7 ENSURING SUSTAINABILITY OF THE ENVIRONMENT AND THE NATURAL RESOURCE BASE

[Given its cross-cutting nature, this chapter should not be read in isolation but should rather be viewed as forming an integral part of the vision to enhance the sustainability and poverty impact of Natural Resource Management. The chapter should therefore be read in conjunction with the other related topics namely Governance, Water & Sanitation, Information Resources-GIS, Agriculture, Fisheries, Tourism, Education, and Health amongst others.]

7.1 Background

The Island of Rodrigues, which is of volcanic origin, is situated some 650 km to the north-east of mainland Mauritius. With its 108 km², it is 18 times smaller than Mauritius and is recognised to be not only the smallest of the “Mascarenes Islands” but also reputedly the youngest, with rocks being dated at only 1.5 million years old. Oval in shape (18km long and 6 km wide), Rodrigues is surrounded by coral reef which forms a lagoon of about 200 km² which also encloses 18 islets.

The island currently faces serious environmental challenges that require urgent attention of all Rodriguans, and in particular the RRA. Indeed, out of a total land area of some 10,800 ha, only 1,000 ha are in private hands implying that the RRA is completely responsible for the management of the lands.

The strategy proposed in this SIDPR rests heavily on environmental mainstreaming in policy and in key economic sectors. The adoption of a sustainable land resources-, solid waste-, and coastal zone-management system is viewed as critical in order to successfully transform, in the long-run, the current situation of land degradation, soil loss, and impoverished ecosystems into diverse cultural landscapes of outstanding aesthetic, economic, and ecological value.

At the same time, a key perspective taken in formulation of the overarching goal is that Natural Resource Management should contribute to poverty alleviation and that the natural resource base should be used in a sustainable manner to enhance the quality of life and the welfare of Rodriguans.

7.2 Situational Analysis

A complete environmental diagnosis was conducted during Phase 1 of the project. The findings are reported in the Diagnosis Report. In the sections below, the core issues are assessed prior to formulating a long-term vision and strategy for Rodrigues.

7.2.1 Approach and methodology

For the purposes of this chapter, emphasis is laid on land, coastal zone and solid waste management. The issue of natural resource management and especially the links between natural resources, quality of life and sustainability are covered in more details in Part IV of this report (i.e., in the various chapters dealing with the productive sectors) as well as in Part V
(which deals with the “soft infrastructure” including a chapter on “Education for a Sustainable Future” and “Improving Health Outcomes in Rodrigues” amongst others). Issues related to water supply and sanitation are addressed in the next chapter.

Exhibit 7.1 - Addressing Environmental Issues

- Land resources comprise all lands under agriculture, including cattle breeding. It also comprises lands which are occupied under forestry, the endemic plants that exist in the forests, natural sites such as caves, and man-made parks and gardens for the preservation of natural resources;

- Coastal zone management includes the preservation of the lagoon areas, the shoreline, beaches, marine areas which require protection, fishing reserves, sand mining, wetlands and waste water management;

- Solid waste management deals with all the activities that are related to solid waste;

- More generally, Natural Resource Management refers to the utilisation of natural resources such as land, water, air, minerals, forests, fisheries, and wild flora and fauna.

7.2.2 Legislative, institutional and regulatory framework

The main components of environment, as defined above, fall under the purview of the Commission for Public Infrastructure, Environment, Housing, Transport and Marine Parks (CPEHTM). However, there are other related sectors to environment which fall under the purview of other Commissions such the Commission for Agriculture, Food Production, Plant and Animal Quarantine and Water Resources. As will become clear below, and which is a cause for concern, the situation is such that there is no dedicated institution to manage in a holistic way issues related to environment and natural resource management.

The Environment Unit of the CPEHTM is responsible for:

- coordinating environmental management activities;

- working with the other units to administer the body of legislation; and

- managing solid waste.
The exhibit below depicts the framework for environmental management in Rodrigues. As in Mauritius, the Environment Protection Act (EPA) 2002 is one of the most important legislation pertaining to the environment. Furthermore, the National Environment Policy (NEP) includes strategies and policy instruments which are specially devised for Rodrigues with the aim to improve environmental management.

An Environment Impact Assessment Review and Monitoring Team has also been set up in order to follow up on projects requiring either a preliminary Environment Reports and/or an EIA as provided under the first Schedule of the EPA 2002. It was recently announced that an Environmental Law Enforcement Committee would be set up to discuss the various provisions of environmental laws and their enforcement in their respective units.

The legal, institutional and regulatory framework compares favourably with Mauritius. It also includes several enabling mechanisms such as the Rodrigues Environment Coordination (REC) Committee, which is chaired by the Chief Commissioner and responsible for the implementation of measures about environment protection and management in Rodrigues. Three sub-committees have also been formed by the REC with well defined terms of reference:

- Waste Management Sub Committee (WMSC);
- Information, Education and Awareness sub-Committee (IEASC); and
- Integrated Coastal Zone Management Committee (ICZM).

Despite the above, the legal and institutional framework relative to environment appears fragmented and there are gaps regarding the regulations of specific areas as mentioned in the White Paper on National Environment Policy (2006).
Exhibit 7.2 - Environmental Management

The above framework has been in place during the past few years only and has contributed in preventing the continuous degradation of the environment. However, there are still a lot of bold measures to take to continue to preserve the environment and the natural resource base. An update on the current state of each of the sub-sectors is provided in the following sections.

