ADAPTATION FUND

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PROJECT/PROGRAMME PROPOSAL

PART I: PROJECT/PROGRAMME INFORMATION

PROJECT/PROGRAMME CATEGORY:	REGULAR PROJECT/PROGRAMME
COUNTRY/IES:	SEYCHELLES
SECTOR/S:	WATER RESOURCES
TITLE OF PROJECT/PROGRAMME:	Ecosystem Based Adaptation to Climate Change in Seychelles
TYPE OF IMPLEMENTING ENTITY:	MULTILATERAL IMPLEMENTING ENTITY
IMPLEMENTING ENTITY:	UNITED NATIONS DEVELOPMENT PROGRAMME
EXECUTING ENTITY/IES:	MINISTRY OF ENVIRONMENT AND ENERGY
AMOUNT OF FINANCING REQUESTED:	$ 6,455,750 (IN U.S DOLLARS EQUIVALENT)
UNDP PIMS NUMBER:	4775

PROJECT / PROGRAMME BACKGROUND AND CONTEXT:

Short Summary

The proposed project seeks to reduce the vulnerability of the Seychelles to climate change, focusing on two key issues—water scarcity and flooding. The climate change projections in the Seychelles show that rainfall, while increasing in overall terms, will become even more irregular. Much of the precipitation is falling in sharp bursts, creating heavy flooding in the wet season, while imposing extended period of drought during the dry season. As the country does not have a large water storage capacity, and the topography of the islands constrains such infrastructure, water supplies are heavily dependent on rainfall. Furthermore, the coastal zone is vulnerable to flooding as a consequence of rising sea surface levels, and increased storm surges from cyclonic activity in the Western Indian Ocean. The project will reduce these vulnerabilities by spearheading ecosystem-based adaptation as climate change risk management—restoring ecosystem functionality, and enhancing ecosystem resilience and sustaining watershed and coastal processes in order to secure critical water provisioning and flood attenuation ecosystem services from watersheds and coastal areas.

Three project components are proposed:

Component 1 will maintain and enhance upland wetlands in watersheds and strengthen the integrity of the forest landscape and the forest water provisioning services (through reforestation and removal of invasive alien species and re-colonize with native plants), retain and improve water holding capacity (and biodiversity features), improving run-of-river barrages and water control structures, sustainably managing watercourses and promoting local stewardship of watersheds. The watershed rehabilitation will be implemented in selected watersheds covering 1,800 ha on Mahe Island and about 1,200 hectares on Praslin Island.

Component 2 will maintain and enhance tidal wetlands, beach berms and coral reef functions with EbA measures that include (a) selective shoreline re-vegetation and protection, (b) wetland enhancement and improvement of tidal exchange, (c) coral reef rehabilitation, enhancement and protection to enhance their climate change adaptation role in flood attenuation, and (d) measures that address saltwater intrusion effects on low lying agricultural areas focusing strategically on sites with high vulnerability to climate change (assets at risk). The interventions will focus on two priority sites where coastal development, erosion and climate change have diminished the natural coastal defenses and opportunities exist to

strengthen the ecosystem attributes and processes. These physical measures will be complemented with policy, legal and institutional capacity development support measures in Component 3. The coastal rehabilitation will be implemented at two sites covering an impact area of about 1,000 ha.

Component 3 will develop the policy framework for watershed management which is needed to support EbA measures to address water scarcity and flooding problems and will increase the capacity to respond to climate change through watershed and coastal management. It will also generate appropriate legislation, regulations, standards and guidelines for watershed and coastal protection, and train government, university faculty and NGO staff in applying EbA measures in development decision making in the Seychelles, influencing watershed and coastal management throughout the Mahe and Praslin Islands (covering approximately 20,000 hectares). This component will also increase the awareness, skills and responsibilities of a wide range of stakeholders including district authorities and community organisations in ecosystem-based adaptation for watersheds and coastal areas, and build the lasting basis for further education, training and application in watershed and coastal ecosystem rehabilitation.

Ecosystem-based adaptation has developed internationally in recognition of the importance of maintaining the ecosystem attributes and functions including hydrological systems and coastal dynamics that underpin the ability to respond to climate change[1]. The underlying principle is that healthy ecosystems can play a vital role in maintaining and increasing resilience to climate change and in reducing climate-related risk and vulnerability.[2] The project will invest in measures to restore ecosystem functionality, building on techniques that have been piloted in Seychelles, and adapting these by incorporating other good practices. Ecosystem based adaptation will be integrated into the country's development planning, policy and land and water management systems, ensuring that environmental impact assessments and management measures protect these ecosystem services.

"Ecosystem-based adaptation" in the context of Seychelles climate change issues and this proposal refers to *the conservation, rehabilitation and enhancement of watercourses, ecosystems, and habitats in order to increase the capability to adapt to changes in temperature, precipitation, storms and sea level rise that affect watershed management and coastal protection.* The watershed and coastal processes that influence the bio-physical landscape are inherently linked to ecosystem attributes and functions. For example, maintaining the hydrological balance in a watershed and utilizing the natural water retention and infiltration properties of the geology, soils and vegetation is central to ecosystem-based adaptation. A drainage basin perspective is necessary for understanding the upstream-downstream connectivity of water supplies, water demands, and emerging water problems.[3] Secondly, maintaining landscape connectivity ensures that the ecosystem functions within forests, wetlands, mangroves, dunes and reefs are part of the system of inter-connected defences and mitigating influences to adapt to climate change.

Environmental and Socioeconomic Context

The Seychelles consists of 115 islands (see **Figure 1**) of which some 40 are granitic and the rest coral formations. The islands are located within 4º and 9º south of the equator and between longitude 46º and 57º east. The country has a land mass of 455.3 km^2, and an Exclusive Economic Zone (EEZ) covering 1,374 million km^2. The four largest granitic islands: Mahé, Praslin, Silhouette and La Digue, which vary in age from some 650 to 750 million years, together account for 48.6 % of the total landmass. The archipelago has a combined coastline of 491 km. The natural ecosystems

[1] See Andrade Pérez, A., Herrera Fernandez, B. and Cazzolla Gatti, R. (eds.) (2010). *Building Resilience to Climate Change: Ecosystem-based adaptation and lessons from the field.* Gland, Switzerland: IUCN.

[2] UNFCCC, Subsidiary Body for Scientific and Technological Advice, Ecosystem-based approaches to adaptation: compilation of information, Durban, 28 November to 3 December 2011

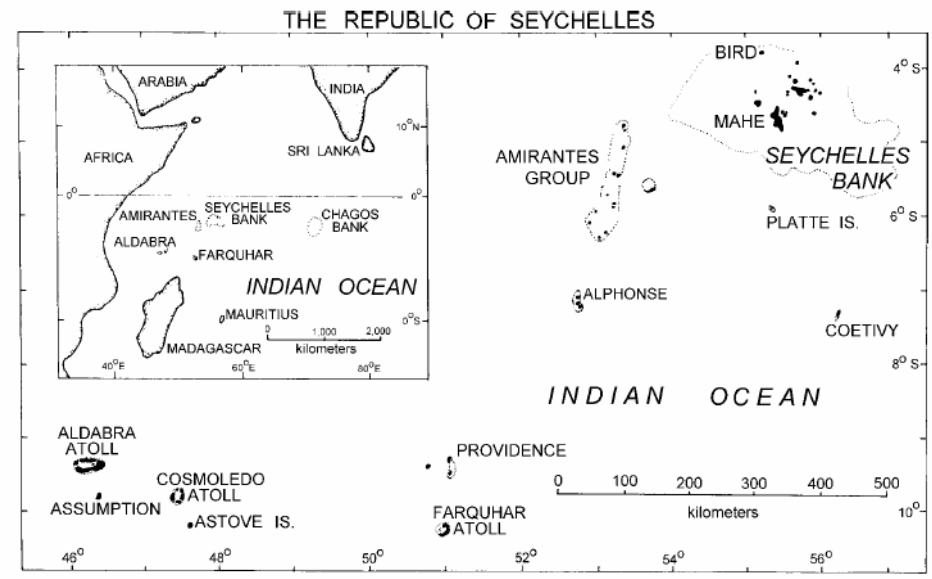
[3] Douglas Ellen M., Kate Sebastian, Charles J. Vörösmarty, Stanley Wood, Kenneth M. Chomitz, *The Role of Tropical Forests in Supporting Biodiversity and Hydrological Integrity A Synoptic Overview*, World Bank Policy Research Working Paper 3635, June 2005, p.3.

