2. BIOPHYSICAL ENVIRONMENT

2.1 Description of the coast and distinctive features

There are no regulation and management plans to preserve the natural and pristine characteristics from both sea based and land based activities in the coastal zone such as fisheries, water sports, dredging, construction of buildings, run off of agricultural chemicals, untreated sewage, and industrial and commercial pollutants from rivers.
Monitoring of the coastal degradation due to other factors than the coastal erosion like removal of coastal rocks to create artificial beaches has to be envisaged.

No bathymetric maps of the lagoon are available to assess possible siltation.

Most of the pristine coastal sites have been exploited and now hotel planners are examining areas less touched by the imprint of change e.g. grazing lands.

2.2 General description of the climate

Climate and the environment naturally undergo changes driven by external factors such as variations in solar output and internal factors such as volcanic eruptions. Moreover, human activities are known to have impacts on the environment. Policies designed to sustain ecosystem goods and services should be based on knowledge of ecosystem responses which can be uncovered by studies related to past climate variability data (Alverson*et al.* 2001).

Paleo-archives document ecosystem responses to changes in mean climate as well as in the magnitude and frequency of extreme events. Plans for sustainability should be designed in light of the full range of regional climatic and hydrological variability, including that revealed in paleo-records.

Present trends indicate that the vulnerability of societies to environmental changes is rapidly increasing; areas with high population densities and limited resources (including fresh water), and regions with sensitive ecosystems are under threat from both environmental degradation and climatic changes (Alverson*et al.* 2001).

A recent study by Love *et al.*(2009)indicates that environmental variability affects distributions of seasonally recruiting fishes (transient species): In coastal areas, fluctuations in salinity resulting from variation in stream discharge were found to be negatively correlated with intra-annual stability of fish assemblages. Similar variations could be expected in the ASCLME basin, pointing to the need for regional studies.

2.3 Marine and coastal geology and geomorphology

The geo-morphology of the shoreline around Mauritius is changing as a consequence of natural forces and human interference. It will continue to evolve with major impacts from accelerated sea level rise (IPCC 2007).

Coastal erosion

Coastal erosion is ubiquitous around Mauritius. The causes are both natural and man-made. The coast has been evolving over geological time as a consequence eustatic sea level rise. Another important factor is the climate regime which has eventually has gradually shaped the coastal region. Climatic factors have been directly involved in the process of weathering and erosion. Beach shape, coastal vegetation and lagoon biotypes, at a particular site, are a reflection of coastal processes which develop as a consequence of the integration of various agencies and climate elements including winds, waves, rainfall and temperature.

Waves in particular are the most important driver shaping the coastline. Three types of waves influence the coast regions. The wind generated-waves mostly emanate from the south-eastern sector. They are usually of moderate height (1.5 to 2.5 m) with wave period of 8 to 10 seconds. But can reach 3 to 4 m occasionally during the winter months. Waves, generated far to the south of the island by polar lows of the high latitudes, often reach the southern and south-western coasts as swells with period of the order of 13 seconds. They occur almost all year round, being more persistent and of higher magnitude during the transitions and winter months, leading to “raz de marée” and flooding on the southern and western coast. High waves and heavy swells associated with tropical cyclones have significant impacts on the shoreline. They can reach the coast from any direction depending on the cyclone track, but they come more frequently from the eastern to northern sectors. Wave height exceeding 10 m occurs frequently during cyclone events. The reefs and lagoons provide some shelter to the beach from the open sea waves. Wave breaking and refraction reduce considerably wave height.

Cyclonic waves are responsible for removing large quantity of sand from the beach and lagoons. However, the average wave climate which prevails all year round acts as a restoring agent. Usually after a certain time of around six months, the beach regains its original shape. Raz de Marée also plays an important role the reconstruction processes of the beach and is responsible for bringing sand from the lagoon to the beach. However, some sand is carried away and lost through passes during cyclone occurrences. These coastal processes have been prevailing over geological time. An equilibrium beach and lagoon profile representing a balance of destructive and constructive forces have eventually been reached and have gradually shaped the coastal zone features and characteristics around Mauritius. If either of these two competing forces is altered as a result of a change in wave or water level characteristics, there is an imbalance: the larger force dominates until the evolution of the beach profile brings the forces back into balance.

With climate change, it is projected by the IPCC that tropical cyclones will most likely become more intense and higher waves will be formed. The average wave climate and the southerly swells from the polar lows will most likely also change. As a consequence, coastal erosion will be enhanced. Sea level rise will worsen the problem. A sea level rise of 59 cm as predicted by IPCC will cause the loss of an average of 59m of beach due to erosion according to the Bruun rule (Robert and Dalrymple 2002).

However, in the immediate the main concern is ill-planned and ill-designed coastal development. Enhanced coastal erosion due to human activities started only a few decades ago. Hard structures placed too near the shoreline gave rise initially to localized erosion. Seawalls built to contain the erosion gave rise to further erosion down drift and other protection measures were taken. Consequently a chain reaction took place.

