



**ADAPTATION FUND**

**REQUEST FOR PROJECT/PROGRAMME FUNDING  
FROM ADAPTATION FUND**

The annexed form should be completed and transmitted to the Adaptation Fund Board Secretariat by email or fax.

Please type in the responses using the template provided. The instructions attached to the form provide guidance to filling out the template.

Please note that a project/programme must be fully prepared (i.e., fully appraised for feasibility) when the request is submitted. The final project/programme document resulting from the appraisal process should be attached to this request for funding.

Complete documentation should be sent to

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# PROJECT/PROGRAMME PROPOSAL

## ■ PART I: PROJECT/PROGRAMME INFORMATION

PROJECT/PROGRAMME CATEGORY:	REGULAR PROJECT
COUNTRY/IES:	<b>REPUBLIC OF MAURITIUS (ROM)</b>
TITLE OF PROJECT/PROGRAMME:	CLIMATE CHANGE ADAPTATION PROGRAMME IN THE COASTAL ZONE OF MAURITIUS
TYPE OF IMPLEMENTING ENTITY:	MULTILATERAL IMPLEMENTING ENTITY
IMPLEMENTING ENTITY:	UNDP
EXECUTING ENTITY/IES:	MINISTRY OF ENVIRONMENT AND SUSTAINABLE DEVELOPMENT, GOVERNMENT OF MAURITIUS
AMOUNT OF FINANCING REQUESTED:	\$9.119, 240

## ■ PROJECT / PROGRAMME BACKGROUND AND CONTEXT:

*Provide brief information on the problem the proposed project/programme is aiming to solve. Outline the economic social, development and environmental context in which the project would operate.*

1. As a Small Island Developing State (SIDS), the Republic of Mauritius (including Mauritius, Rodrigues, Agalega, and various small islets) – ROM - is particularly vulnerable to the adverse effects of climate change, especially in the coastal zone<sup>1</sup>, where a convergence of accelerating sea level rise and increasing frequency and intensity of tropical cyclones (with more intense rainfall events and stronger winds) will result in considerable economic loss, humanitarian stresses, and environmental degradation - this in a narrow, sensitive strip upon which the country is so dependent. The following section clarifies the climate change scenario for ROM in terms of future predictions, current trends, linkages to coastal functions, the observed vulnerabilities of coastal areas of ROM, and the social and economic importance of these vulnerable coastal areas (i.e., the implications of *not* adapting)<sup>2</sup>.

2. The IPCC regional models, including the Indian Ocean, indicate the following future climate scenario for the region:

- an increase in mean annual temperature of up to 3.8°C by 2100 (an increase of 1°C has already been observed in Mauritius in the last fifty years<sup>3</sup>);
- a declining trend in total annual rainfall, but an increase in the frequency of intense rainfall episodes (both have already been evident in Mauritius in the last 50 years<sup>4</sup>);

<sup>1</sup> In this document, the “coastal zone” includes the physical entity of the reefs, lagoons, beaches, and immediate backshore area that is subject to occasional flooding during surges and spring tides, which is the main subject of the proposal; issues such as salinization and loss of agricultural land near coastal areas are not addressed in this proposal.

<sup>2</sup> Note that the First National Communication also included climate change impacts on agriculture, water resources, fisheries, health and well-being, land-use change and forestry, and biodiversity. These are not addressed in this proposal.

<sup>3</sup> Mauritius Meteorological Services (MMS): Climate change impacts on Mauritius. 2008.

<sup>4</sup> MMS, 2008 and G. Gastineau, and B. J. Soden, 2009. Model projected changes of extreme wind events in response to global

- sea level rise (SLR) of 18 – 59 cm by 2100 (the current rate of SLR in Mauritius indicates about 35 cm, if the rate remains constant over the next 90 years<sup>5</sup>);
- an increase in the intensity and rate of intensification of tropical cyclones (already evident since 1975<sup>6</sup>).

3. Despite the relatively long time horizon for these possible climate changes, and the fairly wide range of predictions, the concern in ROM is very immediate and the call for action (practical adaptation policies and measures) is now louder, reflecting a variety of important factors. These are discussed below, as context for the proposed project and to sharpen the focus on what is required in the way of solutions.

4. First of all, the visible and measurable effects of climate change in the coastal zone of ROM have become more apparent over the last ten years, reflecting *increases in the rate of negative changes* in the coastal zone, due to climate change, and an *increase in the number of vulnerable sites*. For example, Mauritius Meteorological Services data indicate that the rate of sea level rise (measured in Port Louis) has averaged 3.8 mm/year over the last five years (albeit a short timeframe sample); this compares to an average of 2.1 mm/year over the last 22 years. The net measured sea level reflects a compounded effect of real sea level rise (absolute water volume increase and more low pressure systems) and a higher frequency and height of waves; i.e., water piled up at that location – both of which have real implications for coastal areas (surge flooding and erosion – see Figure 1). For example, on May 12, 2007, an extra-tropical cyclone south of the island of Mauritius created 10 metre offshore swells within a period of 18 seconds, traveling 50 km/hr, and hitting the south coast as 5-6 metre swells on top of a high tide, resulting in extensive flooding and erosion<sup>7</sup>. The state of coastal vulnerability is therefore *not* stable; there is no time to spare, as the potential cost of remediation will continue to go up, and not likely in a linear manner.

5. There is a direct linkage between climate change effects on coastal ecosystem services (especially coral reefs and lagoons) and the integrity of the whole coastal zone of ROM. In particular, there is scientific evidence that increases in sea temperature have led to increased frequency and areal extent of coral bleaching<sup>8</sup>, which contributes to a failure of the wave attenuation function of reefs. This leads to increased beach erosion rates and loss of lagoonal sediments, especially during storm events (for example, intense tropical cyclone Gamede, in February 2007, which resulted in severe beach erosion on the northern and western coasts of the island of Mauritius and at St. Brandon<sup>9</sup>). There is also evidence that coral growth rates, especially in the passes through the barrier reef, are unable to maintain equilibrium with the current rate of sea level rise<sup>10</sup>, due to the compound effect of recently accelerated SLR, bleaching, accumulated storm damage, increased frequency of freshwater and turbidity events in lagoons (due to storms), and ongoing stresses from local human activities (discharge of wastewater, and anchor damage); Mon Choisy in the north is a good example. Measurements at five key beaches around the island of Mauritius indicate that erosion rates in the last 10-15 years have increased, relative to earlier periods, reflecting this lagging coral growth rate, as well as SLR and storm events.

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warming, *Geophys. Res. Lett.* **36**, L10810, doi:10.1029/2009GL037500.

<sup>5</sup> Mauritius Meteorological Services: Climate change impacts on Mauritius. 2008.

<sup>6</sup> MMS, 2008 and Lal, M., Harasawa, H., Takahashi, K. 2002. Future climate change and its impacts over Small Island Developing States. *Climate Research* **19**: 179 – 192.

<sup>7</sup> MMS. 2008. Technical Report CS28. Cyclone Season of the Southwest Indian Ocean, 2006-2007.

<sup>8</sup> University of Mauritius: Inception Workshop discussions, September 13, 2010.

<sup>9</sup> MMS. 2008. Technical Report CS28. Cyclone Season of the Southwest Indian Ocean, 2006-2007.

<sup>10</sup> Ministry of Environment and Sustainable Development; ICZM Division observations.

6. As coral reefs lose the race with sea level rise, it is imperative that the critical ecosystem function of wave attenuation be replaced in some manner (such as detached, submerged berms in lagoons, adjacent to eroding beaches, to encourage retention of sand in the littoral cell, and eventual beach replenishment). There are few practical alternatives. Rehabilitation of coral reefs is extremely challenging, since traditional methods, such as coral transplants and artificial reefs, are such small interventions in a coral reef system that is under pervasive pressure. Any new coral patches or rehabilitated areas would still be under the same pressures as the whole reef system, including rising sea level (accelerating), increased storm frequency, and bleaching events. Equally important is the need for a monitoring system that tracks the correlation between key ecosystem functions and weather events, to sharpen the understanding of coastal processes in ROM and the extent to which their variability is driven by climate change, which will in turn continue to inform and fine-tune the design of appropriate interventions.

7. Due to a combination of topography, a very high rate of private land holding in the coastal areas of the island of Mauritius (especially the old sugar estates), high population density (626 people/km<sup>2</sup>), and the need for proximity to lagoons to maintain coastal livelihoods, there are almost no financially viable options to move vulnerable communities in coastal areas (many of which are perched on beach crests on Government land; e.g., Riviere des Galets, in the south, and Quatre Soeurs, in the east) to alternative locations. Adaptation therefore requires *in situ* changes in behaviour and site management, and appropriate technical interventions, as well as early warning systems that provide enough time for communities to move away from areas where the risk of storm surge and flooding is imminent. For example, Baie du Tombeau (west coast of the island of Mauritius) has more than 400 buildings and 2.2 km of road that would be affected by a wave run-up just one metre higher than normal, which could lead to a range of impacts, from just a loss of goods due to seawater contamination to real infrastructure damage<sup>11</sup>.

8. The baseline situation for the coastal zone of ROM is already compromised, such that natural fragility has been compounded with the mistakes of poor design and siting of infrastructure (for example, hard structures, such as gabions, and sometimes filao trees, in the dynamic beach zone), pollution in the lagoons, historical sandmining in the lagoons (illegal on the island of Mauritius since 2001; still legal in Rodrigues) and unregulated levels of tourism recreational activities, which stress beaches, lagoons, seagrass beds, and coral reefs. A particular concern is that private landowners and hotels undertake their own remedial measures (usually trying to save a beach, for example, using groynes or seawalls) that are poorly informed, leading to adjacent beach loss, and eventually a total loss of the investment. Extremely clear and practical guidelines on design, siting, and nature of construction in coastal areas are required (as well as management of all waste inputs to the lagoon), taking into account the possible scenarios over the next 80-90 years. Under the Africa Adaptation Programme (see paragraph 64 for details), a legislative review of the EIA regulations is planned. The AF programme is expected to develop the EIA guidelines with respect to coastal protection and rehabilitation works. Regulatory requirements and guidelines will require effective dissemination and enforcement (therefore captured in policies and codified), as well as supporting policy and economic incentives to encourage private sector compliance with the prescribed best practices.

9. There is a lack of technical capacity in ROM to convert climate variability risk management into practical technical interventions appropriate for each vulnerable site. Each coastal site is

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<sup>11</sup> Analysis developed as input to the Draft Second National Communication, August 2010.

unique in terms of driving factors, rate of change, and range of technical options. Good coastal engineering skills are needed for proper assessment of each site and to design appropriate cost-effective interventions. The evidence to date suggests that standard “stop-gap” measures (such as revetments and seawalls in the dynamic beach zone, which induce local scour) are the routine approach in most cases of remedial beach work and have very limited life spans<sup>12</sup>. Capacity-development and application of best practices on-the-job (especially during design and implementation of the proposed coastal protection measures) are therefore very important, and will be addressed by the programme. These need to be aligned with development of new, comprehensive, and strategic policies and guidelines which will ensure that all future development in coastal areas has the maximum possible chance of resilience under the worst possible conditions.

10. Finally, as noted previously, the coastal zone of ROM is critically important to the economy of the country, in terms of domestic and international tourism, as well as fisheries. The tourism link is the main concern in the coastal adaptation strategy for the country, since so much revenue and so many jobs are at risk if beaches continue to erode. There are 90 public beaches around the island of Mauritius, with a total length of 26.6 km, making up 8% of the coastline (there are also public beaches on Rodrigues). These attract both domestic and international tourists. Excluding Rodrigues, as of June 2010, there are 104 registered hotels operational on the island of Mauritius, of which 86 are located immediately adjacent to beaches – these having 21,444 bedplaces, which represents 92.5% of the hotel guest capacity on the island of Mauritius<sup>13</sup>. Clearly, most tourists come to enjoy the beaches (34% of tourists are “repeaters”<sup>14</sup>), and the market response in the hotel industry (building hotel capacity in proximity to beaches, although often misinformed as to climate change risks, and causing local problems of beach loss) reflects that. The beaches on the island of Mauritius are near capacity, in terms of visitor use. While new beaches cannot be created, existing ones can certainly be lost. One might argue, then, that the percentage of beach loss, due to climate change, could translate into a similar percentage reduction in the number of tourists, and a correlated loss of revenue and jobs in ROM. Estimates of costs of climate change and benefits of adaptation are explored further in Part II, Sections B and I, Table 1, paragraphs 31-38.

11. Figure 1 shows all the known coastal sites on the island of Mauritius which are presently vulnerable to the physical effects of climate change (sea level rise, storm surge/flooding, beach erosion). There are 21 beaches currently experiencing erosion (23% of the beaches on the island of Mauritius), many with accelerated rates in the last ten years. In addition, there are a further 22 sites on the island of Mauritius which have experienced surges and flooding in the recent past (there are additional sites on Rodrigues and Agalega). All sites have value to Mauritians and provide the location for their homes and means for their livelihoods. All need attention, with sound adaptation policies and measures that will make these coastal sites resilient and sustainable during the next period of climate change. The proposed programme is intended to start this process, with the implementation of coastal protection measures three specific sites on the island of Mauritius (this is further explained in paragraph 20) which address the full range of climate-related problems at these sites, development of the enabling environment for ROM and knowledge dissemination and management for ROM. This approach will serve to build up the coastal adaptation “toolbox” that can be applied to all sites in the future, with Government of Mauritius and private sector financing working together. Capacity development of Government official will cover a range of ministries. Ministry of Environment is

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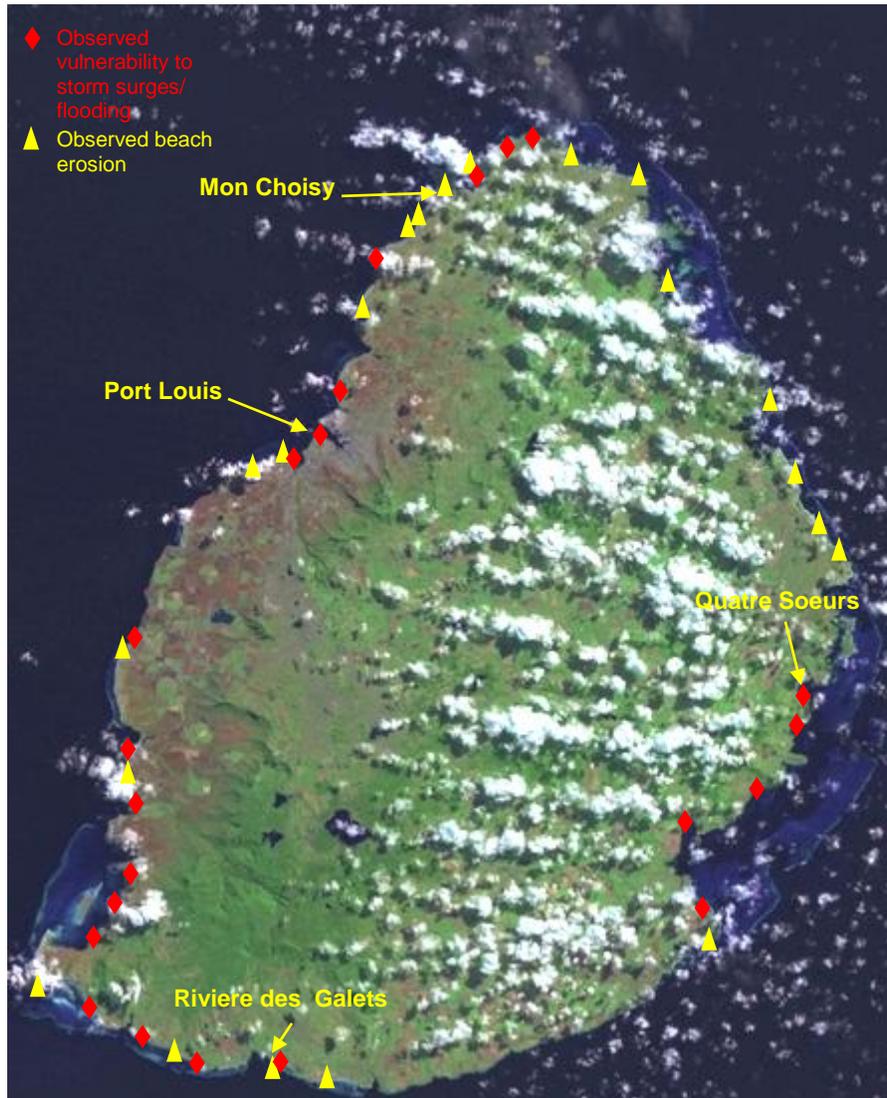
<sup>12</sup> W.F. Baird and Associates Coastal Engineers. 2003. Study on Coastal Erosion in Mauritius. For Ministry of Environment.

<sup>13</sup> Ministry of Tourism List of Hotels as at June 30, 2010.

<sup>14</sup> Page, S. 1999. Tourism and Development: The Evidence from Mauritius, South Africa, and Zimbabwe.

the lead agency to advise on coastal zone management, but for major developments a high level, multi-stakeholder Committee, chaired by a Senior Adviser from the Prime Minister's Office, steers development in the coastal zone, and certain other ministries are also mandated to develop infrastructure and develop guidelines in the coastal zone.

**Figure 1. Vulnerable coastal areas on the island of Mauritius which require climate change adaptation measures over the next 10-20 years. Project sites marked (Mon Choisy, Quatre Soeurs, Riviere des Galets).**



**PROJECT / PROGRAMME OBJECTIVES:**

*List the main objectives of the project.*

12. The overall **goal** of the programme is to ensure that growth and development in ROM are sustainable, with potential climate change effects in the coastal zone fully addressed in all future planning. The **objective** of the programme (becoming evident by the end of the programme) will

be increased climate resilience of communities and livelihoods in coastal areas in Mauritius (all islands), through the following programme components:

- application of adaptation measures to protect currently vulnerable coastal ecosystem and community features (at three priority sites on the island of Mauritius);
- development and implementation of an early warning system for incoming surge on ROM;
- training to promote compliance with climate-proofed planning, design, and location guidelines;
- policy mainstreaming; and,
- knowledge dissemination and management.

13. The programme structure, with approximately 82% on coastal protection measures; 11% on enabling environment (early warning, policy mainstreaming, training) and 7% on knowledge dissemination and management is believed to be the most effective and balanced way of realigning and initiating the coastal adaptation process in ROM, with a priority given to actual interventions that reduce coastal vulnerability.