of the Granitic islands range from beach and dune vegetation on the coastal fringe, lowland and coastal forests up to 200-300m, intermediate forests from 200 to 500m altitude and mountain mist forests over 400-500m. Coastal environments include a variety of wetland types, rocky shores and sandy shores. The coral islands are characterized by mixed scrub vegetation. The majority of the islands are fringed by coral reefs many of which were adversely affected by the mass coral bleaching event of 1998 which was caused by abnormally warm surface sea temperatures[4]. The archipelago's coral reefs cover an area of 1,690 km^2 and include fringing reefs, atolls and platform reefs.

The prevailing climate of the archipelago is equatorial. Humidity is uniformly high and mean temperatures at sea level range from 24ºC to 30ºC. The average annual rainfall is 2,200 mm. The prevailing winds bring the wet northwest monsoon from December to March and the drier southeast monsoon from May to October, with heavier wind. Climatic conditions, however, vary considerably between islands, mainly in relation to their altitudes and location. Rainfall can be as high as 5,000 mm per year on the top of the highest peak (900 m) on the island of Mahé, and as low as 867 mm on the coralline island of Assumption. High intensity rainfall, with intermittent heavy downpours and even occasional torrential rains (up to 250 mm/day) may occur from December to March. The main granitic islands lie to the north of the Western Indian Ocean cyclone belt, but they can occasionally suffer from heavy seas and storm surges from cyclonic activity occurring to the south.

The proposed project will target the uplands and the coastal plateaus of the main granitic islands of Mahé and Praslin, but the outputs will have a bearing on adaptation strategies on the other islands (see **Figure 1 and 2**).

Figure 1: Location of the Seychelles Archipelago

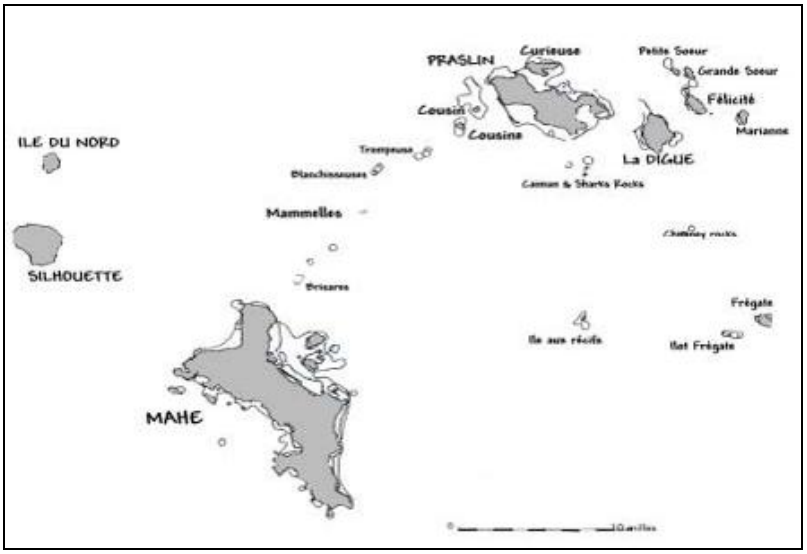


The Seychelles has been inhabited by humans since 1770. The country has a current population of 88,311 (51% men and 49% women)[5]. The bulk of the population resides on the narrow coastal plains of the three granitic islands of Mahé, Praslin and La Digue, where economic activities are also concentrated. Mahé in particular has about 90% of the total population, with some 40% located on the east coast in a coastal belt of 7 km by 1 km to the south of the capital, Victoria. Migration from Praslin and La Digue to Mahé continues to be significant, the main driving force being improved economic and social welfare prospects (employment, education and housing). The

[4] Payet, R.A. Coral Reefs in Small Island States: Status, Monitoring Capacity and Management Priorities. Int. J. of Island Affairs, Special Issue: Island Biodiversity – Sustaining Life in Vulnerable Ecosystems (February 2004). Pp. 57 – 65.
[5] Population and Housing Census 2010.

scarcity of land has prompted the reclamation from the sea of more than 500 hectares of land on the North East of Mahé. This has partly been undertaken to avoid the encroachment of human settlements on the island's forests, which cloak the steep hills that characterize its hinterland.

Figure 2: Inner Granitic Islands



The Human Development Report 2010 classified Seychelles among the list of countries having achieved high human development, with a Human Development Index (HDI) value of 0.836 and a GDP per capita of US$ 9,028[6]. Seychelles ranks amongst the highest within countries in Africa for several human development indicators with a life expectancy in 2009 of 68.4 years (male) and 77.9 years (female), primary school enrolment of 100% for both boys and girls, and an adult literacy rate of 90.8% (both men and women). However, since the beginning of the 1990's, Official Development Assistance (ODA) flows have fallen by over 90% and this has placed a financial burden on the Government's budget. Together with the increased need to borrow from commercial institutions, this has led to a slowdown of the economy resulting from a severe shortage of foreign exchange.

The Seychelles has been transformed from a quasi mono-crop agricultural economy (based on cinnamon and coconut) to a dual economy heavily dependent on tourism and fishing. Today, the main production sectors of Seychelles are fisheries and tourism. The fisheries sector is critically important for assuring food security and economic development. In terms of foreign exchange, it surpasses tourism, although the number of people employed in the sector remains relatively low, accounting for 15% of total formal employment. However, artisanal fisheries remain of great importance in terms of assuring food security for communities, and generating local employment. The tourism sector currently contributes 25.6% of the GDP (2009 data) and agriculture 1.6%.

The proposed project will target the coastal zones and hinterland of the two main granitic islands (Mahe and Praslin) of Seychelles (see Figure 2). The coastal zone includes as a minimum, 'all the inter-tidal and supra-tidal areas of the water's edge; specifically all the coastal floodplains, mangroves, marshes and tide-flats as well as beaches and dunes and fringing coral reefs.'[7]. Further, due to the small size of the islands, the entire land area of Seychelles is regarded as coastal zone[8]. For the purpose of this proposal reference to the islands or coastal zone will imply all terrestrial areas and the sea are up to the fringing reefs.

The table below provides information on the main economic activities in the target area.