Legislation exists for construction to be built at 30 m from the high water mark. However, enforcement poses much problem. Hard constructions continue to be placed at less than 30 m. A ban on sand mining to address the issue of coastal erosion came into force in October 2003. Though about 800 000 tons are no longer being removed from the beach and lagoons, this is not a panacea. An increase in the set back distance, mainstreaming climate change and sea level rise consideration in coastal development plans and more stringent enforcement of coastal regulations and legislations should be given urgent attention.

Accelerated Sea Level Rise

A study (Ragoonaden 2006) has shown that a very slow fall in sea level (- 0.10 mm/yr) occurred in the average annual changes from 1986 to 2003 and the fall at Rodrigues was - 0.32 mm/yr during the same period. However, during the last few years an accelerated sea level rise has been observed. The same pattern has been noted in Rodrigues and other islands in the West Indian Ocean. This is a matter of serious concern in the event that the trend continues. Coastal erosion is expected to worsen threatening more coastal infrastructure and settlement.

Marine pollution

Pollution of the lagoon is mainly land based. The main sources are:

- Domestic and industrial pollution

The main point sources that cause pressures on the environment are the effluents from households, industries and hotels. At present 25% of the population is connected to a public sewerage system. 73% of the population makes use of onsite disposal systems consisting of either cess pits or septic tanks followed by absorption systems. The remaining 2 % make use of pit latrines. Most of the effluents are either discharged directly to the sea or are carried by rain runoff and rivers.

- Agricultural pollution

Over use of fertilizers in agricultural practices represents a serious to coastal ecosystems, in particular coral reefs. The consumption of fertilizers for the year 2005 was 61,266 tonnes. The major nutrients in these inputs are nitrogen (N), phosphorus (P) as phosphate and potassium (K) as potash.

- Pollution from Port Louis harbour

The main sources of pollution in the Port Louis of harbour waters mainly consists of thefollowing:

(i) Oily waste
(ii) Garbage

Foreign fishing vessels are the cause of major oil pollution of port waters, it is testified by various parties that fishing vessels, prior to taking to sea, for a shipping campaign, leave drums of used lubricating oil on the quay without any instructions or message. The Fishing Harbour is extensively used, by Mauritian, Taiwanese and other fishing vessels is considered to be one of the main sources of pollution in the port.

Ocean Acidification

The increase emission of carbon dioxide in the atmosphere is expected to result in ocean acidification causing a decrease in pH value of the sea water. It is expected that the pH which was 8.104 in the 1990s will decrease to 7.949 in 2050. This represents a threat to coral reef growth around the island reducing thus the supply of sand to the lagoon and beaches.

Mineral exploration

There are no minerals in the coastal zone of Mauritius. Sand mining in the lagoons has been banned since October 2003. Sand dunes are also protected by law.

2.4 Freshwater resources and drainage, including rivers, estuaries, delta and coastal lakes

Pollution

Industrialisation started in the second half of the nineteen seventies, and today there are a few industries that are operating – mainly in the textile field. Mauritius being an agricultural country, a lot of pesticides and fertilizers are used. Increase in population growth also results in the generation of more domestic waste. All these human activities obviously lead to greater risks of pollution to both surface water and groundwater. In relation to water pollution the following studies are / have been carried out:

- An independent environment audit on waste water projects by the Ministry of Environment and Sustainable Development in collaboration of other Ministries is ongoing .The overall purpose of the project is to prevent further degradation of the marine, coastal and inland environment

- The National Environmental Laboratory of the Ministry of Environment and Sustainable Development commissioned a project entitled "Assessment of groundwater contamination using isotopes techniques-phase I" in collaboration with the International Atomic Energy Agency (IAEA). The Project bears project number MAR8007 was started in 2007 and is concerned with the aquifer I and II of Mauritius. The project (phase I)has been completed and the final report is awaited.

- The National Environmental Laboratory of the Ministry of Environment and National Development and the Water Resources Unit of the Ministry of Energy and Public utilities commissioned a project entitled "Assessment of groundwater contamination using isotopes techniques-phase II" in collaboration with the International Atomic Energy Agency (IAEA). The Project bears project number MAR8009 was started in 2009 and is ongoing. The project is on the aquifer V of Mauritius.
- A survey on the quality of potable water supply in Mauritius has been commissioned by the Mauritius Research Council (MRC) in 2009

- The Mauritius Sugar Industry Research Institute (MSIRI) together with the Queensland Department of Natural Resources and Mines (QDNRM) with the funding support from the Australian Centre for International Centre for International AgriculturalResearch (ACIAR) commissioned a project entitled " Measurement and prediction of Agrochemical Movement in Tropical Sugar cane Production" from January 1997 to June 2001.

Sediment load

The then Ministry of Local Government and Public Utilities commissioned in May 2006 hydrographic survey and sedimentation study in 4 reservoirs, namely Mare Aux Vacoas, La Ferme, La Nicoliere and Piton du Milieu.