14. The goal will be supported by achievement of the following **outcomes**:

1. Current climate change risks at three coastal sites on the island of Mauritius resolved through design and application of coastal protection measures, using proven technologies (addressing beach erosion and flood risk from storm surges) (short title = *Application of Adaptation Measures for Coastal Protection*).
2. Early warnings for incoming storm surge communicated to coastal communities, indicating the time of incidence and height of storm surges, through the design and activation of an early warning system (short title = *Early Warning System*).
3. Increased capacity of public agencies, private sector entities, NGOs and community-based organizations (CBOs), and individuals to develop infrastructure and conduct livelihoods in the coastal zone of ROM with minimal risk of loss due to future climate change effects (short title = *Training*).
4. Clear and practical alignment of Mauritian policy, strategies, plans, and regulations with the most appropriate best practices for adaptation in the coastal zone, taking into account the expected risks to coastal processes and infrastructure in ROM over the next 50 years<sup>15</sup> (short title = *Policy Mainstreaming*).
5. Effective capturing and dissemination of lessons from the applied activities in the programme (short title = *Knowledge Dissemination and Management*).

## ■ PROJECT / PROGRAMME COMPONENTS AND FINANCING:

*Fill in the table presenting the relationships among project components, activities, expected concrete outputs, and the corresponding budgets. If necessary, please refer to the attached instructions for a detailed description of each term.*

*For the case of a programme, individual components are likely to refer to specific subsets of stakeholders, regions and/or sectors that can be addressed through a set of well defined interventions / projects.*

15. Programme components relate to the six main outcomes, and the outputs identified to achieve them. The outcomes deliver the programme objective. Outputs = deliverables produced by the activities. Details of outputs and activities and their rationale are provided in

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<sup>15</sup> 50 years has been picked as a reasonable timeframe for undertaking economic analyses where required to justify project interventions.

Part II, Section A, and the specific output budgets, summarized below, are explained in Part III, Section D: Results Framework.

PROGRAMME COMPONENTS	EXPECTED OUTCOMES	EXPECTED CONCRETE OUTPUTS	AMOUNT (US\$)
<p><b>1. Application of adaptation measures for coastal protection.</b></p> <p>This component will address current climate change risks at three coastal sites (Mon Choisy, Riviere des Galets, Quatre Soeurs); these will be resolved through design and application of coastal protection measures, using proven technologies (addressing beach erosion and flood risk from storm surges). It will also support monitoring of the link between coastal processes and climate change, to assess effectiveness of the coastal protection measures over time,</p>	<p>1. Current climate change risks at three coastal sites resolved through design and application of coastal protection measures, using proven technologies (addressing beach erosion and flood risk from storm surges).</p>	<p>1.1 Detailed technical assessment of each site, with chronology of previous flood and erosion events and collection of nearshore oceanographic data, during “quiet” periods and “active” periods (one month each) to inform the design of the coastal protection measures at each of the three sites.</p>	<b>205,425</b>
		<p>1.2 Technical design of coastal protection measures at each of three sites, with detailed costing.</p>	<b>119,650</b>
		<p>1.3 Successful implementation of the coastal protection measures at each of the three sites.</p>	<b>5,755,650</b>
		<p>1.4 Analysis of data and development of recommendations on how the interventions can be adjusted for other vulnerable coastal locations in ROM.</p>	<b>109,000)</b>
		<p>1.5 Monitoring programme designed to include suitable parameters, including beach width and slope; depth of adjacent lagoonal sediments; wave height, period, and run-up; direction of nearshore currents.</p>	<b>71,175</b>
		<p>1.6 A targeted coastal process/weather event monitoring system in place.</p>	<b>204,800</b>
			<b>Total for #1 = US\$ 6,465,700</b>
<p><b>2. Early Warning System for incoming storm surge</b></p> <p>This component will focus on development of an early warning system for incoming storm surge</p>	<p>2. Early warnings for incoming storm surge communicated to coastal communities, indicating the time of incidence and height</p>	<p>2.1 Assessment report of the current sea state monitoring systems (Mauritius Meteorological Services and Mauritius Oceanography Institute) including a definition of required critical parameters and</p>	<b>33,155</b>

<p>manned on a 24 hr/day basis, such that coastal communities in ROM are able to safely evacuate prior to future storm surge events.</p>	<p>of storm surges, through the design and activation of an early warning system.</p>	<p>operational requirements for an early warning system.</p> <p>2.2 The early warning system installed and implemented (to link with existing early warning system for cyclones), with communication linkages established from the level of National Coast Guard at Headquarters down to the level of coastal communities.</p>	<p><b>100,550</b></p> <p><b>Total for #2 = US\$ 133,705</b></p>
<p><b>3. Training.</b></p> <p>This component will promote compliance with climate-proofed planning, design, and location guidelines. Activities will ensure that all Government interventions in the coastal zone, designed to reduce erosion or address storm surge effects, incorporate site-specific features and measurably reduce the risk of flooding or the rate of erosion, and will put in place the capacity for ongoing replication of effective coastal adaptive measures by both the Government and private sector.</p>	<p>3. Increased capacity of public agencies, private sector entities, NGOs and CBOs, and individuals to develop infrastructure and conduct livelihoods in the coastal zone of ROM with minimal risk of loss due to future climate change effects.</p>	<p>3.1 “Handbook on Coastal Adaptation” packaged as training modules for coastal communities, relevant Government agencies, NGOs and CBOs, and private sector stakeholders (such as hotel operators); training sessions delivered on a regular basis over the course of the programme (at least twice annually), supported with regular training-of-trainers sessions with NGOs and CBOs.</p> <p>3.2 Short course on Coastal Engineering designed and delivered (twice during programme period).</p> <p>3.3 Specialized course on Cost-Benefit Analysis of coastal adaptation measures designed and delivered (annually, over four years).</p>	<p><b>164,600</b></p> <p><b>134,600</b></p> <p><b>94,825</b></p> <p><b>Total for #3 = US\$ 394,025</b></p>
<p><b>4. Policy Mainstreaming.</b></p> <p>This component will work to ensure that all policies, strategies, plans, and regulations are consistent in recognizing climate change impacts in the coastal zone over the next 50 years and actively supporting adaptation to them. At the same time, opportunities and obligations with regard to management of the</p>	<p>4. Clear and practical alignment of Mauritian policy, strategies, plans, and regulations with the most appropriate best practices for adaptation in the coastal zone, taking into account the expected risks to coastal processes and infrastructure in ROM over the next 50 years.</p>	<p>4.1 A National Coastal Zone Adaptation Strategy that addresses all perceived climate change risks in the coastal zone of ROM over at least the next 20 years, with recommendations for supporting policies and regulations.</p> <p>4.2 A set of recommendations on best technical and institutional adaptation practices suitable for the coastal zone of ROM.</p> <p>4.3 Creation of one “clearinghouse” for climate</p>	<p><b>144,350</b></p> <p><b>46,025</b></p> <p><b>72,825</b></p>

<p>coastal zone will be clear for all stakeholders, including Government.</p>		<p>change oversight in the coastal zone of ROM (a unit or institution, or collection of individuals from various agencies, which is able to make final decisions on the climate appropriateness of future development projects; also having a follow-up enforcement capacity).</p> <p>4.4 Recommendations for new economic instruments.</p>	<p><b>86,850</b></p> <p><b>Total for #4 = US\$ 350,050</b></p>
<p><b>5. Knowledge Dissemination and Management.</b></p> <p>This component will facilitate more frequent and accessible public information on climate change effects in the coastal zone and appropriate interventions, such that District and National Plans reflect perceived climate risks in the coastal zone over the next 50 years and future private sector development will be designed to minimize climate risks in the coastal zone.</p>	<p>5. Effective capturing and dissemination of lessons from the applied activities in the programme.</p>	<p>5.1 Handbook, training modules, and website content capturing best coastal adaptation practices for the Mauritius context.</p> <p>5.2 Dissemination of lessons learned from the programme with coastal stakeholders in other locations in the southern Indian Ocean.</p> <p>5.3 Interpretive signs and small-scale models of coastal processes designed and installed at each site, explaining the science of climate change and coastal processes (in lay terms), so that the linkages between weather, stability of coastal features, and adaptation measures are clear.</p> <p>5.4 Public awareness campaigns on climate change in the coastal zone designed and delivered by outreach trainers, involving the Mauritian media (TV, radio, Internet).</p> <p>5.5 Priority ranking of vulnerable coastal sites established, to guide the order of future investment by the Government of Mauritius and the private sector.</p>	<p><b>86,050</b></p> <p><b>131,100</b></p> <p><b>135,600</b></p> <p><b>125,550</b></p> <p><b>83,050</b></p> <p><b>Total for #5 = 561,350</b></p>
<p>7. Project Implementation – Total Costs</p>			<p><b>7,904,830</b></p>
<p>8. Project/Programme Execution cost</p>			<p><b>500,000</b></p>
<p>9. Total Project/Programme Cost</p>			<p><b>8,404,830</b></p>
<p>10. Project Cycle Management Fee charged by the Implementing Entity (8.5% of programme</p>			<p><b>714,410</b></p>

cost)* Note 1	
<b>Amount of Financing Requested</b>	<b>9,119,240</b>

*\*Note 1: On the request of the Government of Mauritius, the project will be implemented by UNDP using the MIE modality. UNDP is able to provide the following implementation services through its country office, regional and headquarters networks: project identification, formulation, and appraisal; determination of execution modality and local capacity assessment of the national executing entity; briefing and de-briefing of project staff; oversight and monitoring of AF funds, including participation in project reviews; receipt, allocation and reporting to the AF Board of financial resources; thematic and technical capacity building and backstopping; support with knowledge transfer; policy advisory services; technical and quality assurance; and troubleshooting assistance to the national project staff. Further details on the types of specialized technical support services which may be provided are articulated in the table provided to the AFB Secretariat on 14 May 2010 (as annexed).*

**PROJECTED CALENDAR:**

*Indicate the dates of the following milestones for the proposed project/programme*

<b>MILESTONES</b>	<b>EXPECTED DATES</b>
Start of Project/Programme Implementation	February, 2011
Mid-term Review	February, 2014
Project/Programme Closing	February, 2016
Terminal Evaluation	November, 2015

**PART II: PROJECT / PROGRAMME JUSTIFICATION**

- A. Describe the project / programme components, particularly focusing on the concrete adaptation activities of the project, and how these activities contribute to climate resilience. For the case of a programme, show how the combination of individual projects will contribute to the overall increase in resilience.

16. The programme will focus on development and application of approaches and tools for resolving specific vulnerability issues in the coastal zone of the island of Mauritius which are due to climate change. The overall approach is to work from the level of technical solutions at specific coastal sites to the policy and regulatory level, such that future replication of coastal adaptation measures will be catalyzed, supported by new policies, guidelines, and economic incentives, and coastal communities will be increasingly climate resilient and able to protect livelihoods that are tied directly to the integrity of the coastal zone on the island of Mauritius. The proposed coastal protection measures will provide direct benefits to up to 3,150 people whose jobs, houses, and families are currently threatened by coastal erosion, storm surges, and tidal flooding (see Section B, Table 1 below for details on vulnerable populations in the coastal zone, and Sections C, Table 2 for a discussion of the potential costs of not addressing climate change issues in the coastal zone). The programme will benefit ROM more widely in the implementation of outcomes related to early warning, training, policy mainstreaming and knowledge dissemination and management. Capacity development of Government official will cover a range of ministries. Ministry of Environment is the lead agency to advise on coastal zone management, but for major developments a high level, multi-stakeholder Committee, chaired by a Senior Adviser from the Prime Minister’s Office, steers development in the coastal zone, and certain other ministries are also mandated to develop infrastructure and develop

guidelines in the coastal zone. The contributions of each of the six programme outcomes to development of climate resilience in the coastal zone of the island of Mauritius are described below.

17. **Outcome 1:** Current climate change risks at three coastal sites resolved through design and application of coastal protection measures, using proven technologies (addressing beach erosion and flood risk from storm surges and tides) (short title = *Application of Adaptation Measures for Coastal Protection*).

18. Note that site selection criteria were used to identify the most appropriate coastal sites for the coastal protection measures. These criteria included:

- clearly observed/measured changes at the site due to climate change effects in the coastal zone;
- perceived increase in the rate of change and degree of vulnerability in the last 10 years, relative to other sites (therefore increasing concern);
- evident risk of loss of human lives;
- evident risk of damage to housing and infrastructure;
- possibility of disruption of, or constraints to, normal quality of life and peace of mind, due to ongoing risks;
- risk of loss of jobs due to unrestrained changes at the coastal site;
- cost-effective coastal protection measures are available to address all perceived risks at the specific site;
- the site is representative, in terms of changes in coastal processes due to SLR, storm surge/flooding, and wave incidence; therefore coastal protection measures at the site will have a high degree of replicability.

19. The known vulnerable coastal sites (see Figure 1) were then examined with these criteria in mind. Group consensus (Government and programme stakeholders) indicated that Riviere des Galets (south coast), Mon Choisy (northwest coast), and Quatre Soeurs (east coast - as a typical example of a site subject to frequent tidal flooding; subject to District Council agreement) should be the targets for the coastal protection measures. There are certainly vulnerable coastal sites on Rodrigues and Agalega, but the requirement for practicality restricts the programme to the island of Mauritius at this time. Vulnerable sites on Rodrigues and Agalega will be addressed during the planned replication, in which Government of Mauritius and private sector funding will be used.

20. Outcome 1 will involve:

- Preparatory work, which will involve a detailed technical assessment of each site, with a chronology of previous flood and erosion events and collection of nearshore oceanographic data, during “quiet” periods and “active” periods (one month each) to inform the design of the technical interventions at each of the three sites (Mon Choisy – beach erosion; Riviere des Galets – vulnerable to storm surge and erosion; and Quatre Soeurs – frequent flooding during high tides). This preparatory work will involve further sites visits, examination of the scientific data collected to date, and consultation with the communities and stakeholders. All previous known “events” at each site will be carefully documented, so that a chronology can be built up to help in design of technical interventions at each site. The nearshore oceanographic baseline programme at each site will determine prevailing wave incidence direction, wave height and period, tidal range, nearshore currents, and beach/shoreline type, width, and slope, as well as correlating weather conditions. These data will then be used to design the most appropriate and cost-effective technical interventions to resolve the climate

change issues at each site and prevent further losses. The proposed coastal protection measures will take into consideration the navigational importance of traditional passes through the reefs present at the programme sites, used by craft of the National Coast Guard, pleasure craft and fishing boats operating in those areas. An evaluation of the potential impacts on the navigational freedom of the craft will be undertaken.

- Design of coastal protection measures, which will include:
  - detached offshore submerged wave attenuation structures (sloped rock mounds) to induce sediment retention and accumulation (Mon Choisy) and to deflect erosive waves away from a failing gabion revetment (Riviere des Galets);
  - planting of mangroves (these may be considered in association with the wave attenuation devices at Mon Choisy, if the habitat is suitable, to contribute to sediment accumulation, and in the area off Quatre Soeurs to reduce wave energy at the shore);
  - planting of beach crest vegetation, to consolidate sediments there (Mon Choisy and Riviere des Galets);
  - re-constructing public buildings at risk on stilts (Quatre Soeurs);
  - repair and re-sloping of the seawall (Riviere des Galets);
  - sealing the wave-overtopping wall (Riviere des Galets); and,
  - development of a drainage scheme for the backshore, to re-direct surge flood water and wave-overtopping water from the village (where it is currently trapped) to the back of the bay (Riviere des Galets).
- Construction of the coastal protection measures.
- Monitoring of the effectiveness of the interventions at each site The coastal monitoring programme will be designed with observable and measurable parameters which will be most appropriate for determining functional linkages between weather events and coastal condition (for example, beach width and slope; depth of adjacent lagoonal sediments; wave height, period, and run-up; direction of nearshore currents, etc.). The coastal monitoring programme will involve installation of secure video cameras for beach surveillance and reef observation during storm events and “normal” events, to serve as controls (these cameras will be run only during the selected periods, and then will be downloaded for analysis), and follow-up field measurements for the parameters noted above after each weather event. Analysis of data and development of recommendations on how the interventions can be adjusted for other vulnerable coastal locations in ROM. Lessons learned from the implementation of the coastal protection measures will be incorporated into both the guidelines and training materials described in Outcomes 3 and 4.

21. **Outcome 2:** Early warnings for incoming storm surge communicated to coastal communities, indicating the time of incidence and height of storm surges, through the design and activation of an early warning system (short title = *Early Warning System*).

22. This will involve:

- Assessment of the current sea state monitoring systems (Mauritius Meteorological Services and Mauritius Oceanography Institute) and definition of the required critical parameters and operational requirements for an early warning system. This will involve examination of the current real-time sea surface altimeter (satellite) monitoring system operating at the Mauritius Oceanography Institute, including the degree of resolution of areal data and

vertical differentials for sea level, and examination of the operation and effectiveness of the Mauritius Meteorological Services weather and sea state warning systems. Given the previous experiences with storm surges on the south coast (with wave velocities of 50 km/hour), a warning circumference around each island in ROM will be defined, such that coastal communities have at least three hours warning of possible incoming surges (so, incidence of abnormal waves through a circumference at least 150-200 km from the coast (for each of Mauritius, Rodrigues, and Agalega). The critical wave height differential (difference between long-term average wave heights and storm induced swells), whether 3, 4, 5 metres or more, will be determined.

- Installation and implementation of the early warning system (to link with existing early warning system for cyclones), with communication linkages established from the level of National Coast Guard at Headquarters down to the level of coastal communities, so that in future all vulnerable communities can safely evacuate in the event of a storm surge. This will involve the real-time altimeter data being set with an alarm (visual and auditory) that is triggered by the defined wave/swell incidence across the safety circumference. The most effective methods for observation of the alarm and subsequent transmittal through the current community services and emergency response mechanisms to potentially affected coastal communities will then be defined. Linkages between the MMS services and MOI data collection will be examined and optimized, and staff requirements for 24-hour/day monitoring will be addressed through the programme.

23. **Outcome 3:** Increased capacity of public agencies, private sector entities, NGOs and CBOs, and individuals to develop infrastructure and conduct livelihoods in the coastal zone of ROM with minimal risk of loss due to future climate change effects (short title = *Training*).