[6] Indicative Estimate for 2009
[7] Clark, J.R. 1996. *Coastal Zone Management Handbook*. New York: Lewis Publishers.
[8] MFF, 2009. *Mangroves for the Future Initiative. National Strategy and Action Plan 2010 – 2013. Seychelles.*

	The Coastal Zone of the Inner Granitic Islands
Socio-economic context and land uses	The main production sectors of granitic islands are tourism and agriculture[9]. *Tourism:* Prior to completion of the international airport in 1971, the only access to Seychelles was by boat. The tourism industry expanded greatly after the opening of the airport. Tourism arrivals increased steadily for the first 25 years, reaching 47,280 by 1982 and peaking at 130,955 in 1996. Arrivals declined gradually to 124,865 in 1999, before recovering to 130,046 in 2000, and then increasing to 174,529 in 2010. The Seychellois tourism sector contributed 46.1% of the country's GDP in 2010 and directly provided for 56.4% of national employment. It generated US$ 382.5 million of foreign exchange, or 33.2% of the country's foreign exchange earnings in 2010. The contribution of tourism to the national economy is much more significant, since these statistics do not take into account the economic multiplier effect that is spawned by the industry and the creation of value added in other sectors. *Agriculture:* Agricultural development in the Seychelles went through major changes from the 1800's through to 1960, moving away from food production and into a cash crop economy with copra as the main crop and cinnamon in a lesser position. With the growth of the tourism industry, there was a major exodus of labour from agriculture into construction, tourism and other related sectors. The production of traditional crops declined drastically. Agriculture in Seychelles is now characterized by small farms with an average size of 0.5 hectares and rarely exceeding 2 hectares. Farmers employ various levels of technology and management, some of it fairly sophisticated. Currently, about 500 registered farms are dispersed throughout the major granitic islands of Mahé, Praslin and La Digue, where they are mostly found on the coastal plateau. Current agricultural production meets about 4% of the local demand for beef, 50% for pork, 60 – 70% for vegetables and fruit, 80% for poultry and 100% for eggs. Cinnamon and coconut production have dropped considerably in the last 10 years. Agriculture employs around 3,800 persons and currently accounts for about 3.8% of GDP. *Physical Development:* The land area suitable for development is limited. A significant proportion of the main granitic islands of Mahé, Praslin and La Digue is urbanized. The pressure for residential development is strong on the coastal area and the lower parts of the mountains.

Problem Statement: Vulnerability of Island Ecosystems and Communities to Climate Change

The Seychelles is economically, culturally and environmentally vulnerable to the effects of climate change and associated extreme weather events[10]. The effects of climate change are already noticeable in Seychelles and these effects and their associated impacts are projected to escalate in the future. The two biggest climate change vulnerabilities are water scarcity and coastal flooding.

1. Water Scarcity

Fresh water is crucial both for human needs which are indispensable for well-being, such as drinking and sanitation, as well as other sectoral uses which are intrinsic to the development

[9] Fisheries is not considered as a major production sector in the coastal zone, as most fish is caught beyond the fringing reef.
[10] The Seychelles National Climate Change Committee, 2009. Seychelles National Climate Change Strategy.

process (tourism/agriculture). Although the country receives a relatively high average annual precipitation quotient of 2,200 mm of rainfall, the Seychelles is water stressed[11]. The country ranks well in terms of water access comparators - 93% of the population has access to piped water supplies. In 2009, total water demand amounted to 24,489 m^3/day. However, the country has limited capacity to store water. The steep terrain of Mahé and Praslin has prevented the development of dams on rivers. Instead water is pumped from rivers (a few small impoundments have been built to capture water in stream, namely Cascade, Le Noil and Rochon Sites (total capacity 119,000m^3), directly to treatment plants for supply to customers. Excess water is also pumped to a high holding reservoir (La Gogue Dam - capacity 150,000m^3), without its own catchment. This creates a problem during dry spells, when stream base flows can drop dramatically. During such periods, the water supply system is severely stretched to meet demand. Demand for water is growing rapidly at a rate of 8% annually, and is likely to increase as a result of tourism growth. With approximately 18% of the annual water sales in Seychelles attributed to the tourism sector, this growth will have a large impact on water resources especially in terms of planned doubling of available tourism rooms from 6,000 to 12,000 in the next three decades. Similarly, as fishery processing activities increase and diversify, they are expected to draw more water. The agricultural sector, which is heavily dependent on water, will also grow over the next three decades (estimated at 1.2 % per year) which will put additional stress on available water resources.

The annual rainfall over the main granitic islands is increasing; annual trends on Mahé for the period 1972 to 2006 showed an increase of 13.7 mm per year. This increase may be attributed to a few episodic heavy rainfall events and is not evenly distributed across the year[12]. Based on constructed climate scenarios for the islands of Mahé and Aldabra[13], it is concluded that in future the rainy season in Seychelles is 'more likely than not' to be wetter, while the dry season is 'more likely than not' to be drier - a situation already emerging in the 1972 - 2006 interval.

The scenarios indicate that the impacts of climate change on Seychelles' water resources are expected to be severe. The dry southeast monsoon season is expected to become drier and the period between rainfall events during this season is likely to become longer. This will have impacts on stream flow. The water storage capacity in Seychelles will be severely challenged as a consequence.

During prolonged climate changed induced dry spells, stream flows are expected to decrease and at times stop. This will have serious consequences for coastal communities. Further, due to the limited water storage capacity, the country will not be able to benefit from increased rainfall during the wet Northwest monsoon. The climate models predict that rainfall during this period will be more intense, falling in short sharp bursts (such sporadic rainfall events accounting for the overall increase in rainfall).much of this is likely to run off into the sea.

The rainfall – stream flow relationships are illustrated on **Figure 3** graph of mean rainfall and flows (1978-2005) on the Le Noi and Cascade rivers showing a high correlation between rainfall and stream flow in the wetter parts of the island.[14] The river systems are very responsive to rainfall patterns because of the generally small catchment areas and the high runoff rates associated with steep slopes, intense rainfall events and limited infiltration controls.

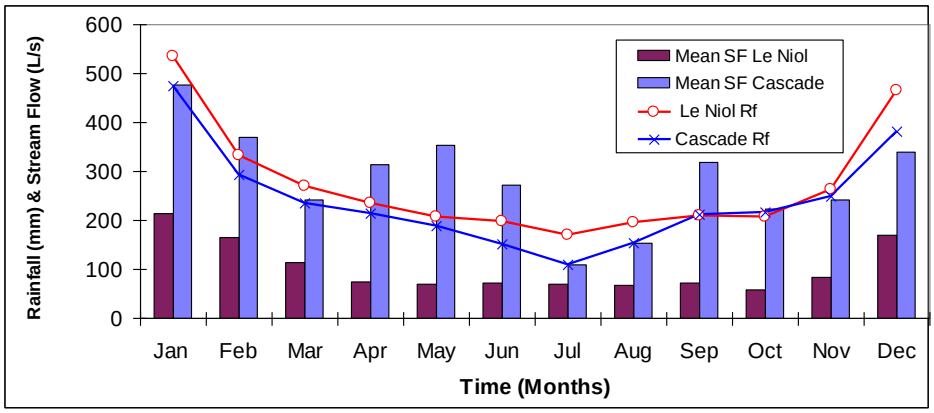
[11] An area is considered 'water stressed' if the per capita water availability is below 1000m^3 per year, or if there is a ratio of withdrawals to average annual run-off (water from rain, snowmelt, and irrigation, which is not absorbed by the ground or evaporated of over 0.4.

[12] Lajoie, F. R. 2004. Report on the WMO/CLIVAR ETCCDMI African Workshop on Extremes. Seychelles.

[13] Chang-Seng, D. 2007. Climate Change Scenario Assessment for the Seychelles, Second National Communication (SNC) under the United Nations Framework Convention on Climate Change (UNFCCC), National Climate Change Committee, Seychelles. Also see Annex 3 for summary of methodology and conclusions.

[14] Denis Chang-Seng and Theodore Marguerite, *Hydro-Climate Statistical Multivariate Model of Seychelles' Dry Season, Seychelles*, Second National Communications, UNFCCC, Seychelles' National Climate Change Committee, Ministry of Environment, Natural Resources and Transport, Nov. 2007.

Figure 3: Rainfall (Rf)-Stream Flow (SF) Relationship



Source: Denis Chang-Seng and Theodore Marguerite, 2007.