The main findings are summarised below:

Reservoir	Capacity before 1996 survey (Mm^3)	Capacity as determined by 1996 survey (Mm^3)	Loss of capacity (Mm^3)	% loss of capacity
Mare aux Vacoas	27.61	25.89	1.72	6.2
La Ferme	11.78	11.52	0.26	2.2
La Nicoliere	5.78	5.26	0.52	9.0

Piton du Milieu	3.27	2.99	0.28	8.6

2.5 Physical Oceanography

2.5.2 Tide regime and waves

Significant storm surges can be expected from long swells generated far to the south of Mauritius; These events have become an almost annual occurrence. Extreme storm surges occurred in May 1976 and on the 31 May and the 01 June 1987.

On March 1995, the combined effect of a strong anticyclone and the tropical cyclone Ingrid which while maintaining an intense circulation developed a blocking situation between longitude 50^0 E and 60^0 E and generated a fairly long longitudinal fetch south of Mauritius. Swells of around 3 to 4 m reached Mauritius causing much damage to the southern coast.

Cyclones can cause immense flooding and loss of valuable infrastructure in many low lying areas. Storm surge components include barometric pressure reduction in low pressure cyclones, wind stress, Coriolis force and wave set up. Swash zone observation after cyclone Carol in 1960, indicative of maximum wave run up levels on the beach showed peak elevations of about 2 to 3m above mean sea level with some up to 4m along the southern coast where the rift is absent or close to the shore. This compares to a maximum surge level of 0.9 m measured at the tide recorder in Port Louis. Hence, storm surge depends on many physical and environment factors.

Extreme waves

Reliable measured observations are available from a Datawell b.v directional wave rider buoy which has been deployed off Mahebourg coast in a water depth of 57 m

Wave data June 1996 to June 2001		
	Highest Mean Significant Height (cm)	**Absolute Height (cm)**
January	396	795
February	430	806
March	928	1521
April	369	735
May	348	710
June	441	917
July	466	797
August	362	753
September	337	776
October	315	761
November	298	625
December	219	492

2.5.3 Sea level change

Sea Level Rise (SLR) as a consequence of climate change is a serious concern for small islands like Mauritius, particularly with regards to coastal erosion. It has been found mathematically that the shoreline retreat rates are 50 to 100 times the rate of SLR (Bruun 1962). The mathematical equation derived by Bruun has been has been modified by others (Dean and Maurmeyer 1983, Edelman 1972) who have come to almost the same conclusion.

Coastal erosion is already ubiquitous around Mauritius and Rodrigues. Hard measures taken to address the issue have, to a large extent, worsened the problem. It is expected that erosion will accelerate due to the projected increase in the rate of SLR with global warming. Taking into consideration the IPCC projection of 59 cm by the end of this century, this implies that the shoreline retreat could be in the range between 29 m to 59 m. Mauritius is a coastal-based destination for tourists. Consequently, an accelerated SLR will impact very serious the sustainable socio-economic development of the country.

As shown in Figures 10 and 11, data analysis shows that sea level rise has been accelerating in the last few years. Reliable data available from satellite particularly Jason- Poseidon altimetry observations also indicate the same pattern. For the Mascarene region, two maps are available. one is based on altimetry observations from 1993 to 2003 (Lieuette et al, 2004) and an updated one from 1993 to 2008 obtained from NASA website (NASA_sea_level_change_trend.jpg). Analysis of the two maps indicates a change from a general fall in the region of the Mascarenes for the first period as observed from analysis of tide gauge data (Ragoonaden, 2006) to a rise in the second period.