24. This will involve:

- Programme lessons will be documented in a “Handbook on Coastal Adaptation”, through collaboration of Government agencies and NGOs, to clearly inform best practices for climate resilience in the ROM coastal zone. The Handbook will then be used as a training module for coastal communities, relevant Government agencies, and private sector stakeholders (such as hotel operators). These training sessions will be delivered on a regular basis over the course of the programme, and the training content and delivery methods adjusted accordingly. The training will focus on the science of climate change in the coastal zone, vulnerabilities, stakeholder obligations (regulatory requirements), and the range of technical options for improving climate resilience. Any developing economic instruments, and the positive implications for coastal stakeholders, will also receive attention. Courses for coastal communities will be tailored to the needs, interests, and absorptive capacity of individual communities. These courses will be delivered through trainers who have been trained as outreach facilitators and who will then accompany the communities in the awareness raising process.
- Development and delivery of a short-course on coastal engineering, in which the range of technical options for beach and infrastructure protection under varying weather/climate conditions is explored. This course will be developed in partnership with the University of Mauritius and will be delivered to any engineers in the Government and private sector who are interested (engineers in ROM will be polled for prospective interest, through their associations; the course will also be open to any other interested individuals, including Government and private sector). The options for eventual certification and course cost-recovery will be examined.
- Development and delivery of a specialized course on cost-benefit analysis for coastal adaptation projects (for Government and private sector individuals).

25. **Outcome 4:** Clear and practical alignment of ROM policy, strategies, plans, and regulations with the most appropriate best practices for adaptation in the coastal zone, taking into account the expected risks to coastal processes and infrastructure in ROM over the next 20 years (short title = *Policy Mainstreaming*).

26. This will involve:

- Determination of a National Coastal Zone Adaptation that addresses all perceived climate change risks in the coastal zone of ROM over at least the next 20 years, with recommendations for supporting policies and regulations. Activities in relation to this output will include:
- Review of all GoM strategies and policies, with a climate change “filter”, using a strategic environmental assessment approach, to determine Government jurisdiction, future vision, and development priorities in the coastal zone which have a bearing on management of climate change risks. This will include review of the District Outline Schemes, the Tourism Development Plan, and other such documents that set targets and locations for development in the coastal zone. EIA guidelines with respect to coastal protection and rehabilitation works will be developed.
- These will then be compared to the coastal habitat and coastal vulnerability maps that have been produced to date to determine where future development is at most risk from the effects of climate change on coastal processes (producing a spatial-temporal development/vulnerability map) that can then be used to set development capacity limits (number of buildings/people per unit area) in each vulnerable area and guidelines for future climate-resilient construction (location, design, resistance to waves and surges, energy and water conservation features, etc.), as well as recommendations for retro-fitting existing infrastructure to improve climate resilience.
- These location-specific results will then be extrapolated back up to the level of strategies, policies, and regulations, to determine what changes need to be made at that level to accommodate the practical climate resilient development measures coming from this exercise.
- A set of recommendations will be developed on the best technical and institutional adaptation practices suitable for the coastal zones of ROM, based on a review of international best practice in coastal zone management which addresses climate change. This will include examination of technical interventions in coastal areas (that are relevant to ROM habitats), institutional structures and processes, regulations, and economic incentives for encouraging public and private sector compliance with recommended best practice for climate resilience in coastal areas.
- Creation of one “clearinghouse” for climate change oversight in the coastal zone; a unit or institution (or collection of individuals from various agencies) which is able to make final decisions on the climate appropriateness of future development projects, and also having a follow-up enforcement capacity. This would be supported by an institutional assessment to determine the most effective institutional arrangement.
- Recommendations for development of new economic instruments will be developed based on an examination of options for economic instruments that will increase the compliance of private sector developers with the new policies and guidelines that are intended to improve climate resilience in the coastal zone. This will include review of the current options (such as the CSR (Corporate Social Responsibility) Fund and the Environment Protection Fee, among others) to determine their appropriateness for increase the direction of funds to coastal adaptation projects. The practicality and implications of other innovations will be examined. The examination of best practice noted above will also inform this activity.

Recommendations for development of new economic instruments will be made, For instance, new developers, who may profit from the interventions made under this programme and any other similar interventions by Government, may be required to contribute towards the benefits derived from preserving the ecosystem services provided.

27. **Outcome 5:** Effective capturing and dissemination of lessons from the applied activities in the programme, (short title = *Knowledge Dissemination and Management*).

28. This will involve:

- Developing the Handbook, training modules, and website content to include the best coastal adaptation practices for the ROM context. This will involve extraction of lessons learned from the other Programme Outcomes and packaging them accordingly in the various training deliverables, as well as their formatting for various science and policy networks (including ALM).
- Dissemination of lessons learned from the programme with coastal stakeholders in other locations in the southern Indian Ocean.
- Development of the coastal protection measures as “visitor” destinations (tourists, scientists, the general public, students, etc.). Interpretive signs and small-scale models of coastal processes will be designed and installed at each site, explaining the science of climate change and coastal processes (in lay terms), so that the linkages between weather, stability of coastal features, and adaptation measures are clear.
- Design and delivery of general public awareness campaigns on climate change in the coastal zone, involving the Mauritian media (TV, radio, Internet).
- Development of a list of vulnerable sites and future coastal adaptation measures, with priority ranking established, for guiding the order of future investment by the Government of Mauritius and the private sector.

**B.** Describe how the project / programme provides economic, social and environmental benefits, with particular reference to the most vulnerable communities.

29. In examining the economic and social implications of “doing nothing” in the coastal zone (*not* addressing climate change impacts - the assumed baseline), the potential accumulated costs of allowing further attrition of coastal resources and livelihoods due to ongoing erosion, storm surges, and frequent tidal flooding (and at an increasing rate in the future) were determined and expressed in 2010 terms (see Table 1). This analysis serves several purposes:

- it allows comparison of the expected full cost of adaptation in the coastal zone with the future cumulative value of lost environmental services, jobs, infrastructure, and security and peace of mind (assuming no interventions), to justify the overall investment, to which the proposed programme makes the initial contribution (examined further in Section I); and,
- the corollary: it sharpens the focus on who exactly will benefit from climate change adaptation in the coastal zone and sets a monetary value to those benefits and beneficiaries over the next 50 years, which helps set priorities for interventions and determine the net return for the overall investment that the Government of Mauritius will make (over the next 10-20 years), which the programme will catalyze and subsequently facilitate (discussed immediately below).

30. Most of the proposed programme has direct application to coastal zone issues on the island of Mauritius (although eventual replication of technical interventions can be applied to all islands). The key process in this analysis is therefore determining who exactly is affected at

vulnerable coastal sites in on the island of Mauritius, what their relationship is to the coastal features and processes under threat, and then determining the value of what will be lost, from the perspective of those who are vulnerable (therefore the value of benefits, if climate resilience is developed and coastal vulnerability is reduced or eliminated). The analysis focuses on beach erosion, storm surges and tidal flooding, as the proposed programme will address these issues directly and provide social, economic, and environmental benefits accordingly. The key benefits are summarized in Table 1 and examined in further detail below (paragraphs 31 to 38, paragraph 54; key data in bold), with explanations of the assumptions and analytical process provided. As noted above, the analysis is based on data for the island of Mauritius, but with eventual replication of proven technical approaches throughout all the islands in ROM, the value of key benefits throughout all of ROM would be higher than amounts noted in Table 1.

Table 1. Summary of key benefits of the proposed programme.

Benefits	Programme (over 5 years)	Extrapolated to island of Mauritius (to 2060)*	'Do Nothing' Losses (Island of Mauritius, to 2060)*
Social Benefits	<p>Direct beneficiaries at coastal sites:                      Mon Choisy: 1,500-2,000 people involved in the beach tourism trade, including their dependents (job security and maintenance of current quality of life, as the beach is maintained).                      Riviere des Galets: 100-150 people (no risk from surge flooding; peace of mind, conducive to re-investment in the community; maintenance of current livelihoods).                      Quatre Soeurs: 1,000 people (refuge from frequent flooding; clear options for protection of coastal infrastructure).</p> <p>Private sector and general public compliance with recommended coastal adaptation measures, leading to protection of coastal assets.                      Security of all coastal communities (minimal risk of surge flooding due to the early warning system).</p> <p>Plans for coastal development, addressing climate change issues, will ensure safety and sustainability of communities in the future (starting within the timeframe of the programme), supported with new policies, regulations, and economic instruments.</p>	<p>For all vulnerable beach sites (with ongoing erosion, of which there are 21), more than 13,000 people who are employed in the beach tourism trade (including their dependents) will have security of jobs, maintenance of quality of life, and will be able to live in proximity to their jobs.</p> <p>Coastal communities throughout the island of Mauritius, currently vulnerable to storm surges (with an estimated total population of more than 3,400), will benefit from the security of the early warning system as well as the adaptation of infrastructure and coastal defenses to prevent flooding due to surges.</p>	<p>As sea level rises and storm surge frequency increases, there will be increasing vulnerability and a sense of insecurity in coastal areas throughout the island of Mauritius, which will lead to fear and anxiety during storms, loss of community cohesiveness, and a general decay in the social fabric of coastal communities.</p> <p>Deterioration of the beach tourism sector will lead to about 10% of the population being displaced and unemployed, or forced to integrate into other parts of the economy, assuming the alternatives are there and can absorb these people.</p>
Economic Benefits	<p>Mon Choisy: an investment of US\$ 2 million, will have a return of US\$ 128 million (in 2010 dollars), which is the accumulated beach tourism revenue over the next 50 years which can be attributed directly to the viability of Mon Choisy beach.</p> <p>Riviere des Galets: , an of US\$ 2.8 million is only 30% of the potential cost (US\$ 9.3 million) associated with moving the community to a safer location at a "green-field" site in a similar coastal area.</p> <p>Quatre Soeurs: an investment of</p>	<p>Replication of coastal adaptation measures developed in the programme to deal with beach erosion will sustain all vulnerable beaches (currently 23% of total number of beaches) and prevent a loss of US\$ 2.55 billion in tourism revenue over the next 50 years that is directly related to the viability of beaches.</p>	<p>With regard to economic losses, these are the corollary of the benefits noted to the left: if no action is taken, then the total cost to the island of Mauritius economy, which would have to be made by other sources of revenue, would be US\$ 3.362 billion over 50 years, which is a</p>

Benefits	Programme (over 5 years)	Extrapolated to island of Mauritius (to 2060)*	'Do Nothing' Losses (Island of Mauritius, to 2060)*
	<p>US\$ 0.8 million will create a community sanctuary from frequent flooding and demonstrate infrastructure alternatives to minimize flooding risk in the future (difficult, however, to monetize).</p> <p>All new coastal infrastructure and buildings in coastal areas (built within the timeframe of the programme) will have a much reduced risk of damage from surges and erosion, which will save considerable amounts of money which would otherwise go towards maintenance and repairs.</p>	<p>Reinforcement of coastal infrastructure and development of coastal defenses will save US\$ 0.5 billion in infrastructure repair costs over 50 years.</p> <p>If vulnerable coastal communities are shielded from storm surges, the total cost of re-establishing (moving) these communities (more than 3,400 people) - US\$ 312 million – can be avoided. If nothing were done, these vulnerable coastal communities and their associated livelihoods would diminish over time, with loss of economic productivity in coastal areas.</p> <p>All new coastal infrastructure and buildings developed over the next 50 years will have reduced maintenance and repair costs, as climate resilience will be an integral part of their design and location, saving significant amounts of money that can be re-directed to other parts of the Mauritian economy.</p>	<p>composite of loss of beach tourism revenue (\$2.55 billion), the cost of making repairs to coastal infrastructure and buildings (\$0.5 billion), and the cost of re-locating communities which are exposed to storm surges and frequent flooding (\$312 million).</p> <p>At the level of communities, economic losses include disruption of livelihoods, loss of income, loss of investment in vulnerable coastal areas, and loss of goods due to sea water contamination,</p>
Environmental Benefits	<p>With interventions proposed for Mon Choisy and Riviere des Galets, the failing reef systems will be replaced with submerged berms, which will help maintain the environmental integrity of the lagoons, beaches, and backshore.</p>	<p>Assuming a full replication of the protection measures for beach erosion, the ecosystem services currently provided by coral reefs (albeit with declining effectiveness), will be replaced with intra-</p>	<p>Without any interventions to replace the wave attenuation function of coral reefs, there will be an accelerated deterioration of the quality of lagoons, loss of biodiversity</p>

Benefits	Programme (over 5 years)	Extrapolated to island of Mauritius (to 2060)*	'Do Nothing' Losses (Island of Mauritius, to 2060)*
		lagoonal wave attenuation structures that will allow the lagoons, beaches, and backshore areas to stabilize in dynamic equilibrium with rising sea levels.	there, accelerated beach erosion, and development of barren backshore areas.

\*for the purpose of analysis, Mauritius in this case is just the island; all values expressed in 2010 prices.

31. The island of Mauritius has remained quite competitive globally in maintaining and growing the beach tourism sector (for example, the number of tourists arriving on the island of Mauritius in the first six months of 2010 was 6.2% higher than the same period in 2009, and tourism revenues were 8.5% higher<sup>16</sup>). The estimate for tourist arrivals for all of 2010 is 915,000 (compared to the peak of 930,456 in 2008), creating expected gross revenues of US\$ 1.286 billion (they were US\$ 1.397 billion in 2008), contributing about 10.4-11.6% to GDP. The estimated “leakage” of this revenue is 24% (this is money that goes offshore, to pay for imports to the island of Mauritius related to tourism supplies, such as food, beverages, etc.; retained foreign exchange is therefore 76%, meaning \$0.98 billion remains in the island of Mauritius economy<sup>17</sup>). There is a Government plan to boost tourism to 2 million arrivals per year over the next five years, although this will further crowd the beaches. Part of this strategy is to offset the decline in revenue from the sugar industry and the export processing zone.

32. In 2008, 28,753 Mauritians were employed directly in the tourism industry (in hotel, restaurant, travel, and tourism businesses with more than ten people). Correcting for the inclusion of other spinoff businesses, such as vendors, and also for businesses with less than ten employees, the total of number of people directly employed in tourism may be 50,000-60,000, or about 10% of the available labour force in 2008<sup>18</sup>. The average wage per person for this sector (average of the tertiary sector, or service sector overall) is US\$ 5,700/year, suggesting that tourism accounts for more than US\$ 300 million in local wages.

33. Thus, the value of sustained beaches on the island of Mauritius is in the order of US\$ 0.91 billion/year (in 2010 terms, assuming 92.5% of tourists are in the beach hotels), with up to 60,000 people directly employed (included in the retained revenues noted immediately above); furthermore, their dependents benefit, such that possibly 10% of the population of the island of Mauritius (about 120,000 people) has some fairly direct link to tourism. This figure (US\$ 0.91 billion/year) does not include possible increases in tourism in the future. We can now translate the observed and possible future vulnerability of the beaches on the island of Mauritius into a “cost of doing nothing”, which is essentially the baseline as of now, since physical works to date have *not* reduced beach erosion rates (due to inappropriate technical designs).

34. As noted in paragraph 11, 23% of the beaches on the island of Mauritius are at risk. It can be assumed that over the next 50 years half of these beaches will be lost to the point of not

<sup>16</sup> Mauritius Central Statistics Office. International Travel and Tourism – First Semester 2010.

<sup>17</sup> Page, S. 1999. Tourism and Development: The Evidence from Mauritius, South Africa, and Zimbabwe.

<sup>18</sup> Ibid, 1999, and CSO, 2009: Labour force, employment, and unemployment, based on the results of the continuous multipurpose household survey – year 2009; note the total population of Mauritius in December 2009 was 1.277 million.

supporting visitors, if there is no intervention (this is realistic, given some observed erosion rates of 1-2 metres per year at beaches which are only 10-15 metres wide, and more during storm events). Thus, 11% of the tourist draws on the island of Mauritius will be lost, progressively over time, as alternative sites for beach tourists do not present themselves. If we take the cumulative 50-year value of beach tourism (US\$ 45.5 billion, assuming no increase in tourist numbers from 2010, to be conservative), then the revenue loss per year will range from US\$ 2 million in 2011 to US\$ 100 million/year in 2060 (in 2010 terms), assuming a constant rate of beach erosion<sup>19</sup>. A more likely case is that the erosion rate will continue to accelerate, and the beach losses will occur sooner, rather than later, with the source of the beach sediments (the lagoonal sediments, which are quite shallow, uniquely so on the island of Mauritius) no longer providing a sink and buffer, as these sediments get pumped beyond the reef, and lost from the littoral system during increasingly intense storm events<sup>20</sup>.

35. With this scenario, the accumulated loss in beach tourism revenue over the next 50 years could be **US\$ 2.55 billion** (a conservative estimate in 2010 terms)<sup>21</sup>. Expressed in human terms, over **13,000 people** who have some direct or indirect connection to the beach tourism industry (assuming a constant 2010 employment scenario and the arguments noted above) would have no income, and would therefore become liabilities of the state, which would be a net cost, in addition to the lost revenues and the loss of taxes on those revenues. The programme, in designing and implementing effective measures to stop beach erosion (simulating the function of coral reefs with submerged wave attenuation structures), even with sea level rise and increasing storm incidence, will provide, initially, direct benefits to up to 2,000 people who have a work association with Mon Choisy. Furthermore, if the technical measures developed by the programme, supported with new policies and regulations, are eventually replicated throughout the island of Mauritius, there will be additional benefits (such as job security, proximity to livelihoods maintained, community cohesiveness, etc.) to over 13,000 people (and their dependents) who have a job vulnerability associated with climate change effects in the coastal zone. The programme will therefore help to protect substantial national revenues that bring benefits to all Mauritians (through reinvestment in infrastructure, jobs, and Government services).

36. In addition to the risk of physical loss of beaches, infrastructure that is immediately adjacent to the dynamic beach zone is at risk, and there is clear evidence of this risk in some areas, with seawalls collapsing and erosion of roadbeds, especially after storms. The maintenance of beaches is critically important as a first line of defense for coastal infrastructure, and the interventions in the proposed programme will demonstrate the most effective approaches in this regard. In addition, all future design and construction of coastal infrastructure in ROM will be informed by the guidelines developed in the programme, which will help reduce or eliminate future infrastructure losses in the coastal zone. For example, assessment of the potential cost of repairs to coastal roads on the island of Mauritius damaged by wave incidence and erosion during a 4-metre wave run-up storm indicates US\$ 20 million<sup>22</sup> could be saved during each storm, if present coastal infrastructure were protected and if all future coastal infrastructure were properly designed and located for climate resilience (using the guidelines to be developed in the programme). Assuming one such storm every two years over the next 50 years (based on

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<sup>19</sup> Assuming a constant erosion rate, that leads to a loss of half of the 21 vulnerable beaches by 2060, with the total revenue loss due to the absence of these beaches being US\$100 million/year (11% of the US\$ 0.91 billion/year that derives from beach tourism revenue), then Year 1 revenue loss due to beach erosion is US\$ 2 million, Year 2 loss is US\$ 4 million, etc. up to Year 50 at US\$ 100 million.