The warming in the Seychelles region, over the period 1972 – 1997, is estimated to be of the range of 0.25ºC[15]. Analysis by Lajoie (2004) indicated that the number of very warm days and nights is increasing dramatically while the number of very cool days and nights are decreasing. Chang-Seng[16] established that the mean air temperature Seychelles is *more likely than not* to warm by +3.0 ° C by the end of this century. The relative rate of warming will occur mainly during the cooler southeast monsoon. Given this projected increase in surface temperatures, evaporation will also increase putting more demand on the water storage facilities. The demand for water by the human population will also increase during hot periods causing heat stress, as a result of increased irrigation, cooling and sanitation uses.

2. Coastal Flooding

As mentioned above, the annual rainfall over the main granitic islands is increasing; annual trends showing an increase. This increase may be attributed to a few episodic heavy rainfall events and is not distributed evenly across the year. The climate models also predict that rainfall during the raining period will be more intense, falling in short sharp busts. These rainfall spells, together with the steep topography of the islands, lead to coastal floods. This is exacerbated by the inherent backward sloping of the coastal plain and a high water table in the coastal plain[17].

Further, the warming of the atmosphere, which has happened globally and estimated at approximately 0.7ºC since 1900[18] has caused the average temperature of the global ocean to increase to depths of more than 3 km. The thermal expansion occurring as a consequence of the increased ocean temperature, as well as a smaller, yet significant effect of discharge of additional water into the oceans as terrestrial ice and snow melt, has led to a rise in sea level. The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report estimated an average rate of 1.8 mm (with a range of 1.3 to 2.3 mm) per year global sea level rise and predicted that this would continue. The limited data on sea level rise in Seychelles makes any conclusive

[15] Payet, R. A. & Agricole, W. 2006. Climate Change in the Seychelles – Implications for Water and Coral Reefs. AMBIO, 35 (4): 182 – 189.
[16] Chang-Seng, D. 2007. Climate Change Scenario Assessment for the Seychelles, Second National Communication (SNC) under the United Nations Framework Convention on Climate Change (UNFCCC), National Climate Change Committee, Seychelles. Also see annex for summary of methodology and conclusions.
[17] Seychelles Agricultural Agency (SAA), 2011. Manual for Best Practices in Soil Conservation and Soil Management for Farmers in the Seychelles. P.7.
[18] Stern, N. 2007. The Economics of Climate Change: The Stern Review. Cambridge University Press, Cambridge, pp. 3 – 24.

assessment difficult but it has been estimated that sea level is rising by 1.46 mm per year around Mahé[19].

The Western Indian Ocean region experiences severe tropical cyclones. Tropical cyclone trajectories do not come close to the main populated islands of the Seychelles, as they are located close to the equator and in the Indian Ocean, cyclones are more generally prevalent South of the Equator South of 10ºS[20]. However, it is important to note that extreme rainfall and wave swells resulting from Indian Ocean tropical cyclones do affect the Seychelles and need to be taken into consideration[21]. Chang-Seng[22] concluded that the trend for the number of tropical depressions in the Seychelles is +0.025 and that since 1990, Seychelles has recorded an increase in tropical storms which formed and moved near the granitic islands of Seychelles. This is projected to increase as a result of climate change. With increased peak winds[23], the wave action affecting the coastal areas of Seychelles has increased as a result of climate change. **Annex 3** provides a summary of the climate change scenario.

Sea level rise also exacerbates coastal erosion as the waves reach further inland at high tide. Shore wave heights are limited by water depths, so with the increase in sea level, the height of waves will increase. Nicholls et. al. (2002)[24] estimate that without adaptation a 1 meter rise in sea level will produce a 14-fold increase in flooding compared to the situation without sea-level rise. Under a lower sea-level rise scenario of 38cm by the 2080s, the global increase in flooding will be seven-fold compared with the situation without sea-level rise. They also forecast that large relative increases in flooding will be felt in the small island region of the Indian Ocean, which includes the Seychelles. For the same reason flooding in the coastal strips is increased, affecting urban areas in low elevation coastal zones.

Barriers to Addressing the Climate Change-Induced Problems

The Government of Seychelles has developed a national framework for climate change mitigation and adaptation responses, for example establishing the Seychelles National Climate Change Committee and a Climate and Environmental Services Division in the Ministry of Environment and Energy. However, barriers exist which prevent the Government and communities from addressing the two afore-mentioned climate change-induced vulnerabilities.

Ecosystems play an important role in determining the vulnerability of communities to climate change—particularly in Small Island Developing States such as the Seychelles. The forests and wetlands of the granitic islands play an important role in regulating stream flows and water quality. Forested land binds the soil, thereby decreasing soil erosion and increasing the capacity of soils to absorb and retain water. This allows water to penetrate deeper into the soil, allowing for less runoff and slower release. Wetlands and riparian vegetation also assist in the reduction of erosion and slow discharge of water from the watershed over a longer period of time. This will have two benefits in ameliorating the effects of climate change on water supplies - providing more regular stream flow during the lengthier dry season, while buffering against flooding following intense rainfall events. Similarly, mangroves and fringing coral reefs protect coastal land against coastal erosion, while

[19] Chang-Seng, D. 2007. Climate Change Scenario Assessment for the Seychelles, Second National Communication (SNC) under the United Nations Framework Convention on Climate Change (UNFCCC), National Climate Change Committee, Seychelles.

[20] In the West Indian Ocean cyclones form west of 100ºE and travel eastwards to the East Africa coast in the period from December to April. Cyclones normally form South of 10ºS—hence South of the Seychelles.

[21] The Seychelles National Climate Change Committee, 2009. Seychelles National Climate Change Strategy.

[22] Chang-Seng, D. 2007. Climate Variability and Climate Change assessment for the Seychelles, Second National Communication (SNC) under the United Nations Framework Convention on Climate Change (UNFCCC), National Climate Change Committee, Seychelles.

[23] Ibid., 2007.

[24] Nicholls, R.J. & Hoozemans, F.M.J. 2002. *Global Vulnerability Analysis*. In Schwartz, M. (Ed). Encyclopedia of Coastal Science, Kluwer Academic Publishers.

coastal sand dunes and wetlands play an important role in controlling coastal flooding. These flood attenuation services are likely to be critical given projected climate change induced flooding risks.

Overcoming the effects of historical land use is a barrier to sustainable water management. Past agricultural practices in Seychelles' plantation economy (from 1800 to early 1970s) transformed the landscapes with a focus on coconut, cinnamon, patchouli, vanilla and more recently tea cultivation. This has left an ecological legacy of soil loss, weak soil fertility and the presence of many invasive species. Varley (1971) and Moustache et. al. (2011) have described the role of human intervention on the granitic islands and the subsequent effects on drainage and soil fertility:

> *Rainfall impact onto the ground was braced by the canopy when the forest had full cover. Once the primary vegetation was removed some 200 years ago on the bulk of the main granitic islands, a series of factors were set in motion to destroy the soil fertility. The removal of the primary forests meant that rain impacted directly onto the ground with the consequence of organic matter containing a large percentage of the circulating plant nutrients were washed away.*[25]

A coastal issue related to climate change (increased sea level) is the increase salt water intrusion in some of the agricultural lands. Every year in Seychelles especially during the dry season, coastal farmers face great loss of vegetable products as a result of high salinity with reported cases of 8 mS/cm which is nearly one quarter of the salinity of sea water. Seychelles crop production sector include 75-80% vegetable that are highly salt intolerant. Their sensitivity to salinity makes it difficult for them to adapt and therefore leads to high economic loss to the farmers.[26]