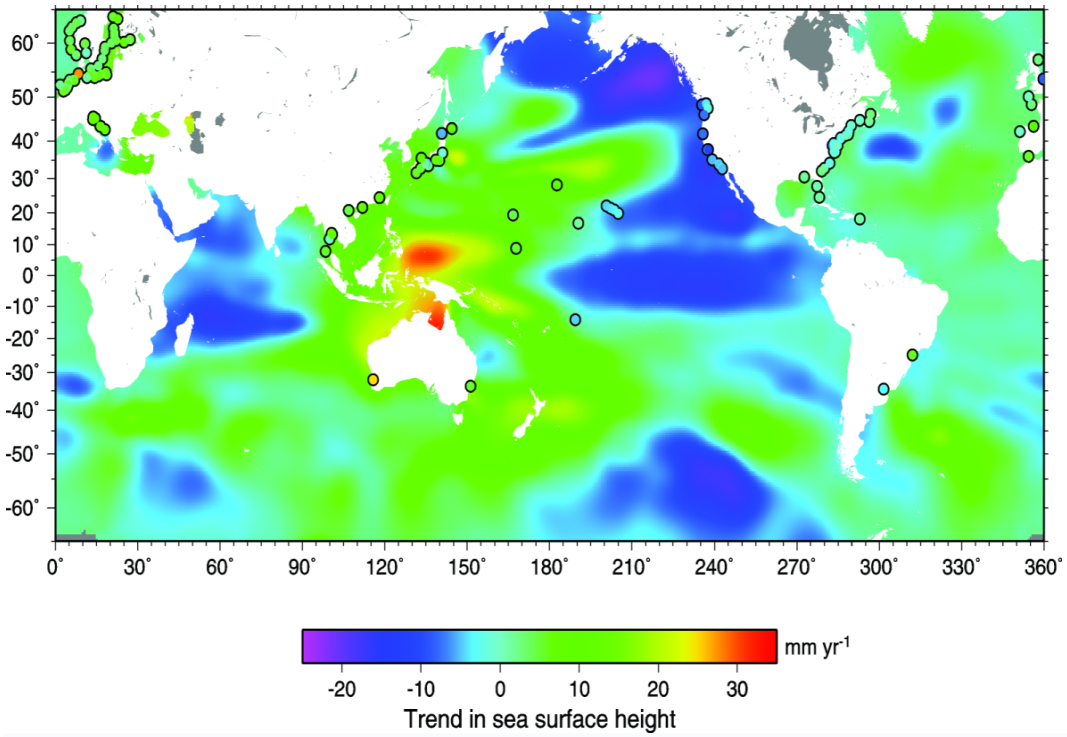

Figure 11. Sea level variation trend from altimetry data (1993 – 2003)

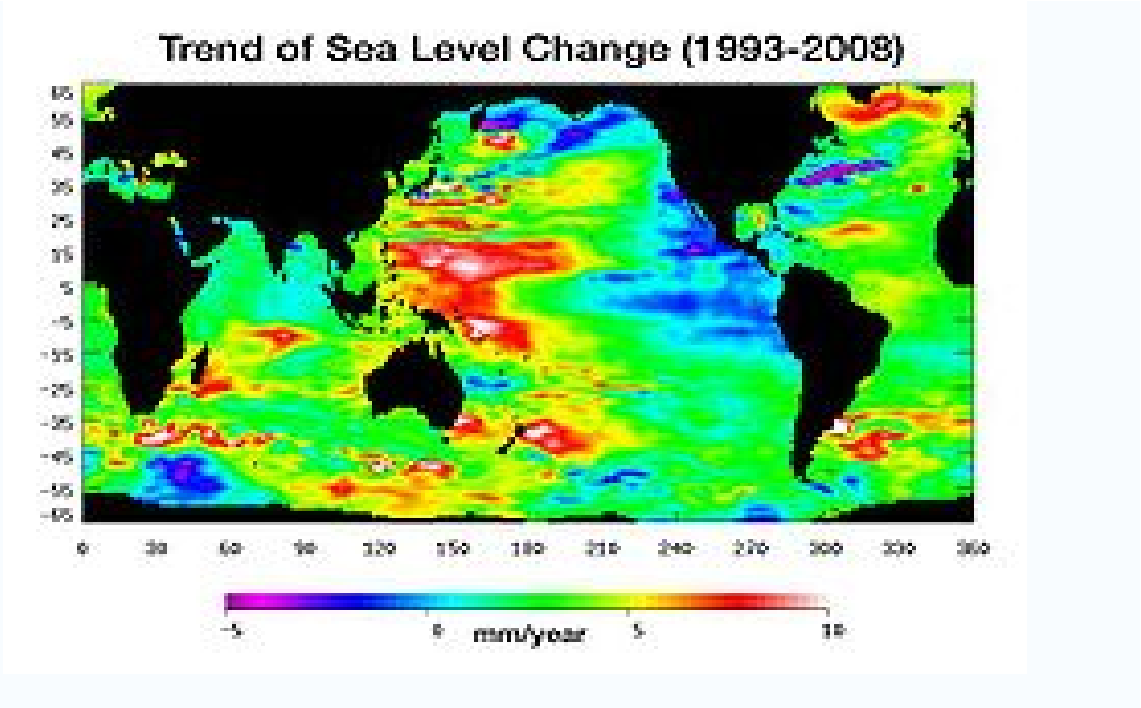

Figure 12. Sea level variation trend from altimetry data (1993 – 2008) Red and white show where sea level has risen the most rapidly. Purple and blue where it has dropped

2.5.4 Ocean Temperature

Coral bleaching

Coral bleaching has become quite common in recent years, besides 1998, some bleaching was also observed in 2002, 2005 (IPCC 2001) and 2009. Mass coral bleaching events are clearly correlated with rises in SST of short duration above the summer maxima (IPCC, 2001).

During the 1998 El Nino wide spread coral bleaching in the Indian Ocean was observed. During this period about 50 % of the corals were bleached in Mauritius compared to Seychelles where coral mortality was almost 100 % in some areas (Cordio 1999).

Global warming poses a threat to coral reefs, particular any increase in SST. Global climate model results show that thermal thresholds will be exceeded more frequently with the consequence that bleaching will recur more often than reefs can sustain. Studies show that widespread coral bleaching will occur when SST exceeds the usual seasonal maximum threshold by around 1^0C and mortality by around 2^0C. However, recent studies have shown that corals may be able to adapt or acclimatize creating new ecospecies with different temperature tolerances. Adaptation or acclimatization might thus result in an increase in the threshold temperature at which bleaching occurs. However, it is likely that more frequent coral bleaching events will recur reducing further both coral cover and diversity on reefs over the next few decades (IPCC, 2007).