7.2.3 Land Use and Land Resources

Land resources are the major assets of Rodrigues. Inappropriate land use contributes to soil erosion and land degradation affects agricultural productivity and is therefore a major factor in food security and poverty. Rodrigues is about 10,800 ha out of which only 1,000 ha is in private hands which mean that the State is completely responsible for the management of the lands. This is a huge responsibility that the RRA should not downplay even though the State lands are leased to private individuals for a specific number of years (depending on the purpose of the development project which are approved by the State Lands Committee.)
The following are the main components of land resources management:

*Exhibit 7.3 - Land Resources Management in Rodrigues*

Land resources in Rodrigues are affected whenever one or more of the above five components are under threat. Indeed, poor land management has resulted in low economic returns from agriculture. This is due to high soil erosion which is itself a result of:

- bad agricultural and grazing practices;
- past deforestation;
- poor building practices (especially the dispersed nature of settlements);
- steep topography; and
- high intensity rainfall (rainfall intensities of up to 150mm per hour is not uncommon).

Besides reducing the agricultural potential of the land, soil erosion has affected rivers and dams as well as the lagoons and coral reefs.

Soil erosion has also been due to poor building practices. In this respect, Rodrigues has been able to deal with the problems of land squatting with the setting up of a Land Squad under the environment unit. However, the problem of scattered housing due to the dispersed nature of settlements has lead to the loss of agricultural land as well as a reduction in the aesthetic appeal of the country side.

*Past initiatives regarding land resources*

Despite several initiatives\(^ \text{15} \) that have achieved mixed results in the past (such as the Anti-Erosion Programme 1984-2004 for agricultural developments under the European Development Funds), Rodrigues still has to adopt more measures to preserve its land resources.

\(^{15}\) A detailed list of initiatives is provided in the Diagnosis Report.
7.2.4 Coastal Zone Management and Marine Biodiversity

Even though Rodrigues is protected by a wide coral platform which encloses its lagoon (240 km²) the latter is endangered by artisanal fishing and land erosion. Indeed, the level of fishing in the lagoon is unsustainable, stocks are being depleted and the pressure is set to increase. An increasing number of fishermen are chasing less fish and octopus using poor fishing practices. These in turn cause severe damage to the corals, reducing the productivity of the lagoon. It is also a cause for concern that the outer reef fisheries are not being utilised despite extremely good returns.

In order to control soil sedimentation of the lagoon, some 40 ha of mangroves have been planted in several bays. Except in rocky areas, they are growing successfully and at the same time helps to establish a new ecosystem. Furthermore, the mangroves have successfully prevented sediment from reaching the sea in some areas.

7.2.5 Marine Biodiversity

7.2.5.1 Introduction

The lagoon and reefs of Rodrigues have not been studied in great detail, resulting in a poor understanding of the biodiversity of the local marine ecosystem. A workshop was organised in 2004 to address some of the issues. The specific aims of the workshop were as follows: (a) To produce a species-level inventory (flora and fauna); (b) To strengthen regional links and offer capacity building; (c) To provide training in taxonomy for bio-diversity assessment; (d) To produce educational posters to raise awareness of local biodiversity; and (e) To update GIS package detailing lagoon biotopes.

The exposed eastern end of the lagoon proved to be particularly rich. Rodrigues lies 650 km east of Mauritius on a submarine rise between the mascarene and St Paul-Chagos ridges. It is 18.3 km long and 6.5 km broad but is surrounded by a large fringing reef forming a lagoon 50 m to 8 km wide. This is the largest reef enclosed lagoon in the Indian Ocean, yet it has received little biological investigation.

Shoals of Capricorn Programme began a marine science and education project on Rodrigues with the primary aims of compiling a biotope map and investigating the increasing siltation of some of the northern and western bays.

Prevailing winds result in the lagoon being narrow at the eastern end and extensive in the west and correlated to this is the degree of exposure of the shores on the mainland. The tidal range is a maximum of 1.5 m which results in parts of the lagoon and reef front drying at low tide. Seagrasses at Rodrigues are limited to Halophila sp and sea grassbeds are always of low density and usually associated with alga Caulerpa sp. Along the north west and western areas, the bays are turbid and often very muddy. In some, mangroves have been planted to stabilise the sediments and prevent the turbidity spreading into the lagoon.

The lagoon is shallow from 0.5 m to 3 m over most of its area with deeper channels (to 40 m) and passes through the fringing reef. The biotopes fall into 4 major categories:
1. Coral reef;
2. Consolidated reef limestone;
3. Lagoon sand and rubble; and
4. Lagoon mud.

The reef front drops some 10-20 m onto an outer sandy plain which slopes down to 60 m which is the average depth of the Rodrigues shelf.

**New Marine Park**

A Marine Park of 42.5 km$^2$ is being implemented in the South East region of the Island under the project “Partnerships for Marine Protected Areas in Mauritius and Rodrigues,” known as the South East Marine Protected Areas (SEMPA). The two broad objectives of the project are: (i) To develop an enabling policy and institutional framework to sustainably co-manage MPA’s throughout the Republic of Mauritius; and (ii) To develop and adopt innovative co-management arrangements for MPAs at a representative demonstration site in Rodrigues.

### 7.2.5.2 Species

**Bivalves and reef coral of Rodrigues**

The species of bivalve consist of 80 taxa out of which 95% are shared with Mauritius. Viader (1937) supports 279 species in Mauritius and Rodrigues has only 29% of the Mauritius fauna. Rodrigues has a diverse coral fauna of 140 species of 40 genera of hard corals (135 species and 37 genera of *zoanthellate scleractinia*). Coral diversity declines with increasing distance from the equator due to lower water temperatures.