Fire prevention and management is also a key issue that is affected by land use practices and ecosystem management, including the extensive historical use of exotic species for both agriculture and erosion control. The forests of Mahe and Praslin are particularly vulnerable to fire because of the dry conditions and the flammable nature of the generally abundant understory and decaying organic material that is subject to further drying from logging or fires. On Praslin, there is an estimated 271 ha of deforested land and a history of 70 recorded wild fires.[27] Some 850 ha are classified as being very high potential fire ignition risk (Senterre, 2009, Table 4). These areas contain the sites of primary interest for watershed rehabilitation. In addition, the areas of high fire hazard risk can be considered in need of fire prevention measures.[28]

There is growing understanding globally and evidence that such ecosystem services will play a major role in mitigating the adverse effects of climate change and in assisting human societies to adapt to its impacts. However, in Seychelles, inadequate attention has thus far been paid to this aspect. The country has made a major investment in protecting biodiversity, and maintaining the scenic values that underpin the tourism industry. This has manifested itself in the creation of an impressive protected area system, covering 47 % of the country, and in much lauded species recovery efforts. However, outside protected area, unplanned and fragmented development activities occurring over the past 30 years, without due consideration to climate change, have led to degradation of ecosystems, and the associated impairment of ecosystem services. Infrastructure development has led to forest loss and degradation in the hinterland. The opening up of forests resulted in the spread of invasive alien species (IAS) with most of the country's forests and wetlands now invaded with high-water use alien species especially along the riparian zones. These

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[25] Moustache A.M., Ibid., 2010, p. 20. (Varley J.A. reference: *Soil analysis and agricultural research in the Seychelles, Report of a visit March-April 1971*, Misc Rpt 119 Foreign and Commonwealth Office, Overseas Development Administration, London, 1971)

[26] Government of Seychelles, *Proposal -Surveying & Monitoring of Coastal Agricultural Area for the Management of Soil Salinity and Sodicity as a Result of Climate Change,* 2012.

[27] Senterre, Bruno, *Forest Fire Risk Assessment on Seychelles Main Granitic Island*, 2009, p. 16-17.

[28] These include: Pointe Chevalier - Zimbabwe - Savoie - Newcome - L'Amitié; Zimbabwe - Salazie - Midlands - Nouvelle Découverte; Hills above Baie Sainte Anne Eastern Praslin National Park; Fond D'Albaretz - Fond Ferdinand – Consolation; Pointe Cabris; Newcome - L'Amitié hills; and Slopes at east of Anse La Blague (Senterre, *Forest Fire Risk Assessment on Seychelles Main Granitic Island*, 2009, pp. 27-28)

species out-compete native species, and do not possess the soil-binding and water regulation functions that the indigenous species have. The modification of coastal habitats such as wetlands and mangroves has been driven by beach front developments for housing, hotels and roads, which has resulted in the removal of coastal vegetation from dune land, thus increasing the vulnerability of beaches to erosion.

The modification of coastal ecosystems is understandable, given the country's geographical constraints as upland areas are mostly unsuitable for agriculture or other types of development. On the coastal areas, where land is at a premium, reclamation has been practiced extensively ever since the islands were first settled. Much of the development that has led to ecosystem modification involved the construction of infrastructure for tourism, housing and recreation, which has benefited the populace. The loss in ecosystem functionality and the consequent impairment of ecosystem services might not have been calamitous, absent climate change. But given climate change, it is a serious concern as it has the consequence of undermining the country's adaptive capacity potential.

There is an urgent unmet need to expand the paradigm the country employs in reducing the vulnerability of the communities and economies to anthropogenic climate change by ensuring that ecosystem based climate risk management objectives are incorporated into the development agenda of Seychelles and taking account of the value of ecosystem services. This requires a paradigm shift in the ecosystem management approaches in Seychelles, from a focus on biodiversity protection and the maintenance of scenic values for tourism, to one that in addition caters for climate change risk management. Further, the approach to the water problem has been generally focused only on water supply infrastructure without sufficient attention on the conditions in the catchment areas or watersheds. The larger scale landscape and watershed perspective is often missing. However, limited experience in ecological rehabilitation work and a lack of knowledge and capacity in ecosystem, watershed and wetland rehabilitation hinders the application of ecosystem based climate change adaptation measures. Although successful plantations to restore ground cover have been completed on some of the islands, there are few examples of comprehensive watershed rehabilitation. Small scale site efforts have occurred to replant a few burned areas, but no substantive recovery of degraded hillsides has to date been implemented and significant capacity and funding constraints are apparent in the existing efforts.

The weak institutional capacity of government and communities to address rehabilitation needs and manage ecosystems to ensure their resilience is a critical barrier to advancing ecosystem based approaches to climate change risk management. There is a notable lack of capacity to plan, monitor and enforce climate resilient land, water and coastal (LWC) use management systems at both national and local levels. The current laws and institutional mandates, including the lack of water policy, contain conspicuous gaps that leave uncertainty about responsibilities and capacity to implement watershed protection and rehabilitation and overall water management. Furthermore, ecosystem resilience to climate change is not presently being factored into land, water and coastal use planning, development activities and investment decisions (including Government budgetary allocations) in different economic sectors. Land use decisions are made primarily with a view to optimising yields and incomes from production activities. The informal custom of open access to and use of the hillside watersheds on Mahe and the casual approach to water management is being strained by increased development for housing and growing water demand. Consequently, LWC use planning has heretofore lacked a focus on managing ecosystem services to reduce vulnerability to climate change, irrespective of the adaptation benefits. Potential climate change risk management strategies will involve modifications to how development occurs in the coastal and near shore areas; adaptation measures at the interface between watersheds and coasts are more complex and may be limited in the ability to overcome long terms risks within the available sources of funding. Underlying reasons for the above barriers are knowledge barriers, such as insufficient awareness on climate change impacts and the necessity of supporting ecosystem resilience as an adaptation measure, and institutional and financing gaps in managing watersheds and coastal ecosystems. Seychelles, like other small island states, has difficulty sustaining environmental

programmes initiated by international projects due to capacity and resource limitations. The technologies must be appropriate and the approach must engage citizens and the private sector in problems that affect their daily lives.

PROJECT / PROGRAMME OBJECTIVES:

List the main objectives of the project.

The overall **goal** of the project is to ensure that development in the Seychelles is sustainable, and resilient to anticipated climate change effects. The **objective** is to incorporate ecosystem based adaptation into the country's climate change risk management system to safeguard water supplies, threatened by climate change induced perturbations in rainfall and to buffer expected enhanced erosion and coastal flooding risks arising as a result of higher sea levels and increased storm surge.

Project Strategy: An ecosystem-based adaptation approach will be applied to watershed and coastal rehabilitation on Mahe and Praslin to address water shortages and watershed and coastal flooding that have been accentuated by climate change.

The project will develop and implement EbA through a landscape and watershed strategy that builds upon the biodiversity conservation programmes to date in Seychelles in relation to restoring or rehabilitating ecosystem functions that support water supply and flood control services. The proposed strategy aims to maintain and enhance watershed and coastal processes using a combination of primarily ecosystem-related interventions that are adapted to the specific watershed and coastal climate change risks. The EbA concept is to "apply practical approaches to adaptation that utilize the services of healthy ecosystems,... appropriately integrated into broader adaptation and development strategies".[29]

Ecosystem based adaptation involves the management and rehabilitation of ecosystems through selected measures intended to increase the resilience to climate change, the general categories of which include increased biological measures (forest and wetland rehabilitation) to filter and trap runoff and sediments, increase rainfall infiltration and reduce forest fire risks within the catchment areas, re-vegetation and protection of shorelines from storm and human damages, enhanced flood control management of tidal wetlands to improve hydro-ecological processes, renovated and increased water detention structures to reduce runoff rates and enhance water balance, and enhanced awareness, policy and institutional development for both watershed and coastal stewardship of ecosystems.