Fish kills

Fish are very sensitive to environment factors. Fish mortality has become quite common in recent years. This has been attributed to discharge of untreated effluents mainly from industries and sewage plants as well as pesticides and uncontrolled use of fertilizers from coastal agricultural activities.

Loss of colour of sea water

The sea water around Mauritius is usually crystal clear. However, during heavy rain episodes over the island, river flooding is a common occurrence. Large amount of debris and soil is discharged into the lagoon leading to a change in the colour of sea water from red to chocolate along a certain distance into the lagoon. However, as the flushing time of the lagoon is quite significant, the sea regains its original colour after a couple of days. Frequent discharge of pollution and nitrates from agriculture and coastal hotels give rise occasionally to algae bloom and red tides.

Sea weed is common in the lagoon but it is not widespread. Sea weed farming is not an activity in the region like in some countries in the region such as Zanzibar where the industry employs between 10 000 to 15 000 people.

2.5.5 Salinity patterns

Issues: Hydrological cycle; changes (anthropogenic); uncertainties

2.5.6 Ocean-atmosphere interaction

Extreme events
Ocean acidification

2.6 Chemical and Biological Oceanography

2.6.3 Primary production

A low primary productivity leads to a decrease in the fish catch.
Phytoplankton blooms may cause fish mortality and affects the ecosystem.
Phytoplankton production is one of the main forces regulating our global climate as it absorbs carbon dioxide from the atmosphere. It plays an important role in the regulation of global warming.

2.6.4 Secondary production

The low productivity affects the demersal fish catch as the absolute amount of organic matter reaching the seafloor depends on the level of primary and secondary production in the surface waters. Several fish species feed directly on zooplanktons (mackerels and some tuna-like species) and a decrease in the zooplankton production will affect the fish production.

The transfers of alien species of zooplankton in ballast water from one country to another is an on-going problem

2.8 Microfauna and meiofauna

The island of Mauritius is an endemic region of fish toxicity, especially ciguatera. The presence of several species of potentially toxic benthic dinoflagellates in the waters of Mauritius as normal flora and the anthropogenic euthrophication and industrial development that would disturb the environment and trigger toxic algal blooms is a genuine concern. Introduction of new toxic species from ballast water is a

potential threat. The tourism industry may suffer in the event of an outbreak of ciguatera fish poisoning. The effect of global warming and associated effects on climate would cause an increase in coral bleaching and mortality thus contributing to favorable habitats for *G. toxicus.*

2.9 Macrofauna (state of biological knowledge)

2.9.1 Invertebrates

Biodiversity
Genetics
Over-exploitation of commercial species

2.9.2 Fish and fishery resources

Biodiversity
Genetics
Over-exploitation of commercial species
Pollution
Destructive fishing methods
Habitat destruction
Conflict with tourism

2.9.3 Mammals

Biodiversity
Genetics
Fishing
Pollution
Destructive fishing methods,
Habitat destruction
Conflict with tourism

2.9.5 Birds

Biodiversity
Predation and Fishing
Pollution
Habitat destruction
Introduced animals destroying nesting sites of ground breeding birds

2.9.6 Exotic and invasive species

Ballast water
Biodiversity
Pollution
Invasive organisms destroying habitats and affecting the ecosystems

2.10 Long term predicted atmospheric changes (and potential vulnerability of Mauritius)

3. HUMAN ENVIRONMENTS

3.1 Coastal and island populations – current status and trends

With increasing population and growing economy adding to the flourishing tourism, the state of the environment is expected to be degraded. The magnitude of impacts and management response to control them poses a major challenge. Appropriate information on the environment will show where policy initiatives ought to be directed and will allow the results of those initiatives to be evaluated.

The unique features of the 322 km of Mauritian coast line consisting of 300 km^2 of coral reefs that form 243 km^2 of reef lagoons not only protect the island from the natural forces of the ocean but also provide income through tourism and fisheries (Ministry of Economic Development and Regional Co-operation).

The country is required to take initiatives for mainstreaming sustainable development concepts in the following developmental features , management of land sustainability; protection of the atmosphere; protection and management of freshwater; sustainable management of oceans and coasts; conservation of biological diversity; promotion of sustainable agriculture and management of waste.

There is a need for an integrated approach for management of the coastal zone to address the future developments without environmental impacts on the already threatened coastal zones. To implement such a programme an effective regulatory mechanism is required in the place of presently scattered responsibilities among various agencies which has been ineffective due to lack of coordination. Other issues to address include pollution control at watershed scale including wastewater, effluent, soil erosion, agricultural and livestock runoff, etc. Also, solid waste carried by rivers and marine littering impact on the coastal marine and lagoon environment. All these pollutants cause deterioration of the coastal water quality, ecosystems and finally the coastal stability and fish catch. The above need for an integrated approach should be realized through the ICZM framework that is under development (UNEP 1999). The direct issues identified are ambient air quality, noise and odor; the coastal zone, land and water resources and waste management.