The living coral cover is generally high. Sea surface temperatures range from 20°C to 27°C and these temperatures are below optimum temperatures for coral growth of about 30°C. The prevailing surface ocean currents in the area of Mauritius and Rodrigues flow westward. Thus, coral larvae and corals attached to floating rafts such as pumice and wood are likely to be carried westward toward Madagascar and African coast. There are no close reefs to the east of Rodrigues. Most of corals found in Rodrigues have ranges that extend both east and west of the Rodrigues and could serve as a source of new corals for Rodrigues. Baladirou and Rivière Banane outer reef had the highest species richness with 45 species each. Corals are primarily autotrophic, relying on the products of the photosynthesis of their symbiotic algae, supplemented by plankton caught by filter-feeding and suspension feeding. Most require hard substrate for attachment, but a few grow well on soft substrates.

The most common corals are Acropora sp. One relatively rare coral species was found, *Astreopora suggesta*. 
Grastropos and Molluscs of Rodrigues

Using sampling techniques which targeted specific micro-habitats, it is possible to determine the micro-fauna of algal turf, polychaete colonies, and some different sediment types.

The list of gastropod taxa exceeds 300 and Rodrigues supports potentially a relatively rich mollusc fauna. The shores along the eastern coasts of the island support much greater mollusk diversity than those in the west which may be attributed to the types of substrate present and the associated habitat. The eastern side of the island experiences greater exposure to the open ocean and prevailing wind and wave regime.

The shores on the north coast west of Port Mathurin and southwest of Port Sud Est are mainly muddy gravels with a low algal diversity, whereas those of the east offer clean substrates (reduced water turbidity) and high algae diversity.

At Petite Butte, water turbidity is a persistent feature. Holothurians are abundant on sandy and silty substrates in Rodrigues lagoon. At the east coast sites, holothurian diversity is greater. In 2001, more than 400 mollusc fauna was inventoried.

Reef Fish of Rodrigues

More than 300 species of fish are present; Scorpaenidae and Pomacanthidae are uncommon and may be attributed to the remoteness of the island from areas of recruitment.

Echinoderms of Rodrigues

About 87 species of echinoderms are inventoried in the Rodrigues waters. The high densities of sea urchins and sea cucumbers especially along the northeast shores in the shallow lagoons of Rodrigues warrant further ecological investigation.

The massive densities of sea urchins, Echinometra mathaei deserve attention, as these are known to be devastating bio-craders of living coral. Possibly intense fishing and removal of predator fish species has contributed to the alarming high densities of this sea urchin. Sea cucumbers are important for lagoon sediment re-working and the dependence on larval recruitment for some species of sea cucumbers must be underlined as they are vulnerable to overharvest.

However, virtual depletion of sea cucumbers of certain species is not prevalent to any degree in Rodrigues.

Algae of Rodrigues

The algal list for Rodrigues includes 22 species mainly the Red Algae before the visit of the shoals of Rodrigues. About 150 species have been inventoried in Rodrigues though some biotapes are missing, namely mangroves - mangrove trees have only been recently introduced, so the associated seaweed flora is still absent. Rodrigues is certainly a pristine area, but some
species present in the tropical Indo-South West Pacific regions are markedly missing in the list of algae.

_Bryozoa of Rodrigues_
Constitute 21 spp from 11 families have been identified.

_Amphipods of Rodrigues_
A total of 110 species were recorded in Rodrigues. Six species new to science have recently been described from Mauritius and were recorded in Rodrigues also.

_Isopeds of Rodrigues_
Isopeds are ecologically important as food items for fishes, predators of invertebrates, as parasites and they also have an important role as scavengers. While there are few data, it is likely that many species could serve as indicators of environmental quality, and it is clear that it is in areas of high disturbance (e.g. trawl grounds, over-fished reef flats) that the scavenging cirolanids can reach plague proportions.

**7.2.6 Solid Waste**
Rodrigues produces some 15-20 tonnes of waste per day which is a relatively small amount. However, the waste amount is increasing gradually and has nearly reached the figure that was projected for the year 2010.

A new landfill site is being constructed at Grenade to cater for the increase in solid waste generation. In addition, the Commission for Environment has embarked on a Waste Segregation Project to promote the recycling of plastic and composting of organic waste.

**7.3 Core issues requiring urgent attention**
Several issues have been identified during the diagnosis phase as well as during the TWG meetings held in Rodrigues during the month of May 2007. These are grouped below in terms of land use and land resources, coastal zone and solid waste.

**7.3.1 Issues related to Land Use and Land Resources**

**7.3.1.1 Land Planning and Management**
- Lack of an endorsed framework for land planning and land use
  - The Planning Development Act 2004 is not applicable to Rodrigues and the National Development Strategy is not statutory to Rodrigues. The RRA needs to endorse a
national strategy around which all future planning initiatives will revolve in a transparent manner;

- Absence of a database and unsustainable land management

- There is an absence of detailed information regarding land resources in Rodrigues. This lack of information makes it difficult for the authorities to come with proper strategies with regards to the environment;

- Dispersed settlements

- One of the main problems in infrastructure development and provision lies in the haphazard settlement pattern. Indeed, the very striking feature about the human settlement pattern in Rodrigues is its dispersed nature. Rodriguans have tended to build their houses in the agricultural land leased to them, so as to make it easier to look after their crops and cattle which roam freely. Consequently, “houses are scattered and isolated, which typify the Rodriguan way of living”[16].” Another reason for same is the absence of an appropriate housing policy, of declared zones, delays in approving housing leases and building permits and lack of enforcement (as reported during the Thematic Working Group meetings held in May 2007);

- Due to the hilly terrain and scattered houses, it is difficult to provide services like water supply, telephone, transport, and so forth to all isolated settlements. Some people have to walk long distances to get to schools, hospitals and other facilities.