These are joint EbA measures aimed at **strengthening the functional connectivity of ecosystems** by (a) maintaining essential *hydrological and inter-tidal processes* that support ecosystems, (b) maintaining the integrity and contiguity of forest landscapes with plant species that are suited to improving *watershed processes*, including runoff/infiltration and fire prevention, and (c) enhancing the *functional and spatial linkages* between the same and different ecosystem types – wetlands, forests, beach berms, reefs and their specific roles in providing for water supply and/or flood attenuation amidst the surrounding development pressures in the landscape.

Functional connectivity will be addressed in Component 1 by enhancing the vegetated groundcover and the watercourses that effect both ecosystem functions and hydrological processes, and thereby the landscape connectivity of the targeted watersheds. Restoring and maintaining the integrity of natural watershed processes at a landscape level from headwaters to adjacent downstream coastal ecosystems is central to the EbA approach presented in this project. The outputs from a habitat

[29] UNFCCC, *Ecosystem-based approaches to adaptation: compilation of Information*, Nov 16, 2011, P. 4.

perspective will include re-vegetated wetlands and forest stands with altered species mix and forest canopy that increase watershed landscape integrity.

In Component 2, this connectivity will be addressed by enhancing the stream channels and flows necessary to maintain effective wetlands, expanding the wetland and shoreline berm vegetation, improving tidal influence on wetlands and rehabilitating the fringing reefs at Anse Royale and NE Point. The outputs from a habitat perspective will include re-vegetated riparian streamsides, re-vegetated or restored wetland areas, intertidal complexes due to greater tidal exchange, re-vegetated beach berms and an expanded coral reef.

In watersheds, the primary objective is to alter the hydrographs in terms of increasing watershed retention of sufficient water to provide for minimum base flows during the dry season and reducing extreme peak flows that generate flooding problems. The EbA strategy is based on increasing upland wetland storage of water, modifying forest stands and canopy at strategic locations, enhancing vegetation ground cover, improving and expanding in-stream and off-channel water control structures that detain or store flow, reducing uncontrolled drainage and sediment inputs at key sites, and better managing the use of the water resources to address climate change risks.

In coastal areas, the primary objective is to restore or enhance the scale and functions of wetlands, beach berms and reefs to the extent possible, so that they are able to withstand increased flooding events. Various biological and physical measures are proposed at selected sites on Mahe through strengthening shoreline stability and vegetation, clearance of feeder and drainage channels and sea outfalls, enhancement of reef conditions, and land shaping/landscaping to enhance and sustain the hydrology. This will also involve measures such as the installation of tidal sluice gates to help manage the essential water flows necessary for healthy wetlands and applying different measures and practices to restore the services of soil to key agriculture areas of Seychelles.

PROJECT / PROGRAMME COMPONENTS AND FINANCING:

The following table describes indicative outputs and outcomes. **Annex 5** summarizes the alignment with Adaptation Fund objectives and indicators. Three sets of watershed outputs and two sets of coastal outputs form the concrete investment measures that have been proposed by the many stakeholders involved in the project design.

PROJECT COMPONENTS	EXPECTED OUTCOMES	EXPECTED CONCRETE OUTPUTS	AMOUNT (US$)
1. Ecosystem-based adaptation approach to enhancing freshwater security and flood control in Mahé and Praslin under conditions of climate change.	Vulnerable coastal communities benefit from enhanced ecosystem resilience and water harvesting capabilities in water catchment areas covering 3000 hectares.	1.1 Management and rehabilitation of critical watersheds to enhance functional connectivity and the resilience of these areas to climate change and reduce water scarcity and watershed flooding	2,193,783
		1.2 Small-scale water storage and detention facilities designed and constructed or rehabilitated in critical waterways for communities to benefit from enhanced ecosystem functioning by forests.	831,217
Total Cost Component and Outcome 1			**3,025,000**
2. Ecosystem-based adaptation approaches	Enhanced ecosystem integrity and	2.1 Ecosystem based measures for flood protection on an urban shoreline	1,168,195

along the shorelines of the Granitic Islands reduce the risks of climate change induced coastal flooding.	functional connectivity covering a total area of 1000 hectares in the coastal areas of Seychelles.	2.2 Ecosystem based measures for flood protection and mitigating salt water intrusion in an agricultural and tourism development area	826,805
Total Cost Component and Outcome 2			**1,995,000**
3. Ecosystem based adaptation mainstreamed into development planning and financing.	Coastal communities throughout the granitic islands actively support and benefit from the enhanced ecosystem water provisioning and flood buffering services provided across 20,000 hectares.	3.1 Policy and legal frameworks for watershed and coastal climate change adaptation	108,169
		3.2 Capacity development for ecosystem based adaptation methods	263,662
		3.3 Lessons learned and knowledge dissemination	108,169
Total Cost Component and Outcome 3			**480,000**
4. Project/Programme Execution cost (including M&E costs)			450,000
5. Total Project/Programme Cost			5,950,000
6. Project Cycle Management Fee charged by the Implementing Entity			505,750
Amount of Financing Requested			6,455,750

Annex 6 presents the detailed project budget information.

PROJECTED CALENDAR:
Indicate the dates of the following milestones for the proposed project/programme

MILESTONES	EXPECTED DATES	
Submission of Concept to AF Board	April 2011	✓
Approval of the Concept by the AF Board	June 2011	✓
Submission to AF of a Full Project Proposal	October 2012	
Approval of Full Project Proposal	December 2012	
Start of Project/Programme Implementation	February 2013	
Mid-term Review	February 2016	
Terminal Evaluation	November 2018	
Project Close	January 2019	

PART II: PROJECT 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.*

The project will implement results-oriented ecosystem based adaptation measures centered on the issues and opportunities identified by local stakeholders. It will focus on the development and application of technological solutions and tools for resolving specific vulnerability issues as a result of climate change in the main granitic islands of Seychelles. In doing so, the project will build on

technologies that have been used in similar contexts, or successfully tested at a pilot scale in the Seychelles (e.g., forest rehabilitation). The overall approach is to work from the level of technical solutions at specific watershed/coastal sites to the policy and regulatory level, such that future replication of adaptation measures will be catalysed, supported by new policies, guidelines, and awareness of watershed stewardship. Communities will be increasingly climate resilient and able to protect water supply and livelihoods that are linked to the integrity of the watersheds and coastal ecosystems on the Granitic islands.

"Ecosystem-based adaptation" in the context of Seychelles climate change issues and this proposal refers to ***the conservation, rehabilitation and enhancement of watercourses, ecosystems, and habitats in order to increase the capability to adapt to changes in temperature, precipitation, storms and sea level rise that affect watershed management and coastal protection***. The watershed and coastal processes that influence the bio-physical landscape are inherently linked to ecosystem attributes and functions. For example, maintaining the hydrological balance in a watershed and utilizing the natural water retention and infiltration properties of the geology, soils and vegetation is central to ecosystem-based adaptation. A drainage basin perspective is essential for understanding the upstream-downstream connectivity of water supplies, water demands, and emerging water problems.[30] Secondly, maintaining landscape connectivity ensures that the ecosystem functions of forests, wetlands, mangroves, dunes and reefs are part of the system of inter-connected defences and mitigating influences against climate change.