3.2 Sites of religious or cultural significance

There is a concern here about **accessibility and management**. The public must have access to heritage and it must be made available to the public. The pitiful state of abandon of many structures which may have great heritage value suggests that their present management is inadequate. The Government of course has a major direct role in protecting such heritage. The world over, private organizations are given the role of managing certain heritage structures, frequently very successfully. This model certainly has application for Mauritius.

There exists a list of Sites and Monuments which are declared National Monuments and which are protected under the National Monuments Act. In early 1999, the National Heritage Trust Fund (NHTF) Board launched a public appeal in the local press calling for propositions for sites or buildings believed to constitute heritage. From this appeal, a large number of buildings have been inventoried.

Cultural Heritage Structures and Sites in Mauritius

Cultural Heritage Structures and Sites in Mauritius have been grouped into the following:

- *Settlement Sites* such as Vieux Grand Port and ApraavasiGhat - stepping Stone of Immigrants
- *Fortifications such as Citadel,* Ile de la Passe, Batterie de l'Harmonie, Donjon St Louis,Port-Louis Fortifications (retranchements), Batterie Dumas,Fort George ,MartelloTowers

- ***Industrial Buildings*** such as Sugar factory Chimneys, Sugar Factories, Flour Mills (Port Louis, Vieux Grand Port) and Water Mills (Balaclava, Medine

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3.3 Human health

The population suffering from non-communicable diseases is high with for instance 24% of persons aged 30 or more having *Diabetes.* Alongside this there are other ills such as high blood pressure, obesity, and cardiac problems (Ministry of Environment and NDU 2005).

Concerns are also high for communicable diseases with HIV AIDS requiring particular attention. The AIDS prevalence is estimated at about 1.8% (UNAIDS) (Ministry of Environment and NDU 1997). The outbreaks of occasional epidemics such as chikungunya, dengue, malaria and influenza pose a major challenge. With climate change and its related effects, these can be expected to be more frequent. The A (H1N1) caused much havoc in the country with several deaths (Ministry of Environment and NDU 1991).

The states of some selected diseases are shown below (CSO 2005)

