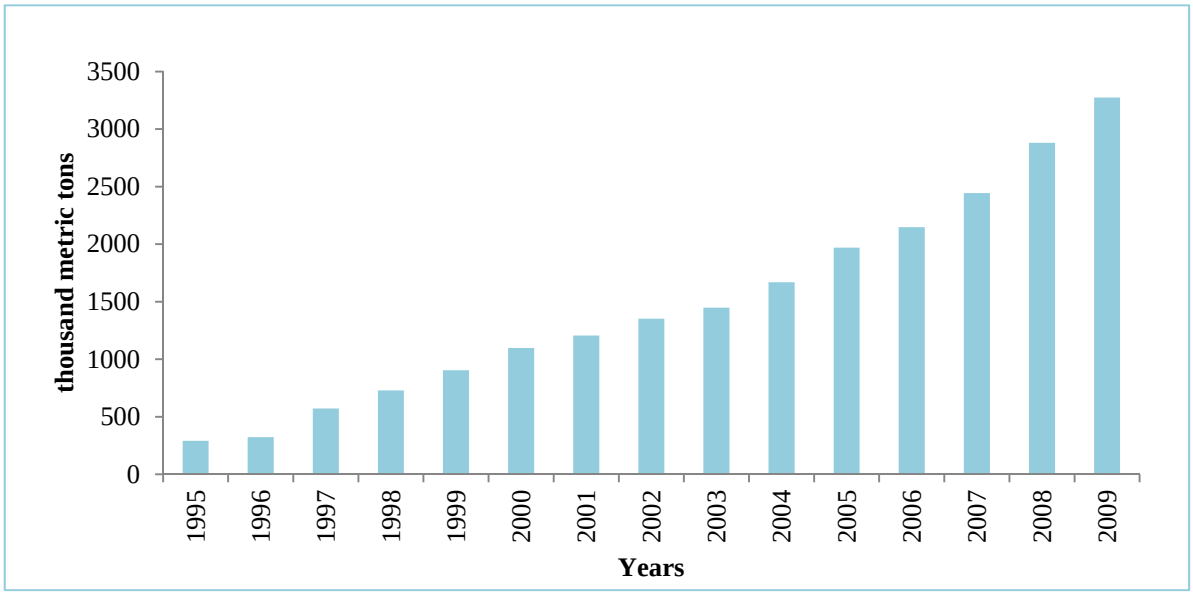


Fig 6.5: Water distribution in Male 1995-2009

Source: Department of National Planning 2011

In Male' today hardly anyone uses the groundwater for drinking, but several households depends on groundwater for washing clothes and some other purposes. Often two taps are installed in many houses, one for piped desalinated water and one for ground water.

Unlike other inhabited islands in Male' household effluent is collected in catch pits and transferred to MWSC's Central Sewage System. Presently most of the household pits are built in Male' are inside a building, in a room or office, in the ground floor, covered with a lid on the opening with concerns about the safety of the use of ground water in Male' being high. Reported incidences revealed that absence of the proper disposal facilities to manage used engine oil or black industrial oil in Male' has posed risks of ground water contamination. Used oil is sometimes being discharged into ditches. . More recently diesel oil from State Electric Limited Company (STELCO) water pipes were found leaking contaminating the ground water within the surrounding area and lagoon adjacent to the area. Other sources of water pollution on building sites include diesel and oil paint, solvents, cleaners and at times large quantities of petroleum are released from leaks and spills during extraction, processing, and distribution.

6.4.2 Marine pollution

Marine pollution is linked to the waste management practices of the country. In the islands there is no solid waste collection and waste is taken by households to designated disposal sites or to the edge of the inhabited areas. The waste management practices of 70 islands were

reviewed to understand the current waste management practices. As revealed from the table waste is frequently dumped within the island, burnt or thrown into the lagoon.

Methods of disposal	Percentage
to the beach/sea	13
Within the island	31
Incinerator	1
bury	8
burn	28
Thilafushi or other island	4
recycle	0
compost	0
Combination	14

Table 6.4: Waste management practices prevailing in the islands 2011

Source: Island Offices, 2011

Disposal sites within the islands are typically uncontrolled and unmanaged and located along the shorelines. With no provisions for collection, treatment and disposal of hazardous waste and non-biodegradable imported products waste is also discarded in this manner often ending up in the lagoon resulting in marine pollution. Also in Male' engine oil in plastic containers are often dumped into lagoon from vessels. As highlighted above recently diesel oil from STELCO pipes was found leaking and contaminating the ground water as well as the surrounding lagoons adjacent to the area where many of the inhabitants go out for swimming as recreational activity. In response to the incident the area was banned for swimming purposes. Without proper monitoring procedures the level of marine pollution is difficult to determine.

6.5 Policies and Strategies

MHE is the main organization mandated for developing policies and strategies related to controlling pollution. Among the organization's policies improving air quality to safe guard human health has direct relevance to controlling air pollution. Strategies formulated under the policy include, establishing fully equipped Ambient Air Quality Monitoring Station in densely populated islands and undertaking monitoring of emissions from point and mobile sources and establish standards for such sources of pollution. With assistance from United Nations Environment Program (UNEP) work is being initiated under these strategies.

Prevention and controlling of water and marine pollution are based on the waste and water and sanitation management policies. The policy of developing solid waste management system to prevent adverse impact on human health and environment through economically viable and locally appropriate approaches is put forward as a major policy with a number of interventions. The implementing agencies and responsible sectors being MHE, Local Government Utility Companies, Environment Protection Agency (EPA) and civil society in general. The sector has outlined the policy of improving water resource management to preserve environment with the following strategies which has direct relevance towards controlling pollution of the water and sanitation.

1. Seeking immediate measures to stop pollution of water tables due to seepage of sewerage and other pollutants
2. Developing land use plans taking into consideration the protection of natural and fresh water resources
3. Establish and effective program for monitoring of water resources quality in the islands
4. Prepare an inventory of natural water catchment areas including wetlands and marsh areas

The regulatory authorities EPA and the Transport Regulatory Authority (TRA) develop technical and financial guidelines and standards for assessment and monitoring procedures. The enforcement of the standards and guidelines are targeted towards controlling pollution.EPA is an independent legal regulatory entity, working under the supervision of a governing body under the MHE. The EPA was formed merging Environment Research Centre (ERC) and Maldives Water and Sanitation Authority (MWSA) on 18 December 2008. The EPA Governing Board is a statutory body, established under the Environment Protection Act, with expertise in environment protection, industry, environmental science, regional issues, environmental law and local government

As a regulatory body EPA aims to reduce pollution through their work related to waste management water supply and sanitation programs and mandatory Environment Impact Assessment (EIA) prior to development activities. EPA charges fines for any party which started development activities without a detailed EIA and halts projects until EIA is complete. Also as the administering authority for waste management at the national level EPA, work towards putting in place uniform measures to seek to reduce the amount of waste that is generated and where waste is generated to ensure that waste is reused, recycled, and recovered in an environmentally sound manner before being safely treated and disposed. These measures are

to be implemented by the island council and city council at the island level with the decentralization and setting up local councils recently.

Similarly the EPA is the administering authority for formulation of regulations with regard to desalination plants and the registration procedures of desalination plants which directly contribute in proper function of water resources. Moreover, water resource assessment and monitoring, water supply and sanitation guidance and regulation development and water and waste water quality compliance monitoring is also the mandate of EPA.

In addition to MHE other concerned department such as Ministry of Economic Development (MED), MOT are working towards implementing renewable energy projects as an alternative source of electricity generation which will assist in achieving cleaner environment. Establishing a carbon neutral transport system under the umbrella of becoming carbon neutral by year 2020 is a noteworthy strategy. Any development towards making Maldives carbon neutral contributes towards controlling and prevention of air pollution. Recent developments include decisions to waive import duties on electric and renewable energy powered vehicles to boost the government's initiative to promote the import and use of environmentally friendly products. The decision also includes waiving import duties on solar panels and solar panel batteries used in marine vessels. With most of the vehicles and marine vessels used in the Maldives relying on fossil fuel – petrol and diesel –giving a duty incentive to encourage the import of eco-friendly vehicles and renewable energy products used in vessels in accordance with documentation issued by the EPA declaring their eco-friendliness. In addition, deliberations on the matter of introducing a feed in tariff system to encourage adoption of renewable energy in order to attain carbon neutrality goal, secure energy security and reduce dependency on imported oil are all land mark decisions towards a cleaner environment.

The Land transport Act 5/2009 provides the legal frame for land transport. Under the land transport Act, TRA develops rules and regulations to help the sustainable development of transport sector. As a means of reducing emissions from vehicles government banned the import of reconditioned motorcycles which and engine capacity of less than 150 cubic meters. Similarly a ban was introduced on the import of cars more than 5 years old. The Authority has implemented regulation which states that all vehicles driving on the roads of the Maldives should have a road worthiness certificate to reduce emission rate of vehicles used in the country. TRA monitors whether vehicles driving on the road have a road worthiness certificate for vehicles without certification and compensation is taken.

7. Conservation of Biological Diversity

Key findings:

Main pressures to marine biodiversity continue to be illegal mining, mainly branched coral and sand, over fishing of reef species and reoccurring of bleaching events. Pressures to terrestrial biodiversity are due to clearing of vegetation, invasive pests and diseases, and use of pesticides and herbicides.

A major conservation effort is the Baa Atoll Conservation Project (BACP) initiated in 2003. The BACP is implemented for achieving biodiversity conservation with the purpose to design, test and demonstrate a management system that will secure and sustain the rich biodiversity and ecological processes of the Atoll for the benefit of the future generation. In 29 June 2011 Baa Atoll was declared as a UNESCO Biosphere Reserve

7.1 Introduction

The biodiversity or the degree of variation of life within the marine ecosystem is rich and diverse while the terrestrial biodiversity is limited characterized by the geomorphic structure of the islands. The islands of Maldives are small, low lying and isolated with limited natural vegetation that is distributed relatively uniform following the pattern of salt tolerant bushes at the edge and larger trees and coconut palms further inland. Native plants of the islands can be ecologically grouped into five categories of vegetation (Adams 1988 cited in P4SD, 2011). They are beach pioneers, littoral hedge, sub-littoral thicket, climax forest and mangrove and swamp forest (P4SD, 2011).With limited arable land characterized by poor soil, low freshwater supplies, the variety of plants and animals are limited.

In contrast the marine biodiversity based on the coral reefs is highly diverse in terms of life. The reef slopes are covered with lush coral vegetation with series of reef terraces with a rich marine biodiversity. The marine resources is the most significant and vital resource base linked to the economic development of the country with tourism and fisheries accounting for 28 percent and 2.8 percent of GDP respectively (DNP, 2010). Biodiversity-based sectors contribute 71% of national employment (78,500 jobs), 49% of public revenue (Rf 2.5 billion), 62% of foreign exchange (US$ 435 million), 98% of exports (Rf 1.7 billion) and 89% of GDP (Rf 135 billion) (Emerton L., Baig S., and Saleem M., 2009), underlining the economic case for biodiversity conservation. With marine biodiversity linked to the economic development of the country management of the biological diversity has become a priority for the sustainable development of the country.

7.2 Pressures to Biodiversity

In terms of biodiversity over 1,100 species of demersal and epipelagic fish fauna including sharks have been recorded in Maldives and the number is likely to exceed 1500 species (MRC 2003 cited in MHE, 2010). Additionally 285 species of marine algae (Ahmed and Saleem, 1999 cited in MHE 2010), 187 species of coral over 400 species of mollusks, over 145 species of crabs, 48 species of shrimps and 83 species of echinoderms exists. (MHAHE, 2002 cited in MHE 2010).

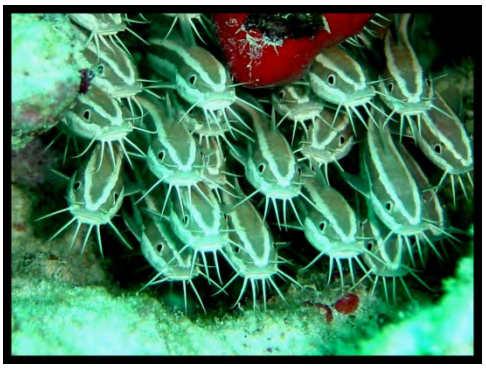
In terms of terrestrial biodiversity, The Global Forest Resources Assessment of 2005 estimated the forest area of Maldives at 1000 ha, although the Agricultural Development Master Plan (2006-2020) of the Maldives estimated the forest areas being 3716 ha(P4SD,2011). Number of plants ranges from 583 vascular plant species out of which 323 are cultivated and 260 are nativated or naturalized. These plants include 214 flowering plants and 5 ferns and over 300 species may be used in traditional medicine (Adams 1984 cited in MHE, 2010).Terrestrial mammalian fauna of the Maldives is limited and very little of the local terrestrial invertebrate fauna are documented. Additionally 13 mangroves belonging to nine genera have been identified (Appendix 7.1). Associated with mangroves are 6 species of plants and 37 species of fungi. (Utawale and Jagtap 1991, cited in MHE, 2010).

The pressures and threats on biodiversity have been in existence over long periods of time and will continue for decades to come. The challenge is the difficult tradeoffs in finding a balance between economic growth, social equity and conservation of environment. Maldives has undergone unprecedented social and economic change over the years which have provided impetus for environmental degradation. The socio-economic forces and circumstances create

incentives for more activities that put pressure on the biodiversity. Today with increase in population and increase in wealth from tourism and other economic activities the pace of development is increasing at a significant rate in the country. The need for land led to reclamation programs, while harbors are dredged to facilitate economic growth in islands. The localized environmental impacts as a result of these developments have threatened the biodiversity. Moreover awareness regarding the importance of biodiversity and the issues associated with the loss of biodiversity is lacking (p 39, MEEW, 2007). Loss of biodiversity coupled with perils from the adverse effects of climate change to a small nation dependent on almost entirely on its coastal marine resources is daunting. There are perhaps few countries that are at greater peril from the adverse effects of climate change and loss of biodiversity than the Maldives.

7.2.1 Pressures to Marine Biodiversity

Pressures to marine diversity include extraction of branched coral and sand, over fishing of reef species and reoccurring of coral bleaching events. The negative effects of these pressures continue while attempts to minimize the pressures and impacts continue through laws, regulations and awareness programs.



7.2.1.1 Demand for coral, sand and branched coral

The demand for coral and sand mining became a major environmental concern in 1990. Historically Maldivians have mined coral for purposes such as building, making lime, or making religious structures. However, coral mining reached a critical status with a boom in the construction industry since 1970s. Direct government intervention in regulating coral mining commenced in 1990, with a ban on mining coral from any house-reef, followed by designating particular areas for sand and coral mining by May 1992. With the regulation in place government increased awareness and provided alternatives stipulating the use of hollow cement blocks instead of coral in all government buildings. Small-scale operations to build these blocks boomed to cater for increasing demand. Programs to increase the level of awareness about the significance of reefs for fisheries and tourism, and their role in the physical protection of islands, helped to reduce the demand for coral as a building material. Positive results include coral blocks replacing mined coral for any building purposes in Male', with declining trends observed in the atolls. At the same time, sand mining from inhabited islands also decreased as

island communities became aware of the negative impacts of sand mining. MOFA which processes the application for sand mining from uninhabited islands reported that data for demand for sand mining exists but has not been compiled for the period 2004 -2009.

Although declining trends are observed in branched coral and sand mining, on many occasions illegal mining have been reported. Most of the outer islands in the Maldives having no easy access to imported river sand and aggregates and transporting these commodities from Male' region is expensive. Therefore, even though it is prohibited, islanders sometimes collect sand from their own beaches.

7.2.1.2 Demand for reef fish

With the introduction of tourism in the 70's and the expansion and development of tourism industry reef fishing became a commercial fishery in the Maldives. Reef fish varieties are in demand for the tourist resorts and some of the reef fish varieties are also exported. The export oriented species include giant clam, sea cucumber, groupers and aquarium fish. The government has brought in restrictions on the fishery as a result of over exploitation. Current conservation and management measures in place include;

22 marine products are prohibited to export (Table 7.1)

39 areas are declared as protected sites (Table 7.2)

70 birds are protected birds of which some are important to the local tuna fishery (Table 7.3)

12 marine species have been declared as protected species. (Table 7.4)

Specific destructive fishing practices are also banned in the Maldives and include:

Use of dynamite or explosives

Use of spear 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

Bait fishes (used for pole & line fishing)	Boulder coral	Dolphin	Mother of pearl shells	Rays
Big eye scad (less than 6 inches)	Branching coral	Eels	Parrot fish	Trochus shell
Black coral	Conch (triton) shell	Lobster	Puffer fish	Turtle
Black coral necklaces	Coral	Lobster meat	Ray skin	Turtle shell products
Turtle shells	Whales			

Table 7.1: List of marine animals prohibited for export

Source: Ministry of Fisheries and Agriculture, 2011

Angafaru	EidhigaliKilhi and Koattey Area	Lankan Thila	Mushimasmigili Thila
Hanifaru	Fushee Kandu	Kuredhu Kanduolhi	Orimas Thila
South Ari Atoll MPA	Filitheyo Kandu	Dhigali Haa	Mayaa Thila
Hithaadhoo	Lhazikuraadi	Vilingili Thila	Guraidhoo Kanduolhi
Olhugiri	Vattaru Kandu	Fushivaru Thila	Emboodhoo Kanduolhi
Hurasdhoo	Faruhuruvalhibeyru	Miyaru Kandu	Gulhifalhu Medhugaonna kohlavaanee
Huraa Mangrove Area	Kashibeyru Thila	Kudarah Thila	Dhekunu Thilafalhuge Miyaruvan
Kuda Haa	Gaathugiri	Thamburudhoo Thila	Makunudhoo KanduOlhi
Rasfari island, lagoon and the surrounding reef	B. Mendhoo	B,Goidhoo marshy area	Maaharuvalhifaru
B, Bathala	B.Mathifaruhuraa	Corbin wreck area	

Table 7.2: Protected areas of Maldives

Source: Ministry of Housing and Environment,2011

Local Name	**Common Name**	**Scientific Name**
Dhivehi Koveli	Asian Koel	*Eudynamys scolopacea*
Dhivehi Hoagulhaa	Audubon's Shearwater	*Puffinus iherminieri*
Kalhu Raabondhi	Black Bittern	*Dupetor flavicollis*
NooMaakanaa	Black Headed Heron	*Ardea melanocephala*

Raabondhi	Black-crowned Night Heron	*Nycticorax nycticorax*
BoakalhuGohorukey	Black-Headed Gull	*Larusridibundus*
Kirudhooni	Black-Naped Tern	*Sterna sumatrana*
EshungaIlolhi	Black-Tailed Godwit	*Limosa limosa*
TheyravaaIlolhi	Black-Winged Stilt	*Himantopus himantopus*
Vaali	Bridled Tern	*Sterna anaethetus*
KalhuMaadhooni	Brown Booby	*Sula leucogaster*
Maaranga	Brown Noddy	*Anous stolidus*
Miyaremu Dhooni	Caspian Tern	*Sterna caspia*
Iruvaihudhu	Catlle Egret	*Bubulcus ibis*
MedhuraajjethereRaabondhi	Central Maldivian Heron	*Butoridesstriatusdidiiphillipsi*
SalvaaDhooni	Common Coot	*Fulica atra*
Chon ChonIlolhi	Common Greenshank	*Tringanebularia*
OlhuvaluKanbili/KulheeKanbili	Common Moorhen	*Gallinula chloropus indics*
AngotiBondana	Common Ringed Plover	*Charadriushiaticula*
Valla	Common Tern	*Sterna hirundo*
Theyravaa/MoalhaLunbo	Crab Plover	*Dromasardeola*
BondanaIlolhi	Curlew Sandpiper	*Calidrisferruginea*
Dheyfaiy Dhooni	Eurasian Spoonbill	*Platalea leucorodia*
Maa Hoagulhaa	Flesh-footed Shearwater	*Puffinus carneipes*
Rathu Reyru	Ferruginous Pochard	*Anthua nyroca*
Bodu Gaadhooni	Great Crested Tern	*Sterna bergii*
Lagnaa	Greater Egret	*Casmerodius albus*
Kunburu Reyru	Garganey	*Anas querquedula*
Alaka	Gray Plover	*Pluvialis squatarola*
Valu Bondana	Great Sand Plover	*Charadrius hiaticula*
Gudugudaa Dhooni	Greater Flamingo	*Phoenicopterus ruber*

Bodu Gaadhooni	Great Crested Tern	*Sterna bergii*
Maahoara	Great Frigatebird	*Fregata ariel*
Kalhu Bulhithunbi	Glossy Ibis	*Plegadis falcinellus*
Kanifulhu Dhooni	Gull-billed Tern	*Gelochelidon nilotica*
Kurulla Dhooni	House sparrow	*Passer domesticus*
Onna Ilolhi	Jack Snipe	*Lymnocryptes Minimus*
Kiru Bondana	Kentish Plover	*Charadrius alexandrinus*
Hoara	Lesser Frigatebird	*Frigata minor*
Funamaa Dhushin	Lesser Golden Plover	*Pluvialis dominica*
Kuda Bondana	Lesser Sand Plover	*Charadrius mongolus*
Ainmathee Gaadhooni	Lesser Crested Tern	*Sterna bengalensis*
Dhivehi Raabondhi	Maldivian Little Heron	*Butorides striatus albidulusi*
Huvadhoo Raabondhi	Maldivian Pond Heron	*Ardeola grayii phillipsi*
Dhivehi Kanbili	Maldivian Water Tern	*Amaurornis Phoenicurus maldivus*
Furedhdhe Ilolhi	Marsh Sandpiper	*Tringa stagnatilis*
Hudhumaa Dhooni	Mask Booby	*Sula dactylatra*
Reyru	Northern Shoveler	*Anas clypeata*
Rahmathee forike	Northern House Martin	*Delichon urbica*
Gohorukey	Pallas's Gull	*Larus ridibundus*
Dhanbu Maakanaa	Purple Heron	*Ardea purpurea*
Bileymaa Dhushin	Pacific Golden Plover	*Pluvialis fulva*
Rathafai	Rudy Turnstone	*Arenaria interpres*
Mushi Fenfoah Dhooni	Red Throated Pipit	*Anthus cervinus*
Maa Dhooni	Red- footed Booby	*Sula sula*
Valla	Roseate Tern	*Sterna dougallii*
Beyndu	Sooty Tern	*Sterna fuscata*
Bondhu Dhooni	Saunder's Tern	*Sterna saundersi*

Girubaa Dhooni	Spot-billed Pelican	*Pelecanus phillippensis*
Dhon Fenfoah dhooni	Tree Pipit	*Anthus trivialis*
Kulhee Kukulhu	Watercock	*Gallicrex cinerea*
Bodu Raabondhi	Western Reef Egret	*Egretta gularis*
Bodu Hoagulhaa	Wedged-tailed Shearwater	*Puffinus pacificus*
Kandu Kanbaa	Wilson's Storm-petrel	*Oceanites oceanicus*
Dondheeni	White Tern	*Gygis alba monte*
Dhandifulhu Dhooni	White-tailed Tropicbird	*Phaethin lepturus*
Bulhithunbi	Whimbrel	*Numenius phaeopus*
Valhoa Dhooni	Whiskered Tern	*Chlidonias hybridus*
Dhon Raabondhi	Yellow Bittern	*Ixabrychus sinensis sinensis*
Fenfoah Dhooni	Yellow Wagtail	*Motacilla flava*

Table 7.3: Protected Birds of Maldives

Source: Ministry of Housing and Environment,2011

One of the major setbacks in implementing timely enforcement measures is the lack of data on abundance and distribution of reef fishes. Research undertaken by the Marine Research Centre (MRC) in 2008 highlights, the reef fish export industry is widespread with the common practice among yellowfin tuna exporters to turn towards reef fish during times of low yellowfin catches. In 2009 reef fish catches, recorded as other marine fishes, totaled to 20.9 thousand metric tons and accounts for 17.9 percent of the total catch of 2009 (MOFA,2010). This is considered to be an underestimate with known cases of non-reporting with large geographic distribution of the fishing communities. The statistics from customs agencies are useful to estimate catch but timely enforcement measures are difficult to make using data on exports. Generally reef fishing can be undertaken throughout Maldives with only restriction around resorts and marine protected areas.