### 7.3.1.2 Agricultural and grazing lands

- Core issues revolve around the following themes: Overgrazing; unsustainable livestock production system; unsustainable cropping practices; fallow agricultural lands; unsustainable cropping practices; decline in soil fertility; poor enforcement and implementation of anti erosive measures; and degraded cattlewalk areas among others;

- It has been observed that grazing lands have increased due to a relaxation of regulations, which has led to damaged agricultural terraces, which in turn contribute to soil erosion. On the other hand, agricultural lands under cultivation have been falling due to a number of factors, namely, complex relationship between market prices and outlets available to the farmer, low yield, and poor farming practices among others.

### 7.3.1.3 Unsustainable management of forest lands and nature reserves

- Core issues revolve around the proliferation of invasives such as the Acacia nilotica; absence of forest cover in cattlewalk areas; and invasive alien species (IAS);

- Forestry plays a crucial role in preventing soil erosion. It is noteworthy that both a forest management and development plan and a forestry manual are available which indicate that

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forest management is on the right track. The forestry unit afforests some 100 ha per year as well as a routine maintenance of 200 ha of forest land. However, there is some concern over the continuing use of exotic species;

- There are 39 species of native plants listed for Rodrigues which are being closely monitored and intensive works are being carried out to facilitate germination, growth and development of the plants. One of the most valued species is the cultivation of *Pandanus Heterocarpus* (Vacoas) used for handicrafts. However, past deforestation has decimated the previously rich and unique biodiversity on Rodrigues. The latter was once covered in rich forest and the present forest land is largely due to re-afforestation;

- Furthermore, past deforestation has lead to the extinction of 11 species of endemic birds, 2 species of giant lizards and 2 specie of giant tortoise.

### 7.3.1.4 Endangered Native Fauna

- According to the White Paper on the National Environment Policy, Rodrigues is “… one of the most degraded tropical islands in the world, although its biodiversity remains high with 133 native and endemic species recorded”;

- There are 36-38 types of endemic flower plants out of which 19-21 are endangered, 7 vulnerable and 8 rare. There are also 3 surviving endemic land vertebratebrates, 2 passerines and Rodrigues Fruit Bat. In an attempt to preserve forest biodiversity, four nature reserves have been established. These were launched with the aim to sensitise and promote the importance of preserving the natural heritage for tourists as well as the local population. Despite that a management plan regarding the nature reserves has been developed, the implementation is yet to be done;

- Much of the remaining native biodiversity is threatened. As well as having a high heritage and existence value, the biodiversity has high importance for the future tourism development plans of the island as an eco-tourism destination.

### 7.3.1.5 Management of Protected Areas/ Nature Reserve/Caves

- There are some 20 identified caves in Rodrigues which represent great places of interest for tourists as well as residents. These caves fall under the management plan for caves which the Rodrigues Environment Coordination committee has proposed. The newly-created company Discovery Rodrigues has the responsibility to promote them as tourist attractions;

- The creation of a botanical garden at Mourouk which forms part of Marine Protected Areas will cater for the conservation of endemic species. However, only Rs500,000 has been allocated for the funding of this project which is considered to be a major constraint;

- Four nature reserves have been established so far in Rodrigues with 2 situated in the main island at Grande Montagne and Anse Quitor and the other two at Ile aux Cocos and Ile aux
Sables. A management plan for these reserves has been made but has not been implemented yet.

7.3.2 Issues related to Coastal Zone Management and Marine Biodiversity

The number of fish and octopus caught during the past few years are on a declining trend. This is attributed to damage caused to coral reefs, bad fishing practices and soil erosion which is causing sedimentation in the sea. Furthermore, the main concern also regards the shoreline, sand extraction, degradation of beaches.

The following issues need to be addressed urgently as part of the long-term strategy for environmental management and protection:

7.3.2.1 Unsustainable exploitation of the coastal and marine resources

- Core issues revolve around the following themes as elaborated in the Diagnosis Report: Bad fishing practices; lack of off lagoon fishery; inadequate assessment of lagoon and off lagoon resources;

- The ecosystem is being affected in a potentially irreversible way by bad fishing practices. The areas where corals have been more affected and degraded are those which are more accessible to fishermen. However, following the regular surveys by Shoals Rodrigues to monitor the lagoon areas around Rodrigues, it has been found that the state of the lagoon varies from coastal region to coastal region. For instance, low coral cover is found on reef flats (except for Passe l’Encre and Grand Bassin) while coral cover on reef slope is stable;

- The results of other surveys regarding the different types of habitat have indicated a decrease in fish abundance at all sites between 2004 and 2005 which is an indication of over fishing. However, it is noted that coral are healthy in South and East because the higher winds and currents keep the silt closer to the shore.

7.3.2.2 Fishing reserves not properly monitored

- As per the Fisheries (Reserve Area) Regulation 1984, there are currently 5 Fishing Reserves in Rodrigues where net or basket trap fishing is banned. However, due to limited capacity, these fishing reserves are not being closely monitored by the relevant institutions.

7.3.2.3 Erosion of sand beaches and coastal zone degradation

- The shoreline, consisting of 70% rocky coast, 21% of silt-clay coast and 9% of coral and sand beaches, is affected by the extraction of sand which leads to erosion of sandy beaches. Despite the fact that erosion of sandy beaches are not considered to be alarming, they are classified as highly vulnerable to erosion. However, erosion of beaches on islets and main islands is causing some concern although sand extraction is illegal one kilometer within any islet;
• Several studies and measures have been implemented in the last few years (as detailed in the Diagnosis Report).