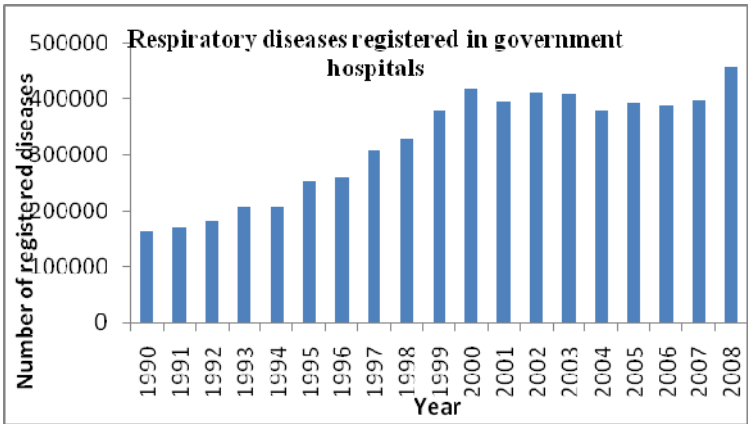

Figure 19 – Respiratory diseases, 1990 - 2008

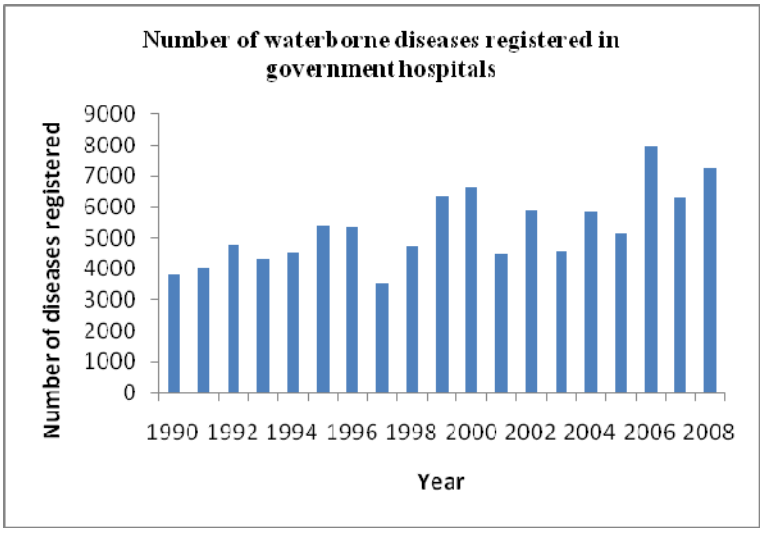

Figure 20 – Water Borne diseases, 1990 - 2008

4. COASTAL LIVELIHOODS

4.1Small-Scale Fisheries

SWOT Analysis

Strengths	**Weaknesses**
• Coastal fishery resources exploited mainly by registered fishermen; resources well managed. • Marine protected areas and fishing reserves exist. • Low capital investment needed to harness the fishery resource in the sector; simple fishing techniques such as nets, traps and lines. • Minimum expenses in terms of costs of operation (short distance to fishing ground). • Relatively good catch from net and trap fishing. • Ready market for fresh fish caught. • Good knowledge of the fishing grounds.	• Resource limitation. Catch rates low. • Access to open sea is limited to certain areas with reef passes. • Recreational fishermen conflicts with artisanal fisheries resource use. • Enforcement is difficult. • Low earnings in the artisanal fishery. Revenue relatively low. • Few young people are willing to join the fishery. • Due to a lack of collateral, fishermen cannot get access to loans. • Safety equipment is expensive. • Lack of infrastructure facilities including supplies of fresh water, ice and electricity at some landing stations.
Opportunities	**Threats**
• Good pelagic fishery resources exist in the open ocean. • Relocating fishing effort to offshore areas; such as fishing around FADs and the semi-industrial fishery. • Training of Fisheries Protection Officers to better control fishing activities. • Availability of demersal fish stocks on the shallow-water banks and on the deep slopes. • Use of new fishing techniques along with echo-sounders, GPS and hydraulic reels. • New types of boats. • Value addition to catch. • Product development for export markets. • Registration of amateur and	• Conflicts among multiple users; namely fishers, amateur and tourists. • Marine aquaculture may create conflict. • Pollution from land based activities. • Impact of certain fishing activities on the marine environment.

recreational fishermen	

4.2Tourism

SWOT Analysis

Strengths • Outstanding natural landscapes (including quality beaches and several WHS) • Outstanding cultural heritage (archaeological, historical and WHS) • Good tourism planning and management capacity at ministry level • Commercially competitive tourism Products • Outstanding notoriety and up-market brand image in source markets • Mix of mid range, up-market and top end tourism infrastructures organised in coastal tourism clusters • Direct airline connections with source markets • Good vocational training facilities	**Weaknesses** • Focus on beach tourism products • Limitation of coastal land • Strong social disparities and persistence of poverty 'pockets' in particular in coastal areas • No income generating objective of national park administrations • Insufficient liquid waste management in urban coastal areas • Coral reef depletion and coastal erosion • High population density • Strong dependency on tourism economy • Tropical diseases (e.g. Chikungunya)
Opportunities • Macro-economic growth and diversification, job creation and poverty reduction through alternative livelihoods • Innovative environmentally sound hotel constructions (e.g. use of alternative energy technologies) • Land and sea based ecotourism Activities • Asset preservation through good governance of tourism-conservation nexus • Socio-professional empowerment and Economic democratization at community level • Creation of regional pole of excellence in tourism education and training	**Threats** • Up-market tourism brand threatened by mass tourism image • Anthropogenic and natural pressures on coastal environments and resources • Direct environmental damage due to tourism activities leisure crafts, diving, etc.) • Further coral reef depletion, acceleration of coastal erosion • Non-accessibility of the poorest to the tourism economy • Transformation of cultural practices and sites (e.g. ceremonies, cemeteries) into spectacle economy • Drinking water scarcity • Transport infrastructure congestion

4.3Mariculture

SWOT Analysis

Strengths	Weaknesses
• High quality seawater • Presence of a Sector Plan • High level of Government interest in developing the sector • Research and monitoring support capacity at Albion • Support for mariculture development from the Bureau of Investments • Existing fish processing and aquafeed production capacity • One stop shop for exports	• Limited Extension Capacity • Acces to the Coast • Poor status of funding at Albion Research Centre • Institutional perception that mariculture should be restricted to large scale developments • No research capacity at the University of Mauritius
Opportunities	**Threats**
• Increased government and / or bilateral support for mariculture development • Greater and dedicated NGO involvement • Large scale commercial mariculture • Integrated approach to value addition and export using diverse national resources • Support services for aquaculture development	• User conflicts in the marine environment • Cyclones • High level of competition for coastal land - particularly with respect to coastal hotel development • Limited access to the Barrachoise • Theft and vandalism

4.4Agriculture and Forestry

SWOT Analysis

Strengths	Weaknesses
• Most population coastal and involved in farming to at least some degree so there are popular incentives to strengthen and support the sector; however most people also have diversified livelihoods which helps with resilience. • Policy measures in place to support the environment to manage coastal resources.	• Heavy and historical reliance on the sugar industry limits long term and sustainable livelihood diversification. • Policies not yet widely implemented, yet efforts to boost tourist numbers are increasing which could put additional strain on delicate coastal resources.