Scientific Name	**Common Name**
Chelonioidea	Marine Turtles
Antipatharia	Black Corals
Charonia tritonis	Conch (triton) Shells
Elasmobranchii	Sharks

Cheilinus undulatus	Napoleon Wrasse
Delphinidae	Dolphins
Tridacnidae	Giant Clams
Mysticeti, Odontoceti Ziphiidae	Whales
	Whale shark
Scleractinia	Stony Coral
Pterioida	Pearl Oysters
Nephropidae	Lobsters (berried female lobsters and those smaller than 25cm in total length - from head to tail)

Table 7.4: Marine species protected in the Maldives

Source: Ministry of Housing and Environment , 2011

Beche de mer fishing started in 1986, at first with very low quantities. A huge increase has brought exports to exceed 300 t/year since 1988. By government regulations SCUBA gear cannot be used to collect sea cucumbers. Data on the export of the sea cucumbers for the period 2004-2009 reveal that over 470 mt of sea cucumber in dried form were exported. Live sea cucumbers are also exported, which provides a considerable amount of income. (Table 7.5) Mariculture of sea cucumber is on the increase which has caused damages to some reefs and mangrove ecosystem. General environmental impacts associated with mariculture activities include wastes from cage cultures, farm escapees and invasive, genetic pollution and disease and parasite transfer and habitat modification. According to the department of Planning, 10 mariculture projects have been approved by November 2011.

	2004	2005	2006	2007	2008	2009
Sea cucumber dried (Qty)	182.06	116.53	87.87		84.01	
Sea cucumber dried (Rf)	31 049.01	23,118.93	12,707.46		7891.33	
Sea cucumber live Qty (No's)				50.00		10,000
Sea cucumber live Value (Rf)				0.32		7.3

Table 7.5: Export of Sea Cucumbers 2004-2009

Source: Statistical Year Book, Department of Planning, 2010

b) Grouper Fishery

Groupers became a prime target for export to the Far Eastern countries, particularly to Hong Kong in 1990. During times of low tuna catches, fishermen sometimes switch fisheries from targeting tuna to catching groupers with the latter fishery being an alternative livelihood to many fishermen in the outer islands. By 2004 assessments by MRC showed that groupers were heavily fished with catch rates declining dramatically and nearly half of the catch being immature. The culture of groupers in the Maldives was initiated by the MRC in 2005 as it became obvious that if the fishery continued without strong management intervention the groupers may become "extinct" from the Maldives. MRC demonstrated that young groupers or fingerlings may be cultured in floating cage systems, similar to what is being practiced in Malaysia and Indonesia.

In the absence of catch statistics the export figures are reviewed to understand the current trend in the grouper fishery. The export statistics from 2004-2009 reveal that groupers are exported live and frozen form (Fig 7.1, Fig 7.2). The annual quantity exported in chilled or fresh form between 2004 to 2009 is 253 metric tons with an annual value of Rf16982 thousand. The quantity of groupers exported alive, accounts for over 95000 in numbers per year with an annual value of over Rf 95000 thousand for the period 2004-2009.

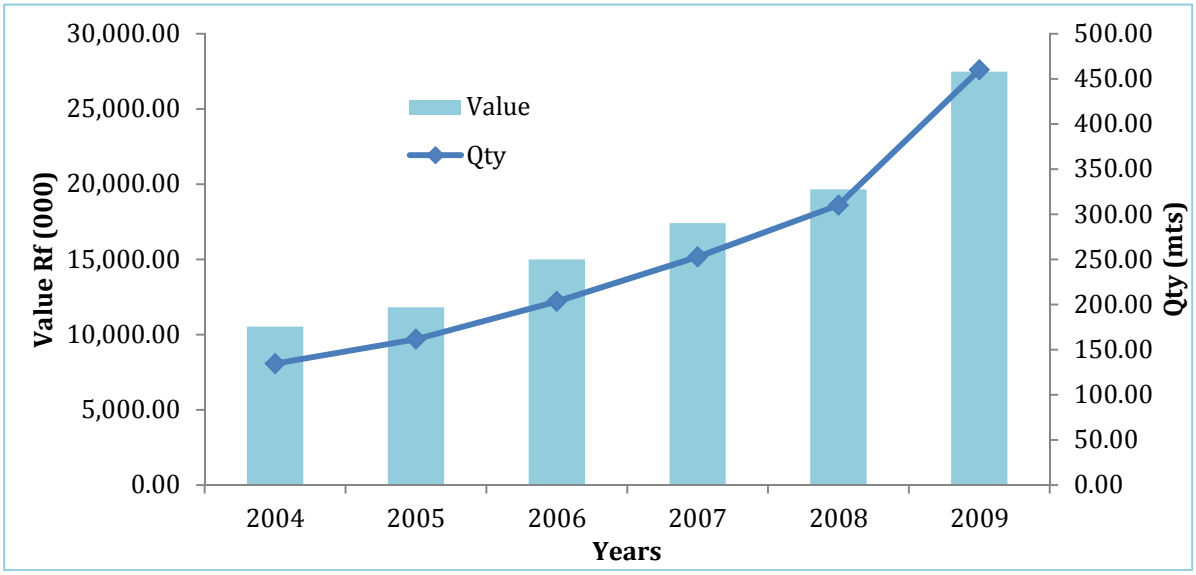


Fig 7.1:-Export of Fresh or chilled grouper 2004-2009

Source: Department of National Planning 2010

Fig 7.2:-Export of live grouper 2004-2009

Source: Department of National Planning 2010

c) Giant Clam

The giant clam fishery, which started in 1990, was short-lived. Two species were exploited (Tridacna squamosa and Tridacna maxima). The export-oriented giant clam fishery came to a stop a year later when the government banned the export of giant clam products. It was believed that further fishing would lead to serious exhaustion of the stocks and localized extinction of clams on some reefs. (MRC , 2008)

d) Shark fishing

Concern for the survival of shark species in the Maldives was growing over the years which led to a total ban on all shark fishing within the Maldivian waters on 15 March. on July 2011 sharks were declared as protected species.

Shark species have slow growth, late maturity and low fecundity resulting in wide generation gaps and low regeneration rates in the population. These factors render sharks vulnerable to over-exploitation. Thirty seven species of sharks have been recorded in the Maldives (Anderson and Ahmaed, 1993, Adam, Anderson and Merret, 1998). Anderson and Ahmed (1993) estimated direct revenue of US$ 2.3 million from divers visiting specific shark diving sites in 1992. They further estimated that the average value of a live grey reef shark was US$ 3,300 per year, while a dead grey reef shark was estimated to provide a one-time value of US$ 32 to the fishermen

(Anderson and Ahmed, 1993). Revenue from export of shark meat and fins was estimated at US$ 0.7 million in the same year.

Export data (table 7.6) shows that prior to the ban, shark products including fresh and chilled shark, frozen shark, and salted dried shark fins, have been exported.

		2004	2005	2006	2007	2008	2009
Shark fresh or chilled	Qty (mt)	1.47	0.12	.0004			
	Value (Rf 000	88.88	6,80	0.05			
Shark frozen	Qty (mt)	86.17	76.41	3.17	1.32		
	Value (Rf 000	289.85 86	390.55	10.17	4.40		
Shark salted dried	Qty (mt)	320.04	248.56	271.16	217.05	233.49	145.8
	Value (Rf 000	2,960.85	2,210.89	3,294.14	1,823.83	1893.65	1281.9
Shark fins (frozen)	Qty (mt)	37.42	29.90	4.20	3.51	0.17	
	Value (Rf 000	1,224.05	712.43	57.12	15.80	21.50	
Shark fins (dried)	Qty (mt)	19.86	13.26	11.98	11.03	8.87	8.6
	Value (Rf 000	7,055.76	6,931.87	2,412.03	1,358.79	871.23	734.2
Shark fins (salted dried)	Qty (mt)		0.33		0.25	0.20	
	Value (Rf 000		4.21		3.00	2.62	
Shark liver oil	liters			5,780.50	469.00	900	6800
	Rf (000)			311.97	62.68	138.78	908.8

Table.7.6:-Quantity and value of shark products exported 2004-2009 –qty and value

Source:-Statistical Year Book, Department of Planning, 2010

e) Aquarium Fishery

The marine aquarium trade of Maldives started around 1979, with Sri Lanka. Europe became the major destination of this trade over the years. In 2007, there were seven registered companies, trading approximately 140 species of fish and 5 species of invertebrates (MRC, 2008). From 2004 to 2009, annually 300,000 fishes were exported with an annual earning of over Rf 7 million (Fig7.3). As a management measure, species based quota system was introduced, based on export data from the Maldives Custom Services (MCS), knowledge of the abundance of each species and knowledge of its tolerance to captivity.

Maldives is a popular destination for snorkelers and divers and the collection of aquarium fish could impact dive tourism. Presently, random checks of the fish exports are scheduled for implementation following the introduction of a fish guide software. There are no specifically designated areas for collection of aquarium fish and collection moved from one area to another as stocks declined. This pattern of resource use may act as indirect time area closures and aid in the replenishment of fish stocks. (MRC 2008)

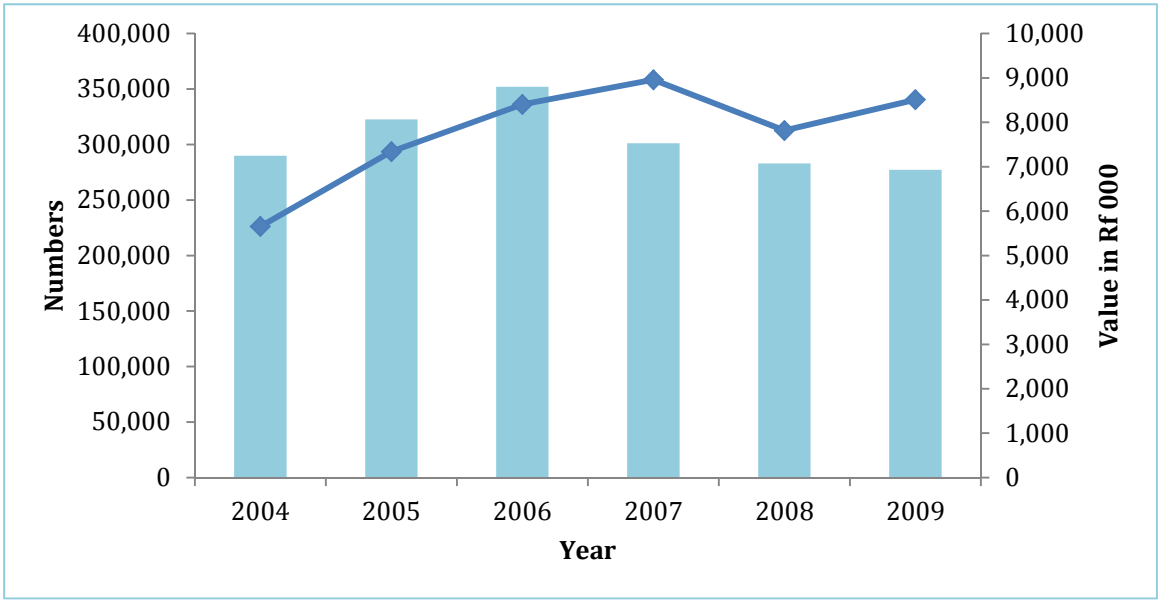


Fig 7.3:-Export of aquarium fish 2004-2009

Source: Statistical Yearbook, Department of National Planning 2010

f) Bait fishery

Bait fishing is integral part of pole and line fishing. Some of the detrimental effects to marine environment are caused by the use of powerful lights to collect live baitfish. When powerful lights are used, it is reported to attract a large number of organisms including tiny fish other than the intended, and these die or are weakened by the time sufficient baitfish is collected for each fishing effort.

7.2.2 Other pressures on marine biodiversity

Coral bleaching events have affected the marine biodiversity. Maldives has previously suffered bouts of coral bleaching (amongst other natural causes) which caused devastating damage to reefs and their inhabitants. The coral bleaching events of 1999 reduced coral cover to a mean of 2.1 percent compared to the pre-bleaching level of 30-40 percent. Coral bleaching events were also reported in 2010.

Other pressure to marine biodiversity includes disposal of non biodegradable waste generated from imported products on to the reefs, pollution and intensive use of reefs for SCUBA diving and snorkeling. Loss of coastal habitat particularly sea grass beds, mangroves and coral reefs are associated with dredging of harbors and land reclamation.

7.3 Pressures on the terrestrial biodiversity

Pressures to terrestrial biodiversity are caused mainly by removal of vegetation, diseases to plants caused by pests, and use of fertilizers and chemicals. The negative effects of these pressures are continuously monitored and minimized through enforcement of regulations and awareness programs which are set up under the policies and strategies of MHE and MOFA.

7.3.1 Removal of vegetation

The vegetation in the littoral zone including the mangroves and other vegetation have benefits in acting as protection belts for coastal processes. The benefits as highlighted in the Maldives National Action Programme to Address Land Degradation, includes preventing soil and beach erosion and reducing the implications of storms, mitigating the effects of salt spray, storm surges, monsoonal winds and tsunami damage. (P4SD, 2011).

However in many islands physical or urban development is implemented without proper land use plans and removal of vegetation to undertake development activities is on an increasing trend. Housing, infrastructure development and agriculture are all encroaching on the limited vegetation areas, including mangroves and pond areas. Land reclamation is also affecting the

natural vegetation on the inhabited islands. According to the DNP 2011, only 22 islands have approved land use plans at present. Reclamations of island lagoons are undertaken to cater for the demand for extra land required for new housing and infrastructure activities. In the absence of data on areas cleared of vegetation, available indicators are reviewed to understand severity of the situation. Table 7.7 outlines some selected indicators on planned and existing infrastructure development of the country excluding Male urban area.

	Existing	planned
Airports	5	10
Transit airport hotels		9
City hotels		9
Resorts	98	18
Yacht marinas	2	
Agricultural activity islands	76	
Fishing activity islands	56	

Table.7.7:-Some existing and planned economic and infrastructure development (excluding Male urbane area -2011

Source:-Department of National Planning 2011

the

the severity of the situation. Coconut trees and other woody trees continues to be logged for house construction and boat building. Table 7.8 to 7.10 indicates demand for timber shown from quantity of trees logged from uninhabited islands. Over the period 2004-2009, government administrations in 13 atolls approved applications to log on average 200 coconut trees per year. Coconut timber is mostly used for constructing parts of fishing vessels.

	2004	2005	2006	2008
Ha	4			
Sh		20		
N	88	127	0	5
R	8	10		0
B	83	0		10
Lh	0	3		0

K	12	0		12
Adh	0	2		0
Dh	46	32	1	30
Th	10	6	10	81
L	84	47	0	164
Ga	20	6	0	0
Gdh	35	115	0	133
	388	368	11	435

Table.7.8:- Demand for Coconut Timber (in numbers) - 2004-2009

Source:- Ministry of Fisheries and Agriculture, 2011

Atolls	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Ha	34		20			
HDh				49		
Sh			171			
N	25	10793	91			
R	87	6318	108	22	54	88
B	296	110		65	161	367
Lh	22				0	
K	153			49	8	
Aa						
M				98		
Dh				1		
Th				7		
L						25
Ga	32					
Gn						53
	649	17221	545	144	353	455

Table.7.9:-Demand for coconut timber in Mt -2004-2009

Source:- Ministry of Fisheries and Agriculture, 2011

Other types of woody trees are also logged for building purposes (Table 7.11). Almost all atolls have requested to cut down trees for different purposes.

Atoll	2004	2005	2006	2007	2008	2009
Ha	1076	270	1682	839	120	
HDh	1596	0	2264	1931	300	
Sh	3097	20	6433	2969	1701	1975
N	7196	312	2747	2218	3535	200
R	5954	423	5862	1803	2445	1730
B	8819	715	3221	4214	4861	4492
Lh	1109	160	790	880	40	
K	10072	406	9457	11967	1806	2346
Aa	3060	0	1642	200	450	1262
ADh	5000	60	2769	1812	1000	300
V	792	0	447	0	0	0
M	1420	0	1843	830	741	
F	250	0	2168	877	514	200
Dh	838	50	1655	563	300	
Th	2706	10	1204	2177	1451	
L	0	0	2571	1124	400	
Ga	755	0	15	30	103	
Gdh	3000	151	623	57	788	
S	130	0	800	790	58	583

Table.7.10:- Demand for other types of timber in numbers -2004-2009

Source:-Ministry of Agriculture and Marine Resources, 2011

Local name	Common Name	Botanical Name
Uni	Nit Pitcha	Guettarda speciosa L.
Midhili	Country Almond	Terminalia catappa L
Dhigga	Sea Hibiscus	Hibiscus tiliaceus L
Hirudhu	Tulip tree	Hibiscus populnea
Funa	Alexandra Laurel Wood	Calophyllum inophyllum L
Kinbi	Sea poison tree	Barringtonia asiatica L (Kurz)
Kaani	Sea Trumpet	Cordia subcordata Lam
Kuredhi	Iron wood	Pemphis acidula
Nika	Banyan	Ficus benghalensis L.
Kandoo	Small leaf orange mangrove	Bruguiera cylindrical Bl.
Kandhu	Hernandia	Hernandia nymphaeifolia

Table.7.11:-Common types of woody trees is used for different purpose -2011

Source:-Ministry of Agriculture and Marine Resources, 2011

In the past wood was extensively used for cooking and while firewood is slowly being replaced by kerosene and gas in domestic cooking, in poorer islands some households still use firewood for cooking as revealed in Fig 7.4.

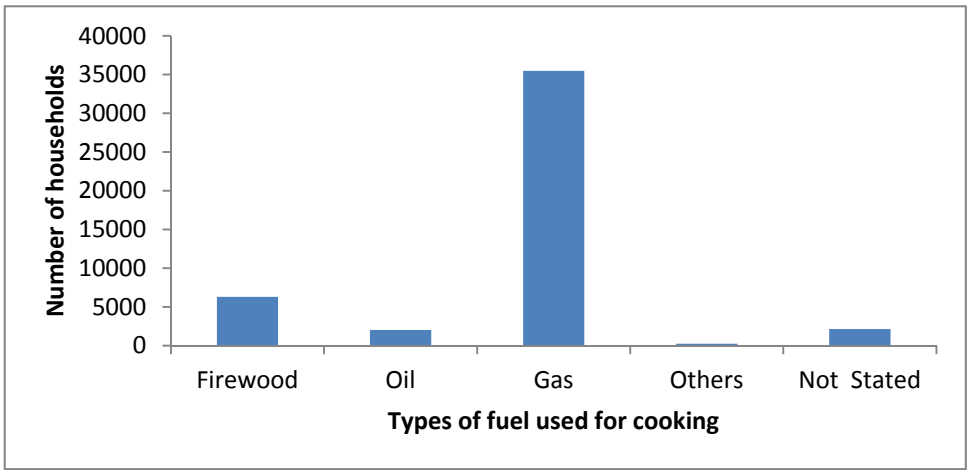


Fig 7.4:-Types of fuel used for cooking –Census 2006

Source:-Department of Planning and Development, 2011

7.3.2 Invasive pest and diseases

Maldives is particularly vulnerable to invasive pests and diseases as the island economy is heavily dependent on imports. These imports are used for meeting local demand as well as that of tourism industry. To date it has been recorded that over 50 diseases causing micro organisms and 53 insect species exist in the country (MOFA 2011). Most of the microorganism and insects are alien species. Data collected from a sample of 60 islands reveals that the most common alien species with the potential to become invasive can be noted as papaya mealy bug, rhinoceros beetle, mealy bugs, scale insects and coconut hispid beetle.

Pests and diseases affect agricultural productivity, in addition to causing negative impacts to biodiversity and environment. Some pest invasions have the potential to become irreversible. Currently the endemic species are highly threatened with increased degradation and fragmentation of natural habitats due to development activities. Recorded events of outbreaks reveal that huge economic losses do occur due to insect and disease invasive species (Table 7.12). Furthermore, biological resources and tree productivity of the country may be threatened by several serious invasive plant species, including *Lantana camara, Mikaniamicrantha* and *Mimosa diplotrich*. Urgent measures to prevent further spread and to manage current incursions have been identified as necessary.

Pests	Details of damage
Gypsy Moth	Causes a lot of nuisance each year through social damage
Coconut Hispid Beetle	Caused extensive damage and loss over USD 259,350 between June 2000-2003
Rhinoceros Beetle	Causes damage to the coconut trees reducing yield
Stem Border	Mango and breadfruit trees are attacked on a country wide scale
Citrus Canker	The local lime varieties are almost wiped out
Banana Weevil borer	Banana trees were affected in 1990
Physillid insect	Affects water and rose apple trees reducing yield
Spiraling white fly and white fly	Common nuisance pest of many crops
Papaya mealy bug	Spreading fast in all papaya growing islands
Sooty Mold Complex	Attach several species of plants including mango, guava, banana and citrus varieties
Anthracnose , fruit rot and virus infections	Fungal , bacterial and viral diseases frequently cause horticultural crop loss

Table.7.12:- Recorded damages caused by alien invasive pests and diseases -2011

Source:-Ministry of Fisheries and Agriculture, 2011

In addition a growing concern about biodiversity of Maldives includes import of birds and other animals as pets. No study has been undertaken to understand the status or the effects of them on biodiversity in the country. Generally released or escaped pets may survive in the wild and can become invasive. Invasive alien species disturb the function of ecosystem and is the leading threat to biodiversity. Data on animals imported into the country reveals that 39 different types of birds, 71 fish species have been imported into the country in 2011 (Appendix 7.2)

7.3.3 Invasive plant species

Ornamental plants are being imported into the country at an increasing rate. Although none of the imported plants noted as invasive the threat exists. Plant and Animal Quarantine Unit under the MOFA control the import of plant disease and pets into the Maldives by sea and air. All invasive species determined by FAO are prohibited imports. From January to November 2011 it is recorded that 105 types of plants have been imported into the country (Appendix 7.3)

7.3.4 Use of fertilizers, herbicides and pesticides

Generally farmers lack awareness about pests and diseases, and the role of herbicides and pesticides. In addition, they do not have adequate knowledge on the application of herbicides and pesticides including doses and frequency of use. Other than pests and diseases, growth of weeds poses additional problems to the farmers. The increase in weeds degrades farmlands and replaces natural vegetation which in turn prevents natural regeneration. As a result, the demand and use of pesticides and herbicides are increasing. A common species is the Lantana camara and grass sp. The grass sp is a rapidly spreading noxious perennial weed among agricultural and natural vegetation. Herbicides are frequently applied for weeding in order to prevent economic losses arising from competition between agricultural crops and weeds. Pesticide residues are detrimental to human health in addition to causing negative impacts on biodiversity and environment.

Table 7.13 illustrates the increase in import of pesticides and herbicides. The annual quantity of fungicide imported is over 2500 kgs between 2004-2009. Similar is the trend for insecticides imported which has gone beyond 2300kgs 147000 liters and 838000 numbers taken into consideration the different types.

Type of pesticide		2004	2005	2006	2007	2008	2009
Fungicides	Kgs	2146.5	1921.53	7221.08	1619.35	1478.6	2115.53
	Ltr	202.13	385.2	308	343.6	512.2	662.15
Herbicides and Algaecides	Kgs	163.3	102	55.24	148	157.2	129.68
	Lts	20.75	15.5			23.6	24
Insecticides and Pesticides	Kgs		37048.98	18738.25	48963.81	14870.48	18769.12
	Ltr	82198.89	96584.82	283008	147491.5	109922.3	163713
	Nos	795598	1611634	449425	1916474	140033	101877
Plant growth regulators	Kgs	500	380.6		30000	27.2	415.27
	Ltr		4.8	12.45	40.6	248.6	19.6
Rodenticides and similar products	Kgs	2132.1	5812.73	3346.57	4102.93	6953.06	3614.25
	Nos	6056	1396	164	1002	1956	2516
Weed killer	Kgs	6.75			2		

Table.7.13:-Imports of pesticides 2004-2010

Source:-Ministry of Fisheries and Agriculture, 2011

Increased use of pesticides is associated with increase in the risk of undesirable side effects on humans, non target-organisms and the physical environment. MOFA advises to follow the guidelines written on the labels of pesticide containers. The use of inorganic fertilizers also shows an increasing trend with 780 mt of fertilizers being imported into the country (Fig 7.5).