7.3.2.4 Lack of awareness on how to assess the sand stock to ensure sustainable exploitation

• It is estimated that about 25,000 tons of sand are removed from the quarry annually under the monitoring of the Fisheries Protection Service and National Coast Guard. Even though the RRA has strengthened the control measures at sand landing station, there has still not been any study to assess the sand stock to ensure sustainable exploitation.

7.3.2.5 Lack of knowledge of how to assess the management of Marine Protected Areas

• Rodrigues is currently implementing a Marine Park project as described above. The project is being funded by the UNDP (GEF) and the RRA in the southern region. The project is expected to preserve the marine ecosystem in this part of the island. Furthermore, the proposal made by Shoals to set up four Marine Reserves has already been approved by the Coordinating Committee and Marine Resources.

7.3.2.6 No monitoring of wetlands

Despite the limited number of wetlands in Rodrigues, no monitoring is done. Furthermore, there has not been any inventory of the species’ richness at Mourouk where one of the wetlands is situated.

7.3.2.7 Inefficient system of wastewater disposal

The system for wastewater disposal facility was generally perceived to be inefficient, as witnessed during the consultative process. The need to identify a new site for setting up of another facility was justified. In fact, there are no piped sewerage facilities in Rodrigues, which has been found to be non-feasible.

7.3.3 Issues related to Solid Waste Management

The issues encountered in the solid waste management sector can be summarised under the following headings:

• Inefficient Waste Collection

  • 85% of all households have their waste being collected. The others tend to dispose of their waste through the backyards.

  • Limited Disposal Capacity of solid waste and littering
• The dump in Rodrigues is nearly filled up and a new site has already been identified. However, it has been observed that the rate at which Rodriguans are producing waste is potentially unsustainable, the limit that was forecasted being exceeded by far.

• Littering and Dumping on landscapes and lagoon;

Despite sensitisation campaigns, it seems that few Rodriguans are aware of the negative impacts of littering on the environment and the landscapes as well on the marine life.

The NEP identified the following issues which are noteworthy:

• Lack of individual and collective responsibilities – lack of awareness in waste reduction activities;

• Cultural barriers to environment protection and cleanliness;

• Absence of community based rural collection programmes;

• Pollution by plastic carry bags, empty bottles, used batteries, rocks, used oil, used tyres etc;

• Fragmented approach to waste management due to absence of qualified personnel;

• Absence of waste water management;

• Absence of policy on the management of used oil, used tyres, used batteries, pig wastes, old computers and asbestos;

• Absence of civic amenity centres for bulky wastes;

• Absence of a scrap yard;

• Absence of research in innovative waste management technology; and

• No proper arrangement for management, collection and disposal of cyclonic wastes.

7.3.4 Issues related to Air Quality and Noise

The following issues were identified:

• Absence of a prevention of noise regulations;

• Absence of appropriate regulations to control the importation of old vehicles; and

• No section of air quality monitoring.
7.4 Previous actions initiated

Several plans have been developed and some actions have been initiated or implemented, like the National Environment Action Plan (NEAP I) in 1988 followed by the NEAP II in 1998, the development of the National Physical Development Plan (NPDP) in 1997, the Island Development Strategy in 2002 and the Tourism Development Plan 2001.

7.5 Way Forward

The overarching goal is to enhance the sustainability and poverty impact of natural resource management by mainstreaming environmental policy-making and in key economic sectors. The adoption of an effective land resource-, solid waste-, and coastal zone-management system is viewed as critical in order to successfully transform, in the long-run, the current situation of land degradation, soil loss, and impoverished ecosystems into diverse cultural landscapes of outstanding aesthetic, economic, and ecological value.

When properly managed, the natural resource base of Rodrigues will provide the foundation for maintaining and improving the quality of life of the population and will make significant contributions to sustainable growth. The strategies proposed below are based on the OECD’s Pressure-State-Response (PSR) model, which is a framework for determining what to measure and how to interpret the findings of the measurement. One advantage of using this OECD approach is that it allows a separate definition for “pressures,” “state of environmental resources,” and “societal responsive actions,” thus increasing the policy relevance of the indicators as illustrated below.

Exhibit 7.4 – OECD’s Pressure-State-Response (PSR) Model
A number of indicators are proposed in Chapter 4 as part of long-term goals of the SIDPR. A few of them complement the MDGs (such as the monitoring and reporting of the ‘average duration of scheduled water supply.’ These indicators seek to inform whether the RRA as well as civil society adequately respond to environmental threats.

7.5.1 Sub-goals

In order to attain the vision as spelt out above, a number of sub-goals are set. The ones mentioned below are by no means sufficient but they are necessary. They complement the other sub-goals mentioned in different sections and sub-sections of this SIDPR. The establishment of many of these goals has emerged from Rodriguans themselves during the extensive consultative process in 2007 that included the organisation of five Thematic Working Group meetings in Rodrigues in May 2007.

7.5.1.1 Sub-goals for Land Resources, Terrestrial and Forest Biodiversity
1. Adoption of a physical development plan (see Section 7.5.2 below);
2. Sustainable land resources management and law enforcement;
3. Arrest land degradation;
4. Sustainable management of forest lands and nature reserves (see Section 7.5.4 below);
5. Monitor proliferation of IAS;
6. Improve management of Protected Areas, Nature Reserves, and Caves;
7. Improve data collection and set-up an appropriate Geo database (see chapter on Information Resources-GIS);
8. Ensure full protection of endangered native fauna.