<sup>20</sup> W.F. Baird and Associates Coastal Engineers. 2003. Study on Coastal Erosion in Mauritius. For Ministry of Environment.

<sup>21</sup> This is the accumulated total expressed in Footnote 17: i.e., US\$ 2 million + US\$ 4 million + Year 3 to Year 50 = US\$ 2.55 billion.

<sup>22</sup> Unpublished data in the draft Second National Communication.

current MMS data), then **US\$ 0.5 billion** in infrastructure repair costs (again assuming 2010 constant costs and constant risk over 50 years) could be precluded with appropriate climate resilient coastal infrastructure. This is a benefit to all Mauritians, who use the coastal infrastructure, and allows re-direction of these funds to investments and services with a higher return.

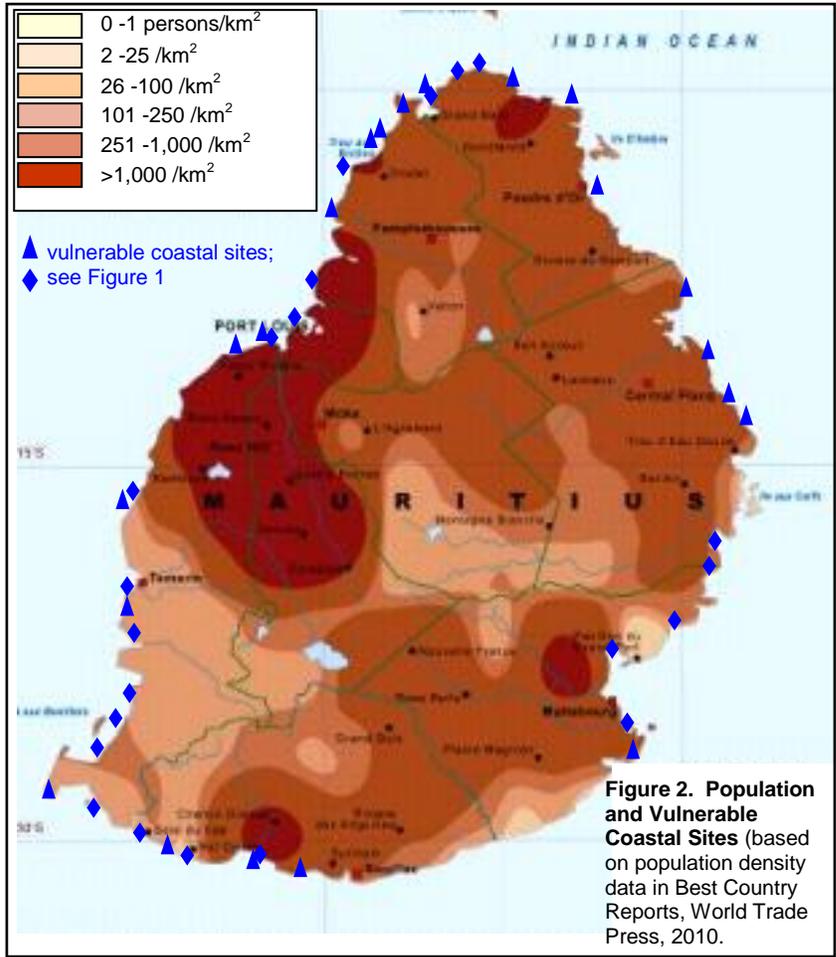
37. Figure 2 shows the relationship between the location of vulnerable coastal sites and the population on the island of Mauritius. This map is used to determine how many people are currently at risk from storm surges and tidal flooding. The surge risk modeling for Baie du Tombeau<sup>23</sup> and the surge event in May 2007 in Riviere des Galets<sup>24</sup> were used to determine a typical surge-flooded area for a sustained one-metre surge in areas that are vulnerable (assumed to be, on average, 0.25 km<sup>2</sup> at each surge-prone site). When overlain with the population density data, and assuming standard building occupancy patterns, it can be assumed that over **3,400 people** in about 1,100 buildings (houses, businesses, public buildings) are currently at risk from storm surges (this number will increase over time, due to natural population growth). These people have suffered (and will possibly again in the future) the consequences of surge flooding, including: loss of goods due to seawater contamination; fear and anxiety during storms; inhibition of investment in local communities; disruption of livelihoods; damage to buildings; and potential risk of loss of life. For these people, the alternatives include relocation, which is both expensive and logistically challenging<sup>25</sup>, or developing the necessary coastal protection structures, which together with the early warning system, would allow these communities to continue to live in proximity to their livelihoods, with a sense of security.

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<sup>23</sup> Unpublished data in the draft Second National Communication.

<sup>24</sup> Ministry of Environment and National Development Unit. Coastal Protection Works at Riviere des Galets. 2009.

<sup>25</sup> With a current coastal property value of US\$ 0.5 million/acre<sup>25</sup> (equivalent to 0.4 hectares); a building-to-land ratio of 20%; an average of 4.7 people per house; 50% additional number of buildings evident in businesses and public buildings; an average house area of 130 square metres<sup>25</sup>; construction costs of US\$ 700/m<sup>2</sup>; 40% additional for road, infrastructure, and service connections (assuming "green-field" development); and, 10% for transaction and transportation costs (all these figures being conservative, for a robust estimate), then the total cost of re-establishing all people who are vulnerable, in 2010, to storm surges is US\$ 312 million (assuming practical alternative coastal sites could be found and developed).



38. Assuming full replication of coastal adaptation measures over the next 10-20 years in the island of Mauritius, the total of revenue, jobs, and maintenance/repair costs saved over 50 years, and the avoidance of expensive alternatives (such as moving whole communities), in 2010 terms is **US\$ 3.362 billion**. Note that these relate only to coastal erosion and flooding from surges and tides; the programme does not address changes in coastal fisheries or freshwater availability in coastal areas. The US\$ 3.362 billion can be seen as the cost of doing nothing (the baseline) in the island of Mauritius. As long as the eventual total cost of full replication of coastal adaptation measures is less than this, then investment in climate resilience in the coastal zone on the island of Mauritius (and, in addition, the other islands) can be seen as an *effective* investment, with a sound return and extensive social benefits (this is examined further in Section C and I below).

C. Describe or provide an analysis of the cost-effectiveness of the proposed project / programme.

39. The main principle of the programme is develop practical experience with coastal adaptation measures to ensure that all vulnerable coastal sites and communities in ROM (all islands) can be made climate resilient over the next 10-20 years. The proposed programme is considered as a **key catalytic investment**, to set the course of action in the right direction. There is substantial physical evidence that neglect of coastal vulnerabilities in the past and the

*ad hoc* responses to site-specific problems have made matters worse: erosion rates have in fact accelerated at beaches which have received some attention (therefore, a waste of Government and private funds), and storm surge and erosion risks to coastal infrastructure have increased. The main concern is this apparent (and measured) increased rate of coastal degradation and the clear linkages between it and sea level rise, increased frequency of storm surges, and declining reef function; an alarming situation that needs attention. So, the question is whether or not the proposed programme is addressing this problem correctly and in a cost-effective manner.

40. The proposed programme budget will support the acquisition of the best technical expertise to help implement, with the full involvement of coastal stakeholders, coastal protection measures and supporting capacity development that will guide all future coastal adaptation in ROM. All Government staff involvement in the programme will be an “in-kind” contribution. The budget will support the design and construction of a range of coastal protection measures at three vulnerable coastal sites, so that there will be direct beneficiaries, with full climate resilience, by the end of the programme. The programme budget will also support development of the enabling environment i.e.: i) early warning system for incoming storm surge that will provide an immediate social benefit in reducing risk caused by storm events; ii) policy, fiscal and regulatory development, and iii) stakeholder training to promote compliance with climate-proofed planning, design, and location guidelines. Furthermore, the budget will support the dissemination and management of lessons learned from the programme, so that all Mauritians have a better understanding of climate change issues in the coastal zone and guidance on what practical solutions will suit each specific site. This three-pillar approach (implementation of coastal protection measures; development of the enabling environment and public awareness) is essential to the full replication of coastal adaptation measures at all coastal sites in ROM in the future. *Not* addressing any one of the pillars would reduce the effectiveness of the whole programme investment. The programme structure, with approximately 82% on technical solutions; 11% on enabling environment and 7% on public awareness-raising is believed to be the most effective and balanced way of realigning and initiating the coastal adaptation process in ROM, with a priority given to actual interventions that reduce coastal vulnerability.

41. For development of the enabling environment (early warning, policy mainstreaming, training), and information dissemination and management, there are no reasonable alternatives to the approaches suggested in the programme, as the programme is designed to address *all* Government instruments that will have some relationship to coastal adaptation and will target the full range of coastal stakeholders and potential vulnerabilities. There are therefore no gaps in the reach of the programme, which will ensure that all the necessary approaches and tools are in place for full replication of adaptation measures to all vulnerable coastal sites in ROM. The combined expenditures for these components are about 18% of the total programme budget.

42. Most of the programme budget (82%) will go to implementation of the coastal protection measures. The cost effectiveness figures are summarised in Table 2 and discussed in more detail in paragraphs 43-50.

Table 2. Cost effectiveness of the proposed coastal protection measures.

Project Site	Project Cost (US\$)	Number of Beneficiaries	Losses Averted/ Benefits Generated	Alternatives to Project Approach and Cost (US\$)
Mon Choisy	2,000,000	Up to 2,000	<p>1,500-2,000 people involved in the beach tourism trade, including their dependents will have job security and maintenance of current quality of life, as the beach is maintained.</p> <p>A project investment of US\$ 2 million, will have a return of US\$ 128 million (in 2010 dollars), which is the accumulated beach tourism revenue over the next 50 years which can be attributed directly to the viability of Mon Choisy beach.</p> <p>The failing reef systems will be replaced with submerged berms, which will help maintain the environmental integrity of the lagoons, beaches, and backshore.</p>	<p>The only way the beach can be sustained is to replicate the wave attenuation function of the reef (which is failing). Rehabilitation of coral reefs is extremely challenging, since traditional methods, such as coral transplants and artificial reefs, are such small interventions in a coral reef system that is under pervasive pressure. Any new coral patches or rehabilitated areas would still be under the same pressures as the whole reef system, including rising sea level (accelerating), increased storm frequency, and bleaching events.</p> <p>Stop-gap measures, such as depositing sand on the beach (only to be lost during the first storm or strong spring tide) are a total waste of money, and at some point the dynamic beach zone is pushed into the backshore and coastal infrastructure, in any case. Other approaches are usually equally ineffective. A particular concern is that private landowners and hotels undertake their own remedial measures (usually trying to save a beach, for example,</p>

Project Site	Project Cost (US\$)	Number of Beneficiaries	Losses Averted/ Benefits Generated	Alternatives to Project Approach and Cost (US\$)
				<p>using groynes or seawalls) that are poorly informed, leading to adjacent beach loss, and eventually a total loss of the investment.</p> <p>The option of “doing nothing” has the cost of US\$ 128 million noted to the left.</p>
Riviere des Galets	2,800,000	100-150	<p>100-150 people will have no risk from surge flooding, as well as peace of mind, conducive to re-investment in the community, and maintenance of current livelihoods.</p> <p>A project investment of US\$ 2.8 million is only 30% of the potential cost (US\$ 9.3 million) associated with moving the community to a safer location at a “green-field” site in a similar coastal area.</p> <p>The failing reef systems will be replaced with submerged berms, which will help maintain the environmental integrity of the lagoons, beaches, and backshore.</p>	<p>The alternative to the proposed approach is to do nothing, in which case the viability of Riviere des Galets will quickly diminish, with community structure and cohesion lost as people leave or die. The Government actually will not accept “neglect” as an option, since this community has already suffered the trauma of a severe storm surge.</p> <p>Another alternative is to relocate the community, which has a cost of US\$ 9.3 million, as noted to the left.</p>
Quatre Soeurs	800,000	approx 1,000	<p>Up to 1,000 people will have a refuge from frequent flooding, and will become familiar with clear options for protection of coastal infrastructure.</p> <p>A project investment of US\$ 0.8 million will create a community sanctuary from frequent flooding and demonstrate infrastructure alternatives to minimize flooding risk</p>	<p>The Quatre Soeurs project is intended to provide an adaptation response for coastal infrastructure and buildings in an area that is very vulnerable at the moment. “Doing nothing” means the community will increasingly suffer the misery of frequent flooding, loss of goods, and damage to buildings, which will</p>

Project Site	Project Cost (US\$)	Number of Beneficiaries	Losses Averted/ Benefits Generated	Alternatives to Project Approach and Cost (US\$)
			in the future.	<p>eventually force the migration of people to other locations, such as Port Louis, with possible social consequences (unemployment, community conflicts, increasing risk of crime, etc.). These “costs” are difficult to monetize, but like the case above, the Government is proactive on maintaining cohesive communities, and does not accept “neglect” as an option.</p> <p>Moving the community is an option, but even more expensive than the case for Riviere des Galets, given the larger population (therefore, more than US\$ 9.3 million).</p>

*Coastal protection measures: Proposed Actions and Alternatives:*

*Mon Choisy*

43. For Mon Choisy, one of the five top beach destinations on the island of Mauritius, which is losing about 1-2 metres of beach width per year due to failure of reef function and increasing sea levels, replenishing the beach sand (a common strategy on the island of Mauritius) is a “band-aid” that is more cosmetic than anything else, and ultimately a waste of money. Building seawalls and revetments to protect the foreshore (the area behind the beach) is also ineffective, as these hard structures in the dynamic beach zone actually accelerate the loss of beach sediments from the littoral system (therefore, also a waste of money and in fact accelerating the problem). Mon Choisy is therefore at risk of disappearing over the next 10-15 years (it is a quite narrow beach), and the adjacent coastal road and buildings will then follow.

44. The only viable technical solution at this site is construction of offshore submerged detached wave attenuation structures (rock mounds) that simulate the reef function and allow retention of sand and eventual beach replenishment by natural means: this is the approach to be implemented in the technical project. With this approach, cost effectiveness can be determined. If it is assumed that Mon Choisy is 1/21 (about 5%) of the beach assets at risk (in fact, given its importance to visitors, it is probably more than this), then solving the beach erosion problem here, investing US\$ 2 million, will have a return of US\$ 128 million (in 2010

dollars),<sup>26</sup> which is the accumulated beach tourism revenue over the next 50 years which can be attributed directly to the viability of Mon Choisy, otherwise lost if there is no suitable technical intervention. The proposed approach for Mon Choisy therefore appears to be cost-effective, and will furthermore have additional value in replication at other similar sites.

#### *Riviere des Galets*

45. In Riviere des Galets, approximately 100-150 people in 40 houses are at risk of flooding from storm surges. The Government has already invested several million dollars over the years in building seawalls and a wave overtopping wall at this extremely vulnerable site (open to swells from the whole of the southern Indian Ocean), but the fact is that these will not be effective and are already being undercut by very high wave energy which prevails at the site (therefore, a further waste of money). An alternative is to move the whole community, but this is both impractical (lack of alternative sites nearby) and expensive: the cost for “green-field” development for people in Riviere des Galets could be US\$ 9.3 million<sup>27</sup>.

46. Therefore, the approach proposed in this programme is to invest US\$ 2.8 million (only 30% of the potential cost of moving the community) in a combination of offshore wave deflection, improved wave over-topping wall, redesigned seawall with appropriate slope, and a proper drainage system for the village. This appears to be the most cost-effective way to solve the coastal vulnerability problems at Riviere des Galets in a sustained manner (and the community will also benefit from the proposed early warning system).

#### *Quatre Soeurs*

47. Quatre Soeurs is a slightly different case from Mon Choisy and Riviere des Galets. This community suffers frequently from flooding due to high tides and storm surges, which is an inconvenience and a serious disruption of the community. Nevertheless, the community would benefit from re-construction of the community centre (which currently floods), with the building elevated on stilts and further protected with replantation of mangroves (Quatre Soeurs is a mangrove area, but there are few mangrove trees in the adjacent lagoon, so the full potential of wave attenuation induced by mangrove tree clusters is not being realized). The new building will provide a refuge for the whole community during storms and spring tides, and will also demonstrate an infrastructure alternative for coastal areas that is not restricted by the new setback rule (30 metres). The setback is intended to protect buildings and coastal habitats, but is also likely to preclude any development in many coastal areas, as many sites are already saturated – there is no room for new buildings that can meet the 30-metre setback. There is already a 5% deviance rate (new buildings that do not meet the setback rule), so reasonable alternatives that allow safe encroachment over rocky shores and muddy lagoons (not beaches) warrant some attention. As noted previously, the involvement of Quatre Soeurs in the proposed programme needs to be confirmed with Local Government.

48. The only alternatives for Quatre Soeurs include “doing nothing”, which will eventually lead to attrition of the community as people move away, as the frequency of flooding increases in the future, or moving the community, which is a very expensive option (given the larger population, more expensive than the US\$ 9.3 million that would be required to move the Riviere des Galets community). Given these alternatives, which are either neglectful or expensive, the proposed

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<sup>26</sup> See Section B above, and footnote 17; Mon Choisy, equivalent to 5% of the vulnerable beach assets, represents 5% of the accumulated beach tourism revenues – US\$ 2.55 billion – that can be maintained, if beach erosion is arrested.

<sup>27</sup> This assumes that 40 houses would need to be built, requiring 2.6 hectares of land at US\$ 3.25 million (current coastal property value of US\$ 0.5 million/acre<sup>27</sup> (equivalent to 0.4 hectares), which accommodates the required building-to-land ratio of 20%, and an average house area of 130 square metres). With construction costs of US\$ 700/m<sup>2</sup>, the total construction cost would be US\$ 3.64 million; then an additional 40% for road, infrastructure, and service connections (assuming “green-field” development); and, 10% for transaction and transportation costs, the total cost of relocating the Riviere des Galets community would be US\$ 9.3 million.

investment for Quatre Soeurs (US\$ 0.8 million) is being set up as a demonstration of building options in the coastal zone; fully monetized cost-benefit analysis is difficult for this site, but if the approaches demonstrated at Quatre Soeurs are replicated in and adjacent to the community, the investment should be cost-effective in keeping the community secure and cohesive, and the community will have a refuge during flood events.