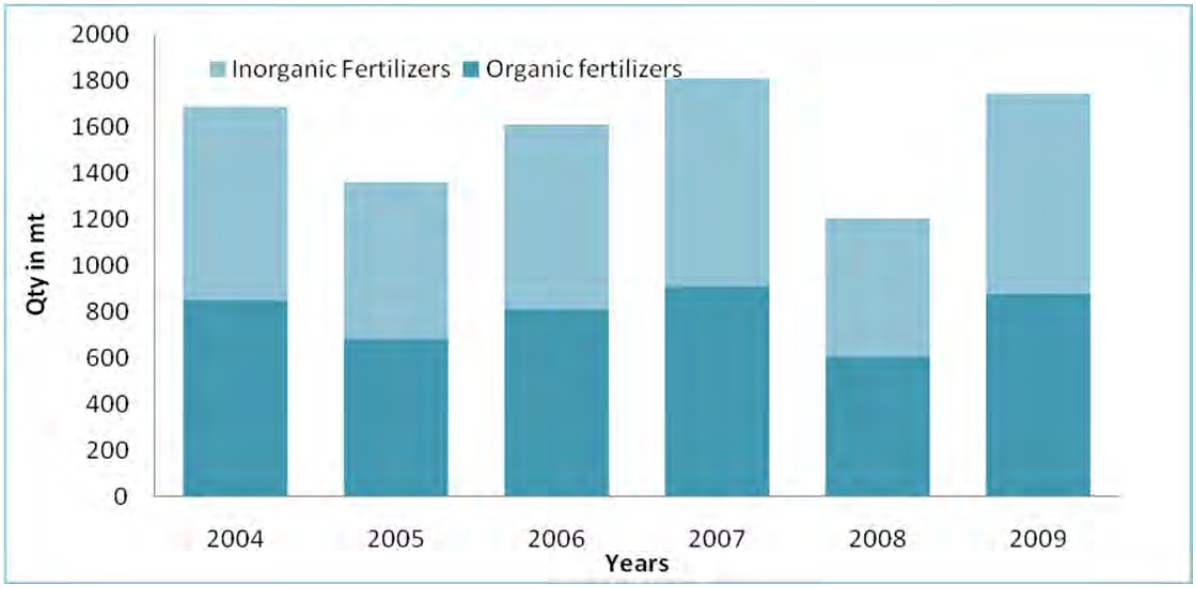


Fig.7.5:-Imports of fertilizers 2004-2009

Source:-Statistical Yearbook, Department of National Planning 2010

7.4 Conservation of Biological Diversity

A widespread recognition exists that conventional approaches have not been effective in conserving the natural environment and biodiversity. As a result government of Maldives has initiated declaring legally protected status to different areas and species in the Maldives. As such, to date, Maldives has accorded protected status to 9 marine species, 39 sites and 70 species of birds. Giving status of legal protection to these areas and species requires institutional strengthening, capacity building, education and awareness towards enforcement of guidelines and management of protected areas. One major program, Maldives Protected Area System Project was implemented between 2000-2003, to address the requirements mentioned. It has provided important lessons directing the way forward.

7.4.1 Protected area management

Recognizing the challenges in managing protected areas, the Government of Maldives, with support from Global Environmental Facility (GEF) and United Nations Development Program (UNDP) is implementing Baa Atoll Ecosystem Conversation Project (AEC) project since 2003. The aim is to design and demonstrate an effective management system for atoll ecosystem conservation and sustainable development on Baa Atoll. The project was formulated to provide the overall framework for sustainable development of the atoll and supports biodiversity

conservation and livelihood. The Baa Atoll Conservation Project (BACP) is the implementing strategy for achieving biodiversity conservation with the purpose to design, test and demonstrate a management system that will secure and sustain the rich biodiversity and ecological processes of the Atoll for the benefit of the future generation. The program is being implemented as a model which can be replicated in other parts of the country. Under the project Baa Atoll is declared as a UNESCO Biosphere Reserve in 29 June 2011.

7.5 Policies and strategies

A strong commitment to the protection and conservation of the biodiversity is enshrined in the constitution of the Maldives ratified in August 2008. Clause 22 of the constitution and article 67

Biosphere Reserve –Baa Atoll

Baa Atoll is famed for its rich biodiversity that includes large mangroves and a unique diversity of fauna. The ring-shaped reef forms are a reef structure which is unique to the Maldives. Hanifaru Bay is considered one the few places in the world where whale sharks congregate in to mate. The bay is also home to some of the largest gatherings of Manta rays worldwide. One hundred individuals gather in the small inlet when the tide pushes plankton into the bay. Recently six areas of Baa atoll were declared protected under law, while the already protected two areas were extended. Mendhu, one of the uninhabited islands of the atoll and its house reef are among the protected areas. Several other uninhabited islands surrounding the area were also declared as protected. The other protected areas include, the marshy swamp in Goidhoo, Dhorukandu, MaahuruvalhiFaru including its surrounding area, MathifaruhuraIsand including house reef, Bathalaahura Island including house reef, GaaganduhuraIsand including house reef and Vinanehfaruhura Island including house reef.The surrounding area of the shipwreck of "Kobin," the ship that ran aground on Fulhadhoo in 1602 is also included in the list of protected areas. The extended areas are Dhigalihaa area, protected since 1998, and the area around Hanifaru Island, protected since 2009. Dhigaligiri and Hanifaru were the extensions to the protected areas.

of the constitution highlights that the state and its citizens and the visitors should respect, protect and conserve the biodiversity of Maldives.

The Environment Protection and Preservation Act 1993 provides the legal justification for the protection of the biodiversity. One of the main policies of MHE is ensuring Biological diversity is sustained for maximization of eco system benefits. Under this policy biodiversity conservation measures are required to be incorporated in all national and sector policies. Under the law marine protected areas highlighted as marine aquariums and activities that are detrimental to marine protected areas and protected species and their habitats, are prohibited. By law cutting

down trees, uprooting, digging out and export of trees and palms from one island to another is prohibited. Also Environmental Impact Assessment (EIA) regulation was formulated in 2007 to strengthen the EIA process and to ensure environmental and socio-economic impacts associated with new developments are accounted for in decision making. Moreover, biodiversity consideration are incorporated in all the environmental plans documents including the Maldives NAPA 2007, NEAP 3, 2009 and the Forestry Policies. The Multilateral Environmental Treaties that Maldives have entered into, all contribute towards protection and preservation of the environment.

The MOFA 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), notifications and written guidelines, drawn in conjunction with the Fisheries Law of Maldives gives guiding principles for the management of fisheries and marine resources. Specific destructive fishing practices are banned in the Maldives. 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, Is also part of the steps taken by the government to conserve and manage coral reefs and the marine environment in a sustainable manner. Biodiversity considerations are incorporated in the regulation formulated for licensing of aquaculture as well.

The agriculture sector's policies and programs and activities incorporates biodiversity consideration. The Sanitary and Phytosanitary protocols that fall under the World Trade Organisation Agreement stipulate that imports of agricultural products may be rejected if a justifiable reason can be found. Under the regulation on import of live plants and plant products import permits and original State Phytosanitary certificate is required for import of live plants. Any shipment without a valid original State Phytosanitary Certificate will be detained until further notice. Shipments must not include dried parts in any of the live plants and plant product or soil particles. The regulation requires notification 72 hrs prior to the expected time of arrival of the consignment and the flight number to plant protection and animal quarantine unit in Hulhule. Additionally, regulations for importation of live animals, regulation on mining and utilization of coral sand and coral aggregates are important efforts contributing to the protection of biodiversity.

Guidelines on keeping pet birds in Maldives and poultry quarantine in Maldives also plays a role towards protection and preservation of the environment. To strengthen the legal framework

bills on plant protection and pesticides have been drafted and are currently open to public consultation. The ministry is also formulating a bill on agricultural land in order to create a conducive environment for sustainable agriculture and forestry development. Conservation of island ecosystems through monitoring, surveillance, training and awareness are part of strategies. The programs promoting biological control of plant diseases and pests also plays a major role towards protection and preservation of environment.

The MTAC has their respective policies and strategies targeted to the protection and preservation of the biodiversity. The Tourism Act of Maldives 1995 provides the legal framework with provision for Regulations on Protection and Conservation of Environment. Regulations on scuba diving also instructs divers to take reasonable care to protect living organisms and their habitats, avoid damage to corals and avoid physical contact with marine animals Protected areas, as their name suggests, are declared to protect areas of the coral reef system, and its resident fish and other animals, and to maintain reefs in a pristine condition.

Scientific Name	**Common Name**	**Local Name**
Avicennia marina	Grey mangrove	Baru
Bruguiera cylindrica	Small-leafed orange mangrove	Kan'doo
Bruguiera gymnorrhiza	Large-leafed mangrove, oriental mangrove	Bodu Kan'doo, Bodu Vaki
Bruguiera sexangula		Bodu Vaki
Ceriops tagal	Yellow mangrove	Karamana
Excoecaria agallocha	Blinding tree, river poison tree	Thela
Heritiera littoralis	Looking glass mangrove	Kaharuvah gas
Lumnitzera racemosa	Black mangrove	Burevi
Pemphis acidula	Iron wood	Kuredhi
Rizophora apiculata		Thakafathi
Rhizophora mucronata		Ran'doo
Sonneratia caseolaris	Crabapple mangrove apple	Kulhavah
Xylocarpus rumphii	Ceder mangrove	Maru gas

Appendix 7.1 Mangrove species identified in the Maldives

Source: - Ministry of Housing and Environment, 2010

Birds	Fish	Fish	Poultry
Agapornis Personatus	*Stagonopleura Oculata*	*Osphronemus Goramy*	*Anas Platyrhyncos*
Agapornis Pullarius	*Taeniopygia Guttata*	*Osteoglossum Bicirrhosum*	*Coturnix Japonica*
Agapornis Roseicollis	*Zenaida Macroura*	*Pangio Myersi*	*Gallus Domesticus Ancona*
Aidemosyne Modesta	*Amphiprion Ocellaris*	*Paracheirodon Innesi*	*Gallus Domesticus Australorp*
Alexendriae	*Amphiprion Percula*	*Pelvicachromis Pulcher*	*Gallus Domesticus Legghorn*
Amazona Aestiva	*Apteronotus Albifrons*	*Phractocephalus Hemioliopterus*	*Gallus Domesticus Minorcas*
Ardeola Speciosa	*Astronotus Ocellatus*	*Plotosus Limbatus*	*Gallus Domesticus Sussex*
Barnadius Zonarius	*Barbonymus Schwanenfeldii*	*Poecilia Latipinna*	*Gallus Gallus Domesticus*
Callipepla Californica	*Botia Macracantha*	*Poecilia Reticulata*	*Melegris Gallopavo*
Chrysolophus Amherstiae	*Butis Butis*	*Poecilia Sphenops*	*Numida Meleagris*
Chrysolophus Pictus	*Calico Goldfish*	*Poecilia Velifera*	**Goats**
Columba Livia	*Carassius Auratus*	*Pseudochromis Paccagnellae*	*Cross bred Malabar*
Columba Livia Domestica	*Carassius Auratus Auratus*	*Pseudomystus Siamensis*	
Coturnix Chinensis	*Cichlasoma Citrinellum*	*Pseudotropheus Tropheops*	**Insects and micro organism**
Coturnix Delegorguei	*Cichlasoma Meeki*	*Pseudotropheus Zebra*	*Apis cerana*
Erythura Cyaneovirens	*Clarias Batrachus*	*Pterophyllum Scalare*	*Eisenia foetida*
Haematenotus	*Colisa Lalia*	*Puntius Conchonius*	
Lonchura Domestica	*Colossoma Brachypomum*	*Puntius Tetrazona*	**Cats**
Lonchura Striata	*Colossoma Macropomum*	*Scarus Coeruleus*	*European*
Lophura Nycthemera	*Cyprinus Carpio*	*Scleropages Jardini*	*European Short Hair*
Louchura Leucogastroides	*Danio Rerio*	*Scleropages Legendrei*	*Siberian*
Melopsittacus Undulatus	*Devario Aequipinnatus*	*Symphysodon Aequifasciatus/Symphysodon Heckeli*	*Siamese-Persian*
Neochmia Modesta	*Dimidiochromis Compressiceps*	*Synchiropus Splendidus*	*Maine Coon*
Neochmia Phaeton	*Garra Ceylonensis*	*Tetraodon Cutcutia*	*Persian*

Neophema Splendid	*Gymnocorymbus Ternetzi*	*Tetraodon Fluviatilis*	*Mixed Breed*
Neopsephotus Bourki	*Gyrinocheilus Aymonieri*	*Thorichthys Meeki*	
Nymphicus Hollandicus	*Helostoma Temminckii*	*Trachemys Scripta*	**Rabbits**
Pavo Cristatus	*Hemichromis Bimaculatus*	*Trichogaster Leeri*	*Leporidae cuniculas*
Peophila Acuticauda	*Hemigrammus Rhodostomus*	*Trichogaster Trichopterus*	
Platycercus Elegans	*Hypostomus Plecostomus*	*Xiphophorus Helleri*	
Platycercus Eximius	*Kryptopterus Cryptopterus*	*Xiphophorus Maculatus*	
Platycercus Icterotis	*Labidochromis Caeruleus*	*Yasuhikotakia Modesta*	
Poephila Acticauda	*Macrobrachium Rosenbergii*		
Poephila Bichenovii	*Macrognathus Siamensis*		
Poephila Personata	*Melanochromis Auratus*		
Polytlis Alexandrae	*Metriaclima Callainos*		
Psephtus Heamatonotus	*Metriaclima Estherae*		
Psittacula Krameri	*Metriaclima Greshakei*		
Serinus Domesticus	*Metynnis Hypsauchen*		

Appendix 7.2: Birds and other animals imported January –November 2011

Source:- Ministry of Fisheries and Agriculture, 2010

Scientific Name	**Scientific Name**
Aglaonema 'Silver Queen'	*Echinodorus harbich spe. spotted*
Aglaonema simplex	*Echinodorus par.'tropica'*
Alternanthera bettzickiana	*Echinodorus subalatus*
Alternanthera lilacina	*Echinodorus uruguayensis*
Alternanthera reineckii	*Egeria densa*
Alternanthera sessilis	*Egeria najas*
Alternanthera sp. 'Red Round'	*Eleocharis parvula*
Amazon with wood	*Eleocharis vivipara*
Ammania gracillis	*Eriocaulon cinereum*
Anubias Barteri var. nana	*Hottonia inflata*

Anubias with wood	*Hygrophila Angustifolia*
Aponogeton crispus	*Hygrophila corymbosa*
Aponogeton elongates	*Hygrophila difformis*
Aponogeton rigidifolius	*Hygrophila polisperma*
Aponogeton ulvaceus	*Hygrophila salicifolia*
Bacopa caroliniana	*Hygrophila stricta*
Bacopa myriophylloides	*Lilaeopsis novae zealandiae*
Bettzickiana Aurea	*Lilaeopsis novaezelandiae*
Bettzickiana Green	*Limnophila aromatic*
Bettzickiana red	*Limnophila hippuroides*
Blyxa aubertii	*Limnophila sessiliflora*
Bolbitis heteroclite	*Limnophilia heterophylla*
Bolbitis heudelotii	*Lobelia cardinalis 'small form'*
Cabomba aquatic	*Ludwigia inclinata*
Cabomba caroliniana	*Ludwigia indianta*
Cabomba Furcata	*Ludwigia repens*
Cabomba piauhyensis	*Ludwigia sp*
Cardamine palaeformis	*Ludwigia stricta*
Ceratophyllum demersum	*Lysimachia nummularia*
Chlorophytum bichetii	*Mayaca sellowiana*
Cryptocoryne balansae	*Micranthemum umbrosum*
Cryptocoryne bechetti	*Microsorium pteropus*
Cryptocoryne cordata car. Siamensis	*Myriophyllum matogrossense (red)*
Cryptocoryne lucens	*Myriophyllum tuberculatum*
Cryptocoryne petchii	*Nesdea specious*
Cryptocoryne pontederiifolia	*Nomaphila siamensis*
Cryptocoryne spiralis	*Nuphar japonica*
Cryptocoryne tropica	*Nymphaea spc.*
Cryptocoryne wendtii "green"	*Nymphaea species "red"*
Cryptocoryne wendtii "red"	*Ophiogopon "Kyoto"*
Cryptocoryne wendtii green	*Ophiopogon japonicas*
Didiplis diandra	*Rotala Indica*

Dracaena deremensis striped	*Rotala rotundifolia*
Cryptocoryne wendtii green	*Rotala rotundifolia "Red"*
Dracaena sanderiana	*Rotala wallichii*
Dracaena sanderiana 'variegatus	*Tonina fluitans*
Drecana margineta	*Trapa natans*
Drecana margineta ver.	*Trichomanes javanicum*
Echinodorus Amazonicus	*Vallisneria Americana*
Echinodorus argentinensis	*Vallisneria asiatica*
Echinodorus Bleheri	*Vallisneria gigantean*
Echinodorus cordifolius	*Vallisneria spiralis*
Echinodorus dekumbens	*Vallisneria torta*

Appendix 7.3: Plants imported into the country January –November 2011

Source:- Ministry of Housing and Environment, 2010

8. Chemical and toxicology

Key findings

Developing a healthy and safe environment for the citizens is a priority under the Environment Law, with provisions for environmentally sound management of hazardous waste, chemicals and oil.

Existing constraints pertaining to chemical management includes lack of chemical database, trained staff and equipment for chemical management. The need to strengthen laws and regulations pertaining to chemical management also exists.

Draft Pesticide Act currently opened up for public consultation and drafting of new regulation under the Law on Importation of Prohibited Items to the Maldives are noteworthy developments towards chemical management.

8.1 Introduction

In Maldives a trend of increase in imports of chemicals is noted by concerned authorities, highlighting that the country is faced with wide ranging issues pertaining to chemical management. The capacity to study and analyse the situation is limited with no baseline information established, to determine whether chemical usage within the country is an emerging health issue. Statistics pertaining to the chemicals imported into the country is unavailable, although prior permission from the Ministry of Defense and National Security (MODNS) is required before importing chemicals into the country.

The general scientific cause and effect of chemicals usage and toxicology states that potential toxic effect increases as the exposure increases and that all chemicals will exhibit effects when exposed to large doses. This aspect emphasizes that toxic potency of chemicals is ultimately defined by the amount of chemical exposure. Generally toxicity or harmful action inherent in a chemical substance occurs when a living biological system comes into contact with a chemical substance. Chemicals enter the body through four main routes which is absorption through the respiratory system, skin, digestive tract, by eating or smoking, through contaminated hands or contaminated work areas and absorption through syringe needle or broken glass.
Skin-absorption may be a significant factor in the use of pesticides in Maldives. It is a well known fact that in Maldives use of pesticides for agricultural purposes is common and increasing in rural islands which is a cause for concern.

8.2 Chemical usage

Chemicals, in any form, are not produced in the country. However, recent rapid developments and urbanization of the country have resulted in an increase in the import and use of chemicals and related components. In the absence of specific databases, analysis of chemical usage in the country has to be based only information on imports available from Maldives Customs Service (MCS)which shows that under the broad category of Chemicals and Related Industries, a variety of chemicals are imported. The CIF value for these Chemicals and Related Industries are published regularly in the Statistical Yearbook (Fig 8.1) which shows that the value has increased over the years. This is a very crude indicator of imports of chemicals and a detail study of the quantity within these categories are required to understand the status on trends in imports of specific chemicals.

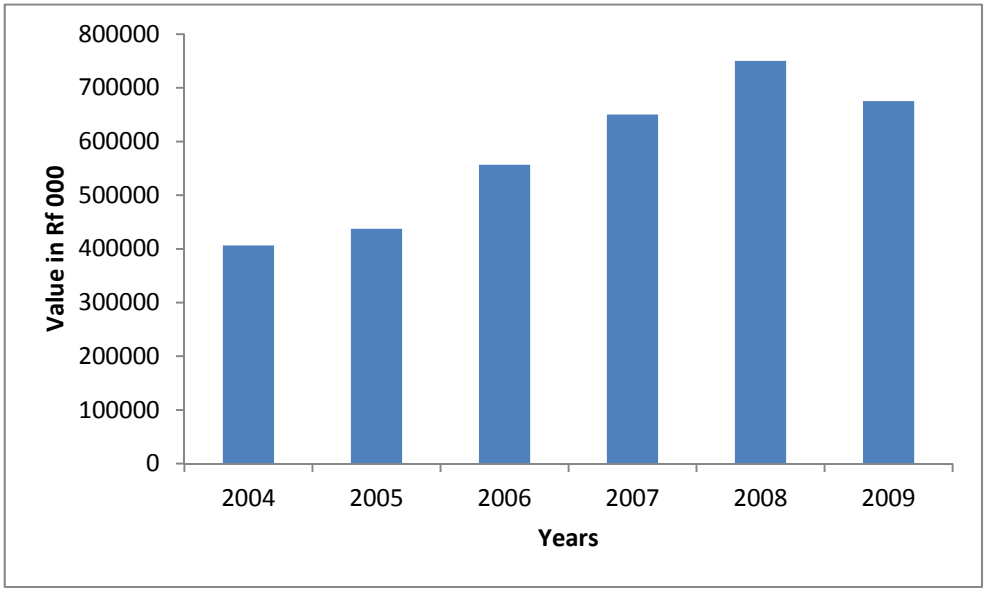


Fig 8.1:-CIF Value of Chemicals and related industries imported 2004-2009

Source: Department of National Planning, 2010

The broad category of imports of chemical and related industries are subdivided under the harmonized system into a number of groups as follows:

Inorganic chemicals, organic/inorganic compounds of precious metals, isotopes

Organic chemicals

Pharmaceutical products

Fertilizers

Tanning or dying extracts, dyes, pigments, paints and varnishes, putty and ink

Oils and resinoids, and perfumery, cosmetic or toilet preparations

Soaps, detergents and cleaners, waxes, scouring products, candles, modeling pastes and dental waxes

Albuminoidal sub, starches, glues and enzymes

Explosive matches and pyrotechnic products

Photographic or cinematographic goods

Based on the above categories the main chemical usage within country can be classified under the following three main categories

Chemicals used for agricultural purposes

Chemicals used for health purposes

Chemicals used for household and industrial purposes.

8.2.1 Chemical used for agricultural purposes

Chemicals usage for agricultural purposes is largely based on the use of the pesticides for control of pest on agricultural crops, plantation trees and ornamentals. Table 8.1 outlines the pesticides imported for agriculture by purposes, for the period 2004-2009

(iirelevant photograph)--------

Type of pesticide		2004	2005	2006	2007	2008	2009
Fungicides	Kgs	2146.5	1921.53	7221.08	1619.35	1478.6	2115.53
	Ltr	202.13	385.2	308	343.6	512.2	662.15
Herbicides and Algaecides	Kgs	163.3	102	55.24	148	157.2	129.68
	Lts	20.75	15.5			23.6	24
Insecticides and Pesticides	Kgs		37048.98	18738.25	48963.81	14870.48	18769.12
	Ltr	82198.89	96584.82	283008	147491.5	109922.3	163713
	Nos	795598	1611634	449425	1916474	140033	101877
Plant growth regulators	Kgs	500	380.6		30000	27.2	415.27
	Ltr		4.8	12.45	40.6	248.6	19.6

Rodenticides and similar products	Kgs	2132.1	5812.73	3346.57	4102.93	6953.06	3614.25
	Nos	6056	1396	164	1002	1956	2516
Weed killer	Kgs	6.75			2		

Table 8.1 outlines the pesticide imported for agriculture purposes for the period 2004-2009

Source: Ministry of Fisheries and Agriculture, 2010

As table 8.1 shows, under the broad category of pesticides, 5 types of pesticides are imported into the country. They include fungicides, insecticides, plant growth regulators, rodenticides and weed killers. It is noted that import of 3 types of pesticides is on the rise, while for the rest quantity imported varied without any significant decreasing trends, during the period between 2004 and 2009.