7.5.1.2 Sub-goals for Coastal Zone and Marine Resources
9. Improve management of coastal zone and adopt a holistic approach;
10. Arrest coastal zone degradation;
11. Ensure sustainable exploitation of coastal and marine resources;
12. Set up and manage 4 other Marine Protected Areas by 2011;
13. Stock assessment of lagoon and off-lagoon resources.
7.5.1.3 **Sub-goals for solid waste management**

14 Ensure an efficient waste collection;

15 Extension of disposal capacity of solid waste and littering;

16 Arrest littering and dumping; and

17 Adopt Waste Stream Reduction strategies.

7.5.1.4 **Sub-goals for air quality and noise**

18 Adopt air quality and noise reduction strategies.

7.5.2 **Key strategy 1: RRA to endorse an appropriate Land Policy Framework**

There is an urgent need to revisit the physical development for Rodrigues from the point of view of future developmental needs. The physical development plan should take the following into consideration:

- Regeneration initiatives such as land reclamation;
- Changes in socioeconomic factors, such as car ownership, unemployment and wage levels;
- Changes in the relative importance of different economic activities;
- The development of new economic activities such as tourism and industry;
- The contribution of agriculture and other rural activities to the island’s economy;
- The need to take account of the supply side of the existing economy and opportunities for economic growth;
- The effect of new restrictions, or relaxations, on local economic activities and outputs;
- The resolution of problems associated with the interrelationships of different uses of land;
- The need to provide development authorities with choice and flexibility for carrying out economic activities; and
- The urban pattern: haphazard settlement to which it is difficult to provide infrastructure facilities or well ordered global villages/flats with integrated infrastructure facilities.

This will require the RRA’s commitment, political will, and capacity. An efficient Land Policy Framework should include security of land rights and land access, strengthening of the institutional infrastructure to administer land rights, and facilitation of land markets and transferability of land rights.
7.5.3 Key strategy 2: Incentives, Property Rights, and Empowerment

In a key document entitled “Making Sustainable Commitments – An Environment Strategy for the World Bank,” the authors stressed on the fact that, in order to enhance the sustainability and poverty impact of Natural Resource Management, there are three strategic themes that need to be addressed. These are especially relevant to Rodrigues and revolve around the following:

• Incentives;
• Property rights; and
• Empowerment.

7.5.3.1 Incentives

• Several case studies in countries/regions similar to Rodrigues show that inefficiencies in the utilisation of natural resources often arise because private and social prices differ and markets are incomplete or even distorted sometimes. This is elaborated further in the chapter on “Sustainable, Integrated Agriculture” in this SIDPR, where the situation of frequent market failures in Rodrigues is highlighted. The result is lower total welfare, especially for the poorest sections of the population. Incentives faced by decision-makers, therefore, are crucial to natural resource management;

• To address this question of incentives, it is proposed to set up a Table Ronde de Rodrigues as depicted in Chapter 5 above. The Table Ronde will have the power to advise on removing obstacles to the proper functioning of existing incentives or will recommend the provision of other types of incentives such as the introduction of exclusive rights;

• The creation of new incentives can take the form of:
  • Removal of policy-induced distortions that undermine sound management of the natural resource base;
  • Complementing market signals with taxes or fees that reflect social opportunity costs (negative incentives), or payments that reflect social benefits; or
  • Selectively regulate the remaining externalities.

7.5.3.2 Property rights

• Evidence show that property rights that are not complete, exclusive, enforced, and transferable often lead to unsustainable and inefficient utilisation of natural resources. The proposed Table Ronde de Rodrigues, should therefore:

  • Clarify property rights where they do not exist, are ambiguous or obscure, or are in dispute;
• Enforce property rights to support better natural resource management and thereby contribute to alleviating poverty; and

• As above, selectively regulate the remaining externalities, using a combination of incentives and negative incentives.

7.5.3.3 Empowerment

When stakeholders have little say in management of natural resources, evidence show that inefficiencies and inequities often crop up and distort the system. In this regard, it is important (as mentioned in Part V of this SIDPR) to build social capital and to promote sound governance principles, as highlighted in the section on Governance above.

Several case studies, including the World Bank’s Mauritania Rainfed Natural Resource Management Project (see Box 7.1), have revealed the synergistic benefits associated with incorporate a role for local communities in the design and implementation of projects. Indeed, participation by local communities is crucial to improved land management as it effectively incorporate in the policy mix the knowledge, needs, priorities and decisions of people living on and using the land.

7.5.4 Key strategy 3: Adapt the Forest Strategy to improve welfare

Evidence abounds on the role that forests can play in poverty alleviation, sustainable economic growth, and the provision of ecosystem services. Forestry is indeed intricately linked with Sustainable Development. Within the context of this SIDPR, and following the report of ARER in 2007 on the potential of forestry as “a major energy source, an important economic sector, and a crucial area for Rodrigues to adapt to climate change,” the following strategy with two distinct goals is recommended:

1 Harness forestry potential to reduce poverty by integrating forests into sustainable economic development (and not only as part of land resources management);

2 Biomass as a major energy source and as a strategy to mitigate the effects of climate change (this is elaborated further in the chapter on Energy below).

Following ARER, the quantity of forest wood that could be exploited is estimated at 150,000 m$^3$, 10% of which could be from renewable sources. It has been estimated that, on top of the current area under forest (some 3,500 ha), an additional 1,000 ha could be transformed into forests, which would imply a total of 4,500 ha of exploitable forests.

The re-afforestation programme therefore (which is a marked success in Rodrigues) should continue unabated. In the medium-term, a new economic sector might emerge namely wood cutting and transformation. In addition, as recommended by ARER, wood wastes from this activity could be used in the proposed gasification unit.