49. To further illustrate the catalytic effect of the proposed programme, calculations were made to determine the total costs of adaptation in the coastal zone on the island of Mauritius (an investment that the Government of Mauritius and the private sector should make over the next 10-20 years, to achieve climate resilience in the coastal zone that is effective to at least 2060<sup>28</sup>), to ascertain the leveraging value of this programme and the return for the full required investment in coastal adaptation.

50. The total cost of adaptation (in 2010 dollars) to address incremental effects of climate change in the coastal zone on the island of Mauritius expected over the next 50 years (due only to sea level rise and increasing frequency and intensity of storms) is estimated to be US\$ 775 million, or about 23% of the cost of doing nothing (the baseline), which is US\$ 3.362 billion. This investment would need to be made over the next 10-20 years to properly arrest degradation in the coastal zone (see footnote 26). The proposed programme budget is US\$ 8.4 million, or about 1% of the total cost of coastal adaptation on the island of Mauritius; therefore considered to be a catalytic investment, which will ensure that all future replication of coastal adaptation measures on the island of Mauritius will bring the full return estimated above (and if replicated on the other islands, additional benefits would accrue). The estimates have been derived as follows:

#### *Beach Erosion*

51. At some point in the next 50 years all beaches on the island of Mauritius may undergo accelerated erosion due to rising sea levels, increasing storm frequency and intensity, and failing reef function<sup>29</sup>, then approximately 20 kilometres of alternative wave attenuation structures will be required to deal with this problem (addressing about 27 km of beach length; assuming that the total length of a wave attenuation device would be about 75% that of the eroding beach that it is expected to protect, which is a coastal engineering norm). Using the Ministry estimate of US\$ 3.4 million per 100 metres of wavebreaker (located in the nearshore)<sup>30</sup>, the total cost of constructing this alternative to a failing reef system would be about US\$ 680 million (in 2010 dollars). In addition to these structures, there would have to be investments in suitable beach crest vegetation, which might require an additional US\$ 20 million.

52. The total cost of adaptation measures to protect the beaches on the island of Mauritius would therefore be about US\$ 700 million over 10-20 years (although ongoing annual maintenance of beaches would then perhaps be less expensive than at present, so there is a net savings in that regard), but bringing a return of US\$ 2.55 billion over 50 years (see Part II, Section B, paragraphs 34-36 – this is lost beach tourism revenue if the baseline (doing nothing, or doing the wrong thing) were to persist; the return might be even higher, as the full cost of adaptation assumes that all beaches in Mauritius may be at risk at some point in the next 50

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<sup>28</sup> Note that all valuations of future costs and benefits are based on the next 50 years – to 2060, but it is expected that the required investments will be (should be) made in the next 10-20 years, which is a reasonable timeframe and pacing for the Government of Mauritius and the private sector to fully replicate climate resilient approaches throughout Mauritius.

<sup>29</sup> At the moment, 23% of the beaches on the island of Mauritius are eroding; it can be expected that *all* beaches will face an increasing erosion risk as sea level rises, possibly in an accelerating manner, and storm frequency increases – this is the conservative assumption used here.

<sup>30</sup> Unpublished data in the draft Second National Communication.

years, so all beach tourism revenue could be at risk, not just the 11% calculated conservatively in Part II, Section B, paragraph 36.

*Coastal Infrastructure (such as roads and buildings)*

53. Preventative works (roadbed reinforcement, sloped revetments, raising roadbeds in flood-prone areas, cross-drainage, retrofitting public buildings on stilts, as well as addressing protection measures for coastal communities which are vulnerable to surges, such as Riviere des Galets) undertaken over the next 10-20 years could cost US\$ 75 million (based on rough estimates of lengths of vulnerable roads and number of public buildings at risk, and the unit costs for road work and building construction noted in this document and the draft Second National Communication). On the other hand, the ongoing cost of repair of infrastructure damage due to storms and erosion over 50 years was estimated in Part I, Section B, paragraph 36 at **US\$ 0.5 billion**.

54. The total cost of relocating people from surge-prone areas to safe areas, but still in reasonable proximity to the coast where they will continue to undertake their livelihoods (an ultimate solution that does not require any interventions at the affected sites) can be estimated, serving as a “proxy”, or a replacement, for the value of a safe coastal location. Using Mauritius-specific land, construction, and transaction costs (a current coastal property value of US\$ 0.5 million/acre<sup>31</sup> (equivalent to 0.4 hectares); a building-to-land ratio of 20%; an average of 4.7 people per house; 50% additional number of buildings evident in businesses and public buildings; an average house area of 130 square metres<sup>32</sup>; construction costs of US\$ 700/m<sup>2</sup>; 40% additional for road, infrastructure, and service connections (assuming “green-field” development); and, 10% for transaction and transportation costs - all these figures being conservative, for a robust estimate), then the total cost of re-establishing all people who are vulnerable, in 2010, to storm surges is **US\$ 312 million** (assuming practical alternative coastal sites could be found and developed)<sup>33</sup>. With the benefit of precluded repair costs for damaged infrastructure (paragraph 53) and the benefit of avoiding the relocation of vulnerable coastal communities (immediately above), the adaptation investment for climate-resilient coastal infrastructure (US\$ 75 million) could have an accumulated return of about US\$ 0.8 billion over the next 50 years.

**D.** Describe how the project / programme is consistent with national or sub-national sustainable development strategies, including, where appropriate, national or sub-national development plans, poverty reduction strategies, national communications, or national adaptation programs of action, or other relevant instruments, where they exist.

55. ROM completed its First National Communication in 1999 and is currently completing the draft Second National Communication. The proposed programme is completely consistent with the priority given by the Government and stakeholders, in both documents, to adaptation measures in the coastal zone, recognizing the dependence of the Mauritian economy on beaches, the reefs, and the resources in the lagoons. Sea level rise, and the increasing risk of storm surges, are given due attention in all climate change documents in ROM.

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<sup>31</sup> Based on review of current coastal properties for sale on the island of Mauritius.

<sup>32</sup> CSO, Construction Price Index, 2008.

<sup>33</sup> This assumes that, if communities were to be moved, that would happen over the next 10-20 years, with costs expressed in 2010 terms.

56. The proposed programme addresses the gaps in policies, capacity, and lack of understanding of practical technical options that are frequently referred to in a series of documents, including:

- the National Environmental Action Plan (NEAP 1, 1988 and NEAP 2, 1999), which underscores the importance of proper planning and development in the coastal zone;
- the National Development Strategy (2003) which establishes the commitment toward sustainable coastal land use and development, including mitigating the impacts of climate change and addressing coastal erosion; and,
- the Environmental Protection Act (2002), which emphasizes the need for environmental impact assessment (including strategic environmental assessment for new policies or development plans), but also implicitly recognizes the lack of technical capacity for both undertaking and reviewing EIAs.

57. The programme also recognizes the challenges inherent in the National Tourism Development Plan, which, as mentioned previously, aims to double the number of tourist arrivals by 2015. With a primary focus on beach tourism, and recognizing the commitment to sustainable coastal land use (the National Development Strategy) and the increasing risks identified in the National Communications, the proposed programme will work at the crux of the matter: how to accommodate an increase in beach tourism in the face of increasing rates of coastal degradation caused by climate change, the two dynamics working in opposition. Saving the beaches and ensuring that future infrastructure development in coastal areas is climate resilient, the main outcomes of the proposed programme, will achieve the balance between future development, management of climate variability, and maintaining the integrity of the coastal zone in ROM.

58. The National Environmental Action Plans, and the Integrated Coastal Zone Management Unit in the Ministry of Environment and Sustainable Development, which has been established to respond to environmental issues in coastal areas, also emphasize the need to maintain water quality in the lagoons (which currently suffer from agricultural run-off, leachate from septic tanks, and untreated sewage, in some cases). Poor water quality in the lagoons is one of several factors which reduce the viability of the reefs, which are critical for development and maintenance of the beaches. The programme will focus specifically on replacing the reef function in areas where beaches are eroding, not on wastewater management *per se*, as this issue is not directly tied to climate change<sup>34</sup>. The integrity of the wave attenuation structures will not be dependent at all on water quality; they will be constructed under the assumption that coral reef function will continue to degrade (or at least will not improve in the foreseeable future). Regardless of this, wastewater management in ROM is absolutely critical, and should be addressed through existing regulatory measures and improvement in the effectiveness of the

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<sup>34</sup> The focus of the present proposal has been purposely laid on coastal zone management without integrating the wastewater management component, so as not to overlap with ongoing programmes. The Republic of Mauritius aims at 50 % connection of the Mauritian population to sewer networks by 2015, with a target of 80 % connection by 2030. RoM has thus been implementing its First Sewage Master Plan, with several projects having either been already implemented or heading towards completion; e.g. the Grand Baie Sewage Plan, St. Martin Sewage Plan, Montagne Jacquot Treatment Plan, and the Plaine Wilhems Sewage Project. A Second Sewage Master Plan is currently under preparation, with tenders having already been launched for the recruitment of consultancy firms.

Environmental Police. There is a risk that, even if all beaches can be saved through appropriate adaptation measures, poor water quality in the lagoons will keep the beach tourists away.

59. The proposed programme is completely convergent with the UNDP Country Programme (2009-2011). The Country Programme is anchored in the ROM Ten-Year National Economic Reform Programme, with a focus on capacity development in four strategic national initiatives, including the Empowerment Programme (EP), the “Zone d’ Education Prioritaire (ZEP), Programme-Based Budgeting (PBB) and sector strategies, and environmental protection, energy, and management of natural resources. The proposed adaptation programme is obviously aligned with the latter strategic initiative. In addition, the proposed programme is in line with UNDP’s Strategic Plan (2008-2011), as it promotes inclusive growth, gender equality, and MDG achievement, as well as addressing environment and sustainable development. In implementing the Country Programme, UNDP seeks to develop national capacities through policy advice, advocacy, and technical support for implementation, which is consistent with the intent and structure of the various programme components.

E. Describe how the project / programme meets relevant national technical standards, where applicable.

60. For the coastal protection measures at the three proposed sites, various national technical standards apply, with which the project will be compliant. These include the following:

- an EIA license, which will involve specification of the technical projects, baseline studies, public consultation, and completion of the EIA process, for ultimate approval by the Ministry of Environment and Sustainable Development (this has already been accommodated in the project timeframe and required technical work);
- a Beach Authority Clearance, as all hard structures to be constructed under the project will be located along the crest of the dynamic beach zone, or offshore; they therefore fall under the jurisdiction of the Beach Authority (responsible for the beach and all areas out to 100 metres); the Beach Authority has been fully involved in consultations and proposal development, and welcomes any technical approaches that will protect the beaches;
- District Council Clearance; required for structures to be built within specific District jurisdiction; the District Councils for Mon Choisy and Riviere des Galets have been involved in proposal development from the beginning; the District Council for Quatre Soeurs will review the concept for that area, which has been proposed as an example of climate resilient coastal buildings;
- A letter of no-objection from the Ministry of Housing and Lands (which is already informed of the proposed sites for the coastal protection measures, and has indicated informal approval);
- clearance from Ministry of Fisheries and Rodrigues (similarly, the Ministry of Fisheries and Rodrigues has reviewed the details of the proposed coastal protection measures and does not have objections);
- a Building Permit; required for the retrofitting of any buildings at Quatre Soeurs;

- a letter of no-objection from the Ministry of Public Infrastructure, Land Transport and Shipping and National Development Unit (this ministry has also been fully involved in consultations and proposal development and is supportive of the technical concepts).

61. In addition to formal approvals and required compliance with technical standards noted above, the proposed reconstruction of the community centre in Quatre Soeurs will require a variance from the set-back rule (in fact, the whole point of the innovation). All other hard structures at the three technical project sites will be considered as protective works and will undergo a coastal engineering screening to minimize risk of erosion or other secondary effects in adjacent areas. This screening will be undertaken by the proponents and the ICZM Division in the Ministry of Environment and Sustainable Development, and competent coastal engineers (provided for in the programme budget). Mauritian engineering standards will apply to the design, construction, and monitoring of the proposed structures at Mon Choisy, Riviere des Galets, and Quatre Soeurs, and there will be full consultation with stakeholders and beneficiaries at each site, so that the communities understand the concepts and can give their full endorsement to them.

**F. Describe if there is duplication of project / programme with other funding sources, if any.**

62. There are three projects underway which have some bearing on climate change management in coastal areas in ROM. The themes and timeframes of these projects are described below, to indicate how synergies might be developed (some of these projects providing a platform for activities indicated in the proposed programme) and how duplication can be avoided.

63. The first project, “Maurice, Ile Durable” (MID, Programme for a Sustainable Mauritius: 2009 - 2012) is funded by the Agence Française de Développement (AFD), UNDP, and the Government of Mauritius. The main theme of the project is to reduce ROM’s dependence on fossil fuels, with a focus therefore on the energy sector. MID will promote adaptation as a deliberate process to guide policy to ensure sustainable development, reduce vulnerability, and minimise risk to humans from climate change. Given the thematic focus (mitigation), the lack of specificity on coastal areas, and the mention of adaptation in an over-arching manner (and the fact that the project is just starting), there should be minimal overlap with the proposed programme, and in fact plenty of time to ensure that synergies can be found.

64. The second initiative that is relevant is the US\$ 3 million “Africa Adaptation Programme - AAP”, a regional programme supported by UNDP and funded by Japan, in which ROM is a participant. The AAP has a challenging agenda, is only just getting underway, and is expected to be completed by the end of 2011 (as the proposed programme is just getting up and running). The AAP is designed to: introduce dynamic, long-term planning mechanisms to manage the inherent uncertainties of climate change; build leadership capacities and institutional frameworks to manage climate change risks and opportunities in an integrated manner at the local and national levels; implement climate-resilient policies and measures in priority sectors; examine financing options to meet national adaptation costs at the local, national, sub-regional and regional levels; and, knowledge sharing so that national development processes can be adjusted to fully incorporate climate change risks and opportunities. Clearly, there is thematic overlap, but it is important to note that the AAP does not focus on the coastal zone (with two small exceptions, discussed below) and is very much concentrated on training and capacity building, rather than design and implementation of specific adaptation measures. As noted previously, AAP will be completed just as the proposed programme is getting established. Two outputs from AAP, directly related to coastal adaptation, can be incorporated into the proposed

programme, to accelerate programme activities. These include generation of a detailed coastal flooding risk map, which can be used in Activity 1.1 in the proposed programme, and development of several cost-benefit analyses, which can be used to inform the development of the cost-benefit analysis course in Activity 4.3 in the proposed programme. As noted previously, the AAP will take a higher-level view of climate change adaptation (without a specific focus on the coastal zone) and will run for a fairly short period. This will create a *general* awareness of adaptation concepts within Government agencies, which can then be exploited, expanded, and given a sharper focus during the five years of the proposed programme. All areas of convergence between the AAP and the proposed programme are noted in the Results Framework in Part III, Section D.

65. The third initiative that is relevant is the “Project to Reinforce the Capacity of Members of the Indian Ocean Commission (IOC) to Adapt to Climate Change”, a 3-year €3,645,000 regional project that started in 2009, involving Comoros, Madagascar, La Réunion, ROM, and the Maldives. The focus of the project is establishing regional cooperation between member states of the IOC to better facilitate adaptation to climate change. With a focus on regional capacity (including delivery of formal and informal courses), the project is concerned with developing regional climate change models (the Indian Ocean has not yet been addressed by IPCC), so that there is a better understanding of the regional impacts of climate change, better capacity to identify the vulnerabilities in the participating countries, and development of a regional strategy on adaptation to climate change. Note that the project, in maintaining a regional overview, does not give a specific sharp focus to the coastal zone, and concentrates more on the drivers of climate change than on the specific measures that might apply in the coastal zone in ROM. It can therefore be seen to set the stage for understanding climate change; the proposed programme can then benefit from this more detailed understanding in setting the most appropriate adaptive measures in the coastal zone.

**G.** If applicable, describe the learning and knowledge management component to capture and disseminate lessons learned.

66. Learning and knowledge management is recognized as an important component of the programme, reflecting one of the key themes of the Adaptation Fund. Seven percent of the programme budget is directed to this outcome, and all other programme components related to policy mainstreaming, the monitoring system, and the coastal protection measures are designed to produce results that will go into the materials required for subsequent capacity-development and public awareness-raising. The outputs in the knowledge management component of the programme (#5) are as follows:

- Handbook, training modules, and website content capturing best coastal adaptation practices for the Mauritius context.
- Comparative assessment of the cost effectiveness of infrastructure and ecosystem-based adaptation approaches.
- Comparative assessment of coastal zone adaptation measures in the southern Indian Ocean, with potential application in ROM, through dissemination of lessons learned from the programme and examination of experiences in other countries.
- Interpretive signs and small-scale models of coastal processes designed and installed at each site, explaining the science of climate change and coastal processes (in lay terms), so

that the linkages between weather, stability of coastal features, and adaptation measures are clear.

- Public awareness campaigns on climate change in the coastal zone designed and delivered, involving the Mauritian media (TV, radio, Internet).
- Priority ranking of vulnerable coastal sites established, to guide the order of future investment by the Government of Mauritius and the private sector.

67. In addition to the programme-specific knowledge management activities, the Government of Mauritius and UNDP will take advantage of various sponsored networks to disseminate programme results and to increase awareness of what the programme is addressing and how it is doing that. This will include the “Adaptation Learning Mechanism (ALM)” and “wikiADAPT”, with a focus on documenting the following:

- assessment of the costs and benefits of adaptation;
- the value of ecosystem services and ecosystem-based options for adaptation;
- best practices in integrating adaptation into national and local development policy, and programme design and implementation mechanisms;
- lessons learned with regard to removing the most common barriers to adaptation, with special attention to the roles of local partners, Government, international partners, and UN agencies and International Financing Institutions (IFIs);
- the conditions for success, and failure factors, with regard to replication and scaling up;
- exploring the catalytic role of public policy (fiscal and regulatory) and possible leverage in financing.

68. Annual programme monitoring visits and quarterly and annual reporting will ensure that lessons can be captured as they are generated, both to refine programme design and direction, as required, and to feed into the broader mechanisms referred to above. All monitoring information and any reflections on the programme will be shared with stakeholders, so that a common understanding of appropriate project design, implementation measures, and necessary flexibility is developed, which will help enormously in designing the required replications of the coastal adaptation measures throughout ROM (and elsewhere, hopefully).