Type of pesticide	2004	2009	Increase in percentage
Fungicides (Ltrs)	202.13	662.15	228
Insecticides (ltrs)	82,198.89	163,713	99
Rodenticides (ltrs)	21,32.1	3614.25	70

Table 8.2: Increase in use for pesticides

Source: Ministry of Fisheries and Agriculture, 2011

With an increasing trend, cause for concern arises due to the inadequacies on the instructions on use of and precautions to be taken in the application of pesticides leading to gross abuse. Based on different assessments and observations, MOFA have identified several inadequacies with regard to the to the use of pesticides for agricultural purpose which are summarized in table 8.3

Key issues	Details
Inadequacy in labeling	Some labels in foreign language Some shops even repack with their own labeling Older farmers are not able to read the labels
Pesticide abuse	Recommended protective gear is hard to find and often not usedFarmers are unable to distinguish plant disease and plant pest Frequent doses are applied Pre harvest intervals not known and respected Sunken well used for irrigation purposes are used to mix the pesticide
Inadequacy in Storing and disposal	Empty containers are sometimes buried or disposed off as garbage
Inadequacy in registration process	No registration process. Permission granted by MoFA based on WHO of hazardous class List not updated in a timely manner

Table 8.3: Issues related to use of pesticides

Source: Ministry of Fisheries and Agriculture, 2011

In the absence of the data pertaining to use of pesticides in the country, information from MOFA were reviewed to analyse the situation on use of pesticides within the country.

According to (Krantz, 2007) a review of the pesticides that had been approved by MOFA during the period January 2006 to May 2007 revealed that 221 different types of pesticides had been imported, which included 19 types that falls into WHO Hazard Class I (extremely/highly hazardous). The survey further showed that the list of imported products included many products that are highly toxic to fish and/or carry a high risk of groundwater contamination. Several of the imported products are known carcinogenics. Additionally according to Wulp,

(2009), brief surveys conducted in shops during July 2009 found two products that fall in WHO Hazard Class I: Methomyl and Monocrotophos. Both are now prohibited in Maldives. Large proportions of the products on sale are "old generation" generics that are relatively cheap to buy, but tend to have higher social costs to health and environment. Many of the products currently used are no longer permitted in the EU and in principle could be substituted by newer alternatives that are more selective and have lower human toxicity. Increasing overuse of pesticides and disregard of pre-harvest intervals are observed indicating a high risk of pesticide residues.

To date no significant residue testing has been conducted and the degree of contamination of fruit and vegetables remains unknown. The Maldives Food and Drug Authority (MFDA) has a laboratory that is used for conducting a range of tests including water quality, histamine in fish, alcohol traces in beverages, etc. At present, routine tests for pesticide residues on fruits and vegetables, are not undertaken.

Support is being received from UNDP and UNEP for activities to raise awareness on the hazards caused from the misuse and abuse of pesticides. In addition to the training provided by MOFA pesticide selling outlet and 6 shops which sell agricultural pesticides provide some information on the safe use of pesticides. MOFA outlet provides advice on incidence of pests and proper treatment, to the people who come to buy pesticides. The outlet also display different types of pesticides, and provide information on most effective or relevant pesticide that is recommended for farmer use. The collection included *Actellic, Carbendazim, Carbofuran, Carbusulfan, Chlorpyrifos, Cypermethrin, Deltamethrin+triazophos, Endosulfan, Fenthion, Fenvalverate, Fipronil* and *Imidacloprid*. Information sheets written in national language have been prepared for all pesticides on sale, emphasizing precautions to be taken in the handling and application of pesticides, especially in the protection of eyes and skin. Shops which sell pesticides are also required to provide information on the proper handling and use of pesticides.

The main distributor of pesticides in the country provides color leaflets with translated product information, which includes pictures of the pests for which the product is intended, dosage rates for different pest-crop combinations, and pre-harvest intervals. The company provides training to farmers on the agricultural islands. Their main pesticide product distributed by the company is Carbofuran (3% GR), which in the first half of 2009 accounted for more than 50% of the volume imported. Other imports are Sulfur, Avermectin, Dimethoate, Profenofos and Mancozeb. The company also imports softer products and is trying to develop their market, but change in demand is slow as farmers are accustomed to the older product listed above.

8.2.2 Chemical used for health purposes

The Centre for Community Health and Disease Control (CCHDC) functioning under Ministry of Health and Family (MOHAF).is responsible for public health vector control. Its policy is to minimize the use of chemicals and use environmental control options where possible. The main vectors that do require chemical control are mosquitoes transferring dengue fever and Chikungunya virus. Chemical control of mosquito is applied when dengue cases increase, typically twice per year. Control involves fogging in areas of Male' and Villingilli with Ultra Low Volume (ULV) application in specific areas with high concentration of mosquito presence. Overall, volumes used are modest. In the past, pesticides weresupplied from World Health Organisation (WHO), but at present the Centre obtains them from importers in Male'. Pesticides are applied by staff of the MOHAF who received basic training and have access to the necessary protective gear. Vector control at the resorts is mainly carried out by specialized pest control operators who buy their own pesticides. In Male' there are at least three companies offering such services. Some of the resorts control pests on their own. The CCHDC uses Malathion and Deltamethrin for its public health related activities.

8.2.3 Chemicals for household use

Household pesticides are used for pest sanitation in tourist resorts (mainly mosquito's, rodents and cockroaches). Other pest control operations include activities undertaken by specialized pest control companies and includes protection of ornamentals from pests.

Table 8.4 provides the some of the pesticides imported for household use for the period 2004-2009, of which many of the products shows increasing trends.

Type of pesticide		2004	2005	2006	2007	2008	2009
Antiseptic , Disinfecting Or Sterilizing Solution	Ltr	7350.8	7537.18	8879.99	18722.45	9404.62	25275.85
Antiseptic Cream	Kgs				919.53		346.68
Antiseptic Cream, Dettol Cream and Glove power	Kgs					5195.44	
Mosquito Coil	No	878164	2020651	1046315	1764839	2277603	2649870
Mosquito coil and mosquito repellent	Kgs	38789.29	28898.9	473822.2	42295.31	19595.26	10922.71
Mosquito mat	Nos						

Naphthalene moth balls	Kgs	28639.47					
Detol	Lts	35753.85	19957.11	35957.6	41487.95	46619.05	33239.32
Detol Cream and glove powder	Kgs	133.26	444.86	1372.08			
Disinfectant	Kgs	5016.5	6763.28	5468.25	5960.19	3002.26	4145.37
Fly trap and cockroach trap	No	8822	3500	13812	12834	12174	7099

Table 8.4: Some of the pesticides imported for household use 2004-2009

Source: Ministry Fisheries, Agriculture and Marine Resources, 2011

Pesticides are used to control mosquitoes, rats, cockroaches, termites and ants. Pest control services providers offer regular pest control services to the resorts. One company provide pest control services for about 70 resorts and provides training and supplies to other resorts. In some islands they have a permanently stationed staff. All pesticides for use on resorts are supplied through Male' and all imports follow the established approval procedure. According to MFDA they receive about 12 requests per month, mainly from pest control companies and resorts. Information provided by MFDA indicated that the total quantity approved during the first half of 2009 was only 0.7 mt. According to MFDA there are about 6 companies in the Maldives that provide pest control services.

8.2.4 Chemicals for construction purposes

In addition to the household use, chemicals are an integral part of construction activities. Data on chemical used for construction purpose is not available. Generally a number of chemicals are used in the construction process, in order to provide greater stability, durability, strength, and luster to the structure. Several chemicals such as adhesives, epoxy products, sealants, joinery products, are commonly used for the purpose of construction. Construction workers handle toxic substances on a daily basis, usually without apparent impact or injury.

8.3 Disposal of chemicals

Chemical should not be disposed of by common means like other by-products used in our lives,and as such, a formal procedure is in place. The MDANS is formally responsible for disposal of hazardous chemicals. This is done at the island of Tamburudhoo, which is used for military training.

Household pesticides containers are often disposed of with the every-day garbage. Empty containers are buried or burned at the edge of the fields, or disposed of with the garbage. Importing companies maintain small stocks that are turned-over relatively fast and then replenished by new imports. New stocks typically are ordered every 1-3 months. The CCHDC stores its pesticides on the nearby island of Thilafushi, the "industrial" island where waste is disposed

8.4 Policies and Strategies

The Government of Maldives gives high priority to develop a healthy and safe environment for the citizens. According to the SAP 2009-2013 the government aims to 'Ensure protection of people and the environment from hazardous waste and chemicals.' Under this policy two main strategies are outlined.

They are:

- Establish a National Chemical Information System and develop regulations and guidelines for safer use, handling and disposal of all chemicals.
- Initiate a Hazardous Waste Communication (notification and movement system) to meet international systems

Different organisations work towards the protection of people from the effects hazardous waste and chemicals. The Environment and Protection and Preservation of Act (Law no 4/93) of MHE has its provisions on environmentally sound management of hazardous waste, chemicals and oil. The MDNS is mandated by Law 4/75, Law on Importation of Prohibited Items to the Maldives" to regulate, among others, the import of dangerous chemicals into the country. Article 5 of the Act states that all dangerous chemicals (except for fireworks) and acids and other poisonous items produced using these chemicals can only be imported into the country with written permission from the MDNS and in accordance with such rules and regulations set out by the Ministry. The Ministry has formulated the relevant Regulation stated in Article 5, but it is yet to be implemented. Implementation has been delayed due to the unavailability of trained staff and the necessary equipment needed to carry out specific tasks stated in the regulation.

Control and Regulation of chemicals is split between different organizations. Pesticides are regulated through the MOFA which process the request of imports of chemicals. Requests typically contain the trade name, unit size and number of units. In several cases the active ingredient and formulation are also provided. MOFA looks up the category of the product (fertilizer, insecticide, fungicide, herbicide, etc) and attempts to find the active ingredient if it

has not been provided and are then checked against the list of prohibited pesticides. Products that are not on list get approved and send to the MDNS for the final approval.

The Agricultural Master Plan 2006-2012 also emphasizes on the regulation of pesticides and states that the ten-point action plan suggested for the agriculture sector in the NBSAP needs to be internalized and integrated in all agricultural development programmes and projects. The NBSAP action plan for agriculture encompasses a comprehensive array of actions including minimal use of chemicals harmful to soil and soil organisms, adoption of Integrated Pest Management practices, controlling the handling and use of pesticides, and provision of adequate institutional and legal framework.

MFDA also play an important role in approval of public health pesticides. The same principle applied by the MOFA is used for public health issues/medical sector. MFDA uses a positive list for approval of public health pesticides. Only pesticides on the positive list get approved. It has a format for requesting approval, which contains the Brand name, Chemical name, Quantity and Intended Use. Information about the formulation and concentration is not requested. The scheme has been in existence since 2006.

Pharmaceuticals are under the mandate of the MOHAF. For ODS, prior approval is necessary from MHE. The MDNS approves importation of pesticides that have been given a no-objection by MoFA or MFDA.

Maldives is a Party to many chemical related conventions and agreements such as the Montreal Protocol on Substances that Deplete the Ozone Layer, Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, Stockholm Convention on Persistent Organic Pollutants, Rotterdam Convention on the Prior Informed Consent Procedure for certain hazardous chemicals and pesticidies in interntaional trade. The country is also a member of the Intergovernmental Forum on Chemical Safety, Strategic Approach to International Chemicals Management. The Maldives is also Party to the Convention on the Prohibition of the Development, Production, Stockpiling and use of Chemical Weapons and on their Destruction (CWC), with the MDNS being the National Authority. The Ministry is currently working on drafting a bill on Chemical Weapons with assistance from OPCW.

Implementation and monitoring of environmentally sound management of hazardous waste and chemicals has been a challenge to Maldives due to the lack of a chemical database or even a baseline indicating the usage and disposal of these chemicals. The legal framework and the rules

and regulation developed reveal the concept of precaution is recognized. Planned efforts towards strengthening the foundations of chemical management include draft bill on pesticides which is currently for public consultation. This National Pesticide Act will be the major legal instrument to regulate import, use and dispose all types of pesticide in the country. The MDNS also has formulated the relevant Regulation stated in Article 5, of the Law 4/75 "Law on Importation of Prohibited Items to the Maldives"

The project formulated for the Strengthening Capacities for National Strategic Approach to International Chemicals Management in Maldives also includes important components that would strengthen the chemical management within the country. The project includes plans to assess legal, institutional, administrative and technical aspects of chemical management and the extent of chemical availability and use in the country with existing capacities and inadequacies. Formulation of the national chemicals management database is also an important component of the project. These efforts when implemented will greatly improve the chemical management within the country providing a much needed baseline assisting adherence to the national as well international obligations toward chemical management.

9. Energy

Key findings:

- Government is focused on making the country carbon neutral by 2020. Policy mechanism designed to accelerate investment in renewable energy includes waiving import duties on solar panels, solar panel batteries used in marine vessels, and on renewable energy powered vehicles.
- Power Purchasing Agreement with STELCO and Chinese company has been signed under which a wind farm of 20 MW is to be established to power greater Male region. The plan also includes connecting the greater Male' region through submarine cable to establish a regional power grid.
- Other important policy mechanisms designed to accelerate investment in renewable energy includes opening the sector to for private investors and introducing feed-in tariff making it mandatory for utilities companies to purchase power from independent renewable energy power producers.

9.1 Introduction

The Maldives has announced plans to green its energy sector as pledged under the Copenhagen Accord to become carbon neutral by 2020. The government appointed a task force to deliberate on the various pre-requisites and requirements for reducing energy sector carbon emissions in line with overall objective of carbon neutrality. A roadmap in the energy sector to reduce dependence on fossil fuels was developed which was build on 5 key areas. (Fig 9.1)

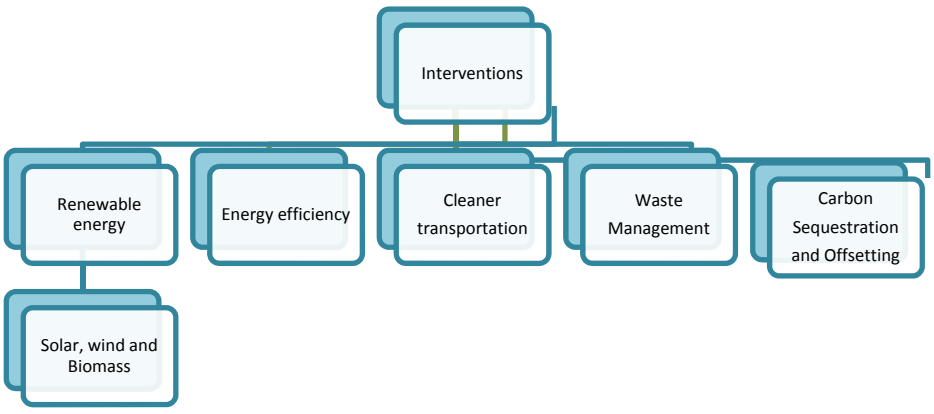


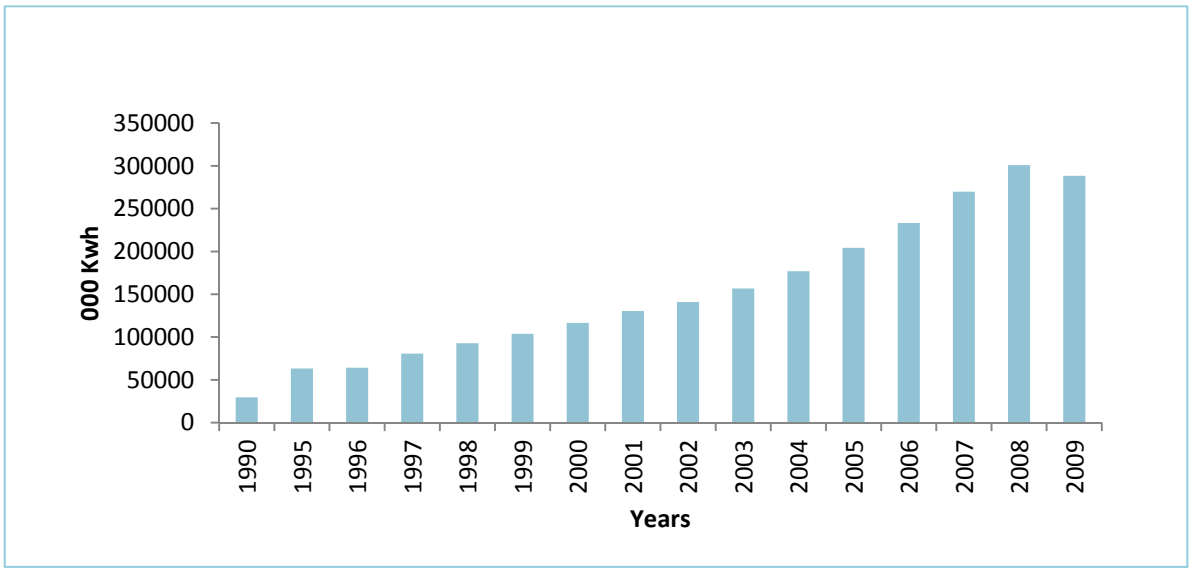
Fig 9.1:-Key areas of intervention for achieving carbon neutrality by year 2020

Source: Ministry of Housing and Environment, 2011

These measures were announced in the face of stark warnings from scientists that rising sea levels even by one meter could engulf the Maldives and other low lying nations rendering the islands almost entirely uninhabitable. For Maldives to become carbon neutral by the year 2020 the increasing demand for energy need to be reduced. Prerequisites and requirements for reducing energy sector carbon emission in line with the overall objective of carbon neutrality, is to be determined with the formulation of the Carbon Neutral Master plan by 2012. The Framework for Energy Investment in the Maldives was developed as a preparatory exercise prior to start of the renewable energy investment plans. The Maldives 2009 Carbon Audit Report (2010) estimated increase in energy demand at 85% for the Male' region and 77% for the provinces underlining the need investing in renewable energy.

9.2 Energy Sector

The energy sector of the country relies on imported fuel which consists of diesel fuel oil used for electricity production followed by petrol, LPG, aviation fuel and kerosene oil. Maldives imports all its fuels in refined form and in very small quantities, which makes fuel even more expensive. The geography of the country with island scattered over vast distance makes it difficult and costly to transport fuel to the communities. As figure 9.2 illustrates yearly consumption of fuel is growing rapidly, resulting in increase in the proportion of foreign exchange spent on fossil fuels.



Note: Data from the provincial utility companies not included in the year 2009

Fig 9.2: Electricity production 1990-2009

Source: Department of National Planning, 2010

Maldives is a small nation consisting of 1192 islands out of which inhabited remains at 194, while another 97 islands are developed as tourist resorts, each of them having independent electric power generation systems and other utility infrastructure. The electricity production is decentralized and based on production units of various sizes. The State Electric Limited Company (STELCO) provides electricity to 7 islands, while Utility Companies provide electricity to the other islands. The energy usage of the country by service providers is outlined in Table 9.1

Utility Companies	**Generation of electricity**	
	GWh	%
STELCO	237	71
Upper North Utilities Ltd	22.3	7
North Utilities Ltd	19.4	6
Central Utilities Ltd	6.7	2
South Central Utilities Ltd	8	2
South Utilities Ltd	29.8	9
Upper South Utilities Ltd	10.6	3
Resorts industries	NA	NA
Total	**333.8**	**100**

Table 9.1: The energy usage of the country by service providers -2009

Source: Department of National Planning, 2010

The total installed power capacity of the 7 utility companies is equal to 106.2 MW. The main electricity provider STELCO has an installed capacity of 61.98 MW with 49. 6 MW installed in the capital Male'. The power plants of STELCO are diesel operated. Without a complete connection by a grid system privately owned diesel generators are operated in the resorts and other industries. The generation of electricity by province reveals that 71 percent of the power is generated for the greater Male' area. Maldives Energy Authority estimates that the resort with their diesel generators will be generating 120 GWh.

The power generation and distribution systems set up in the islands are currently in the process of being integrated into the government utility companies. These utilities were previously operated by Island Development Committees with the financial assistance from the Government. Under the Asian Development Bank, Outer Islands Electrification Project implemented from 2005-2010 under which community generators were installed in a number of islands. In term of electricity utilization it is estimated 47% is utilized for residential purposes, 35% for manufacturing and commercial purposes and 16% for government buildings while 2% accounts public places and schools (Fig 9.3)

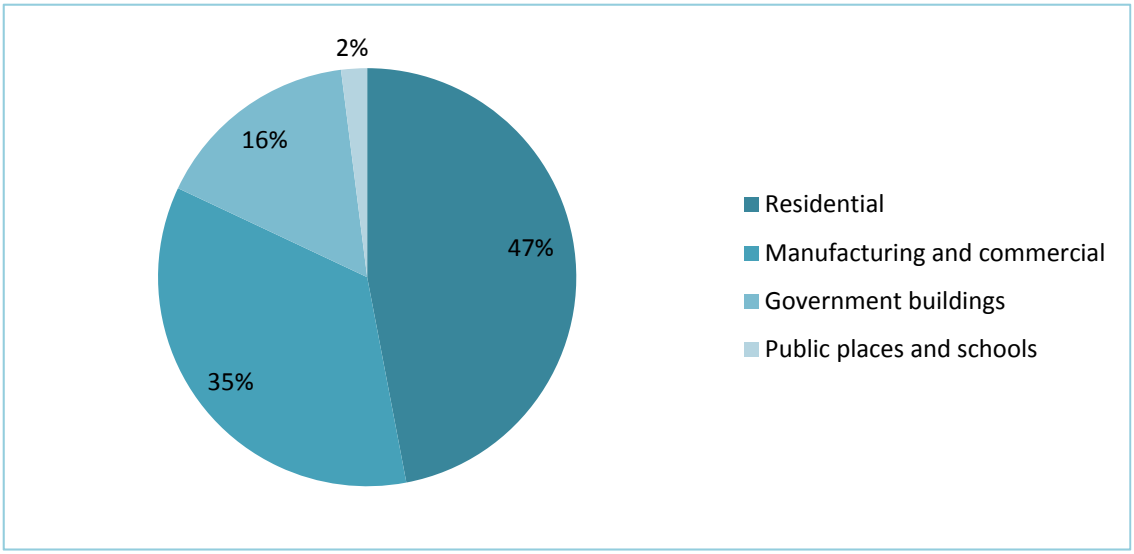


Fig 9.3: Electricity Utilization in Male 2006-2009

Source: Department of National Planning, 2010

9.3 Renewable Energy

The three potential renewable energy resources in the Maldives are solar, wind and biomass. Potential for marine energy is being studied and is yet to be determined. Initially renewable energy technology applications in Maldives were limited to some applications of solar photovoltaic cells in navigation lights and in outer island telecommunication systems. Renewable energy was used to power navigational lights (marking the reefs), communication transceivers on fishing boats and supply power for remote installations on the national telecommunication network. Solar energy is also used on a small scale for producing hot water for homes and in the tourism industry.

After unveiling the plan of becoming carbon neutral by the year 2020 government has focused on policy mechanism designed to accelerate investment in renewable energy. Import duties on solar panels, solar panel batteries used in marine vessels, and on renewable energy powered vehicles were waived. Also the regional utilities companies are to purchase electricity produced by renewable energy companies to the STELCO's grid. Due to the need for a specialist government agency to direct the Maldives towards its goal to become carbon neutral by 2020 the government created a Renewable Energy Investment Office (REIO) under MEA. The purpose of creating REIO is to come up with economic solutions to the country's energy concerns and expedite implementation of these solutions. REIO will assist government to draw investment plans and proposals for foreign aid to facilitate investment and support in alternative energy projects in Maldives. Other functions mandated include finding and applying appropriate alternative energy solutions and assisting regional utilities companies in seeking investments and capacity building in the area of renewable energy technologies.