7.5.5 Key strategy 4: Re-organisation of settlements into key areas

To save on the cost of services and facilities, a line of thought that has cropped up in the previous National Physical Development Plan and which is still valid in the current context is that it might be necessary to group the isolated settlements in important key villages. Only the latter would be encouraged to develop rather than all the scattered settlements. Hence, it is necessary to study and identify these key villages. This settlement policy should be considered in the new master plan in preparation, based on the current cadastral study.

The NPDP recommends that once agreement has been reached on the selection of key villages, the names of these villages should be circulated to all the ministries, with an instruction that certain facilities to be provided in the future should be located in the key villages and not elsewhere.

7.5.5.1 Key villages and sub-regions

In the hilly terrain of Rodrigues, it is not possible to have a uniform pattern of settlements. Due to mountainous areas, certain places are disadvantaged by the non-accessibility or non-availability of good agricultural land. Certain settlements have developed into nodal points providing services to the surrounding area. It is proposed to study the distribution of services and facilities and rank the settlements according to the number and type of facilities present. Each facility is assigned a numerical score which varies according to the importance of the facility. Key villages are those with high scores, indicating the presence of many services and facilities. These key villages have been identified by the NPDP.

The area served by the existing key villages will be drawn by circles with a radius of 1.25 km, so that the maximum walking distance will be only 2 km, taking into consideration gradients and obstacles to movement. In the areas which are not properly served, new key villages will be proposed so that no one is disadvantaged.
It is possible to identify a hierarchy of key villages based on the point’s score of each settlement. The key village with the highest score is called a "Regional Centre"; at the next level down are "Sub-Regional Centres"; then there are "Service Centres"; and finally there are fourth order settlements. Higher order centres also perform the functions of lower order centres. Thus, Port Mathurin is a Regional Centre for the whole of the Rodrigues "Region" and at the same time is a Sub-Regional Centre for the northern sub-region of the island.

**Regions and Sub-Regions**

The whole island is considered as one region. Four sub-regions have been delineated as north, south, west and central-east based on the influence of the major settlements.

### 7.5.5.2 Selection of Key Villages

**Ranking of Key Villages**

The following 27 settlements were selected by the NPDP as key Villages based on population, location, accessibility and availability of existing facilities and services. Points were given for each available facility/service for each location. These facility scores are set out in Table 7.1. The key villages were ranked as follows based on their facility scores.

**Table 7.1 - Ranking of village/centres**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Village/Centre</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Port Mathurin + Camp du Roi + Creve Cœur</td>
<td>85</td>
</tr>
<tr>
<td>2</td>
<td>La Ferme + Manique</td>
<td>37</td>
</tr>
<tr>
<td>3</td>
<td>Mont Lubin + Malabar</td>
<td>33</td>
</tr>
<tr>
<td>4</td>
<td>Port Sud-Est</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>Rivière Cocos</td>
<td>21</td>
</tr>
<tr>
<td>6</td>
<td>Baie aux Huitres</td>
<td>19</td>
</tr>
<tr>
<td>7</td>
<td>Roche Bon Dieu</td>
<td>19</td>
</tr>
<tr>
<td>8</td>
<td>Grande Montagne</td>
<td>19</td>
</tr>
<tr>
<td>9</td>
<td>La Fouche</td>
<td>17</td>
</tr>
<tr>
<td>10</td>
<td>Petit Gabriel</td>
<td>17</td>
</tr>
</tbody>
</table>
### Table 7.1 - Ranking of village/centres

<table>
<thead>
<tr>
<th>Rank</th>
<th>Village/Centre</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>Mangues</td>
<td>17</td>
</tr>
<tr>
<td>12</td>
<td>Saint Gabriel</td>
<td>15</td>
</tr>
<tr>
<td>13</td>
<td>Grand Baie</td>
<td>15</td>
</tr>
<tr>
<td>14</td>
<td>Citronelle</td>
<td>14</td>
</tr>
<tr>
<td>15</td>
<td>Pointe Cotton</td>
<td>14</td>
</tr>
<tr>
<td>16</td>
<td>Deux Montagnes</td>
<td>12</td>
</tr>
<tr>
<td>17</td>
<td>Quatre Vents</td>
<td>11</td>
</tr>
<tr>
<td>18</td>
<td>Les Choux</td>
<td>11</td>
</tr>
<tr>
<td>19</td>
<td>Plaine Corail</td>
<td>11</td>
</tr>
<tr>
<td>20</td>
<td>Topaze</td>
<td>10</td>
</tr>
<tr>
<td>21</td>
<td>Petit Gravier</td>
<td>9</td>
</tr>
<tr>
<td>22</td>
<td>Rivière Banane</td>
<td>9</td>
</tr>
<tr>
<td>23</td>
<td>Baie Malgace</td>
<td>7</td>
</tr>
<tr>
<td>24</td>
<td>Lataniers</td>
<td>7</td>
</tr>
<tr>
<td>25</td>
<td>Dans Bebe + Vainqueur</td>
<td>5</td>
</tr>
<tr>
<td>26</td>
<td>Soupir</td>
<td>5</td>
</tr>
<tr>
<td>27</td>
<td>Bois Puant Mort</td>
<td>3</td>
</tr>
</tbody>
</table>

*Source: MHLTCLP (NPDP Team - Planning Division - Ministry of Housing, Lands and Town & Country Planning), National Physical Development Plan: Rodrigues, 1994*

### 7.5.5.3 Hierarchy of Key Villages

The following discussion results from the findings and recommendations of the NPDP team.
**Regional Centre**

Port Mathurin has the highest facility score and is thus the Regional Centre for the island.