**H. Describe the consultative process, including the list of stakeholders consulted, undertaken during project preparation.**

69. During the development of original concept (the first draft proposal submitted to the Adaptation Fund Board in April 2010), all major Government stakeholders were consulted and consensus was developed with regard to the main theme of the programme and its structure, as well the approximate budget weighting for the different components. For development of the full proposal, the stakeholder consultation process (in September 2010) was more formally designed, and coordinated by the Ministry of Environment and Sustainable Development, with

three workshops/briefings, and opportunities provided for additional bilateral meetings and field visits. This process was managed by the Ministry of Environment and Sustainable Development (Climate Change Division) and involved:

- First Working Group Briefing: review of the programme structure, the comments from the Adaptation Fund technical review of the concept, and discussion of information gaps and site selection criteria for the proposed project sites.
- One-on-one meetings with all stakeholders, to facilitate additional data collection and verification of programme priorities.
- Brainstorming Workshop with Working Group: inventory of all vulnerable coastal sites, development of the site selection criteria, and development of arguments for cost-benefit analysis and project site justification.
- Second Working Group Briefing: review and consensus on the revised programme structure and the economic arguments for the various programme components.
- Field visits to Riviere des Galets and Mon Choisy, to consult with beneficiaries and to scope the range of technical options for these sites (Quatre Soeurs was examined through satellite images). Satellite images were also used to verify technical options for Mon Choisy and Riviere des Galets.
- Meetings with the Deputy-Director, Director, Supervising Officer, and Minister of Environment and Sustainable Development, for concurrence with the revised programme.

70. The stakeholders who were involved in this process through the month of September were as follows:

- Ministry of Environment and Sustainable Development.
- Ministry of Finance & Economic Development.
- Ministry of Tourism and Leisure.
- Ministry of Local Government and Outer Islands.
- Ministry of Fisheries and Rodrigues.
- Ministry of Housing and Lands.
- Ministry of Public Infrastructure, National Development Unit, Land Transport and Shipping & National Development Unit (Public Infrastructure Division).
- Mauritius Meteorological Services.
- District Council North, Pamplemousses/Rivière du Rempart District Council (for site at Mon Choisy).
- District Council Grand Port Savanne, District Council Head Office (for site at Riviere des Galets).
- Road Development Authority.
- Beach Authority.
- University of Mauritius.
- Mauritius Oceanography Institute.
- Indian Ocean Commission.
- International Organization for Migration.
- Central Statistics Office.
- Representatives in communities in Mon Choisy and Riviere des Galets.

71. In addition, all stakeholders involved in the consultation process were given various drafts of the programme proposal, so that comments on specific elements of the programme could be collected and addressed in the final draft.

I. Provide justification for funding requested, focusing on the full cost of adaptation reasoning.

72. **Outcome 1:** Current climate change risks at three coastal sites resolved through design and application of coastal protection measures, using proven technologies (addressing beach erosion and flood risk from storm surges).

73. *Baseline:* The beach at Mon Choisy (one of the top five beaches on the island of Mauritius) is eroding at a rate of about 2 metres/year, and risks disappearing within the next 15-20 years. The community at Riviere des Galets is exposed to storm surges, with a failing seawall, openings in the wave overtopping wall, and an inadequate drainage system in the village – this community has experienced storm surges in the past and is living in fear of the next surge. Buildings in Quatre Soeurs frequently flood during high tides, and the community does not have a refuge from future floods. Current measures at all three sites (importation of sand at Mon Choisy, and cutting the casuarina trees along the beach crest; a failing seawall at Riviere des Galets; and *no* interventions at Quatre Soeurs) will not address *any* future risks related to climate change. The loss of the beach at Mon Choisy could result in a loss of US\$ 128 million in beach tourism revenue over the next 50 years. If no further measures are implemented at Riviere des Galets, the community is likely to suffer attrition over the next ten years; the cost of moving the community to another coastal location could be as high as US\$ 9.3 million. At Quatre Soeurs, an increased incidence of flooding will stress the community and lead to some attrition as well; the cost of moving the community to another suitable location is even higher than the cost of relocating the community at Riviere des Galets, so this is not a viable option.

74. There is no coastal monitoring system in place that helps explain the linkages between weather events and coastal processes on the island of Mauritius. As a consequence, coastal zone practitioners and scientists in ROM are unable to inform the policy and decision-makers with regard to the most appropriate coastal adaptation measures that should be incorporated into future coastal zone development plans, and there will continue to be beach erosion, building and infrastructure failures due to accelerating sea level rise and increasing frequency of storm surges, with significant costs due to required maintenance and repairs and lost revenue from beach tourism.

75. *Adaptation Alternative:* The proposed alternatives for the three sites involve design and construction of site-specific technical interventions that will resolve the climate change issues at these sites in a sustained manner. The overall process includes determining the chronology of coastal process “events” at each site in the past and improving the understanding of physical processes at each site, through collection of oceanographic data in quiet and active periods. Detailed technical specifications and costs for physical interventions at each of the three sites will then be determined. Interventions at Mon Choisy will include construction of detached offshore submerged wave attenuation structures (sloped rock mounds) to induce sediment retention and accumulation, as well as planting of mangroves in the lagoons, and planting vegetation on the beach crest. At Riviere des Galets, interventions will include repair and re-sloping of the seawall, construction of detached offshore submerged wave attenuation structures (sloped rock mounds) to deflect erosive waves away from a failing gabion revetment, sealing the wave-overtopping wall, development of a drainage scheme for the backshore, to re-

direct surge flood water and wave-overtopping water from the village (where it is currently trapped) to the back of the bay, and planting of beach crest vegetation. At Quatre Soeurs, the proposal includes re-constructing public buildings at risk (the community centre, to start with) on stilts, fitted with rainwater harvesting tanks and solar panels, and planting of mangroves (to reduce wave energy at the shore).

76. Furthermore, the programme will design and implement a coastal process/weather event monitoring system that will fill the gap in understanding of climate change processes in the coastal zone. This will involve definition of the appropriate parameters for a coastal monitoring system and its subsequent design, implementation of the coastal monitoring system at eight locations around the island of Mauritius; and, regular reporting of data, analysis, and interpretation made available to all coastal practitioners. The monitoring results will be used to inform technical design of coastal structures, and the coastal monitoring approach can then be used to measure the effectiveness of the programme's coastal protection measures.

77. The total cost of these activities at the three coastal sites, including the monitoring between coastal processes and weather, is US\$ 6,465,700. The estimated number of direct beneficiaries is about 3,150 people.

78. **Outcome 2:** Early warnings on incoming storm surge communicated to coastal communities, indicating the expected time of incidence and height of storm surges, through the design and activation of an early warning system.

79. *Baseline:* Mauritius Meteorological Services provides warnings to shipping based on perceived wave climate, and cyclone warnings for the general populace, but this system does not anticipate rogue swell conditions, which are not always due to local cyclones, but sometimes are caused by convergent weather systems quite far from ROM. As a consequence, vulnerable coastal communities cannot prepare for potential surges and flooding, and suffer stress and insecurity during periods of heavy seas, and actual loss of goods and building damage when surges do strike.

80. *Adaptation Alternative:* The proposed alternative will involve assessment of the usefulness and practicality of the sea surface satellite data at the Mauritius Oceanography Institute and the Mauritius Meteorological Services weather forecasting and warning system, so that parameters and analytical procedures for the early warning system can be defined. The early warning system will then be designed, tested, and implemented during the course of the programme, so that all coastal communities in ROM (Mauritius, Rodrigues, and Agalega) will have a much-reduced, hopefully negligible, risk associated with future storm surges. This early warning system will link to the existing early warning system for cyclones. The cost of activities under Outcome 3 is US\$ 133,705.

81. **Outcome 3:** Increased capacity of public agencies, private sector entities, and individuals to develop infrastructure and conduct livelihoods in the coastal zone of ROM with minimal risk of loss due to future climate change effects.

82. *Baseline:* Public agencies are unclear on their obligations regarding management of climate change effects in the coastal zone, and the private sector and general populace do not know what options there are for coastal adaptation, nor how to initiate such measures in the most practical, cost-effective manner. In addition, Mauritian engineers are not familiar with the designs and construction techniques required to develop effective coastal protection measures that will address future sea level rise and increasing frequency of storm surges, and decision-

makers are not experienced in the application of cost-benefit analysis, which is required to make appropriate decisions on interventions required to protect coastal assets in the future. The real concern with this baseline is that individuals, businesses (especially hotel operators), and Government agencies will continue to undertake *ad hoc* measures to protect their individual coastal territories or public areas, not being properly informed, and perhaps even accelerating coastal erosion rates, or increasing the climate change risks in adjacent properties, inducing ever-increasing costs related to repair of coastal infrastructure and leading to further losses of beach tourism revenues.

83. *Adaptation Alternative:* The proposed alternative is to focus on capturing the lessons learned from the other programme outcomes and capturing them in a handbook that can then be used, with tailoring for specific stakeholder groups, to disseminate best coastal adaptation practices to address all issues in the coastal zone of ROM. Formal stakeholder and practitioner training is expected twice per year over three years. The programme will also support the design and delivery of a coastal engineering short course (at least twice during the programme period), to develop engineering expertise that can then be used for the proper design and construction of coastal protection measures throughout ROM. The programme will also support the development and delivery of cost-benefit analysis courses for practitioners and decision-makers – to be delivered at least four times during the programme period. The cost of activities under Outcome 4 is US\$ 394,025.

84. **Outcome 4:** Clear and practical alignment of Mauritian policy, strategies, plans, and regulations with the most appropriate best practices for adaptation in the coastal zone, taking into account the expected risks to coastal processes and infrastructure in ROM over the next 20 years.

85. *Baseline:* Current policies and regulations in ROM are inconsistent with regard to management of climate change effects in the coastal zone (they do not envision the coastal zone in 2060), and do not provide clear guidance or incentives for practical implementation of adaptive measures. This partly reflects the confused jurisdictions of various ministries and agencies with regard to authority and regulations that apply to beaches, lagoons, and reefs, and also the variable understanding of how exactly climate change manifests itself in the coastal zone and what are the appropriate technical options that need to be accommodated in policies and regulations. As a consequence, future development of infrastructure and buildings in the coastal zone will risk being vulnerable to increasing sea level and an increased frequency of storm surges, resulting in beach erosion, infrastructure damage, and flooding of buildings in low-lying coastal areas, with a potential cost to the Mauritian economy of US\$ 3.362 billion (in 2010 dollars) over the next 50 years.

86. *Adaptation Alternative:* The proposed alternative is to develop a National Coastal Zone Adaptation Strategy which addresses all perceived climate change risks in the coastal zone over the next 20 years, with clear recommendations for appropriate policies, regulations, and guidelines for adaptation. This effort will be reflected in District Outline Schemes and the National Tourism Development Plan recognizing spatial limitations and capacity limits related to climate change risks. These plans will provide guidance on appropriate locations and designs for infrastructure. EIA guidelines with respect to coastal protection and rehabilitation works will be developed. The programme will facilitate development of a “toolbox” with the most appropriate technical, institutional, regulatory, and economic instruments available for all coastal practitioners in ROM. Recommendations will be developed regarding the structure and processes of an oversight and regulatory body that addresses all climate change issues in the coastal zone with jurisdictional clarity, and this body will be established as a “clearinghouse” for

all climate change issues in the coastal zone by the end of the programme. Finally, there will be analysis and development of recommendations for design and implementation of economic instruments that will facilitate public and private sector compliance with the best coastal adaptation practices. The cost of activities under Outcome 1 is US\$ 350,050.

87. **Outcome 5:** Effective capturing and dissemination of lessons from the applied activities in the programme.

88. *Baseline:* There is no consistent awareness nor understanding of the implications of climate change in the coastal zone; households, communities, and Government organizations do not factor into their plans and activities the possible climate change effects. The consequence is that individuals do not understand the future consequences of their actions in the coastal zone, how their buildings and infrastructure may be impacted by rising sea level and more frequent storm surges; nor do they have adequate information for accommodating climate change effects in their development plans. At the moment, without clear policy direction and economic instruments which can induce appropriate development in the coastal zone, and without knowledge of a range of technical options that address site-specific coastal processes, coastal assets will continue to erode and buildings and infrastructure will suffer increasing risks from sea level rise and increased frequency of storm surges, with significant costs (for the Government and the private sector) accumulating and being re-directed away from other essential social services and better development opportunities.

89. *Adaptation Alternative:* The proposed alternative is a consolidated effort to disseminate the best coastal adaptation practices developed in the programme to all coastal stakeholders, practitioners, decision-makers, and scientists. This disseminated awareness and understanding of climate change and coastal processes, and the need for adaptation measures will reinforce the compliance with the developing policies, regulations, and technical approaches. The proposed activities will ensure consistent and comprehensive coastal adaptation themes in all training material produced by the programme, and delivery of training and public awareness campaigns that is tailored to specific stakeholder groups. It is expected that Mauritian coastal practitioners will disseminate lessons from the programme to other countries in the southern Indian Ocean and to examine the experiences in those countries and their potential application to coastal sites in ROM. The programme will facilitate the development of interpretive models and signs, and dynamic explanations of coastal processes and climate change impacts at each of the three technical project sites. It is expected that the sites where the coastal protection measures are implemented will become visitor destinations in their own right, attracting scientists, the general public, and tourists. These efforts are expected to increase public awareness of the coastal adaptation issues in ROM and an understanding of possible solutions. Finally, through the outputs of the other programme components, the programme will support the assessment of all vulnerable coastal sites in ROM, with mapping, scaling, and assessment of the importance and degree of risk each site faces with regard to climate change in the future. This ranking of coastal site adaptation priorities will facilitate the order of replication of coastal adaptation measures, to be implemented by the Government of Mauritius and the private sector. The cost of activities under Outcome 6 is US\$ 561,350.

## PART III: IMPLEMENTATION ARRANGEMENTS

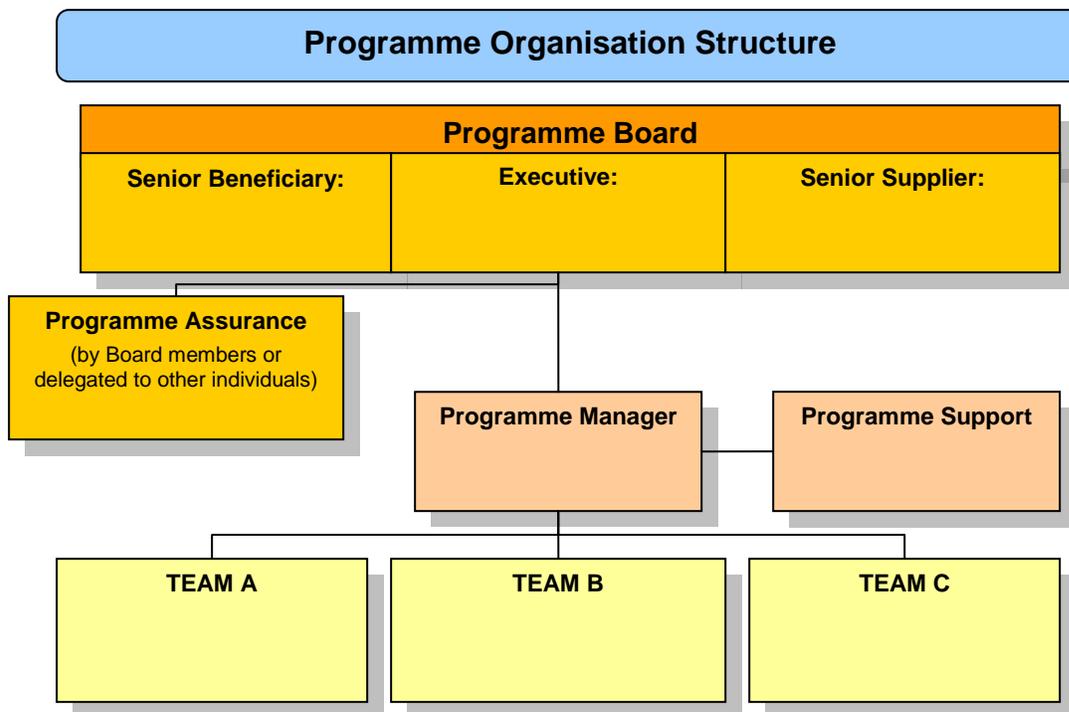
A. Describe the arrangements for project / programme implementation.

90. The programme will be implemented in the fashion in which it has been developed, with the Ministry of Environment and Sustainable Development taking the lead role in facilitating the logistics and delivery of all programme components, and each of the participating Government agencies taking a technical lead for specific activities, as identified in Section D below. UNDP will be responsible for management oversight, monitoring and evaluation (see Section C), and procurement of all equipment and technical services (using standard UNDP procedures), as a Multilateral Implementing Entity.

91. The key programme partners (to be involved in the various technical teams) include the following:

- Ministry of Environment and Sustainable Development;
- Ministry of Finance and Economic Development;
- Ministry of Housing and Lands;
- Ministry of Fisheries and Rodrigues;
- Ministry of Public Infrastructure;
- Beach Authority;
- Ministry of Tourism and Leisure;
- Ministry of Local Government and Outer Islands;
- District Councils;
- Mauritius Oceanography Institute;
- Mauritius Meteorological Services;
- University of Mauritius; and,
- Relevant NGOs.

92. The organization of the various programme partners, the executing entity (Ministry of Environment and Sustainable Development), and the implementing entity (UNDP) is shown in the figure below.



93. The Programme Board will be responsible for making management decisions for the programme, in particular when guidance is required by the Programme Manager. The project board chaired by MoESD comprising the relevant stakeholders and UNDP CO representative. The Programme Board will play a critical role in programme monitoring and evaluations (see Section C below) by quality assuring the processes and products of the programme, and by using evaluations for performance improvement, accountability, and learning. It will ensure that required resources are committed and arbitrate on any conflicts that may arise within the programme, and will negotiate solutions as required. In addition, the Programme Board will approve the appointment and responsibilities of the Programme Manager and any delegation of its Programme Assurance responsibilities. Based on the approved Annual WorkPlan, the Programme Board will also consider and approve the quarterly plans and will also approve any essential deviations from the original plans.

94. In order to ensure UNDP's ultimate accountability for the programme results, Programme Board decisions will be made in accordance with the standards that shall ensure management for development results, best value money, fairness, integrity, transparency and effective international competition. Potential members of the Programme Board will be reviewed and recommended for approval during the Programme Appraisal Committee meeting. Representatives on the Programme Board are noted in the figure above. Within the Programme Board, the Senior Supplier's primary function will be to provide guidance regarding the technical feasibility of the programme. The role of the representative of the Senior Beneficiary will be to ensure the realization of programme results from the perspective of programme beneficiaries.