Today use of renewable energy is encouraged and promoted with a number initiatives being implemented. The project "Male' Clean Energy Promotion" funded under the grant aid from Japanese Government has installed solar PV in 5 sites in Male' with the total installed capacity being estimated at around 395 kW. This is the largest commercial scale renewable energy investment program in the Maldives at present. Renewable energy is also used by the telecommunication company of Maldives in 174 sites based on power generated from solar panels or solar-diesel hybrid systems. The site which has the highest generation of solar power has a capacity of 3.5 kW while the total capacity approximates at 130 kW

a) Solar energy

Solar data for resource assessments are limited. MMS collects the number of hours of sunshine and the temperature per day but no solar energy radiation data is collected. Power generation potential through photovoltaic and small solar thermal is significant. A feasibility of using solar energy production was determined using satellite data for three locations in south north and centre of the country. The study revealed that solar radiation and daylight hours across the country are reasonably good with lots of solar heating and solar potential. It was found that the potential is high as every square meter of available land area can provide about 5 kWh/day. Detail studies for all inhabited islands and resorts are being undertaken to estimate the exact system configuration and investment options for each island. Work is ongoing with islands being classified according to population size, demand and load pattern with sample islands being selected for implementation of pilot projects after which it could be replicated in the rest of islands. Thinadhoo in the South and K Dhifushi in the central region are at present selected as sample islands with work ongoing at present.

b) Wind Energy

Available wind data is limited to records of wind speeds at various airports in the country. These wind measurements are at 10 meters above the ground, and because of the low altitude, these are not representative of wind speeds at the higher levels at which turbines are usually positioned. Measurements made by the US based National Renewable Energy Laboratories have indicated that the largest wind potential in the country is in the islands located between 4.5^{o} and 6^{o} N latitudes. A feasibility study was undertaken to assess potential northern inhabited island sites, based on the consumption and demand. It is inferred that wind can be utilized in smaller size because of their lower cut off speed and small demand in islands. Also it is inferred that wind is slightly better at the Northern Regions than in central and southern regions. Work on measuring the wind at various heights is ongoing at present

New developments towards harnessing wind energy includes signing an agreement with STELCO with XMEC New Energy of China to provide renewable energy for 25 years in the Male' area which constitutes Male', Hulhumale', Villimale' and industrial Thilafushi.The project will provide up to 20 megawatts of electricity to STELCO's grid. Under the agreement the company will generate 50 megawatts of wind energy for the Male' area and a Liquefied Natural Gas (LNG) plant is to be built to provide 30 megawatts of energy on windless days to prevent service disruption."The energy harnessed from the wind turbines and back up LNG plant is to be fed to the STELCO grid via submarine cables connected to Male' and Hulhumale'," XMEC is scouring areas in Male' atoll to locate the wind turbines and LNG plant. (www.haveeru.com)

c) Biomass Energy

In 2003-04 a biomass study was undertaken which reported that the total accessible biomass potential resource is 20 000 toe. For investment decision at present the recommendation is to undertake a detail study to understand the different types of biomass.

It is important to highlight that in the past, biomass is the main source of energy for domestic purposes in most of the outer islands. Fuel wood is used for cooking and smoking of fish. Biomass includes dry branches from trees and shrubs, coconut husks, dry coconut leaves, and coconut shells. However, with the depletion of wood resources and subsequent restrictions on tree cutting, households have switched to kerosene and LPG for cooking instead of biomass materials.

A source of biomass material is municipal solid waste. According to Municipality Waste Management Section in Male', the typical composition of municipal solid waste is paper and cardboard (33%); kitchen waste (15%), and construction waste (industrial/scraps) (52%). About 15% of the construction waste is wood. Daily solid waste generation in Male's is on the average 140 tons. Biodegradable waste (mainly food waste) is about 25 tons/day. The solid waste is sorted prior to transporting to the island of Thilafushi. Only the biodegradable and combustible materials (i.e., organic) are dumped in the pits. The combustible materials are burned and the residue ashes (plus unburned matter) are dumped into the pit. Previously Thilafushi was just a reef and now it has a reclaimed area of 100,000 square meters. Some industries now exist in the area such as a cement packing plant and a LPG refilling plant. South Asian Regional Initiative for Energy reports that Landfill gas from the area can be recovered and utilized for power and heat generation for use by the industries located in the area.

The presently planned The Municipal Solid Waste (MSW) Management Project at Thilafushi Island in Maldives to be implemented from 2013-2020 has the objective of establishing a facility of capacity 200 TPD to treat municipal solid waste at Thilafushi island in Maldives. The waste processing & power generation facilities have been identified for availing carbon benefits under Clean Development Mechanism (CDM).The waste shall be processed using in vessel composting and gasification technologies. The CDM is an arrangement under the Kyoto Protocol allowing industrialized countries with a greenhouse gas reduction commitment to invest in projects that reduce emission in developing countries as an alternative to more expensive emission reduction in their own countries.CDM allows a country with an emission-reduction or emission-limitation (Green House reduction) commitment to implement an emission-reduction project in developing countries.

9.3.1 Barriers for renewable energy development

Development of renewable energy technology requires identifying and addressing the existing barriers confronted by the energy sector. At the initial stage limited information on the renewable resources potential in the country, is one of the main constraints. Presently, detail information on potentials of renewable energy technology is required to design, develop and utilize clean energy. Lack of policies on the utilization of renewable energy, and inadequate regulations and procedures to support development of renewable energy based projects, are limitations. Such policies, regulations and procedures need to be developed confirming to internationally accepted best practices in order to attract investors and financiers for renewable energy technology projects. Limited capacity in the government to design, develop and implement renewable energy programs is also identified as a major limitation. Limited institutional mechanism to support widespread dissemination of renewable technologies, as well as in the dissemination of knowledge and skills in the operation and maintenance of renewable systems are some of the barriers that have been identified in various studies.

9.3.2 Efforts to encourage renewable energy

In 1999, The Renewable Energy Technology Development and Application Project (RETDAP) was implemented which established some basis necessary for renewable energy development. Advocacy and awareness raising activities, on-the-job training, seminars and study tours were undertaken under the project. In addition, a detailed assessment of wind, solar and biomass resources was carried out, followed by in-house training of relevant government officials and a assessment of least-cost renewable energy technologies.

The country's first energy supply and demand balance and Wind Energy Resource were developed in 2003. This was followed by an assessment of the potential for utilization of solar energy and landfill gas in 2004 and development of Energy Balances and Indicators. Fund for Renewable Energy System Applications (FRESA), a revolving fund, has been designed and established and loans are being disbursed. At present four loans have been disbursed amounting to a total of Rf 3.176.580. The efforts to develop an alternative energy capability led to the establishment on pilot basis, of solar-diesel, solar-wind-diesel hybrid systems. These were relatively small systems which in their initial stage functioned well, but high maintenance cost and lack of local technical capacity created many challenges.

A feasibility study for application of grid connected Photovoltaic power systems in Male' (the capital) and Hulhumale' (a satellite island) was carried out in 2009. The study proposes to place PV panels on large buildings in Male' and Hulhumale' including the President's Office. The study found PV systems to be a feasible option but the initial investment cost could be prohibitively high for the individuals (Feasibility study for Application of grid connected Photovoltaic power systems in Male' and Hulhumale', 2009).

In February 2010, preparatory work on introducing grid connected PV systems was carried out. The work included study of technical requirements for the grid connection and developing a Manual for Photovoltaic Grid Connection (Grid-connected PV system in the Maldives, March2010)

A solar power system was installed in Presidential Residence, Muleeaage on 7th October 2010.which is capable of generating 11.5 kW of installed peak output. This is expected to save more than $300,000 over the life of the system. Sungevity designed the system remotely from its headquarters in Oakland, California and trained local staff at Presidential Palace to install, manage and maintain the system. Sungevity is also conducting an energy audit of the Presidential residence to identify ways to cut energy wastage. Renewable energy installation best practice always includes an energy audit, to identify immediate savings and cost-effective energy conservation
measures.

Source: http://www.presidencymaldives.gov.mv/

In addition, government is also promoting Public –Private-Partnerships to develop and scale up renewable energy usage in Maldives. The formations of Utility Companies have facilitated Public Private Partnership as national and international companies could partner with utility companies to develop and implement renewable energy projects in Maldives. (Table 9.3)

Island	Renewable energy source	Capacity
Adh. Mandhoo	Solar Diesel hybrid system	12.8kWp PV panels + 108k Wh battery bank
R.Faninu	Wind-Solar-diesel hybrid	5kWp solar – 3.5 kW wind
B.Goidhoo	Wind-Solar-diesel hybrid	5kWp solar – 3.5 kW wind
L.Fonadhoo	Solar-diesel hybrid	5kWp Solar
L.Gan	Solar-diesel hybrid	10kWp Solar
HA. Uligamu	Solar-Wind-diesel/LPG hybrid system	45 kW hybrid mini- grid system consists of: 2.64 kWp PV 43.2 kW Wind Turbines
M.Raimandhoo	Solar-Wind-Diesel hybrid	45 kW hybrid mini- grid system consists of:2.64kWp PV Array +32.4kW wind turbines + Battery
GA.Kondey	Solar-Wind-Diesel Hybrid	25 kW hybrid mini- grid system consists of:5.28kWp PV Array +10.8kW wind turbines + Battery Backup
Sonevafushi Resort	Solar System	70 Kwp solar array
K. Girifushi	Wind System	2 kW wind turbine
Muliaage	Solar System	11.1 kWp Solar PV Grid Connected System
Telecom Application	Solar hybrid	Total 258 kW in 174 islands
Total installed capacity Solar: 47.8kWp Wind: 93.4kW		

Table 9.2: Existing Renewable energy projects

Source: Ministry Housing and Environment, 2010

Project	Renewable energy source	Capacity
Project for Clean Energy Promotion in Male	Solar PV grid system	Total of 675 kW to be installed 395kW of roof top solar PV grid connected system being installed in 5 public buildings and is expected to be commissioned by February 2011 280 kW in another 5 public buildings is planned to be installed by end of 2012
Grid Connected PV systems in 6 islands	Solar PV grid system	Total 448kW in 6 islands
Supply of electricity using RE for Greater Male Region	Solar Wind Hybrid system	20MW wind + 15 MW LNG hybrid system that will supply energy to Male Region
Dhiffushi Island	Solar PV grid system	40kW grid connected solar PV system

Table 9.3: Ongoing renewable energy projects being implemented in the country

Source: Ministry Housing and Environment, 2011

Additionally, Research and Development of Carbon Capture and Sequestration projects targeting reduction in GHG emission, is at present at the design stage, with data collection and preparation of project documents. Corresponding efforts are made towards improving the standards for energy conservation. Standards for power plants and vehicles have been established in 2009 and in 2010 respectively. In addition, a study was compiled on achieving fuel conservation and efficiency in different modes of transportation. Incentive schemes are planned for establishing charging centers to support increase use of electric vehicles and use of alternative cleaner fuels on existing vehicles. Work is also planned to reduce the supply side energy losses. Standards are to be prepared to reduce emissions from appliances, and encourage vessels to use clean fuels. Energy usage with GHG emissions, by different sectors and status of carbon neutrality is to be established

In 2011 a framework for energy efficiency was formulated which outlines recommendations for energy efficiency. Four sectors were studied and recommendations were outlined for achieving energy efficiency including a framework to regulate and monitor energy usage to promote protection of the environment and human health. Planned actions include developing,

regulations to facilitate market driven tariffs and competitions encouraging formation of joint ventures to produce energy from renewable sources and establish regional and interconnected submarines grids Guidelines and design requirements have been developed to ensure energy efficiency in buildings. In future, buildings will be qualified and certified as energy efficient building.

A study on 4 resorts outlined measures that can cut down their green house gas emission by 25 percent, and identified the need for detail assessments prior to making general recommendations applicable for tourism sector. Use of desalination technology based on waste heat is also estimated to save around 850 tons of diesel oil per annum in Male', Hulhumale' and Vilingili. Use of energy efficient equipments and appliances are recommended for the households and public buildings. In addition, exhaust gases from electric generator sets are known to produce large amount of heat (about 700 degrees Celsius at full load), which is being wasted presently. It is recommended that this waste heat to be utilized for different purposes.

9.3.3 Policies and Strategies

The SAP 2009-2013, the National Energy Policy 2009-2013 and National Energy Action Plan 2009-2013 of the government provides the contextual background for energy policy of the country. Electricity is a basic service which the government plans to provide at an affordable rate. The production and distribution of electricity should not compromise health of people and the environment.

With climate change and its associated impacts looming, government targets to make the country carbon neutral by 2020 and as such promoting renewable energy technology is a major intervention. Several activities initiated falls under programs planned for the period 2009-2013, and table 9.4 shows progress achieved.

Strategy/Objective	Actions/Program/Activities	Current Status
1.Access to affordable and reliable electricity supplies for all	1.Develop and increase incentives in form of grants and financing for power sector development, 2 .Increase private sector participation in developing and managing sustainable electricity supplies 3 Increase more reliable and safe RE based electricity 4 Maintain Electricity unit prices in islands 5.Increase subscribers to RE-based electricity	1.26 loans disbursed under revolving fund established at MOFT 2. Six utility companies established Initiate and facilitate private sector partnership with utility companies 3.0.20% achieved by 2009 and current status to be measured Maintaining average Unit price constant (Tariff + surcharge). Currently possibilities for adopting feed-in tariff is being explored 0.2%~ 1%
2 .Carbon neutrality achieved by 2020	1Standards established for exhaust emissions, EE appliances, vehicles and vessels that use clean fuels 2.Forecasts of energy usage by different sectors, GHG emissions and status of carbon neutrality developed 3 Research and Development of Carbon Capture and Sequestration projects targeting reduction in GHG emission increased 4 .Demand for diesel fuel decreased	1. Exhaust emission standard established for power plants and vehicles in 2009 and 2010 respectively. A monitoring mechanism was also established. 2. Energy demand and supply study completed for 2009, and energy audit completed. Working on the energy demand and supply study for 2010 3.The development of CCS technology, Data collection Project Document preparation ongoing 4.-3%
3.Cost reduction through energy efficiency and energy conservation	1.Study compiled on all areas of improvements to achieve fuel conservation and efficiency in different modes of transportation 2.Incentive schemes developed for establishing charging centers to support increased use of electric vehicle and use of alternate cleaner fuels on existing vehicles 3. Supply side energy losses reduced 4. Fuel import cost reduced	1.Sea transport network completed 3. reduced to some extent 4. 8 percent

4. National energy security increased via diversified energy source	1. Indigenously available renewable sources of energy developed for use, increased	
	2.Study conducted on energy demand and supply at regional/ provincial levels	2.Local Energy demand and supply 2009
	3. Renewable Energy Centre established and courses on renewable energy introduced in school and national college curriculum	3.RE course at FET and RE kiosk established
	4.Suppliers mandated to participate as strategic partners in ensuring timely, quality and quantity availability of required petroleum products at selected supply centers, increased	4.Proposals to develop fuel storage
	5.Feasible regions opened for fuel market for investors, increased	5.Proposal developed
	6. Communities generating their own Power supplies from household waste and bio fuel, increased	
	7.Non Conventional renewable Energy (bio gas) installed capacity,	
	8. Electricity provisions to households through conventional/ non conventional renewable energy supplies creased	8.Contract signed, funds approved Install 700kW Solar PV; RE project at Thinadhoo
5. Institutional and Legal framework of the energy sector, strengthened	1. Frameworks to regulate and monitor energy usage focused on protecting the environment and human health established	
	2.Regulations developed for facilitating market driven tariffs, competition, encouraging formation of JV, energy production from renewable sources and for establishing regional and interconnected submarine grids	
	3. Guidelines and design requirements for ensuring energy efficiency in building developed	3.Energy audits for buildings completed
	4. Buildings qualified for certification as energy efficient, increased	

Table 9.4: Policies, programs and status –energy sector 2011

Source: Ministry Housing and Environment, 2011

On May 24 2011 cabinet decided to establish specialist government agency, REIO identify economic solutions to the country's energy concerns and expedite implementation of these solutions. REIO will assist the government to draw up investment plans and proposals for foreign aid to facilitate investments and support in alternative energy projects in the Maldives. Other functions mandated to the REIO include finding and applying appropriate alternative energy solutions and assisting regional utilities companies in seeking investments and capacity building in the area of renewable energy technologies. The other lead agency responsible for the development of the energy sector is the Climate Change and Energy Department (CCED) of the MHE.

Energy bill is being drafted for submission in the parliament. The authority is responsible for approving tariff proposed by utility companies. It also issues licenses to power producers and regulates the electricity sector and is also responsible for preparing engineering and regulatory codes and orders. Some of the salient functions performed by MEA are:

- Determine standards and operating the regulations for the administration and monitoring of the power sector in accordance with government policy on energy
- Develop the regulatory code and standards on the production and use of energy in Maldivian context..
- Issue permits to the parties that wish to provide electricity services and determine guidelines for tariff structure.

The Authority was formed in April 2006 replacing the Maldives Electricity Board. Shortage of skilled personnel is hindering the development of energy sector. With technical and financial capacity constraints confronting the sector, the government is relying on the support of the international community. MEA has received funding from World Bank and Asian Development Bank to strengthen regulations and to develop standards. Work is initiated to start on January 2010.

10. Post Tsunami Status of Environment

Key findings

- Maldives has come a long way in the tsunami recovery efforts
- All islands are provided rainwater tanks after the tsunami and 52 islands have desalination plants that can be used in emergencies
- Approximately 66% of the islands have IWMCs at various stages of operation
- Efforts are underway to install healthy sanitation systems
- Lack of comparative data make it difficult to gauge recovery of coastal areas that were impacted by tsunami

10.1 Introduction

Maldives is highly vulnerable to climate change and its consequences, which was proven by the Asian Tsunami of 26 December 2004 in which 35% of the 198 inhabited islands were categorized as high or very high impacted islands. These islands experienced major physical damage to infrastructure, crops and natural vegetation. The damage to natural vegetation and to the rest of the environment highlighted existing threats.

The pre-tsunami situation of the environment of the Maldives can be assessed, in detail, from the State of the Environment Report 2004 (SOE 2004), published just after the Tsunami. The following chapter will, highlight some of the important impacts and recovery.

10.2 Background

The tsunami caused damage and destruction on a nationwide scale in the Maldives. Eighty two people died and 26 are still missing or presumed dead. Over one-third of the population was directly affected by the tsunami, and some 29,000 people had to leave their homes. All but nine

inhabited islands were either partially or wholly flooded. Sea walls were breached on most islands, causing severe flooding, and in some cases islands were submerged and remained so for few days. The economic damage and losses were the equivalent of 62 percent of the country's GDP. Fifty three islands experienced severe damage to infrastructure and environment. Flooding wiped out power plants, communication equipments, contaminated water supplies, irrevocably damaged jetties, harbors, causeways, agricultural land and equipments, and fishing vessels and equipment. The tsunami, thus, represented the worst natural disaster in the country's history.

10.3 Pre-Tsunami Status

Lack of data compromises the information available for an accurate assessment of the environment before the tsunami. However, from published reports, before and after, the tsunami the following can be highlighted.

10.3.1 Fresh water supply

Male' area (including Vilingili and Hulhumale') water supply comprises of piped desalinated water. In the islands, water supply comprises of communal and household rainwater tanks and ground water. SOE (2004) reported that population and development pressures have lead to an increasing groundwater extraction, resulting in the depletion of the fresh water lens, which in turn, has led to salt water intrusion. Further, ground water is at risk from bacterial contamination caused by affluent leakage from solid waste and sewage from poorly constructed and maintained septic tanks.

10.3.2 Sanitation

Sanitation in most islands consisted of pour –flush latrines connected to a sewage system and to a lesser extent defecating to holes made within the household compound. In densely populated islands, the maintenance of septic tanks is complex with absence or limited desludging. When desludged, the material is dumped into the beach or directly to sea. In other islands, small bore systems usually convey raw sewage into the lagoon. In many islands septic tanks are connected to a soak pit from which sewage migrate to the soil contaminating ground water. Sewage treatment in Maldives was non-existent except for resorts.

10.3.3 Solid waste

Formal solid waste disposal systems that existed before the Tsunami were limited to Thilafushi, resorts and industrial islands, Kulhudhufushi and Hithadoo landfill sites. In other islands, waste was dumped to a designated area in the island or to the beach; some islands also practiced regular burning of solid waste.

10.4 Impacts of Tsunami

The tsunami was perhaps the worst natural disaster in the known history of the country, affecting the entire population. The worst impact was loss of family members, resulting in psychological stress. Almost all faced health issues from damaged to water systems including freshwater wells, and damaged to rainwater harvesting equipments, compounded by the spread of the solid waste throughout the islands washed over and inundated. Other impacts, include losses (both short and long term) to livelihoods, land and infrastructure. Damage to the environment could not be easily addressed. Following the Tsunami, UNEP conducted an environmental assessment in February 2005. This report highlighted the following:

10.4.1 Freshwater supplies

Ground water lens were significantly affected by salt water intrusion directly into the ground and through raised sea levels. In some cases ground water was forced up in the wells and others were filled with salt water from flooding. In addition, as sewage systems (septic tanks) were located close to wells, wells were contaminated. Post-tsunami studies by the government, reported that freshwater lens was affected severely through pollutant migration and sewage contamination of groundwater sources (NRRP, 2005). Further NRRP (2005) reported that the duration for rehabilitation of the ground water sources was uncertain. Rainwater harvesting equipments were also damaged in the worst affected islands.

10.4.2 Solid waste

Tsunami waste was categorized as hazardous waste, vegetation, soil, sediment; municipal waste from dump sites, health care waste, demolition waste, oil, leakage from septic tanks and waste generated by relieve operations. UNEP (2005) reported that tsunami created approximately 290,000 cubic meters of demolition waste and estimated pre-existing waste to

be about 50,000 cubic meters. Much of the waste was dispersed over the affected islands. Dumpsites were completely washed over in some islands.

10.4.3 Sanitation

Extent of damage to the sanitation systems are directly linked with number of households that needed repair and/ or reconstruction, which were estimated at approximately 50,000. The number of septic tanks and associated connections lost to the Tsunami was estimated to be 1,500 units, while small bore sewer and outfall loss in highly affected areas needed replacement of 126 km to 2.4 km of outfall.

In addition to the above, UNEP (2005) also highlighted the following:

10.4.4 Island vegetation

ADB-UN Joint Assessment Report stated that the damage to land and ground water resources resulted in severe negative impacts on vegetation of 35 agricultural islands and salt water intrusion into the water lens resulted in browning of vegetation in 112 inhabited islands. MOFA estimated that tsunami damaged field crops in 2,103 farms; destroyed backyard crops in 11,678 homesteads and damaged more than 700,000 fruit trees and 840,000 timber trees (ADB-UN 2005).

10.4.5 Coastal Land Forms

Very little baseline data existed in the Maldives before the Tsunami on coastal land forms. Therefore, it was difficult to determine the impact of the Tsunami on the coast. However, known tsunami impacts included complete island over wash to inundation of islands. Beach erosion of the islands located close to the eastern reef rim were found be significant whether inhabited or otherwise. The tsunami appeared to have worsened chronic shoreline erosion problems in many islands. In cases where islands were over washed, prominent scarps developed along western sandy shorelines resulting in deposition of sediment westward into adjacent reef flat/lagoon areas. Inside the islands, local scour around obstacles such as buildings, and development of thin, patchy sediment deposits were found.

10.4.6 Coastal Vegetation

Ironically tsunami related impact on coastal forest was due to clean-up operations, which caused significant damage to coastal forest on a number of inhabited islands by bulldozing demolition debris and garbage into and over thickets of vegetation along the coast. In addition, because native species are salt tolerant, coastal forests were not affected much except individual trees without much vegetation around. In these cases, the trees were found to be pushed over or uprooted.