The following table summarizes the ecosystem-based rationale for each of the project components:

Table 2: EbA Rationale for Project Components

Project Components	***EbA Rationale***
1. Ecosystem-based adaptation approach to enhancing freshwater security and flood control in Mahé and Praslin under conditions of climate change	This component proposes to utilize and enhance the natural watershed processes by increasing streamflow by removing high-water use IAS from catchment forests, encouraging rainfall detention and infiltration in upland forests and wetlands, reducing runoff and sedimentation from forest landscapes, and protecting and enhancing the water holding capacity of wetlands, stream channels and barrages with soil and water conservation and streamflow control measures. This component will therefore strengthen wetland and forest ecosystem functions and watershed processes through a combined set of technologies at the landscape level, developing a new watershed management approach to managing stream flows and water availability for domestic and agricultural water supply in the Seychelles.
2. Ecosystem-based adaptation approaches along the shorelines of the Granitic Islands reduce the risks of climate change induced coastal flooding.	This component proposes to strengthen the conservation and enhancement of tidal wetlands, shorelines, reefs and other coastal habitats at selected high vulnerability sites (North East (NE) Point and Anse Royale), increase freshwater inputs and tidal exchange to assist in maintaining wetland ecosystem processes and promote EbA in restoring some wetland functions, improving connectivity of wetland systems and enhancing reef protection and development at selected locations. It will also facilitate increased freshwater (from watershed management) to combat salt water intrusion in farm ponds in the coastal plateau. Cost-effective EbA methods will be applied in combination with various soft engineering technologies to address site specific issues and opportunities that will enhance climate change resilience to coastal flooding, including that related to salt water intrusion in the agricultural area.
3. Ecosystem based adaptation mainstreamed into	This component proposes to increase national recognition of the importance of watershed and coastal processes and ecosystems in adapting to climate change stress, develop a much-needed policy framework for watershed management and

[30] Douglas Ellen M., Kate Sebastian, Charles J. Vörösmarty, Stanley Wood, Kenneth M. Chomitz, *The Role of Tropical Forests in Supporting Biodiversity and Hydrological Integrity A Synoptic Overview*, World Bank Policy Research Working Paper 3635, June 2005, p.3.

development planning and financing.	water supply catchment area protection, and provide the necessary legal and institutional mechanisms, capacity development and the standards, guidelines and skills for watershed and coastal management to apply ecosystem-based adaptation. It will also address the need to increase dedicated financing for ongoing water supply watershed management.

The ***project hypothesis*** is that multi-faceted ecosystem rehabilitation measures and better management of watersheds and coastal habitats can increase water availability and reduce flooding and salt water intrusion effects associated with climate change in Seychelles. These interventions are proposed within the context of an ecosystem-based approach that emphasizes:

(a) sustaining natural watershed characteristics as much as possible in the face of human interventions to ensure hydrological systems are balanced within a normal range of seasonal and annual flows that can assist to modulate the effects of changes in precipitation and temperature that are being imposed by climate change;

(b) maintaining the natural hydrological, geomorphologic processes and hydro-dynamics that affect the wetland, estuarine, shoreline and near-shore environments including the climate change adaptation functions such as flood attenuation and storm protection that are provided by effectively functioning tidal wetlands, mangroves, beach berms and coral reefs;

(c) protecting and enhancing the natural character, complexity, integrity (connectivity) and critical mass of ecosystems which provides a more dynamic basis to accommodate external climate stress to the extent possible alongside the developed landscape and thereby strengthens the resilience to climate change effects; and

(d) establishing the policy and support frameworks for commitment and cooperation of government, civil society and communities working jointly to effectively meet the challenges posed by climate change.

Component 1: Ecosystem-based adaptation approach to enhancing freshwater security and flood control in Mahé and Praslin under conditions of climate change.

An ecosystem-based adaptation approach will be implemented in five targeted watersheds on the islands of Mahe and Praslin to enhance freshwater security (reducing the climate change induced vulnerability of coastal communities to water scarcity during projected dry spells). Mahe Island is drained by about 25 main rivers and streams (**Figure 4**), and another 70-odd very small streams many of which are ephemeral in that they only flow during the wet season. The stream gradients are generally steep and channels are often incised and situated within moderately deep gullies. There are at least 55.7 km^2 of catchment areas that serve the domestic water supply systems on Mahe. The Public Utilities Corporation (PUC) has the responsibility for potable water supply. It has identified 32 catchments on Mahe (Table 3). The watersheds, which include all of the lands that drain into the main rivers and streams, encompass a much a larger area. The main rivers are presented on **Table 3** although there are many other small streams that drain directly to the sea.

Table 3: Mahe Island and Praslin Island Catchment Areas and Watersheds

	Catchment areas from PUC map (above barrages)	*Catchment area km^2*	*Watershed area km^2*		*Catchment areas from PUC map (above barrages)*	*Catchment area km^2*	*Watershed area km^2*
	MAHE ISLAND						
1	La Gogue	0.656		17	Cascade South	1.01	4.6
	Riv Anse Etoile		1.9		Riv Francois (airport)		1.8
2	Machabee	0.41		18	Caiman	2.08	2.8
3	Le Niol	1.616		19	Grand Basin	1.303	2.3
4	Rodos	0.94		20	Du Cap	1.704	2.0
5	Grand St Louis	1.29	4.6	21	Jouanis	2.41	
6	Rochon	2.133	3.1	22	Souvenir	1.31	
7	Mare aux Couchons	5.416	9.1	23	Anse aux Poules Bleues	1.864	2.1
	Riv. Major		1.8		Riv. Anse Louis		3.1

8	Lislette	2.71		24	Mont Plaisir	1.24	2.5?
9	Antas	0.92		25	Royale	0.687	2.6
10	Desert	0.61		26	Anse a la Mouche	0.73	
11	Bioliere	1.08		27	Baie Lazare	2.407	3.5
12	Grand Anse	4.396	4.4	28	Bougainville	0.95	
13	Seche	2.59	2.3	29	Takamaka	0.95	
14	Daubon	2.37	2.9	30	Intendence	1.365	1.7
15	Mamelles	2.89	3.5	31	Anse Forbans	1.32	1.3
16	Cascade	3.204		32	Grande Police	1.14	1.6
					TOTAL MAHE	55.7	
	PRASLIN ISLAND						
1	Novelle Decouverte R.m	3.302	n.d.	2	Fond B'Offay R.	1.832	n.d.
					TOTAL PRASLIN	4.864	n.d.

Catchment area km^2 – from PUC water supply study map, 1979. This is the area above the PUC barrage
Watershed area km^2 – from Universite de Reunion map, 2001. This is the full watershed area to discharge at sea
Proposed project watersheds are shaded in Table 3.

Figure 4: Mahe Island Catchment Areas

Streams on Mahe are characterised by steep slopes with maximum slopes from 12.5% up to 25%. The lengths of the main rivers do not exceed 4 km on Mahé and 3.5 km on Praslin. The hydrographic basin surfaces are all smaller than 10 km². Praslin Island has 16 major watersheds making up about 16.4 km^2.

The project will engineer a paradigm shift from site based protected area management, primarily for biodiversity conservation to a landscape based management system, aimed at rehabilitating ecosystem functionality and resilience with the specific purpose of enhancing water provisioning services during the extended dry season. This will have the added benefit of reducing flooding risk following climate change induced intense heavy rainfall events. The project activities in Component 1 contribute to climate change resilience by developing and demonstrating the EbA technologies for improved watershed management in collaboration with the *Seychelles Water Development Plan 2008-2030*, seeking to increase water capture and availability, stream flow regulation and erosion control in selected watersheds on Mahe Island and in an important dry zone on Praslin Island, and strengthening watershed stewardship at the local level to counter the climate-induced extremes.