95. The Programme Manager will have the authority to run the programme on a day-to-day basis on behalf of the Implementing Partner (Ministry of Environment and Sustainable Development), reporting to the Director of Environment, within the constraints laid down by the

Board. The Programme Manager’s prime responsibility will be to ensure that the programme produces the results specified in the programme document, to the required standard of quality and within the specified constraints of time and cost. The Programme Support role includes programme administration, management, and technical support to the Programme Manager, as and when required.

96. All Government agencies who are programme partners will be expected to contribute staff time and facilities “in kind” to the programme, for the Programme Board involvement, for the various workshops required to advance activities and facilitate collaboration, and for the technical involvement and oversight that may be required in the specific programme activities (within the technical teams). Operational costs associated with programme activities, that is, increments that are imposed by specific programme requirements, will be covered by the programme budget.

97. Risk management and programme monitoring and evaluation are important elements of programme management and implementation and are addressed in Sections B and C below.

**B. Describe the measures for financial and project / programme risk management.**

98. Potential programme risks are identified below, along with proposed countermeasures. It is assumed that all programme risks are “owned” by both UNDP, as the Implementing Entity, and the Ministry of Environment and Sustainable Development, as the Executing Entity, although UNDP has the ultimate responsibility with regard to all financial risks, and the right of cessation of activities, or withdrawal of funding in the event of risks that cannot be otherwise managed.

#	Description	Type	Implications: Impact (I) & Probability (P) (1=low; 5=high)	Countermeasures/ Management Response
1	High level endorsement of proposed policy and regulatory changes to support coastal adaptation may be lacking (enabling legislation may be delayed); there may also be concerns about creating a new climate change oversight function within the MinEnvSD that cuts across the jurisdictions of other ministries/agencies.	Political	Other ministries and agencies, such as Ministry of Finance and Economic Development, and the Beach Authority, may perceive a loss of power/ authority in terms of development and coastal areas, leading to lack of support for the MinEnvSD, and lack of involvement in programme activities. P = 2 I = 4	The Programme Steering Committee and the various programme activities will provide many opportunities for discussing the most appropriate institutional structures and processes for adaptation in coastal areas, hopefully building up a consensus that gives a role to all relevant ministries/agencies.
2	Districts (local government) may perceive themselves in a peripheral role, with their development put aside for the sake of climate change adaptation.	Political	Local governments may minimize their involvement in the programme, or obstruct the development of planning guidelines that will dictate what is and is not acceptable in the coastal zone. P = 2 I = 4	Ensure adequate representation from the District Councils in the Programme Board and in programme activities; ensure that the positive results of the coastal protection measures are disseminated and well understood by the District Councils.
3	Government of Mauritius commitment to climate change management could wane as development priorities become more prominent and compete, especially in	Political	It may become more difficult to get the full engagement of higher level Government staff and politicians, if adaptation appears to constrain development, or has an apparent high cost that is not understood to bring benefits.	Constant reiteration of the risks of climate change and the positive net benefits of adaptation investments is required.

#	Description	Type	Implications: Impact (I) & Probability (P) (1=low; 5=high)	Countermeasures/ Management Response
	the run-up to elections.		P = 2 I = 3	
4	There may be a misunderstanding about the jurisdictional area of an agency that has climate change management oversight and right of enforcement.	Regulatory	Discussions about the area of operation of various ministries and agencies (MinEnvSD, Beach Authority, Ministry of Public Works, etc.) may become a distraction from other programme activities and stifle the analysis of required institutional structures and processes for proper coastal adaptation. P = 2 I = 2	It is precisely the analysis of overlapping jurisdictions and conflicting regulations that will sort out respective roles and improve the situation for all ministries/agencies, so that coastal adaptation can proceed accordingly.
5	MinEnvSD may have limited management capacity for programme activities to be undertaken, and for the eventual assumption of climate change management oversight and enforcement; conflicts between the CC Cell and the ICZM Division may become apparent.	Organizational	Respective roles in the programme and foreseen beyond the programme period may remain clouded, or under constant discussion, without advancing the situation. P = 3 I = 4	UNDP will maintain a strong link with the programme, and the various programme activities that address institutional aspects will be guided by technical consultants, who will bring valid experiences from other countries, which should inform the situation in ROM.
6	Varying, possibly conflicting, perceptions of the climate change risks and coastal adaptation approaches may become apparent, based on previous experiences and technical expertise.	Operational	Confused expectations of the programme will disrupt the flow of programme activities and the collection of appropriate information; this in turn may limit the usefulness of programme outputs, or the degree to which various stakeholders use the information. P = 2 I = 4	Frequent dialogue with programme partners and reinforcement of solid principles of climate change management and appropriate adaptation measures will be required; several other projects (AAP and IOC) will help in this regard; the role of technical consultants will be important here.
7	Delays in fund transfers and procurement of technical services and equipment.	Financial	Late funding (slow transfer of funds) or limited absorptive capacity for the programme (UNDP/MinEnvSD) may delay some activities, and have a knock-on effect, as outputs from one component are required for the initiation of other components. P = 2 I = 5	Programme activities have been designed and paced to ensure a reasonable chance of completion over five years (a timeframe less than this would be too ambitious); the Programme Board will provide required oversight for management of programme inputs.
8	Climate variability accelerates and coastal degradation occurs at a faster pace than anticipated.	Environmental	The proposed coastal sites for the coastal protection measures no longer fit the site selection criteria; the technical designs for the three sites do not correctly anticipate physical factors. P = 1 I = 5	The climate change models from the IOC project, and the nearshore oceanographic programme, should address this potential risk, or at least allow safety factors to be designed into the technical specifications for each site.

**C. Describe the monitoring and evaluation arrangements and provide a budgeted M&E plan.**

99. Programme monitoring and evaluation (M&E) will be in accordance with established UNDP procedures and will be carried out by the Programme Team and the UNDP Country Office. The

Results Framework noted in Section D below defines the performance indicators for programme implementation at the output and outcome levels. The means of verification for each of these indicators will involve independent examination of the policies, guidelines, regulations, training materials, technical project interventions, and knowledge management outputs that the project will produce (all specified in the proposed targets, and therefore not repeated here or in the table in Section D). A Monitoring and Evaluation system for the programme will be established based on these indicators and the means of verification noted above, and will be the ultimate responsibility of UNDP. The table below describes the indicative M&E workplan and corresponding budget. Note that the M&E budget is absorbed within the Programme Cycle Management Fee noted in Part I.

#### Indicative Monitoring and Evaluation Workplan and Corresponding Budget.

Type of M&E Activity	Responsible Parties	Budget US\$ (excluding programme staff time)	Time Frame
Inception Workshop and Report	<ul style="list-style-type: none"> <li>▪ Programme Manager</li> <li>▪ UNDP CO</li> </ul>	Indicative cost: 10,000	Within first two months of programme start-up
Measurement of Means of Verification of programme results	<ul style="list-style-type: none"> <li>▪ UNDP RTA/Programme Manager will oversee the hiring (specific studies and institutions), and delegate responsibilities to relevant team members.</li> </ul>	To be finalized in Inception Phase and Workshop	Start, mid- and end of programme (during evaluation cycle) and annually when required.
Measurement of Means of Verification for Programme Progress Reports on output and implementation	<ul style="list-style-type: none"> <li>▪ Oversight by Programme Manager</li> <li>▪ Programme team</li> </ul>	To be determined as part of the Annual Work Plan preparation	Annually prior to ARR/PIR and input to the annual work plans
ARR/PIR	<ul style="list-style-type: none"> <li>▪ Programme Manager and team</li> <li>▪ UNDP CO</li> <li>▪ UNDP RTA</li> <li>▪ UNDP EEG</li> </ul>	None	Annually
Periodic status/ progress reports	<ul style="list-style-type: none"> <li>▪ Programme Manager and team</li> </ul>	None	Quarterly
Mid-term Evaluation	<ul style="list-style-type: none"> <li>▪ Programme Manager and team</li> <li>▪ UNDP CO</li> <li>▪ UNDP RTA</li> <li>▪ External Consultants (i.e., evaluation team)</li> </ul>	Indicative cost: 40,000	At the mid-point of programme implementation
Final Evaluation	<ul style="list-style-type: none"> <li>▪ Programme Manager and team,</li> <li>▪ UNDP CO</li> <li>▪ UNDP RTA</li> <li>▪ External Consultants (i.e. evaluation team)</li> </ul>	Indicative cost : 40,000	At least three months before the end of programme implementation
Programme Terminal Report	<ul style="list-style-type: none"> <li>▪ Programme Manager and team</li> <li>▪ UNDP CO</li> <li>▪ local consultant</li> </ul>	None	At least three months before the end of the programme
Audit	<ul style="list-style-type: none"> <li>▪ UNDP CO</li> <li>▪ Programme Manager and team</li> </ul>	Indicative cost per year: 3,000	Yearly
Visits to field sites	<ul style="list-style-type: none"> <li>▪ UNDP CO</li> <li>▪ UNDP RTA (as appropriate)</li> <li>▪ Government representatives</li> </ul>	Minimal	Yearly

Type of M&E Activity	Responsible Parties	Budget US\$ (excluding programme staff time)	Time Frame
TOTAL Indicative Cost (excluding programme team staff time and UNDP staff and travel expenses)		US\$ 187,000	

100. Once the programme starts, a Programme Inception Workshop will be held (within the first two months of the programme) involving those with assigned roles in the programme organization structure, the UNDP Country Office and, where appropriate/feasible, regional technical policy and programme advisors as well as other stakeholders. The Annual Workplan (AWP), with a detailed M&E Strategy, will be agreed at the Inception Workshop.

101. Programme progress will be monitored as follows:

- Programme progress on a quarterly basis will be monitored in the UNDP Enhanced Results Based Management Platform, and the initial risk analysis in the risk log will be updated accordingly.
- Annual Review/Project Implementation Reports (APR/PIR) will be prepared to monitor progress made from programme start-up and, in particular, for the previous reporting period.
- Periodic Monitoring through site visits: the UNDP CO and Regional Coordinating Unit (RTA) will conduct visits to coastal sites, based on the agreed schedule in the Programme Inception Report/Annual Work Plan to assess first hand the progress of the programme. Other members of the Programme Board may also join these visits. A Field Visit Report/BTOR will be prepared by the CO and the UNDP Regional Coordinating Unit and will be circulated after the visit to the Programme Team and Programme Board members.
- The programme will undergo an independent Mid-Term Evaluation. The Mid-Term Evaluation will determine progress being made toward the achievement of outcomes and will identify course correction, if needed. It will focus on the effectiveness, efficiency and timeliness of programme implementation; will highlight issues requiring decisions and actions; and, will present initial lessons learned about programme design, implementation, and management. Mid-term evaluation findings will be incorporated as recommendations for enhanced implementation during the final half of the programme's term. The organization, terms of reference and timing of the mid-term evaluation will be decided after consultation between the programme partners. The Terms of Reference for this Mid-term Evaluation will be prepared by the UNDP CO, based on guidance from the Regional Coordinating Unit. The management response and the evaluation will be uploaded to UNDP corporate systems, in particular the UNDP Evaluation Office Evaluation Resource Center (ERC).
- An independent Final Evaluation will take place three months prior to the final Programme Board meeting (prior to programme closure) and will be undertaken in accordance with UNDP guidance. The Final Evaluation will focus on the delivery of the programme's results as initially planned (and as corrected after the mid-term evaluation, if any such correction took place). The Final Evaluation will look at impact and sustainability of results, including the contribution to capacity development and the achievement of adaptation benefits. The Terms of Reference for this evaluation will be prepared by the UNDP CO, based on

guidance from the Regional Coordinating Unit. The Final Evaluation should also provide recommendations for follow-up activities and will require a management response, which will be uploaded to PIMS and to the UNDP Evaluation Office Evaluation Resource Center (ERC).

- D.** Include a results framework for the project proposal, including milestones, targets and indicators.

102. The results framework for the proposed programme is noted below, with required inputs (detailed budgets), expected outputs for each outcome, performance indicators, means of verification, and responsibilities. Activity budgets are also summarized by Programme Component in Part I.

Intended Outcome as stated in the Country Programme Results and Resource Framework:

Applicable Key Result Area (from 2008-11 Strategic Plan): **Promote climate change adaptation.**

Programme title and ATLAS IDS: **ADAPTING COASTAL ZONE MANAGEMENT IN MAURITIUS TO ADDRESS THE IMPACTS OF CLIMATE CHANGE.**

Outcomes	Outcome Targets	Outputs	Output Indicators	Means of Verification Outcome Level		Responsible Parties	Inputs & Cost (US\$)
				Method	Timing		
<p><b>Outcome 1</b> (ATLAS Output) Current climate change risks at three coastal sites resolved through design and application of coastal protection measures, using proven technologies (addressing beach erosion and flood risk from storm surges and tides). <u>Indicators</u></p> <ul style="list-style-type: none"> <li>• Beach erosion at Mon Choisy is arrested and beach accretion is occurring.</li> <li>• The community in Riviere des Galets does not suffer economic losses from surges during storm events.</li> <li>• Buildings in Quatre Soeurs do</li> </ul>	<p>By 2014, current climate change risks at three coastal sites (Mon Choisy, Riviere des Galets, Quatre Soeurs) resolved through design and application of coastal protection measures, using proven technologies (addressing beach erosion and flood risk from storm surges).</p>	<p><b>1.1</b> Detailed technical assessment of each site, with chronology of previous flood and erosion events and collection of nearshore oceanographic data, during “quiet” periods and “active” periods (one month each) to inform the design of the technical interventions at each of the three sites.</p> <p><b>1.2</b> Technical design of coastal protection measures at each of three sites, with detailed costing.</p>	<p><b>1.1</b> Clear chronology of coastal process “events” at each site and oceanographic dataset for each of the three sites.</p> <p><b>1.2</b> Detailed technical specifications and costs for coastal protection measures at each of the three sites, suitable for tendering.</p>	<p>Review of coastal monitoring data for the three technical project sites. Field observations at the technical project sites.</p>	<p>Annual review.</p> <p>Semi-annual field trips.</p>	<p>1. Ministry of Environment and Sustainable Development; Ministry of Finance and Economic Development; Ministry of Housing and Lands; Ministry of Fisheries and Rodrigues; Ministry of Public Infrastructure; Beach Authority; Ministry of Local Government and Outer Islands; District Councils; Mauritius Meteorological Services; Mauritius Oceanography Institute; University of Mauritius.</p>	<p><b>1.1</b> International consultant 74,250 National consultant 63,000 Travel 10,500 DSA 24,675 Local transportation 5,000 Oceanographic gear leasing 20,000 Printing 3,000 Miscellaneous 5,000</p> <p><b>Total 205,425 (29,775 in 2011; 175, 650 in 2012)</b></p> <p><b>1.2</b> International consultant 49,500 National consultant 31,500</p>

Outcomes	Outcome Targets	Outputs	Output Indicators	Means of Verification Outcome Level		Responsible Parties	Inputs & Cost (US\$)
				Method	Timing		
<p>not flood during spring tides or storm events.</p> <p><u>Baseline</u> (2010) = the beach at Mon Choisy is eroding at a rate of about 2 metres/year; Riviere des Galets is exposed to storm surges, with a failing seawall, openings in the wave overtopping wall, and an inadequate drainage system in the village; buildings in Quatre Soeurs frequently flood during high tides.</p>		<p><b>1.3</b> Successful construction of physical interventions at each of the three sites.</p>	<p><b>1.3</b> Physical works properly designed and constructed at each of the three sites.</p> <p><b>1.3</b> Coastal degradation and vulnerabilities at each of the three sites arrested.</p> <p><b>1.4</b> Comprehensive data on the effectiveness of the structures at</p>				<p>Travel 3,500 DSA 21,150 Workshops 8,000 Printing 3,000 Miscellaneous 3,000 <b>Total</b> <b>119,650 (in 2012)</b></p> <p><b>1.3</b> International consultant (oversight) 49,500 National consultant (site supervision) 63,000 Travel 7,000 DSA 21,150 Riviere des Galets works (subject to detailed design) 2,800,000 Mon Choisy works (subject to detailed design) 2,000,000 Quatre Soeurs works</p>

Outcomes	Outcome Targets	Outputs	Output Indicators	Means of Verification Outcome Level		Responsible Parties	Inputs & Cost (US\$)
				Method	Timing		
		<p><b>1.4</b> Analysis of data and development of recommendations on how the interventions can be adjusted for other vulnerable coastal locations in ROM.</p> <p><b>1.5</b> Monitoring programme designed, to include scoping of suitable</p>	<p>each of the three sites.</p> <p><b>1.4</b> Recommendations for structural adjustments (location, design, materials, etc.) for interventions at other coastal sites in ROM.</p> <p><b>1.5</b> Design report</p>				<p>(subject to detailed design) 800,000 Printing 5,000 Miscellaneous 10,000 <b>Total</b> <b>5,755,650 (in 2013)</b></p> <p><b>1.4</b> International consultant 33,000 National consultant 42,000 Travel 7,000 DSA 14,100 Workshops 8,000 Printing 2,000 Miscellaneous 3,000 <b>Total</b> <b>109,000 (72,670 in 2014; 36,330 in 2015)</b></p> <p><b>1.5</b> International consultants: 24,750 National consultants:</p>

Outcomes	Outcome Targets	Outputs	Output Indicators	Means of Verification Outcome Level		Responsible Parties	Inputs & Cost (US\$)
				Method	Timing		
		parameters, including beach width and slope; depth of adjacent lagoonal sediments; wave height, period, and run-up; direction of nearshore currents, etc.  <b>1.6</b> A targeted coastal process/weather event monitoring system in place	<b>1.6</b> A functional monitoring system in place.				21,00 Travel: 3500 DSA: 11,925 Workshops: 6000 Printing: 2000 Misc: 2000 <b>Total 71,175 (in 2011)</b>  <b>1.6</b> International consultants: 16,500 National consultants: 120,750 Travel: 13,500 DSA: 7050 Workshops: 8000 Monitoring equipment (procurement & maintenance): 30,000 Printing: 4000 Misc: 5000 <b>Total: 204,800 (85,300 in 2011; 29,875 in each of 2012, 2013, 2014, 2015.</b>  <b>Total for #1: US\$ 6,465,700</b>
<b>Outcome 2</b> (ATLAS Output)	By 2012, an early warning system	<b>2.1</b> Assessment of the current sea	<b>2.1</b> Assessment of the usefulness	Visits to the early warning	Semi-annual.	<b>2.</b> Ministry of Environment	<b>2.1</b> International