**Sub-Regional Centre**

Based on the facility scores obtained, La Ferme and Mont Lubin have been identified as Sub-Regional Centres and will service the western sub-region and central-east sub-region respectively. Port Mathurin and Port Sud-Est are also Sub-Regional Centres. Port Mathurin will serve the northern sub-region. For the south sub-region, Port Sud-Est has been selected.

**Service Centre**

Third order settlements are termed "Service Centres” and they serve a hinterland of about 1.25 km radius.

The following Service Centres, according to their rank: (minimum 17 points), were selected and 1.25 km radius circles were drawn around them to represent their hinterlands. Regional Centres and Sub-Regional centres will also act as Service Centres and serve their areas.

(1) Port Mathurin ; (2) La Ferme ; (3) Mont Lubin ; (4) Port Sud-Est ; (5) Rivière Cocos ;(6) Baie aux Huitres ; (7) Roche Bon Dieu ; (8) Grande Montagne ; (9) La Fouche ; (10) Petit Gabriel ; and (11) Mangues.

Once the hinterlands were mapped, it was apparent that certain areas were not served by Service Centres. To remedy this, the following additional Centres were selected, based on the population of the villages and the area needed to be served.

(12) Grand Baie ; (13) Plaine Corail ; (14) Petit Gravier ; (15) Riviere Banane ; (16) Topaze ; (17) Baie Malgache ; (18) Bois Puant ; (19) Dans Bébé + Vainqueur ; and (20) Soupir.

The nine additional Centres will be developed into Service Centres by providing the minimum level of facilities and services required at this level in the hierarchy.

In each of the 20 Service Centres, there will be at least a primary school, community health centre, community centre, football ground, a few shops, reading room, chapel, bus route, etc. Each Service Centre will serve approximately 2,000 people. It is normal to have one primary school for every 3,000 to 5,000 people, but in Rodrigues this standard may have to be increased, so as to ensure that home to school distances are not too long. To encourage the parents to send their children to school, it is necessary that primary schools are located within reasonable walking distance of their catchment population.

**Facilities and Services to be provided**

Each centre should have the minimum required facilities and services to serve their hinterlands.
7.5.5.4 Development Plan

Port Mathurin, Mont Lubin/Malabar/Lataniers and La Ferme are three strategic centres in Rodrigues which have high development potential. There are many applications to lease land in and around these centres. In order to properly manage the release of State Land and control new building, it is necessary to prepare development plans.

7.5.6 Other strategy considerations

7.5.6.1 Law enforcement and adoption of regulations

Law enforcement remains a pre-requisite in various sub-sectors. It is important that these laws and regulations be enforced and adopted to eliminate any risk of regulatory inefficiency. The following areas need law enforcement and regulations:

- State Land lease;
- Replication of Area Action Plan of La Ferme;
- Livestock (Cattlewalks) regulations; and
- Coastal Zone Management.

7.5.6.2 Continuity of on-going programmes

There are several initiatives and programmes, such as the Anti Erosion Program, which, even though have generated mixed results, are viewed as crucial for the sustainable development of Rodrigues.

7.5.6.3 Recruitment of personnel

In some cases such as in the management of land resources, more land surveyors would be needed. It is therefore suggested that all possibilities of recruitment, namely contracting out of private sector, to address specific issues be considered.

7.5.6.4 Training programmes and refresher courses

The strategies that are being implemented will not only require new staffs but also provide regular training to the existing staffs as well. This will have the effect of making their work more efficient and thus contribute in achieving the goals towards environmental sustainability. The identified list of training programmes which deals with the different strategies are as follows:

- Land management and administration;
• Agricultural engineering (topography, terrace management, hydroponics, irrigation, livestock housing designs);

• Animal nutrition and animal feed;

• Dry land farming system;

• Statistics and biometry;

• Forest, islet and biodiversity management;

• Remote sensing and satellite Imagery;

• Phytosanitary control;

• Scientific staffs;

• Staffs from relevant institutions;

• Agricultural Extension;

• Management of wetland.

7.5.6.5 Awareness campaigns
The population as a whole must be sensitised through awareness campaigns. Each Rodriguan should in the medium term understand that the idea of environmental sustainability is beyond the concept of throwing litter here and there only. It is crucial that the whole population through well defined target groups (fishers, farmers, students, etc) be made aware of the importance of preserving the land resources and coastal zones while minimising the amount of solid waste.

7.5.6.6 Waste minimisation
Minimisation of waste will arouse from a proper waste management. The following targets are national targets as identified at National level:

• The growth in the quantity of waste generated shall remain lower than the rate of economic growth;

• Raise the overall recycling rate of Municipal Solid Wastes to 25%;

• Setting up of a hazardous waste treatment facility;

• Reduce and eventually eliminate anti-social behaviours (littering and illegal dumping); and

• Optimise resource recovery.
7.5.6.7  **Air quality and noise**

AS per the NEP (2006), the following are the national targets for Mauritius which also concerns Rodrigues:

- The ambient air quality standards shall be met;
- Introduction and reinforcement of sectoral air emission standards such as for Power Plants, Industries and Incinerators;
- Introduce an Air Quality Indexing system to communicate air quality to the public;
- Vehicle emissions shall meet national standards;
- Enhance public transportation as an attractive alternative to private cars;
- Encourage the use of bicycles to ease traffic congestion;
- Encourage renewable and clean energy; and
- Noise pollution shall be reduced drastically from the present level;

Furthermore, it is necessary to introduce a Prevention of Noise Regulations to better control noise pollution in Rodrigues. In addition, appropriate regulations to control the importation of old vehicles are also necessary. In an attempt to control the air quality and noise environment, a mobile air quality monitoring section should be set up.