Opportunities	Threats
• Tourism could generate more revenues and popular interest in developing livelihoods among coastal people if this is promoted in the form of ethical and eco-tourism. • Programmes to counter past mangrove depletion could be extended.	• Poverty reduces options for coastal communities and encourages illegal activities that are detrimental to coastal resources. • Increasing tourism could undo all coastal management efforts if visitor numbers rise above sustainable levels

4.5Energy

SWOT Analysis

Strengths	Weaknesses
• Strong environmental regulations • Government supports clean energy development, mostly from existing sugar industry • Strong coastal protection regulations	• Heavy reliance on the sugar industry limits sustainable livelihood diversification. • Coal remains an important source of energy
Opportunities	**Threats**
• Mauritius is in a position to become a regional leader for “green energy”	• Focus on energy demand through the development of sugarcane cultivation could hamper food security

4.6Ports and Coastal Transport

SWOT Analysis

Strengths	Weaknesses
• Positive government promotion of economic development. • Industrious and skilful population. • Established tourist and agricultural industries. • Relative stability and good financial standing.	• Transport costs to market. • Exposure to cyclone damage.
Opportunities	**Threats**
• Increasing investment in coastal property and tourism facilities. • Further growth of financial centre. • Attraction of Far East investment in manufacturing. • Port expansion to claim more hub activities.	• Competition from Eastern countries in export markets for manufactured goods. • Competition for tourism and port activities from Madagascar.

4.7Coastal Mining

SWOT Analysis

Strengths	Weaknesses
• Strong environmental regulation • Strong coastal protection regulations • The Ministry of Environment strongly concerned with the coastal zone protection • Sand mining activities have been banned from 2001. • No mineral potential identified	
Opportunities	**Threats**
• Good NGO involvement • ICZM implemented	

6. PLANNING AND MANAGEMENT

6.1 National Disaster Management Plans (Mauritius)

Lack of coordination
Awareness and communication of plans in place
Implementation of the plan (when the event happens, institutions aren't prepared to implement measures)
Alert network for tsunami early warning

6.2 Environmental sensitivity mapping

The ministry of Environment and Sustainable Development commissioned the study of Environmentally Sensitive Areas in Mauritius and Rodrigues in January 2008 and same was completed in April 2009

The overall goal of the study was to protect and conserve the environmentally sensitive areas (ESAs) in Mauritius and Rodrigues and the main objectives were:

- Identify, classify and demarcate all the environmentally sensitive areas in Mauritius and Rodrigues
- Priotise the ESAs for protection and create a database for all ESAs to support and enhance decision making
- Develop a comprehensive policy and legislations for the protection ,conservation and sustainable development of ESAs
- Prepare a comprehensive management plan for ESAs which will be finally and institutionally sustainable in Mauritius and Rodrigues

6.3 Coastal management / development plans

- The ICZM Project is devoid of a proper Geographic Information System (GIS). A greater emphasis should be placed on spatially-referencing data collection and provision of island-wide mapping of coastal ecosystems. There is no data repository of all EIAs and Building and Land Use Permits to enable tracking of the development of the coastal zone. The GIS is an essential management tool to assist in the decision making process.

- The supporting infrastructure for the tourism industry has developed constraints in the form of, *inter alia* inadequate effluent treatment leading to deterioration in water quality in some of the lagoons. It is felt necessary to place a ceiling on the number of tourists in order to protect the environment and, indeed, the future of the tourism industry itself.

- The solution to address erosion problems takes a little longer due to lack of adequate knowledge. Commercial, recreational and everyday users of the coast expect the Government to make them aware of environmental concerns in the Coastal Zone and to highlight where progress is being made towards environmental improvement. The time to consolidate the awareness and sensitize visitors about the need for protection of the existing species is very opportune.

- There is also a lack of coordination between government agencies managing the coastal zone and enforcing legislation in place. A monitoring plan to improve coordination amongst institutions that conduct reasonable environmental monitoring and measurement activities conducted by government agencies, academia and private non-profit organisations should be integrated.
- The rapid coastal population growth is faster than management plans.

- Although legislation is in place to regulate or prohibit destructive fishing practices and removal of corals, further guidelines have to be developed. Overfishing of the lagoon has to be prevented and fishing practices such using large nets, which cause physical damage to lagoon corals, and basket trap fishing, have to be reviewed.

6.4 Areas under special management

- In spite of pressure from tourism development and urbanization, poaching activities such as uncontrolled fishing endanger the coral beds that are still in good health.
- lack of participation in planning process (leading to conflicts)
- Lack of education and awareness of the value of managed areas. A more vigorous awareness campaign is necessary to sensitize the public and different users of the marine parks. Emphasis has to be laid on the need for the conservation and the sustainable use of the park.
- conflict over increasing area under protection
- According to the surveys carried out by the Fisheries Division on the coral bleaching process which started in late February 1998, a similar programme has to be initiated to measure regularly the bleaching process in the sea around the whole island of Mauritius.
- The current Management Plan for Le Morne is a good framework document, but needs to be augmented with detailed sub-plans and extended to address the marine environment of the buffer zone. It is necessary to develop a marine habitat map for the whole of the Le Morne area, to identify the marine resources in the zone.