10.5 Post-Tsunami Recovery

Almost 7 years after the tsunami, recovery work has been almost finished for some of the sectors. Communities impacted have revived their livelihoods. Reconstruction of houses and settlements including redevelopment of public infrastructure are nearly completed. Both education and health sector have recovered from the impacts. Information on all these aspects of the tsunami recovery is available. However, information on the recovery of the environment is limited, in terms of their comparability. There have been reports prepared including NAPA of Action 2007, NEAP 2009, NSDS 2008 and various Disaster Risk Assessments for many islands. For a pre- and post tsunami status comparison are made with regard to the available information.

10.5.1 Fresh water

After the Tsunami, government with International assistance provided rainwater storage tanks for all islands and desalination plants for some islands. The tables below show the potential freshwater availability in the atolls.

Atoll	Total storage /Ltr)	Total Roof Area /m2
Haa Alif	9,600,264	155,671
Haa Dhaalu	9,451,685	91,823
Shaviyani	4,339,900	93,944
Noonu	7,713,900	114,181
Raa	7,075,200	132,389
Baa	7,654,000	124,560
Lhaviyani	5,853,460	90,163
Kaafu	4,748,250	128,936
Alif Alif	1,658,800	35,673
Alif Dhaalu	4,784,000	66,400
Vaavu	1,490,500	20,740
Meemu	3,673,200	50,031
Faafu	1,930,500	23,919
Dhaalu	2,917,500	40,778
Thaa	7,430,650	155,768
Laamu	6,251,000	174,871
Gaafu Alif	6,339,500	359,352
Gaafu Dhaalu	2,712,800	30,544
Gnaviyani	8,271,000	224,226
Seenu	10,146,500	93,903

Table 10.1: Status of rainwater harvesting capability, 2011

Source: An Assessment of Rainwater Catchment and Storage Capacity in the Maldives, MHE 2011

Atoll	Island	Plant Capacity	Status
HA	Filladhoo	3 Ton	Not operational
HA	Dhidhdhoo	10 Ton	Not operations
Hdh	Kulhudhuhfushi	NA	Operational
Sh	Komandoo	50/10 Ton	Operational
Sh	Maroshi	10 Ton	Operational
Sh	Funadhoo	20 Ton	Operational
N	Holhudhoo	10 Ton	Operational
N	Maafaru	10 Ton	Not Operational
N	Velidhoo	10 Ton	Operational
N	Manadhoo	10 Ton	Operational
R	Meedhoo	10 Ton	Not Operational
R	Maduvvari	10 Ton	Not Operational
R	Alifushi	10 Ton	Operational
R	Hulhudhuffaaru	10 Ton	Operational
R	Ungoofaaru	10 Ton	Not Operational
B	Goidhoo	10 Ton	Not Operational
B	Thulhaadhoo	10 Ton	Not Operational
B	Dharavandhoo	10 Ton	Not Operational
B	Hithaadhoo	10 Ton	Operational
B	Kendhoo	10 Ton	Not Operational
B	Eydhafushi	10 Ton	Operational
Lh	Naifaru	30 Ton	Operational
Lh	Hinnavaru	30 Ton	Operational
K	Maafushi	500 Ton	Operational
K	Dhiffushi	10 Ton	Not Operational
K	Guraidhoo	10 Ton	Not Operational
K	Gaafaru	10 Ton	Not Operational

K	Thulusdhoo	10 Ton	Not Operational
Atoll	Island	Plant Capacity	Operational
Adh	Mahibadhoo	10 Ton	Operational
Adh	Maamingili	30 Ton	Not Operational
V	Keyodhoo	10 Ton	Not Operational
M	Dhiggaru	10 Ton	Not Operational
M	Muli	10 Ton	Operational
M	Kolhufushi	10 Ton	Not Operational
F	Nilandhoo	10 Ton	Not Operational
Dh	Meedhoo	10 Ton	Operational
Dh	Kudahuvadhoo	10 Ton	Not Operational
TH	Buruni	10 Ton	Operational
TH	Dhiyamigili	10 Ton	Operational
TH	Guraidhoo	10 Ton	Not Operational
TH	Madifushi	10 Ton	Operational
TH	Veymandoo	10 Ton	NA
L	Gan	240 Ton	Operational
L	Isdhoo-Kalaidhoo	10 Ton	Operational
L	Maavah	10 Ton	Not Operational
GA	Villingili	30 Ton	Operational
GA	Dhaandhoo	10 Ton	Operational
GA	Maamendhoo	10 Ton	Not Operational
GA	Kolamaafushi	10 Ton	Operational
GDh	Thinadhoo	160 Ton	Operational
GDh	Gadhdhoo	10 Ton	Operational

Table 10.2: Desalination capacity in the islands, 2011

Source: Ministry of Housing and Environment nt , 2011

For a more detailed assessment of freshwater situation, refer to chapter 4.

10.5.2 Solid waste

In general, there appear to be a weak system in place for waste management. Waste volume has been increasing with increasing population and development activities. There is however, a lack of corresponding responses for effective and adequate solid waste management. Thilafushi, the main waste landfill is a waste disposal facility.

There is some recycling done at waste collection facilities in Male' and Thilafushi. Some of the recycled waste, mostly iron, are exported by private exporters. There are 134 Island Waste Management Centres (IWMCs) in the Maldives, covering approximately 66% of islands but most were either never operational or not operational anymore. Islands continue to dispose of their waste in environmentally unfriendly and unhealthy ways.

There is no formal system for collecting, treating and disposing of hazardous waste, which is currently not consistent with environmental and public health requirements. At present, efforts to handle and dispose of hazardous waste are minimal, and the country lacks a secure hazardous waste storage, treatment or disposal facility.

For a more detailed assessment of solid waste situation, please refer to chapter 5.

10.5.3 Sanitation

Sewerage systems have been installed in 27 islands from 2005 -2011 and during the period, 2009 – 2011 (May 2011) 13 sewerage systems have been completed in different islands. The new systems consist of sewerage network for the whole island, with pump stations, sewage treatment facilities and sea outfalls (MHE, 2011). Installation of proper sanitation systems across the country is underway.

11. Environmental governance

Key findings

- Environmental governance remains high on the national agenda as the country is highly susceptible to the effects of climate change with rising sea levels and coastal erosion.
- By law state and the civil society has an obligation to protect and preserve the environment.
- Under environmental governance the role and functions of international organizations, state and civil society have become ever more important
- Funding needs for climate change and adaptation, was estimated at US $ 175,890,345 million and was highlighted in the Maldives Donor Conference of 2010

11.1 Introduction

Development in the Maldives has always been a challenge due to the dispersed nature of the population. Small islands with population dispersal translate directly into severe diseconomies of scale in production, transport and provision of essential infrastructure and services with the unit cost of schools, hospitals and other social infrastructure typically 4-5 times higher than those in continental developing countries. The country's geography is unique even by the exceptional standards of small archipelagoes and development efforts are constrained due to this.

At present the country is going through a political transition with the first democratic elections held in November 2008. State level policies are being changed to adhere to a system of democracy and better governance through decentralization. The country's political transition after 30 years is having a profound effect on all sectors and it is a major challenge to provide effective services. With the Decentralization Act passed, island councils and atolls councils have been elected paving way for decentralization. The political and institutional change, coupled with volatile external economic shocks and with the daunting environmental problems have resulted in new and challenging issues magnifying the existing internal socio-economic pressures. The ecologically fragile coral atolls with a population of over 300,000 people

scattered over 194 islands is economically dependent on fishing and tourism. Both of these economic sectors are fragile and vulnerable to external factors and natural disasters.

Maldives is recognized as one of the most vulnerable countries in the world in the context of climate change and sea level rise. Environmental governance remains a priority on the agenda as the country is highly susceptible to the effects of climate change with rising sea levels and coastal erosion. The role and functions of international organizations, state and civil society has become ever more important today. Conservation and protection of the environment is essential for survival for the Maldives as the challenges facing the country directly impacts the people, economy and the society.

11.2 Policies and Strategies

The State and the civil society have an obligation towards protecting the environment. Article 22 of the Constitution of the Maldives states that it is a fundamental duty to protect and preserve the natural environment of the country for the benefit of present and future generations. The State is to undertake and promote desirable economic and social goals through ecologically balanced sustainable development. Article 67 of the constitution states that the exercise and enjoyment of fundamental rights and freedom is inseparable from the performance of responsibilities and duties and that it is the responsibility of every citizen to preserve and protect the natural environment, biodiversity resources and beauty of the country and to abstain from all forms of pollution and ecological degradation. Environment related issues feature high on the SAP 2009 -2013 and sector policy documents such as the NEAP 3 and NSDS 2009-2013.

11.2.1 Strategic Action Plan 2009-2014

At the national level directions to sustainable development are outlined in the SAP 2009-2013. It contains key policies and strategies related to the development of the country including those addressing environmental issues. The SAP 2009-2013 recognizes the extraordinary environmental challenges that Maldives is facing, especially climate change and SLR and its associated impacts. According to SAP 2009-2013 adaptation to climate change and disaster risk mitigation and management is a priority of the government and it is being mainstreamed into policy making and programming in all sectors of development. The guiding principle of the environment policy of the Government is to view the natural environment as the key to socio-economic development. It is to ensure provision of the fundamental services such as the right to

access to safe drinking water and sanitation and safe disposal of solid waste. (Strategic Action Plan, 2009, p390)

Environment is addressed in SAP 2009-2013 under the theme of Economic Development with cross cutting sectors identified and addressed. Cross cutting sectors are Tourism, Fisheries, Agriculture, Small and Medium Enterprises (SMEs), Employment and human Resource Development, Environment, Water and Sewerage Services, Energy, Land Reform, Communication, Science and Technology Gender, Trade and Investment, Disaster Risk Management, and National Security. Thus mainstreaming environmental protection into all areas is recognized as key focus in the current planned period.

The goals of the environmental sector includes the following

1. Maneuver Maldives as a central player on climate change globally.
2. Promote the rights of all citizens from the impacts of climate change.
3. Protect and preserve the natural environment to ensure prosperous economic development.
4. Reduce GHG emissions and achieve carbon neutrality.
5. Minimize pollution for the development of healthy communities through proper waste management.
6. Create public awareness on environmental values

The main challenges and constraints on ensuring environmental sustainability are also identified as one of the weakness within the legislative framework with lack of a mechanism to assess and evaluate implementation of the environmental laws and regulations. Inefficient utilization of the existing resources and disparities between donor funds and donee's sectoral needs is also recognized as one of the weakness within the sector with poor aid coordination further aggravating the problem. Poor inter/intra sectoral commitment and coordination with lack of a common platform for data sharing or information dissemination are major constraints limiting proper management of the sector. In addition, lack of public awareness on environment friendly practices and inadequate financial resources hinders the speedy implementation of the programs and strategies.

11.2.2 National Environment Action Plan 3

The environmental sector's action plan is articulated in the NEAP and the sector is currently guided by third action plan. The inception of the NEAP was in 1989 and it addressed environmental planning and management needs of the country and represented a combined

approach to managing and solving the problems pertaining to the environment and subsequently finding ways of overcoming these problems.

The aim of the NEAP is to protect and preserve the environment of the Maldives and sustainable management of the resources for the collective benefit and enjoyment of the present and future generations. The onus of aiding the government to maintain and improve the environment of the country falls within the ambit of the NEAP objectives. It is an expedient to make legal provision in order to maintain clean and healthy environment by minimizing as far as possible, adverse impacts likely to be caused from environment degradation.

11.2.3 National Strategy for Sustainable Development 2009-2013

In April 2009, environment sector formulated the Maldives NSDS 2009 as the national document for sustainable development which includes the goal of achieving carbon neutrality by 2020. It outlines the approach to address climate change, environmental degradation and resource constraints. The NSDS identifies specific goals, objectives and targets that the stakeholders have to achieve and it includes indicators to assess progress. Seven key goals are:

Goal 1: Adapt to climate change
Goal 2: Protect coral reefs
Goal 3: Achieve carbon neutrality in energy
Goal 4: Ensure food security
Goal 5: Establish a carbon neutral transport system
Goal 6: Protect public health
Goal 7: Achieve full employment and ensure social security

Other sectoral policy documents formulated under specific goals and the theme of protection and preservation of environmental are outlined in table 11.1

Goal	**Policy documents**		
Adapt to Climate change	NAPA 2007	First National Communication of Maldives to UNFCCC	
Protecting Biodiversity	NAPA 2007	NBSAP -2010	
Achieve carbon neutrality in Energy	National Energy Policy	Science and Technology Master Plan	Technology Needs Assessment

Ensure food security	NAPA 2007	Agriculture Master Plan	
Carbon Neutral transport system	Transport Master Plan	Male International Airport Master plan	
Achieve Public Health	NAPA 2007	Health Master Plan	
Sustainable tourism	Tourism Master Plan		
Disaster Management	Maldives Strategic National Action Plan (SNAP) for Disaster Risk Reduction and Climate Change Adaptation		

Table 11.1: Goals identified to protect and preserve the environment with corresponding sectoral policy documents

Source: Ministry of Housing and Environment, 2011

11.3 Laws and regulations

The Environment Protection and Preservation Act was passed in 1993 to protect the environment. The Act provided the framework upon which regulations and policies can be developed to protect and preserve the natural environment and resources for the benefit of the present and future generations. The Act was passed to support and promote the protection, enhancement and prudent use of the environment while recognizing the following goals

- Maintaining environmental protection is essential to the integrity of ecosystems, human health and socio-economic well being of the society
- Maintain the principle of sustainable development, including
- The principle of ecological value, ensuring the maintenance and restoration of essential ecological processes and preservation and prevention of loss of biological diversity
- The precautionary principle will be used in decision making so that where there are several threats of serious irreversible damage the lack of full scientific evidence certainty shall not be used as a reason for postponing measures to prevent environmental degradation
- The principle of pollution prevention and waste reduction as the foundation for long term environmental protection including,
- the conservation and efficient use of resources
- The promotion, development and use of sustainable scientific and technological innovations and management systems

- The importance of reducing, reusing recycling
- The principle of shared responsibility of all Maldivians to sustain the environment and the economy both locally and globally through individual and government actions
- The linkage between economic and environmental issues recognizing that long term economic prosperity depends upon sound environmental management and recognition that effective environmental protection depends on a strong economy
- The comprehensive integration of sustainable development principles in public policy making in the country
- The polluter pay principle confirming the responsibility of anyone who creates an adverse effect on the environment to take remedial action and pay for the cost of that action
- Taking remedial action and providing for rehabilitation to restore an adversely affected area for beneficial use
- Government plays catalyst role in the area of environmental education, environmental emergencies, environmental research and the development of policies, standards, objectives and guidelines and other measures to protect the environment
- Encourage the development and use of environmental technologies, innovations and industries

Provide a responsive, effective, fair and timely and efficient administrative and regulatory system, recognizing that wherever practical, it is essential to promote, the purpose of this Act primarily through non-regulatory means such as cooperation, communication, education, incentives and partnerships.

11.4 Disaster Management

A key development within this period has been the drafting of a bill addressing disaster risk reduction and disaster management. The bill when passed into law will grant legal authority to the activities of National Disaster Management Centre (NDMC) and support the implementation of various policies and action plans developed to mitigate and address natural and environmental disasters.

On 8 June 2011, The Government endorsed the first Strategic National Action Plan (SNAP) that integrates Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA). SNAP concept is prepared in accordance with the necessary strategic plans and Manifesto of the government. The new action plan which places DRR and CCA in the development planning of the Maldives is

a collaboration led by of the Government of Maldives with support from the United Nations system in the Maldives and the United Nations International Strategy for Disaster Reduction (UNISDR). SNAP is guided by both the Hyogo Framework of Action, a global blueprint for reducing disaster risks which was adopted in Kobe Japan in January 2005, as well as the objectives of the UNFCCC.

With consultations with key sectors including housing, construction, environment, health, education, media, development planning and tourism, SNAP builds upon lessons learned from past disasters. It promotes good governance, empowers local communities, builds resilience, and promotes risk sensitive regional and local development. SNAP focus on aspects of governance, and decentralization, as key for successful DRR and CCA. Maldives is one of the Small Islands States threatened by sea level rise and storm surges with more than 1,192 coral islets that lie on average just 1.5 meters (4.8 feet) above sea level. A warmer sea will translate into higher water levels and will considerably damage coral, on which the islands depend on for fishing and tourism. Disaster reduction action can now delay this inevitable event by decades. It is hoped that SNAP will provide short and long-term strategic direction and action to reduce the risk of disasters and enhance climate change adaptation in the country. It will identify and present priority programs and projects which the Government, together with partners, may undertake to attain the country's DRR and CCA goals.

NDMC and related government and international agencies have been working on addressing disaster management issues. Some of the projects being undertaken include:

- Developing a Disaster Risk Profile for the Maldives
- Strengthening the Institutional and Legal Systems for Disaster Risk Management
- Review of institutional and legal framework for Disaster Risk Reduction in Maldives
- Disaster Management and Environment for Sustainable Development
- Capacity Building for Crisis Prevention & Recovery in Maldives
- Strengthening National and Communities' Capacities for Effective Early Warning Dissemination and Responses
- Disaster Risk Reduction (DRR) Mainstreaming and Disaster Management in Schools
- Detailed Island Risk Assessment in Maldives
- Design Safe Shelters in the Maldives
- Detailed Cost Benefit Analysis for Risk Mitigation Measures in three Selected 3 islands
- Procurement and Installation of Early Warning Systems (Automatic Weather Observation, Doppler Weather Radar, Seismometer, Weather Data Integration System etc).

11.5 Role of the main stakeholders

Environmental governance requires all stakeholders including international organizations, government institution, and civil society to play an active role in implementing the policies and strategies formulated for the protection and preservation of the environment. The challenge for the government and the civil society is finding a balance between economic growth and social equity and the conservation and protection of the environment. The Non Governmental Organizations (NGO) have also progressed, with 700 NGOs registered in the country, though comparatively few are regularly active. Live and Learn Country Office in the Maldives, Eco Care and Blue Peace are notable active NGO's working towards promotion of greater awareness, understanding and action toward human and environmental sustainability.

For a country which has embarked on democratic reform as recent as 2008 the demands are overwhelming and critical. Structural adjustment program have been initiated with a target to balance the budget by end of 2010. Key priorities such as social protection and human development, strengthened infrastructure, efficient and effective delivery of decentralized services, and decent employment for all are high on the agenda.

The present government's key pledges for the period 2009 -20012 are based on providing nationwide transport system, affordable living costs, affordable housing, affordable quality health care and prevention of narcotics abuse and trafficking. The priorities are targeted on addressing, new and long standing social issues and narrowing down the disparities between the capital Male' and the outer atolls, and as well as within the atolls themselves. Human resource capacity constraint in delivering basic services has always been challenge. Maldives graduated from Least Developed Country to middle-income status in January 2011, which entails a range of new challenges related to removal of development and trade preferences.

With such an ambitious democratic agenda at the forefront, major components of environment protection continue to rely on the international support. Table 11.3 and Fig 11.1, outlines, national government's allocated expenditure, for the environment sector. Lack of financial resources hinders proper implementation of the programs and strategies.

Particulars	2007	2008	2009	2010	2011	2012
Total expenditure						
Total Public services	36.6	35.9	37.8	40.5	38.4	41.4
Public service – environmental protection	1.7	0.9	1.1	1.2	1.2	1.2
Social services	53.4	49.5	44.4	45.4	50.2	49.5

Table 11.2: Percentage share of government's environmental protection expenditure from budgets 2007-2011

Source: Department National Planning, 2010

A critical opportunity for support was the donor conference held in 2010. The forum was one of the most opportune moments for international donors to assist the country in underscoring its commitments. Of the five priorities climate change and adaptation was a key area. Climate change poses an existential threat to the Maldives. Funding for these major environmental programmes is essential. The following table shows amount of financing sought by the government, for priority areas, for the next three years which the government hopes to raise from the international community.

Areas	Amount in US $
Total Assistance requested	447,463,904
Budget support	45,000,000
Macroeconomic reform	38,352,877
Public sector reform	3.304.752
Social development	168,742,702
Governance	14,706,797
Climate change and adaptation	175,890,345
- Water and sewerage	- 43,700,000
- Coastal Protection	- 15,095,500
- Alternative energy protection	- 4,905,820
- Integration of communities	- 112,190, 025

Table 11.3: Financing Gaps 2010-2013 identified for the Maldives Donor Conference 2010

Source: Ministry Finance and Treasury 2010

11.6 Maldives in the International Arena

Maldives gives high importance to taking part in the international agenda on environment and as such Maldives is a member of many international organizations, international agreement and treaties. Table 11.4 gives a list of environment related conventions, treaties and agreements signed and ratified by the Maldives

DESCRIPTION **International Organization/ Convention**	**DATE** **Signed, Ratified, Acceded**
ENVIRONMENTAL GOVERNANCE	
1. United Nations Environment Programme	15.12.1972
2.South Asian Cooperation on Environment Program	10/22/2006
3.South Asian Association for Regional Cooperation	08/5/1985
4.Global Environmental Facility	NA

5. South Asian Seas Programme	NA
POLLUTION AND CHEMICALS	
6. Basal Convention on the Control of Transboundary Movement of Hazardous Waste and their Disposal -22 Mar 1989, Basel	28.4.1992
7.Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade -10 Sept 1998, Rotterdam	17.10.2006
8. Stockholm Convention on Persistent Organic Pollutants- 22 May 2001 Stockhom	17.10.2006
9.Male' Declaration	NA
10. Intergovernmental Forum on Chemical Safety	NA
Strategic Approach to International Chemicals Management SAICAM	NA
BIODIVERSITY CONSERVATION	
11.Convention on Biological Diversity – 5 June 1992, Rio de Janeiro	9.11.1992
Access and Benefit Sharing	NA
Subsidiary Body on Scientific Technical and Technological advice	NA
12. Cartagena Protocol on Biosafety to the Convention on Biological Diversity -29 Jan 2000, Montreal	3.9.2002
Biosafety Clearing House	NA
13.United Nations Convention to Combat Desertification, 14 Oct 1994, Paris	3 .9. 2002
14.Mangrove for the future (MFF)	NA
OZONE LAYER PROTECTION	
15. Vienna Convention of the Protection of the Ozone Layer -22 March 1985, Vienna	26.04 1988
Montreal Protocol on Substance that Depletes the Ozone Layer -16 September 1987, Monteal	16.5 1986
Amendment to the Montreal Protocol on Substance that Depletes the Ozone Layer -29 June 1990, London	
Amendment to the Montreal Protocol on Substance that Depletes the Ozone Layer -25 November 1992, Copenhagen	27 .9. 2001
Amendment to the Montreal Protocol on Substance that Depletes the Ozone Layer -3 December 1999, Beijing	3 .9. 2000
CLIMATE CHANGE AND ENERGY	
16.United Nations Framework Convention on Climate Change (UNFCCC) – 9 May 1992, New York	9. 11. 1992
Kyoto Protocol to the United Nations Framework Convention on Climate Change -11 Dec 1997 Kyoto	30.12.1998

17.Intergovernmental Panel on Climate Change	NA
RELEVANT TO OTHER MINISTRIES	
19.World Health Organization – 22 July 1946 New York	05.11.1965
20.Food and Agriculture Organization	8.11.71
21.United Nations Convention on the Law of the Sea -10 Dec 1982 Montego Bay	7.9.2006
22.International Convention on Civil Liability for Oil Pollution Damage 1969	12.9.1981
Protocol (of 1976) to the International Convention on Civil Liability for Oil Pollution Damage 1969	12.9.1981
Protocol of 1992 to amend International Convention on Civil Liability for Oil Pollution Damage 1969	20 .5. 2005
23. International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage	14.6.81
Protocol of 1992 to amend International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage	20.5.2005
24. International Convention for the Control and Management of Ships Ballast water and Sediments	22.6.2005
25.International Treaty on Plant Genetic Resources for Food and Agriculture	2. 3. 2006
26.WMO/ESCAP Panel on Tropical Cyclones	21.6.1982
27.UN/Ad-Hoc Committee on the Indian Ocean	8. 1980
28.United Nations Educational, Scientific and Cultural Organisation (UNESCO)	18.7.1980
29.United Nations Development Program (UNDP)	21.9.1965
30.United Nations Childrens Fund (UNICEF)	6.4.1971

Table 11.4: Maldives International Organization Participation

Source: Ministry of Housing and Environment,2011

Following is a brief description of the some of the treaties, conventions and agreement for which Maldives is a party to.