Outcomes	Outcome Targets	Outputs	Output Indicators	Means of Verification Outcome Level		Responsible Parties	Inputs & Cost (US\$)
				Method	Timing		
<p>Early warnings for incoming storm surge (including the expected time of incidence and height of storm surges) communicated to coastal communities through a new early warning system.</p> <p><u>Indicator</u> Coastal communities are able to safely evacuate prior to future storm surge events (there are no people left in the surge zone when the surge hits).</p> <p><u>Baseline</u> (2010) = MMS provides warnings to shipping based on perceived wave climate, and cyclone warnings for the general populace, but this system does not anticipate rogue swell conditions.</p>	<p>for incoming storm surge designed and activated, to warn coastal communities of the time of incidence and height of storm surges.</p>	<p>state monitoring systems (Mauritius Meteorological Services and Mauritius Oceanography Institute) and definition of required critical parameters and operational requirements for an early warning system.</p> <p><b>2.2</b> The early warning system installed and implemented (with links to early warning system for cyclones), with communication linkages established from level of National Coast Guard at Headquarters down to the level of coastal communities.</p>	<p>and practicality of the satellite data and the MMS system.</p> <p><b>2.1</b> Parameters and analytical procedures for the early warning system defined.</p> <p><b>2.2</b> Early warning system up and running and effective during future storm events.</p>	<p>system facility (expected to be in Mauritius Oceanography Institute, with connections to the MMS); review of the early warning logs.</p> <p>Interviews with coastal communities that have experienced surges, to confirm the effectiveness of the early warnings.</p>	<p>After each surge warning.</p>	<p>and Sustainable Development; Ministry of Public Infrastructure; Ministry of Local Government and Outer Islands; District Councils; Mauritius Meteorological Services; Mauritius Oceanography Institute.</p>	<p>consultant 12,375 National consultant 7,875 Travel 3,500 DSA 5,405 Workshop 2,000 Miscellaneous 2,000 <b>Total 33,155 (in 2011)</b></p> <p><b>2.2</b> International consultant 16,500 National consultant 10,500 Travel 3,500 DSA 7,050 Workshops 4,000 Hardware for alarm 5,000 Staffing for alarm monitoring (cost support declining during programme period)</p>

Outcomes	Outcome Targets	Outputs	Output Indicators	Means of Verification Outcome Level		Responsible Parties	Inputs & Cost (US\$)
				Method	Timing		
							50,000 Printing 2,000 Miscellaneous 2,000  <b>Total</b> <b>100,550</b> <b>(70,550 in</b> <b>2011; 15,000</b> <b>in 2012;</b> <b>10,000 in</b> <b>2013, 5,000 in</b> <b>2014)</b>  <b>Total for #2:</b> <b>US\$ 133,705</b>
<p><b>Outcome 3</b> (ATLAS Output) Increased capacity of public agencies, private sector entities, and individuals to develop infrastructure and conduct livelihoods in the coastal zone of ROM with minimal risk of loss due to future climate change effects. <u>Indicators</u></p> <ul style="list-style-type: none"> <li>All Government interventions in the coastal zone, designed to reduce erosion or</li> </ul>	By 2015, increased capacity of public agencies, private sector entities, and individuals to develop infrastructure and conduct livelihoods in the coastal zone of ROM with minimal risk of loss due to future climate change effects.	<b>3.1</b> “Handbook on Coastal Adaptation” packaged as training modules for coastal communities, relevant Government agencies, and private sector stakeholders (such as hotel operators); training sessions delivered on a regular basis over the course of the project (at least twice annually).	<b>3.1</b> Handbook complete, fully relevant to Mauritius coastal context, and used for coastal stakeholder and practitioner training twice per year over three years.	Examination of site designs for coastal adaptation measures (at the project sites, and elsewhere).  Monitoring of beach erosion rates at all sites with new coastal protection measures; post-surge observations in coastal villages. Review of applications and plans for	Annually, to the End of the programme.  Annual field observations/ monitoring; field observations and interviews after each surge event.  Annual review of applications and plans.	<b>3.</b> Ministry of Environment and Sustainable Development; Ministry of Housing and Lands; Ministry of Fisheries and Rodrigues; Beach Authority; Mauritius Oceanography Institute; Mauritius Meteorological Services; University of Mauritius; relevant NGOs.	<b>3.1</b> International consultant 39,500 National consultant (also trainer) 63,000 Travel 7,000 DSA 14,100 Workshops 10,000 Printing 15,000 Training venues 12,000 Miscellaneous 4,000 <b>Total</b>

Outcomes	Outcome Targets	Outputs	Output Indicators	Means of Verification Outcome Level		Responsible Parties	Inputs & Cost (US\$)
				Method	Timing		
<p>address storm surge effects, incorporate site-specific features and measurably reduce the risk of flooding or the rate of erosion (evident in site plans and in subsequent monitoring).</p> <p>• Ongoing replication of effective coastal adaptive measures by both the Government and private sector, evident at new sites, through submission and approval of plans, and monitoring of construction of new interventions).</p> <p><u>Baseline</u> (2010) = public agencies are unclear on their obligations regarding management of climate change effects in the coastal zone, and the private sector and general populace do not know what options</p>		<p><b>3.2</b> Short course on Coastal Engineering designed and delivered (twice during programme period).</p> <p><b>3.3</b> Specialized course on Cost-Benefit Analysis of</p>	<p><b>3.2</b> Coastal engineering short course designed and delivered (2x); trainees certified.</p> <p><b>3.3</b> C-B Analysis course designed and delivered (4</p>	<p>new coastal adaptation measures and for new development in the ROM coastal zone.</p>		<p><b>164,600</b> (100,600 in 2012; 21,333 in each of 2013, 2014, 2015)</p> <p><b>3.2</b> International consultant 33,000 National consultant (also co-trainer) 63,000 Travel 3,500 DSA 14,100 Workshops 6,000 Printing 5,000 Training venues 6,000 Miscellaneous 4,000</p> <p><b>Total 134,600</b> (107,600 in 2012; 27,000 in each of 2013 and 2015)</p> <p><b>3.3</b> International consultant</p>	



Outcomes	Outcome Targets	Outputs	Output Indicators	Means of Verification Outcome Level		Responsible Parties	Inputs & Cost (US\$)
				Method	Timing		
<p>and infrastructure in ROM over the next 20 years.</p> <p><u>Indicators</u></p> <ul style="list-style-type: none"> <li>All relevant policies, strategies, plans, and regulations are consistent in           <ol style="list-style-type: none"> <li>having a clear vision statement for adaptation in the coastal zone;</li> <li>in recognizing climate change impacts in the coastal zone over the next 50 years; and</li> <li>in clear Government institutional responsibilities for adaptation in the coastal zone.</li> </ol> </li> </ul> <p><u>Baseline</u> (2010) = current policies and regulations are inconsistent with regard to management of climate change effects in the coastal zone (they do not envision the coastal zone in 2060), and do not provide clear guidance or incentives for</p>	and infrastructure in ROM over the next 20 years.	<p><b>4.2</b> A set of recommendations on best technical and institutional adaptation practices suitable for the coastal zone of ROM.</p> <p><b>4.3</b> Definition of the required structure and processes for one “clearinghouse” for climate change oversight in the</p>	<p>guidelines for adaptation.</p> <p><b>4.1</b> District Outline Schemes and the National Tourism Development Plan recognize spatial limitations and capacity limits related to climate change risks, and provide guidance on appropriate locations and designs for infrastructure.</p> <p><b>4.2</b> A “toolbox” with the most appropriate technical, institutional regulatory, and economic instruments available for all coastal practitioners in ROM; recommendations feeding into the policy and regulatory review.</p> <p><b>4.3</b> Clear recommendations on the structure and processes of an oversight and regulatory body that addresses all</p>	<p>plans, and regulations.</p> <p>Review of draft policies, strategies, plans, and regulations for clear reference to a 2060 vision, consistency in references to climate change effects in the coastal zone, and assurance that all stakeholder groups are addressed. Review of the proposed institutional structure and processes for coastal zone management.</p>	<p>At the end of Year 3 and the end of programme.</p>	<p>Infrastructure; Beach Authority; Ministry of Tourism and Leisure; Ministry of Local Government and Outer Islands; District Councils.</p>	<p>2,000 Miscellaneous 2,000</p> <p><b>Total 144,350 (in 2011)</b></p> <p><b>4.2</b> International consultant 33,000 Travel 3,500 DSA 3,525 Workshop 2,000 Printing 2,000 Miscellaneous 2,000 <b>Total 46,025 (in 2011)</b></p> <p><b>4.3</b> International consultant 24,750 National consultant 21,000</p>

Outcomes	Outcome Targets	Outputs	Output Indicators	Means of Verification Outcome Level		Responsible Parties	Inputs & Cost (US\$)
				Method	Timing		
practical implementation of adaptive measures.		coastal zone of ROM (a unit or institution, or collection of individuals from various agencies, which is able to make final decisions on the climate appropriateness of future development projects; also having a follow-up enforcement capacity).	climate change issues in the coastal zone with jurisdictional clarity. <b>4.3</b> Eventual establishment of that body (whether through the ICZM Division in the Ministry or the Climate Change Division).				Travel 3,500 DSA 10,575 Workshops 8,000 Printing 3,000 Miscellaneous 2,000 <b>Total</b> <b>72,825 (in 2012)</b>
		<b>4.4</b> Recommendations for new economic instruments,	<b>4.4</b> Clear analysis and recommendations for design and implementation of economic instruments that will facilitate public and private sector compliance with the best coastal adaptation practices.				<b>4.4</b> International consultant 33,000 National consultant 26,250 Travel 3,500 DSA 14,100 Workshops 6,000 Printing 2,000 Miscellaneous 2,000 <b>Total</b> <b>86,850 (in 2012)</b>

Outcomes	Outcome Targets	Outputs	Output Indicators	Means of Verification Outcome Level		Responsible Parties	Inputs & Cost (US\$)
				Method	Timing		
							<b>Total for #4: US\$ 350,050</b>
<p><b>Outcome 5</b> (ATLAS Output) Effective capturing and dissemination of lessons from the applied activities in the programme. <u>Indicators</u></p> <ul style="list-style-type: none"> <li>• More frequent and accessible public information on climate change effects in the coastal zone.</li> <li>• Appropriate interventions in the coastal zone are reviewed and approved.</li> </ul> <p><u>Baseline</u> (2010) = there is no consistent awareness nor understanding of the implications of climate change in the coastal zone; households, communities, and Government organizations do not factor into their plans and activities</p>	By 2015, effective capturing and dissemination of lessons from the applied activities in the programme.	<p><b>5.1</b> Handbook, training modules, and website content capturing best coastal adaptation practices for the Mauritius context.</p> <p><b>5.2</b> Dissemination of lessons learned from the programme with coastal stakeholders in other locations in the southern Indian Ocean.</p>	<p><b>5.1</b> Consistent coastal adaptation themes in all training material produced by the programme. <b>5.1</b> Good potential for practical application of training materials.</p> <p><b>5.2</b> Mauritian coastal practitioners able to disseminate lessons from the programme to other countries in the southern Indian Ocean and to examine the experiences in those countries.</p>	<p>Review of government approvals for coastal zone adaptation measures and development schemes in coastal areas. Review of District and National Plans for inclusion of climate change risks in the coastal zone. Field observations of representative infrastructure and building development in the coastal zone.</p>	<p>Annually, to the end of the programme.</p> <p>Annually, to the end of the programme.</p> <p>Annually, to the end of the programme.</p> <p>Semi-annual field trips.</p>	<p><b>5.</b>Ministry of Environment and Sustainable Development; Ministry of Fisheries and Rodrigues; Ministry of Public Infrastructure; Beach Authority; Ministry of Local Government and Outer Islands; District Councils' Mauritius Meteorological Services; Mauritius Oceanography Institute; University of Mauritius.</p>	<p><b>5.1</b> International consultant 16,500 National consultant 42,000 Travel 3,500 DSA 7,050 Workshops 6,000 Printing 8,000 Miscellaneous 3,000 <b>Total 86,050 (in 2012)</b></p> <p><b>5.2</b> National consultant 31,500 Travel 48,000 DSA 37,600 Workshops 6,000 Printing 4,000 Miscellaneous 4,000</p>

Outcomes	Outcome Targets	Outputs	Output Indicators	Means of Verification Outcome Level		Responsible Parties	Inputs & Cost (US\$)
				Method	Timing		
the possible climate change effects 50 years from now.		<p><b>5.3</b> Interpretive signs and small-scale models of coastal processes designed and installed at each site, explaining the science of climate change and coastal processes (in lay terms), so that the linkages between weather, stability of coastal features, and adaptation measures are clear.</p> <p><b>5.4</b> Public awareness campaigns on climate change in the coastal zone designed and delivered, involving the Mauritian media (TV, radio, Internet).</p>	<p><b>5.3</b> Interpretive models and signs installed at each of the three coastal sites.</p> <p>5.2. These sites marketed and visitor attendance recorded.</p> <p><b>5.4</b> Relevant public awareness campaigns designed and delivered.</p> <p><b>5.4</b> Increasing public awareness of the coastal adaptation issues and possible</p>				<p><b>Total</b> <b>131,100</b> <b>(32,775 in each of 2012, 2013, 2014, 2015)</b></p> <p><b>5.3</b> International consultant 33,000 National consultant 42,000 Travel 3,500 DSA 14,100 Model materials, signage, and operational costs 25,000 Printing 12,000 Miscellaneous 6,000 <b>Total</b> <b>135,600 (in 2013)</b></p> <p><b>5.4</b> International consultant 16,500 National consultant 31,500 Travel 3,500</p>

Outcomes	Outcome Targets	Outputs	Output Indicators	Means of Verification Outcome Level		Responsible Parties	Inputs & Cost (US\$)
				Method	Timing		
			solutions.				DSA 7,050 Materials and Printing 12,000 Airtime 50,000 Miscellaneous 5,000 <b>Total</b> <b>125,550</b> <b>(70,550 in 2012; 18,333 in each of 2013, 2014, 2015)</b>
		<b>5.5</b> Priority ranking of vulnerable coastal sites established, to guide the order of future investment by the Government of Mauritius and the private sector.	<b>5.5</b> All vulnerable coastal sites in ROM mapped, scaled, and assessed for importance and degree of risk to climate change in the future.  <b>5.5</b> Replication of coastal adaptation measures initiated, with Government of Mauritius and private sector funding.				<b>5.5</b> International consultant 16,500 National consultant 42,000 Travel 3,500 DSA 7,050 Workshops 8,000 Printing 4,000 Miscellaneous 2,000 <b>Total</b> <b>83,050 (in 2013)</b>
<b>Total Inputs (February 2011 – February 2016)</b>							<b>US\$ 7,904,830</b>

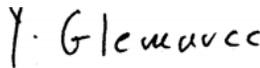


**PART IV: ENDORSEMENT BY GOVERNMENT AND CERTIFICATION BY THE IMPLEMENTING ENTITY**

**A. RECORD OF ENDORSEMENT ON BEHALF OF THE GOVERNMENT<sup>35</sup>** *Provide the name and position of the government official and indicate date of endorsement. If this is a regional project/programme, list the endorsing officials all the participating countries. The endorsement letter(s) should be attached as an annex to the project/programme proposal. Please attach the endorsement letter(s) with this template; add as many participating governments if a regional project/programme:*

Mr Ali Mansoor Financial Secretary Ministry of Finance and Economic Development	Date: (Month, day, year)
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**B. IMPLEMENTING ENTITY CERTIFICATION** *Provide the name and signature of the Implementing Entity Coordinator and the date of signature. Provide also the project/programme contact person's name, telephone number and email address*

I certify that this proposal has been prepared in accordance with guidelines provided by the Adaptation Fund Board, and prevailing National Development and Adaptation Plans and subject to the approval by the Adaptation Fund Board, understands that the Implementing Entity will be fully (legally and financially) responsible for the implementation of this project.	
 Yannick Glemarec Director Environmental Finance Implementing Entity Coordinator	
Date: (October, 22, 2010)	Tel. and email: +1 – 212 906-6843 <a href="mailto:yannick.glemarec@undp.org">yannick.glemarec@undp.org</a> .
Project Contact Person: Jessica Troni	
Tel. And Email: + 27 12 354 8056 <a href="mailto:jessica.troni@undp.org">jessica.troni@undp.org</a>	

<sup>35</sup> Each Party shall designate and communicate to the Secretariat the authority that will endorse on behalf of the national government the projects and programmes proposed by the implementing entities.

**Annex 1 UNDP Environmental Finance – Specialized Technical Services**

<b>Stage</b>	<b>Specialized Technical Services Provided</b>
<b>Identification, Sourcing and Screening of Ideas</b>	Provide information on substantive issues and specialized funding opportunities (SOFs)
	Verify soundness and potential eligibility of identified idea
<b>Feasibility Assessment / Due Diligence Review</b>	Technical support: provide up-front guidance; sourcing of technical expertise; verification of technical reports and project conceptualization; guidance on SOF expectations and requirements
	Provide detailed screening against technical, financial, social and risk criteria and provide statement of likely eligibility against identified SOF
	Assist in identifying technical partners; Validate partner technical abilities.
	Obtain clearances – SOF
<b>Development &amp; Preparation</b>	Technical support, backstopping and troubleshooting
	Technical support: sourcing of technical expertise; verification of technical reports and project conceptualization; guidance on SOF expectations and requirements
	Verify technical soundness, quality of preparation, and match with SOF expectations
	Negotiate and obtain clearances by SOF
	Respond to information requests, arrange revisions etc.
	Verify technical soundness, quality of preparation, and match with SOF expectations
<b>Implementation</b>	Technical and SOF Oversight and support
	Technical support in preparing TOR and verifying expertise for technical positions. Verification of technical validity / match with SOF expectations of inception report. Participate in Inception Workshop
	Technical information and support as needed
	Technical support, participation as necessary
	Advisory services as required
	Allocation of ASLs
	Technical support and troubleshooting, Support missions as necessary.
	Project visits – at least one technical support visit per year.

Stage	Specialized Technical Services Provided
	Technical support, validation, quality assurance
	Return of unspent funds
<b>Evaluation and Reporting</b>	Technical support, progress monitoring, validation, quality assurance
	Technical support, participation as necessary
	Technical support in preparing TOR and verifying expertise for technical positions. Verification of technical validity / match with SOF expectations of inception report. Participate in briefing / debriefing
	Technical analysis, compilation of lessons, validation of results
	Dissemination of technical findings

**Service standards:**

1. initial response to communication within 2 working days
2. full response to communication (with the exception of a response requiring travel) within 10 working days