11.6.1 Biodiversity and Conservation

a. Convention on Biological Diversity

- The Convention on Biological Diversity (CBD) focuses on the following objectives.
- The conservation of biological diversity
- The sustainable use of the components of biological diversity
- The fair and equitable sharing of the benefits arising out of the utilization of genetic resources

Under the convention the National Biodiversity Strategy and Action Plan (NBSAP) has been formulated outlining three goals. The goals are conservation and sustainable use of biodiversity; capacity building for biodiversity conservation through a strong governance framework and improved knowledge and understanding; and community participation, ownership and support for biodiversity conservation. On November 2010 Maldives released the Fourth National Biodiversity Report on the status, trends, and threats to biodiversity. In addition to the status, trends and threats to biodiversity, the report also highlights the status of implementation of the NBSAP in the Maldives and the present efforts to mainstream biodiversity in national, sectoral and cross-sectoral plans of the country.

b. The Cartagena Protocol on Biosafety

The Cartagena Protocol on Biosafety to the CBD is an international treaty governing the movements of living modified organisms resulting from modern biotechnology from one country to another. It was adopted on 29 January 2000 as a supplementary agreement to the CBD and entered into force on 11 September 2003.

The Protocol seeks to protect biological diversity from the potential risks posed by living modified organism through modern biotechnology. The firm commitment of the Maldives to the development and support of the biodiversity policy has paved way for the formulation of the National Biosafety Framework (NBF) for the country in 2006.The NBF, developed with financial assistance from the GEF, is the result of collaborative efforts undertaken by the ERC and the UNEP. The NBF will enable Maldives to fulfill its obligations as a Party to the Cartagena Protocol on Biosafety, to which the Maldives joined on 2 September 2002.

c. Mangroves For the Future

Mangroves For the Future (MFF) is a multi-agency, multi-country initiative for the long-term conservation and sustainable management of coastal ecosystems such as mangroves, coral reefs, wetlands, forests, lagoons, estuaries, beaches and sandy shores. MFF focuses on the countries' worst-affected by the Tsunami of 29 December 2004, namely, India, Indonesia,

Maldives, Seychelles, Srilanka and Thailand. The initiative also covers other countries in the region that face similar issues. MFF uses mangroves as a flagship for ecosystem but is inclusive of all coastal ecosystems.

MFF provides a collaborative platform among the many different agencies, sectors, and countries who are working towards common goal of addressing challenges to coastal ecosystems and livelihood issues. The cost sharing agreement between the International Union for Conservation of Nature and UNDP Maldives took place in 02 April 2009 for the implementation of MFF activities in Maldives. Since then the MFF National Strategy and Action Plan has been formulated.

d. United Nation Convention to Combat Desertification

The United Nations Convention to Combat Desertification (UNCCD) is formed to combat desertification and to mitigate the effects of drought through national action programs that incorporate long-term strategies supported by international cooperation and partnership arrangements. Maldives acceded to the UNCCD in September 2002. Major programs or projects that contribute towards UNCCD include building capacity for SLM and mainstreaming SLM into the national development framework. In addition, ministries and departments have undertaken steps for SLM including development of land policy and have initiated activities to establish a Land Information System.

11.6.2 Climate Change

a. United Nations Framework on Climate change

Maldives became party to the UNFCCC on 12th June 1992. Maldives comes under non-Annex1 parties. The National Communication (NC) to UNFCCC is an important strategic tool to help countries align their interests and priorities to the overall goals of the Convention. This is also the principal instrument for highlighting and disseminating climate change concerns to a wider national audience. The main elements of the NC are information regarding emissions including reduction on emissions, and details of the activities the Party has undertaken to implement the UNFCCC. The first NC was submitted by the Maldives in November 2001. Plans are underway to formulate the project document required to finance the second NC to be submitted to the UNFCCC.

Maldives participated in the 16th COP meeting held in Cancun, Mexico in December 2010. This two-week meeting is the sixteenth Conference of the 194 Parties to the UNFCCC and the sixth

meeting of the 192 Parties to the Kyoto Protocol. By June 2011 Maldives formulated SNAP guided by both the Hyogo Framework of Action, as well as the objectives of the UNFCCC.

b. Kyoto Protocol

The Kyoto Protocol (KP) is an international agreement linked to the UNFCC and the major goal of Kyoto Protocol is to set binding targets to industrialized countries for reducing greenhouse gas emissions. The Kyoto Protocol was adopted in Kyoto Japan on 11 December 1997 and entered into force on 16th February 2005. Under the Kyoto Protocol countries must meet their targets primarily through national measures but offers additional means of meeting their targets by of way of three market based mechanism including Trading Emissions, Clean Development Mechanisms and Joint Implementation.

In recognition of the possible negative impacts of climate change, sea level rise and environmental degradation, Maldives played a key role along with Alliance of Small Island States in the negotiations leading to the Kyoto Protocol and became the first country to sign the Kyoto Protocol on 16 March 1998

11.6.3 Ozone Layer Protection

a. Vienna Convention and Montreal Protocol

The Montreal Protocol on Substances That Deplete the Ozone Layer is designed to protect the ozone layer by phasing out the production of numerous substances believed to be responsible for ozone depletion. Due to its widespread adoption and implementation it has been hailed as an example of exceptional international co-operation.

Maldives has taken various steps to regulate ODS to comply with obligations under the Montreal Protocol. Maldives was able to meet phase-out targets in advance to schedule applicable to Maldives through the Refrigerant Management Plan and Terminal Phase-out Plan. In April 2010 HCFC Phase-out Management Plan was prepared to phase out the HCFC in line with the commitments. The plan is to phase-out all use of HCFCs by 2020.

Under the Montreal Protocol on Substance that Deplete the Ozone Layer Maldives has prepared the Country Program in 1993 which was approved by the 10th Meeting of the Executive Committee. From March 1994 onwards Maldives has implemented six phases of the Institutional Strengthening program. To phase out ODS, primarily CFC's training program for refrigeration and air conditioning firms, technicians, customs and enforcement officers, were

conducted in the last ten years. In addition, awareness and information outreach and technical assistance projects for phasing–out ODS with end users were carried out.

11.6.4 Pollution and Chemical related

a. Basal Convention

A central goal of the Basel Convention is to protect human health and the environment by minimizing hazardous waste production through an "integrated life-cycle approach", which involves strong controls from the generation of a hazardous waste to its storage, transport, treatment, reuse, recycling, recovery and final disposal. In Maldives hazardous waste is defined as any waste that is harmful to human health and environment. By law disposal of hazardous waste within the territory of Maldives is prohibited while no restriction have been made on export of hazardous wastes. Maldives restricts the import of hazardous waste and other wastes through Law no 4.93. Strengthening the reduction and elimination of waste through national policies and strategies is a continuous process. By law EIA are mandatory for new development projects including those related to industries. Establishment of Basel Convention Regional Centre for South Asia is being planned under SACEP activities.

b Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade

The Rotterdam Convention, is a multilateral treaty to promote shared responsibilities in relation to importation of hazardous chemicals. The convention promotes open exchange of information and calls on exporters of hazardous chemicals to use proper labeling, include directions on safe handling, and inform purchasers of any known restrictions or bans. Signatory nations can decide whether to allow or ban the importation of chemicals listed in the treaty, and exporting countries are obliged make sure that producers within their jurisdiction comply with the terms of the convention.

In October 2006, Maldives acceded to both the Rotterdam Convention and the Stockholm Convention. The Prior Informed Consent procedure empowers countries to make their own informed decisions on the use and import of pesticides and prevents export of unwanted pesticides.

c. Stockholm Convention on persistent organic pollutant

The Stockholm Convention on Persistent Organic Pollutants is a global treaty to protect human health and the environment from chemicals that remain intact in the environment for long periods, and become widely distributed geographically, accumulating in the fatty tissue of

humans and wildlife, resulting in adverse effects to human health or to the environment. Exposure to persistent organic pollutants can lead to serious health effects including certain cancers, birth defects, dysfunctional immune and reproductive systems, greater susceptibility to diseases and even diminished intelligence. Maldives Acceded to the Convention in 2006

d. Intergovernmental Forum on Chemical Safety

Intergovernmental Forum on Chemical Safety (IFCS) provides an open, transparent and inclusive forum for discussing issues of common interest and also new and emerging issues in the area of sound management of chemicals. IFCS plays a unique multi-faceted role as a flexible, open and transparent brainstorming and bridge-building forum for Governments, intergovernmental organizations and non-governmental organizations from the private sector. This role has facilitated consensus building on issues and actions addressing the sound management of chemicals. By its efforts it contributes to the implementation of the Strategic Approach to International Chemicals Management (SAICM) and the work of other chemicals-related international organizations and institutions. The purpose is to provide policy guidance, develop strategies in a coordinated and integrated manner, foster understanding of issues and promote the required policy. Chemical safety is the prevention of the adverse effects, both short- and long-term, to humans and the environment from the production, storage, transportation, use and disposal of chemicals.

11.6.5 Environmental Governance

a. South Asian Cooperative for Environment Program

South Asia Co-operative Environment Program (SACEP) is an inter-governmental organization, established in 1982 by the governments of South Asia to promote and support protection, management and enhancement of the environment in the region. SACEP member countries are Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. The Governing Council is responsible for determining policy and programs of SACEP and it oversees these activities by meeting regularly to review the ongoing programs and to endorse new recommendations put forward by Secretariat. It consists of one representative from each member states who will be of ministerial rank. SACEP supports national government's efforts for environmental protection and sustainable development.

Since its creation, SACEP has implemented a number of projects and programs in the areas of environment education, environment legislation, biodiversity, air pollution, and the protection and management of the coastal environment. SACEP is also secretariat for the South Asian Seas Program (SASP). The Male' Declaration on control and prevention of air pollution and its likely

trans-boundary effects for South Asia is a significant effort which encourages intergovernmental cooperation to combat the trans-boundary air pollution problem. In November 2010, 12th Governing Council Meeting of the SACEP was undertaken in Colombo, Sri Lanka. Ongoing programs listed include partnership for cleaner fuels and vehicles, environmentally sustainable transport, environmental data, information and management and project on environmental management.

b. South Asian Seas Program

SASP is a co-operative partnership, formally adopted in 1995 for the protection and management of the shared marine waters and associated coastal ecosystems of five maritime SACEP countries - Bangladesh, India, Maldives, Pakistan and Sri Lanka. SACEP Secretariat based in Colombo, Sri Lanka is also Secretariat to the SASP.

South Asian Seas Program priorities changed significantly with the December 2004 Tsunami and presently, the development of strategies to cope with natural disasters is the major area of focus. The Action Plan mandates SASP to focus specifically on Integrated Coastal Zone Management (ICZM), development and implementation of national and regional oil and chemical spill contingency planning, human resources development through strengthening regional centers of excellence and protection of the marine environment from land-based activities. However, this does not preclude SASP to venture into other areas of importance such as revising the South Asian Seas Action Plan based on current global and regional trends Additionally, SASP encourages and assists countries to implement their responsibilities towards different global and regional conventions and related programs in a coherent and co-ordinate manner.

12. Recommendations

1. Strengthen the EIA process with an emphasis on EIA monitoring

- Develop and introduce data collection protocols
- Develop and environmental database (GIS) using information from EIA's
- Develop methodology for systematic monitoring and phase in the monitoring frame work
- Establish an environmental information database to track reporting and other performance benchmarks
- Complete a review of existing policies and legislation relevant to environmental management, including a review of existing EIA regulation and EIA process
- Strengthen evaluation process of EIA's
- Undertake a resource assessment to determine the level of staffing, training and other support required to implement an efficient and effective EIA monitoring and surveillance program
- Increase EIA awareness and capacity building
- Publish and annual national report that provides both quantitative insights into the outcomes of the EIA process
- Strengthen EIA monitoring and implementation
- Develop environmental guidelines for selection of sites for development purposes
- Increase skills of EPA/EIA unit staff for monitoring
- Strengthen public participation in EIA evaluation and monitoring
- Decentralize EIA monitoring and compliance to atoll councils

2. Conserve and sustainability use biological diversity and ensure maximum ecosystem benefits

- Mainstream biodiversity conservation into all national development and sectoral policies
- Define national government, provincial and Atoll Council Offices and community responsibilities for biodiversity conservation
- Ensure biodiversity conservation as core component in all provincial development strategies, atoll development plans and island land use plans
- Introduce informal agreements and market based instruments for biodiversity conservation
- Establish a fully functional Protected Areas system in the Maldives that provides adequate protection to terrestrial marine, and mangrove ecosystems threatened species

3. Develop resilient communities addressing impacts of climate change disaster management and coastal protection

- Develop locally appropriate coastal protection and flood control measures in inhabited islands
- Protect INIA and regional airports from predicated sea level rise and wave induced flooding
- Review national adaptation strategy and programs and implement NAPA
- Improve building designs to increase resilience and strengthen enforcement of building code
- Integrate climate change risks into resilient island planning
- Develop the conceptual and operational framework for the Resilient Island Program (RIP) through ha review of RIP concept and its contribution to DRR
- Enhance adaptive capacity to manage climate change related risks to fresh water availability by appropriate wastewater treatment technologies
- Develop climate change adaptation implementation strategy for major development related sectors
- Protection of human settlement by coastal protection measures on selected islands
- Increase engagement of civil society to combat climate risks
- Implement national obligations under the UNCCC
- Reinforce climate negotiations
- Assess socio-economic impacts of climate change on fisheries and agriculture

4. Strengthen adaptation and mitigation responses for beach erosion and develop a system to assist communities where livelihood and property are affected by beach erosion

- Develop and introduce guidelines for coastal modification to prevent erosion
- Implement measures for erosion control in severely affected islands
- Establish a financing mechanism for beach erosion and coastal protection
- Protection of settlements by coastal protection measures on selected islands
- Conduct further research into viable alternative protection measures with a greater appreciation of more cost effective softer measures
- Establish a climate research body on intensify Maldives Meteorological Services with a specific mandate to gather weather data and model climate impacts for the Maldives
- Ensure an effective early warning is implemented in full with adequate capacity for implementation at all levels

- Develop guidelines for settlement planning for, inter alia, building codes, land reclamation, harbor development and land use, to ensure that any development is sustainable and resilient to climate change

5. Ensure management of solid waste to prevent impact on human health and environment through approaches that are economically viable and locally appropriate

- Submit to parliament a bill on waste management that would clearly delineate roles and responsibilities at individual level, island level, and atoll, provincial and national level
- Develop the policy and regulatory framework for public private partnership in waste management services
- Develop IWMC on all inhabited islands and ensure that the centers are equipped to enable the island communities to manage the waste
- Develop and construct Provincial Solid Waste Management Facilities with particular emphasis on recovery and recycling
- Enable establishment of waste collection and transfer services in the Provinces to remove hazardous, residual and recyclable waste from inhabited islands for safe disposal, storage or proceeding

6. Ensure protection of people and environment from hazardous waste and chemicals

- Establish a National Chemical Information System and develop regulation and guidelines for safe use, handling and disposal of all types of chemicals
- Initiate a Hazardous Waste Communication inoculation and movement system to meet international standards

7. Improve air quality to safeguard human health

- Establish a fully equipped Ambient Air Quality Monitoring Stations in densely populated islands
- Undertake monitoring of emissions from point and mobile sources and establish standards for such sources of pollution

8. Ensure a fully functional decentralized environmental governance system

- Define mandate of national, provincial atoll and island for environmental administration
- Strengthen capacity to implement the decentralized environmental mandate

- Identify the appropriate options for fund raising to implement the decentralized environmental sector responsibilities
- Create post of Provincial and Atoll Environment Officers

9. Develop a low carbon economy to achieve Carbon Neutrality by 2019

- Formulate and establish and action plan and legal framework to become Carbon Neutral by 2020
- Introduce renewable alternative technologies
- Submit to parliament a bill on reaching carbon neutrality by 2020
- Introduce incentives to private sector to engage in low carbon measures
- Establish a policy to provide incentives for businesses involved in providing renewable sources of energy
- Undertake monitoring of emissions from point of mobile sources and establish standards for such sources of pollution

10. Inculcate environmental values in the society and enable and environmentally friendly lifestyle

- Develop and deliver waste awareness and training campaigns that engage and inform the community, formal and informal education sectors, the media, commercial and industrial enterprises and government agencies about the waste management system and practices
- Raise awareness about impacts of global warming climate change and the importance and advantage of becoming carbon neutral.

Source: Strategic Action Plan 2009-2013, Department of National Planning, 2009

13 Projects

PROJECT NAME: COASTAL PROTECTION WORKS

SECTORS: Environment

STATUS: Ongoing

SUMMARY:

The project focus is to protect the islands of Maldives from erosion. The following table outlines the islands identified for the project and the status of the projects.

Island/Infrastructure	Status
Ha Dhidhoo	initiated
R Alifushi	initiated
M Dhiggaru	initiated
S. Hulhudhoo Meedhoo	initiated
M. Naalaafushi	completed
M. Maduvaree	completed
M. Dhiggaru	ongoing
N.Holhudhoo	planned
Ha.Hoarafushi	planned
Gn.Foamulaku	planned
Male International Airport	planned

PROJECT NAME: DREDGING, RECLAMATION AND SHORE PROTECTION WORKS FOR THAA THIMARAFUSHI AIRPORT DEVELOPMENT AND LAND RECLAMATION PROJECT

SECTOR: Airport, Construction, Environment and Land

STATUS: Planned

SUMMARY:

An area of 31 hectares is proposed to be reclaimed for the airport runway and other services. Another 10 hectares is proposed to be reclaimed as part of an expansion of the existing Thimarafush island. A total of 732m of shore protection is proposed to be constructed under the project.

PROJECT NAME: MALDIVES PUBLIC SECTOR INFRASTRUCTURE PROJECT (SHORE PROTECTION COMPONENT)

SECTOR: Environment

STATUS: Planned

PROJECT NAME: RENEWABLE ENERGY TECHNOLOGY DEVELOPMENT ASSIST PROGRAM (REDTAP)

SECTORS: Renewable Energy

STATUS: Ongoing–Base activities completed, final evaluation pending

SUMMARY:

The RETDAP will facilitate the promotion of the widespread implementation and ultimately, commercialization of RE technologies (RETs). The project seeks to establish an environment conducive to the adoption and commercialization of RETs in the country. It involves the design, development and implementation of appropriate policies, strategies and interventions addressing the fiscal, financial, regulatory, market, technical and information barriers to renewable energy development and utilization.

Start Date: March2004

End Date: November 2011

Funding Type: Grant

Funding Source: GEF, UNDP

PROJECT NAME: SOLAR POWER SYSTEM FOR A SMALL ISLAND

SECTOR: Electricity, Environment

STATUS: Planned

SUMMARY: **Solar Hybrid and Mini-grid development for small islands.**

This project deals with installation and commissioning of a hybrid solar PV system in the Island of K. Dhiffushi which will serve as pilot project. The experience gained from this exercise will be used to replicate similar projects in other small islands by encouraging private sector investments.

The main objectives of this project include the reduction on the dependency on fossil fuels and to move towards the carbon neutral target, produce technical capacity at island and utility levels in installation and operating/maintenance, and creating awareness at national and international

levels regarding global warming,

The project is funded by ADB and Global Sustainable Electricity Partnership.

PROJECT NAME: HARBOUR PROJECTS

SECTOR: Environment –Harbour

STATUS: Ongoing/Completed

SUMMARY:

Island/Infrastructure	Status	Scope
Ha Thakandhoo	Completed	Dredging, construction of rock boulder breakwater, construction of concrete quay wall and filling of sand between quay wall and original shore line
Ha Uligamu	Ongoing	Dredging, construction of rock boulder breakwater, construction of concrete quay wall and filling of sand between quay wall and original shore line
Ha Maarandhoo	Completed	NA
Hdh Kuribi	Ongoing	NA
Hdh Kumundhoo	Completed	Dredging, construction of rock boulder breakwater, construction of concrete quay wall and filling of sand between quay wall and original shore line
Hdh Nelaidhoo	Ongoing	NA
Hdh Finey	Completed	NA
Hdh Kulhudufushi	Completed	NA
Sh Foakaidhoo	Planned	NA
Sh Bilehfahi	Completed	Dredging, construction of rock boulder breakwater, construction of concrete quay wall and filling of sand between quay wall and original shore line
Sh Goidhoo	Completed	NA
Sh Narudhoo	Completed	Dredging, construction of rock boulder breakwater, construction of concrete quay wall and filling of sand between quay wall and original shore line
Sh Milandhoo	Ongoing	Dredging, construction of rock boulder breakwater, construction of concrete quay wall and filling of sand between quay wall and original shore line
N Holhudhoo	Planned	NA

N Landhoo	Completed	NA
N Velidhoo	Planned	NA
N Kudafari	Ongoing	NA
N Kedhikolhudhoo	Completed	Dredging, construction of rock boulder breakwater, construction of concrete quay wall and filling of sand between quay wall and original shore line
R Rasmaadhoo	Completed	Dredging, construction of rock boulder breakwater, construction of concrete quay wall and filling of sand between quay wall and original shore line
R Fainu	Ongoing	NA
R Angolhitheemu	Completed	Dredging, construction of rock boulder breakwater, construction of concrete quay wall and filling of sand between quay wall and original shore line
R Kinolhos	Completed	Dredging, construction of rock boulder breakwater, construction of concrete quay wall and filling of sand between quay wall and original shore line
R Maakurathu	Completed	Dredging, construction of rock boulder breakwater, construction of concrete quay wall and filling of sand between quay wall and original shore line
R Meedhoo	Completed	Dredging, construction of rock boulder breakwater, construction of concrete quay wall and filling of sand between quay wall and original shore line
R Alifushi	Completed	NA
R Maduvaree	Completed	NA
R Vaadhoo	Completed	NA
B Hithaadhoo	Completed	NA
Lh Kurendhoo	Ongoing	NA
Lh Naifaru	Planned	NA
Lh Olhuvelifushi	Completed	NA
K Maafushi	Completed	Dredging, construction of rock boulder breakwater, construction of concrete quay wall and filling of sand between quay wall and original shore line
K Vilingili	Completed	NA
AA Rasdhoo	Ongoing	Dredging, construction of rock boulder breakwater, construction of concrete quay wall and filling of sand between quay wall and original shore line
AA Ukulhas	Ongoing	NA
AA Thoddoo	Completed	NA

Adh Maandhoo	Planned	NA
Adh Mahibadhoo	Completed	NA
M Mulah	Delayed	Harbour reconstruction
M Maduwaree	Completed	NA
M Naalaafushi	Completed	NA
F Bilehdhoo	Ongoing	NA
F Feeali	Planned	NA
F Magoodhoo	Planned	NA
Dh Bandidhoo	Completed	NA
Dh Kudahuvadhoo	Planned	NA
Th Kibidhoo	Planned	NA
Th Veymandhoo	Completed	Dredging, construction of rock boulder breakwater, construction of concrete quay wall and filling of sand between quay wall and original shore line
L Mundoo	Completed	NA
L Gan	Completed	Dredging, construction of rock boulder breakwater, construction of concrete quay wall and filling of sand between quay wall and original shore line
L Maamendhoo	Completed	Dredging, construction of rock boulder breakwater, construction of concrete quay wall and filling of sand between quay wall and original shore line
Ga Gemanafushi	Planned	NA
Ga Nilandhoo	Completed	NA
Ga Kolamaafushi	Planned	NA
Ga Maamendhoo	Planned	NA
Gdh Fares Maathoda	Planned	NA
Gdh Hoadhedhoo	Planned	NA
Gdh Madaveli	Planned	NA
Gdh Nadalla	Completed	Dredging harbor channel
Gdh Fiyori	Completed	Dredging harbor basin and constructing quay wall
Gn .Fuahmulah	Planned	Harbour breakwater head repair project
S Feydhoo	Ongoing	NA

S Hithadhoo	Ongoing	NA
S Hulhudhoomeedhoo	Ongoing	NA
S Maradhoo Feydhoo	Ongoing	NA

PROJECT NAME: PROVIDE 2500 LTR WATER TANKS FOR ALL HOUSES IN 45 ISLANDS-PHASE 2

SECTORS: Environment –Utilities/water

STATUS: Ongoing

SUMMARY:

Atoll	**Island**	**Donor**	**Status**
Gdh	Thinadhoo	MWSC	April-11Completed
Hdh	Kulhudhufushi	MWSC	March-1Completed
K	Maafushi	MWSC	March-1Completed
Sh	Komandoo	Community	Completed
Atoll	Island	Donor	
Lh	Hinnavaru	USAID	Ongoing
Ha	Dhihdhoo	USAID	Ongoing
Gdh	Gahdhoo	Adaptation Fund	Ongoing
Adh	Mahibadhoo	Adaptation Fund	Ongoing
R	Dhuvaafaru	MWSC	ongoing
Ha	Ihavandhoo	Adaptation Fund	Ongoing
S	Feydhoo	Southern Utilities Limited/Biwater International	Ongoing
S	Hithadhoo		Ongoing
S	Hulhudhoo		Ongoing
S	Hulhudhoo-meedhoo		Ongoing
S	Maradhoo		Ongoing
S	Maradhoo-feydhoo		Ongoing
Gn	Fuvahmulah		Ongoing

Aa	Ukulhas	Climate change trust fund	Agreement to be signed shortly

PROJECT NAME: ASSISTANCE FROM GIZ (PROJECT TO BE DESIGNED)
STATUS: Preparatory Work

SUMMARY

Attempt to develop zero carbon strategy (This project is on hold at present)

Start Date: TBD

End Date:

Funding Type: Grant

Funding Source: GIZ

PROJECT NAME: STRENGTHENING LOW-CARBON ENERGY ISLAND STRATEGIES
SECTORS: Climate Change

STATUS: PIF Submitted

SUMMARY

Strengthen national capacities to formulate and manage implementation of policies and strategies for an accelerated public-private sector partnerships for the medium- and long-term deployment of low carbon energy strategies and programs. Also under the project investments would be made on energy efficient investments

Start Date: 2012

End Date:

Funding Type: Grant

Funding Source: GEF

PROJECT NAME: INCREASING CLIMATE RESILIENCE THROUGH AN INTEGRATED WATER RESOURCE MANAGEMENT PROGRAMME (IN HA. IHAVANDHOO, ADH. MAHIBADHOO AND GDH. GADHDHOO ISLAND

SECTORS: Climate Change

STATUS: Preparatory Work

SUMMARY:

The objective of this project is to ensure reliable and safe freshwater supply for Maldivian communities through the rollout of an integrated water resource management program in HA. Ihavandhoo, ADh. Mahibadhoo and GDh. Gadhdhoo. The project will ensure consistent, safe and equitable access of all island communities to safe freshwater in a changing climate. Through a targeted mix of the following investments, the project will address the effects of variable rainfall, extreme weather events, salinization and pollution of aquifers: Establishment of a sustainable freshwater supply system that incorporates and integrates rainwater harvesting and desalination technology

- Improvement of groundwater quality through artificial groundwater recharge and better integration between freshwater and wastewater management
- Increasing community participation in the development, allocation and monitoring of freshwater use in a changing climate
- Replication and up scaling of climate-resilient freshwater management

Start Date: Quarter 4 of 2011

End Date: NA

Funding Type: Grant

Funding Source: Adaptation Fund Board

PROJECT NAME: MALDIVES PUBLIC SERVICES INFRASTRUCTURE PROJECT-SEWERAGE SYSTEM

SECTORS: Environment –Utilities

STATUS: Ongoing

SUMMARY:

Atoll	Island	Donor	Type of system	Status
L	Isdhoo/Isdhoo-Kalaidhoo	JICA	Small Bore Sewer	Completed -September-07
K	Hura	Private	Conventional Gravity System	Completed -2008
HDH	Kulhudhuffishi	GOM	Conventional Gravity System	Completed-Mar-10
TH	Guraidhoo	ADB grant	Small Bore Sewer	Completed -May-08
L	Dhanbidhoo	UNDP	Small Bore Sewer	Completed -Jul-08
R	Dhuvaafaru	IFRC	Small Bore Sewer	Completed-July-08
K	Maafushi	IFRC/ARC	Small Bore Sewer	Completed -Jul-08

K	Guraidhoo	IFRC/ARC	Small Bore Sewer	Completed-Jul-08
DH	Kudahuvadhoo	IFRC/ARC	Small Bore Sewer	-Completed-Jul-08
TH	Vilufushi	British Red Cross	Conventional Gravity System	Completed-Jul-08
R	Ungoofaaru	UNICEF		Completed -Feb-09
N	Manadhoo	UNICEF	Vacuum System	Completed-Feb-09
F	Nilandhoo	UNICEF	Vacuum System	Completed-Feb-09
DH	Meedhoo	UNICEF	Vacuum System	Completed-Mar-09
AA	Rasdhoo	US State Dept	Conventional Gravity System	Completed-April-10
HA	Dhihdhoo	US State Dept	Conventional Gravity System	Completed-July-10
GA	Villingili	American Red Cross	Small Bore Sewer	Completed-May-10
GA	Dhaandhoo	American Red Cross	Small Bore Sewer	Completed-June-10
M	Muli	JBIC Loan	Conventional Gravity System	Completed-September-10
SH	Funadhoo	JBIC Loan	Conventional Gravity System	Completed-October-10
B	Eydhafushi	JBIC Loan	Conventional Gravity System	Completed-October-10
TH	Thimarafushi	Kuwait Fund loan	Conventional Gravity System	Completed-January-11
LH	Hinnavaru	Kuwait Fund loan	Conventional Gravity System	Completed-January-11
V	Felidhoo	US State Dept	Conventional Gravity System	Completed-May 10
B	Kudarikilu	Community		Completed—2008
K	Gulhi			Completed
Aa	Thoddoo	SEK/MNDF/GOVT.		Ongoing

L	Gan	AFD Loan		Ongoing
Gdh	Thinadhoo	AFD Loan		Ongoing
Adh	Mahibadhoo	ADB Loan		Ongoing
L	Fonadhoo	ADB Loan		Ongoing
S	Feydhoo	Southern Utilities Limited/Biwater International		Ongoing
S	Hithadhoo			Ongoing
S	Hulhudhoo			Ongoing
S	Hulhudhoo-meedhoo			Ongoing
S	Maradhoo			Ongoing
S	Maradhoo-feydhoo			Ongoing
Gn	Fuvahmulah			Ongoing
N	Miladhoo	Works corporation Ltd		Ongoing
M	Kolhufushi	Abu Dhabi Fund		Ongoing

PROJECT NAME: SUPPORT TO REHABILITATE THE TARO FEILD ON GDH. FIYOARI

SECTORS: Agriculture and Environment

STATUS: Ongoing

SUMMARY:

To device and implement an appropriate system/mechanism for the drainage of salt water from the affected area so as to provide better protection and security for the community from island-wide flooding, and thereby minimize economic losses by minimizing damage to the Taro fields and other vegetation, property and infrastructure in the islands.

The objectives are;

- Restore the livelihoods of the Fiyoari farming community.
- Protect the islands' indigenous vegetation, private and public property and infrastructure from the future floods related to storm surges.
- Manage floods in the aftermath of storm surges through a proper drainage system.
- Increase production of sedge (hau) in Gdh. Fiyoari.

PROJECT NAME: LEASE OF UNINHABITED ISLANDS FOR ENVIRONMENT PURPOSES

SECTOR: Environment

STATUS: Ongoing

PROJECT NAME: HUVANI CONTROL PROGRAM

SECTOR: Agriculture, Environment

STATUS: Ongoing

PROJECT NAME: EMERGENCY PEST CONTROL

SECTOR: Agriculture, Environment

STATUS: Ongoing

PROJECT NAME: MALDIVES CLIMATE CHANGE MAPPING PROJECT

SECTOR: Environment

STATUS: Ongoing

SUMMARY:

The general aim of the program is acquisition of environmental data, setting up tools and developing indicators to facilitate evaluation and monitoring of the effects of climate change in the Maldives archipelago.

The specific objectives are as follows:

- National capacity-building in terms of information management and the monitoring of climate change issues
- Acquiring and processing environmental data
- Research & Development: _ Monitoring methods and actions to adjust to climate change
- Creation of the Maldives Environment and Climate Change Geoportal

Start Date: Jan-10

End Date: Jun-11

Funding Type: Grant

Funding Source: Agent Franchice de Development (A.F.D)

PROJECT NAME: SECOND NATIONAL COMMUNICATION UNDER NATIONAL OBLIGATION TO UNFCCC

SECTOR: Environment

STATUS: Project Document Formulation Complete

SUMMARY:

Fulfilling the obligation to UNFCCC by reporting national circumstances on a period basis
Under this GHG inventory and CC vulnerability assessment would be carried out

Start Date: January 2011

End Date: NA

Funding Type: Grant

Funding Source: GEF

PROJECT NAME: IMPACT2C - QUANTIFYING THE IMAPCTS OF 2 DEGREE CELIUS TEMPERATURE RISE

SECTOR: Environment

STATUS: Preparatory Work

SUMMARY:

This project focuses on climate change impact, vulnerability and adaptation due to a global averaged surface temperature change of 2°C (and if appropriate of 1.5°C) from pre- industrial level for the coastal regions of small islands. This is achieved by;

- Analyzing sea-level impacts using a climate impacts model (DIVA), with a focus on small islands
- Understanding today's problems and engineering solutions to protect small islands such as the Maldives, using a case study of select islands.
- Using case study islands, analysis flooding and submergence through GIS and possible adaptation options
- Investigating other climate aspects of coastal change.

Start Date: October-11

End Date: October-14

Funding Type: Grant

Funding Source: European Union

PROJECT NAME: ADB ENERGY REGULATORY TECHNICAL ASSISTANCE

SECTOR: Environment

STATUS: Preparatory Work

SUMMARY:

Start Date: November-11

End Date:

Funding Type: Grant

Funding Source: ADB

PROJECT NAME: INTEGRATING CLIMATE CHANGE RISK INTO ISLAND PLANNING IN THE MALDIVES

SECTOR: Environment

STATUS: Ongoing

SUMMARY:

The main objective of the project is to analyze risks of climate change and existing measures to counter impacts of climate change in the islands. The project involves assessment of climate risks and existing adaptation options and its effectiveness in Maldives, capacity building of island administrators, development of guidelines on coastal protection activities and demonstration of soft and hard adaptation measures. Project also focuses of on streamlining information dissemination of climate change information to the public

Start Date: Feb-10

End Date: Mar-14

Funding Type: Grant

Funding Source: GEF-LDCF

PROJECT NAME: WETLAND CONSERVATION AND CORAL REEF MONITORING FOR ADAPTATON TO CLIMATE CHANGE (WCCM)

SECTOR: Environment

STATUS: Planned

SUMMARYThe main aim of the WCCM project is to contribute to the climate change adaptation capacity of the Republic of Maldives in the context of wetland and coral reef management. Accordingly, this project has two development objectives.

Two community-based wetland management plans (CBWMP) are approved and under implementation.
At least five tourist resorts produce data (baseline and one monitoring) on coral reef health.

The implementation period of this project is 18 months. Due to the short duration, and pilot nature of the WCCM project, the indicators capture intermediate outcomes.

PROJECT NAME: GEO MAGNETIC PROJECT

SECTOR: Environment

STATUS: Planned

SUMMARY:

The scope of the project is to study ionospheric current systems (space weather effects) and to study crustle and upper mantle electrical conductivity in the region. The project also focuses to provide data for international geomagnetic community

Objectives:

To install and maintenance of a geomagnetic observatory in S.Gan and also training and education of young Maldivian scientists to measure process and analyze geomagnetic data

PROJECT NAME: REDUCE IMPACTS OF CLIMATE CHANGE DRIVEN DEGRADATION THROUGH PROTECTION AND CONSERVATION OF MANGROVE AND WETLAND ECOSYSTEM

SECTOR: Environment

STATUS: Planned

SUMMARY:

The two wetlands will be identified from the following in consultation with the Local Councils: Hithadhoo's Eidhigali Kilhi (updating of CBWMP); Hithadhoo's Southern Wetland Area [Maamendhoo Kulhi and Fehele Kulhi], Fuvahmulah's Fuvahmulaku Bandara Kulhi and Dhandi Magu Kulhi)development of CBWMP

PROJECT NAME: HCFC PHASE OUT MANAGEMENT PHASEOUT PLAN

SECTOR: Environment

STATUS: Ongoing

SUMMARY:

The activities of the project include

- HCFC phase out policies &enforcement (HPP)
- Promotion of ozone climate co-benefits.
- Enhanced awareness and out reach
- Plan for gradual reduction of HCFCs

PROJECT NAME: MALDIVES ENVIRONMENTAL MANAGEMENT PROJECT (MEMP)

SECTOR: Environment

STATUS: Ongoing

SUMMARY:

The general aim of MEMP is to upgrade solid waste management in the North and North Central Province. The MEMP main objectives are

To construct a Regional Waste Management Facility (RWMF) and the associated waste management and collection infrastructure in the various islands and atoll.

To strengthen the capacity for environmental management in the Maldives at the island level

The Project has four (4) components which include:

- Regional Solid Waste Management Program
- Regional Environment Assessment;
- Environmental capacity and Human Resource Initiative; and
- Project Management and project Communications

PROJECT NAME: NATIONAL CAPACITY SELF ASSESSMENT FOR GLOBAL ENVIRONMENTAL MANAGEMENT

SECTOR: Environment

STATUS: Ongoing

PROJECT NAME: NATIONAL ECONOMIC ENVIRONMENT DEVELOPMENT STUDIES

SECTOR: Environment

STATUS: Completed

SUMMARY

The proposed study intends to bridge the gap between initiatives in the climate domain and the national development plan. This study will enable the government to identify financing needs to implement mitigation and adaptation measures in key economic sectors and to identify financial instruments and policies that will support the implementation of these measures. The main objectives of the proposed work are to support the Government of Maldives in the following areas;

- To select key sectors for climate change mitigation and adaptation measures based on priorities identified in the second national communications, NAPA and the country's

national development plan(s) to serve as basis for the financial needs assessments.

- To assess financing needs required to address mitigation and adaptation measures in selected key sectors and to identify appropriate financial and regulatory instruments to support them
- To raise awareness and facilitate informed consensus among government agencies on policy actions required to mobilize finance and investment

Start Date: Mar-10

End Date: May -10

Funding Type: Grant

Funding Source: UNFCCC

PROJECT NAME: SMALL SCALE FUNDING AGREEMENT

SECTOR: Environment

STATUS: Ongoing

SUMMARY: NA

PROJECT NAME: PREPARATION OF NATIONAL ADAPTATION PLAN OF ACTION

SECTOR: Environment

STATUS: Completed

SUMMARY:NA

PROJECT NAME: ETHICS AND INTEGRITY

SECTOR: Environment, Human Resource Development

STATUS: Completed

SUMMARY: NA

PROJECT NAME: STRATEGIC SUSTAINABILITY MASTER PLAN

SECTOR: Environment

STATUS: Planned

SUMMARY:NA

PROJECT NAME: NATIONAL ASSESSMENT REPORT

SECTOR: Environment,

STATUS: Completed

SUMMARY

National Assessment Report is the reporting mechanism under the Mauritaus Strategy Implementation (MSI) +5 . It outlines the achievement of the MDG with respect to MSI

Start Date: April 2010

End Date: September -2010

Funding Type: Grant

Funding Source: UNDP

PROJECT NAME: OUTER ISLAND ELETRIFICATION PROJECT (OIEP)

SECTOR: Energy

STATUS: Completed

SUMMARY

Upgrade or newly install Electrification systems for 20+ islands

Start Date: April 2010

End Date: December 2010

Funding Type: Loan

Funding Source: ADB and Government of Maldives

PROJECT NAME: CLEAN ENERGY MALDIVES

SECTOR: Energy

STATUS:In Progress

SUMMARY: NA

Start Date: January 2011

End Date:

Funding Type: Grant

Funding Source: Japanese Government

PROJECT NAME: SCALING UP OF RENEWABLE ENERGY PROGRAM

SECTOR: Energy

STATUS:In Progress

SUMMARY

The Government of Maldives is developing a national clean energy investment plan for achieving the carbon neutrality goal and increasing the penetration of renewable energy for power generation. The SREP IP will be a major contributor to the national plan and will identify SREP interventions for achieving the Maldives clean energy goals.

Start Date: May 2011

End Date: May 2016

Funding Type: Grant

Funding Source: CIF

PROJECT NAME: SOLAR GRID CONNECTED SYSTEM FOR SMALL ISLAND (DHIFFUSHI 40KW PROJECT

SECTOR: Energy

STATUS:In Progress

SUMMARY

Kansai as a leader of e8 project install the PV system in Maldives which will be the pilot project followed by the expanding installation of PV systems all over the Maldives, by utilizing ADB fund.
More concretely about the pilot project, PV system up to max about 40kW (same level as Tuvalu

Project to use the lesson learned then) will be installed to the local island (Dhiffushi) whose max demand is about 100kW ~ 300kW, and operated cooperatively with the existing diesel generators.
That will contribute to the reduction of CO2 emission and the curtailment for diesel fuel expense.

Start Date: September 2011

End Date: Marc 2013

Funding Type:

Funding Source: ADB in collaboration with Global Sustainable Electricity Partnership (GSEP)

PROJECT NAME: DANIDA GREEN FACILITY

SECTOR: Climate Change

STATUS:In Progress

SUMMARY

The DANIDA Green Facility Phase II aims at creating a number of CDM projects in the Maldives and enabling The Maldives to fully participate in the global carbon market

Objectives and expected results of the project includes*:*
The Maldives will be able to identify, design, approve, finance where appropriate, implement and monitor CDM projects that both address their country's sustainable development priorities and offer a cost-effective option for carbon credit buyers to comply with their obligations under the Kyoto Protocol.

Start Date: September 2011
End Date: Dec 2013

Funding Type: Grant

Funding Source:DANIDA

Start Date: September 2011
End Date: Dec 2013

Funding Type: Grant

Funding Source:DANIDA

PROJECT NAME: PREPERATION OF FOURTH NATIONAL NATIONAL REPORT TO CBD

SECTOR: Environment

STATUS: Completed

SUMMARY

The project was funded by GEF ,the report is based on the status of Biodiversity ,threats to Biodiversity ,trends in biodiversity and the efforts in conservation of biodiversity.

PROJECT NAME:ATOLL ECOSYSTEM-BASED CONSERVATION OF GLOBALLY SIGNIFICANT BIOLOGICAL DIVERSITY IN THE MALDIVES-BAA ATOLL

SECTOR: Environment and Agriculture

STATUS: Ongoing

SUMMARY:

The project objectives:
To mainstream biodiversity into major institutions and policies
To establish model sustainable biodiversity conservation practices in Baa Atoll through stakeholder involvement
To pilot sustainable natural resource management and livelihood development practices in Baa Atoll through stakeholder involvement.

PROJECT NAME: SUPPORTING COUNTRY ACTION ON THE CBO PROGRAM ON THE WORK ON PROTECTED AREAS

SECTOR: Environment

STATUS: Ongoing

SUMMARY:

Scoping the requirements and establishing the mechanisms for developing a protected areas system plan and developing capacity to manage existing protected areas based on appropriate forms of governance that generate positive incentives to support their long term integrity and maintenance

PROJECT NAME: SUPPORTING COUNTRY ACTION ON THE CBD PROGRAM OF WORK ON PROTECTED AREAS

SECTOR: Environment

STATUS: Ongoing

SUMMARY:

The protected areas of of B. Hithaadhoo, AA. Hurasdhoo and Mayathila is the focus of the project.

The project objectives:

To scoping the requirements to establish the mechanism for developing protected areas

To plan and develop capacity to manage existing protected areas based on appropriate form of governance that generate positive incentives to support their long-term integrity and maintenance

PROJECT NAME: MONITORING CORAL REEF ECOSYSTEM HEALTH

SECTOR: Environment

STATUS: Planned

SUMMARY: NA

PROJECT NAME: STRENGTHENING NATIONAL AND COMMUNITIES CAPACITIES FOR EFFECTIVE EARLY WARNING DISSEMINATION AND RESPONSE

SECTOR: Environment

STATUS: Ongoing

SUMMARY: NA

PROJECT NAME: ESTABLISHMENT OF REGIONAL INTERGRATED MULTIHAZARD EARLY WARNING SYSTEM

SECTOR: Environment, Information Communication Technology

STATUS: Ongoing

SUMMARY:

Developing and sustaining regional early warning arrangements among 26 countries in Africa and Asia against tsunami and hydro meteorological hazards. The collaborating countries to contribute resources towards sustaining the regional arrangements for multi hazard warnings

The project objectives are

- To facilitate establishment and maintenance of core regional observation and monitoring networks and ensure data availability for early warning purposes.
- To provide research and development support to national meteorological hydrological services for providing localized hydro-meteorological risk information
- To enhance the capacities of national systems to respond to early warning information of various lead times at national, sub national, local and at risk community levels within each national early warning framework

PROJECT NAME: ESTABLISHMENT OF NATIONAL EARLY WARNING SYSTEM(Phase 2)

SECTOR: Environment, Information Communication Technology

STATUS: Ongoing

SUMMARY

To establish and maintain a reliable meteorological, seismological network to provide accurate weather, earth quake and tsunami related information / warning to the country.

The project objectives:

- To install meteorological, seismological equipment to monitor, analyze and forecast weather related phenomenon and to monitor and analyze oceanographic events in the country.

PROJECT NAME: ESTABLISHMENT OF NATIONAL EARLY WARNING SYSTEM PHASE 1

SECTOR: Environment, Information Communication Technology

STATUS: Completed

SUMMARY:

- Under the project the following installations were undertaken
- weather radar systems were installed in n Maldives Meteorological services,
- a short period seismometer 2 automatic weather stations in B Dharavandhoo and F Nilandhoo
- Global Telecommunication System was upgraded and a Meteosat Receiving System was installed

PROJECT NAME:SOUTH ARI ATOLL WASTE MANAGEMENT PROJECT

SECTOR: Environment –waste management

STATUS: Ongoing

SUMMARY: NA

PROJECT NAME: HULHUMALE WASTE YARD DEVELOPMENT PROJECT 2010

SECTOR: Waste Management

STATUS: Completed

SUMMARY: NA

PROJECT NAME: TOURISM SECURITY PROJECT

Sectors: Tourism, Environment, Judicial Services

STATUS: Ongoing

SUMMARY:

The focus is to develop and enhance Tourism Police Unit which was established in 29 March 2009 with drafting up regulation to enhance tourism security.

PROJECT NAME: CAPACITY BUILDING AND MAINSTREAMING SUSTAINABLE LAND MANAGEMENT IN THE MALDIVES

SECTOR: Environment

STATUS: Ongoing

SUMMARY:

Project objectives are

- Institutional capacity building
- Policies and reputational framework
- National /Sectoral policies and regional planning
- Formulation of NAP

PROJECT NAME: RECLAMATION GA DHAANDHOO

SECTOR: Environment –Land

STATUS: Ongoing

SUMMARY: NA

PROJECT NAME: CONSULTANCY WORK FOR S.GAN LAND USE PREPERATION

SECTOR: Environment –Land

STATUS: Ongoing

SUMMARY: NA

PROJECT NAME: LAND MANAGEMENT DATABASE PROJECT

SECTOR: Environment –Land

STATUS: Ongoing

SUMMARY: NA

Source: http://isles.egov.mv/

Ministry of Housing and Environment

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