The project proposes to have a significant impact on stream flows in order to enhance water availability during the dry season and to moderate peak flows during the wet season in five watersheds. The five project areas under Component 1 are:

Mare aux Couchons River Watershed

The Mare aux Couchons River is located in north-west Mahe with its headwaters within Mornes Seychellois National Park. The river has an estimated 5.416 km^2 catchment area above the PUC gauging station and a watershed area of more than 9 km^2 (Table 3). The watershed is 100% vegetated, with 15% Albizia Dominant Forest[31]; 47% Bush Vegetation[32] and 38% Mixed Forest[33]. These areas have very high rates of infestation by woody IAS with little native species present[34]. The Albizia dominated forest is concentrated along the riverine areas with large dominant stands of *Falcataria mollucana* (Albizia – an IAS). Large parts of the watershed were deforested in the early 20th century and used until the 1970s for the production of *Cinnamomum verum* bark and leaf oil. Since then a Mixed Forest has established of which an estimated 92% of the woody species are invasive species[35]. The most common of the invasive trees in the Mixed Forest is *Cinnamomum verum*, but *Alstonia macrophylla*; *Falcataria molluccana*; *Pentadesma butyracea, Psidium cattleianum* and *Syzygium jambos* are also present. Of the native species found, *Northea hornei* is the most common, but also found are *Aphloia theiformis*, *Canthium bibracteatum*, *Memecylon elagni* and *Timonius sechellensis*. A number of endemic palms and pandans are also present. Pockets of less invasiveness and more native species are found in the watershed. Only 3.5% of the soils in the watershed are considered eroded[36].

An important wetland occurs in the watershed. Based on historical data (photographs) and physical survey of the wetland, it is clear that the wetland previously covered an extended area. The wetland is badly sedimented most probably from previously detrimental land uses in the area. Areas of the wetland is also invaded by exotic species mostly *Cinnamomum verum*. The wetland is therefore not

[31] Albizia Dominant Forest: Mixture of various species, but dominated by *Falcataria molluccana*, rarely as a pure stand. More than 50% of standing volume is represented by *F. molluccana*. Standing volume is high with *F. molluccana* reaching diameter of 100 cm or more.

[32] Bush Vegetation: Mixture of *Cinnamomum verum*, *Chrysobalanus icaco* and various tree species, generally lower than 10m

[33] Mixed Forests: Mixture of endemic and exotic species with a height predominantly more than 10m.

[34] Robinson, J. *Watershed Needs Based Assessment of the Targeted Watersheds for Adaptation Fund proposa*l. DoE, MEE

[35] Kuffer, C. 2006. *Impacts of woody invasive species on tropical forests of the Seychelles.* Swiss Federal Institute of Technology Zurich and Robinson, J. *Watershed Needs Based Assessment of the Targeted Watersheds for Adaptation Fund proposa*l. DoE, MEE

[36] DoE. 2011. Coastal Environment GIS-Based Resource Mapping. European Union, through IOC under the ReCoMap project.

functioning optimally and its water holding capacity (and slow water releasing properties) is undermined. The watershed is steep and contains some deep, v-shaped channels and pools. Water is abstracted directly from the Mare aux Cochons River.

Mont Plaisir River Watershed

Mont Plaisir River is located on the east side of Mahe Island. The water storage facilities include two small barrages with an upstream catchment of 1.24 km^2 area above the 10m contour and a watershed area of approximately 2.5 km^2 (Table 3). Agriculture (mostly slash-and-burn agriculture with more permanent agricultural plots in the watershed valleys (basin)) was the past land use of the existing forested area[37]. This type of agriculture has declined in Seychelles since construction of the airport in 1971 and Seychelles entry in international trade. The watershed is 34% built up/residential areas, with the rest close to 100% vegetated, but highly degraded due to the presence of Invasive Alien Species.

Of the forested area 12% is Albizia Dominant Forest; 40% Mixed Forests and 48% Bush Vegetation. Small pockets of natural forests are found in the uphill areas. In the Albizia dominant forest an estimated 95% of all woody tree species are invasive[38]. The most dominant species are *Falcataria molluccana* and *Adenanthera pavonina*. In the Mixed Forest, IAS infestation is similarly high (estimated at 96%) with *Alstonia macrophylla*, *Annona squamosa*, *Cananga odorata*, *Cinnamomum zeylanicum*, *Hevea brasiliensis* and *Ricinus communis* dominant in the woody species, with *Merrenia peltata* and *Philodendron lacerum* dominant among the creepers. In the Mixed Forest very little undergrowth is found under the tall trees and climbers. A few native palms are present. The Shrub Vegetation is again largely invasive species dominated by *Cinnamomum verum*, *Dicranopteris linearis* and *Chrysobalanus icaco*. 55% of the soils of the watershed are considered partly eroded[39]. The Valley soils have high carbon content and high water soil infiltration rates; while the partially eroded Seychelles Red Earth Soil, low carbon content and little water infiltration properties. This high percentage of soil degradation in the watershed is due to past land uses and the current state of invasiveness by IAS.

Baie Lazare River Watershed

Baie Lazare watershed (and related streams) is a small, complex watershed that includes Baie Lazare, Dame Les Rois and Val'Endore rivers and various tributaries. There are many low density residential uses and marginal farms in the upper watershed. There are also several livestock operations in the watershed that adversely affect water quality and stream flow conditions. The watershed is 17% built up/residential and agricultural areas, with the rest close to 100% vegetated, but highly degraded due to the presence of Invasive Alien Species.

Of the forested area 13% is Albizia Dominant Forest; 34% Mixed Forests and 53% Bush Vegetation. Small pockets of natural forests are found in the uphill areas. The Albizia dominant forest is dominated by IAS, namely *Falcataria molluccana* and *Adenanthera pavonina,* with *Cinnamomum verum* and *Sandoricum indicum* also present. In the Mixed Forest, IAS infestation is estimated at 95% with *Cinnamomum verum*, *Adenanthera pavonnia*, *Tabebuie pallicla*, *Alstonia macrophylla*, *Anacardium occidentale*, *Falcataria molluccana* and *Terminilia catappa* the dominant woody species[40].

A wetland of approximately 10 ha on abandoned farmland occurs at the upland valley between two hills that form the headwaters. The wetland is partly silted up and heavily invaded by IAS including *Chrysobalanus icaco*, *Cinnamomum verum*, *Falcataria molluccana*, *Eucalyptus* spp., *Casuarina*

[37] Robinson, J. *Watershed Needs Based Assessment of the Targeted Watersheds for Adaptation Fund proposa*l. DoE, MEE.

[38] Robinson,J. *Watershed Needs Based Assessment of the Targeted Watersheds for Adaptation Fund proposa*l. DoE, MEE.

[39] DoE. 2011. Coastal Environment GIS-Based Resource Mapping. European Union, through IOC under the ReCoMap project.

[40] Robinson, J. *Watershed Needs Based Assessment of the Targeted Watersheds for Adaptation Fund proposa*l. DoE, MEE

equisetifolia, *Anacardium occidentale, Raphia farinifera* and *Heliconia psittacorum*. Some native species are still found in the wetland including some native reeds. Half the wetland has been drained for agricultural purposes with abandoned fields still present.

51.8% of the soils of the Baie Lazarre River watershed are considered partly eroded[41].

Two important PUC barrages and a water treatment facility occur in the mid reaches of the watershed and there are two more PUC barrages on Dame Les Rois River, with an upstream catchment of 3.427 km^2 area above the barrage on Baie Lazare River. The watershed has a total area of about 3.5 km^2 (Table 3).

There are significant competing demands for water within this watershed, most notably in the combined use of the Le Roi barrage for PUC potable water and for the many farms that depend upon the river for irrigation. There are many unauthorized abstractions from private landowners and significant water shortages during the dry periods. A recent survey for example found 39 unauthorized connections on Baie Lazure River and 21 on the adjacent Dame Le Roi River. PUC requirements take precedence during these periods and agricultural withdrawals are suspended which creates hardships for the farmers who depend upon this water. There are two important recorded abstractions for agricultural purposes at the moment: 900m^3/d at Baie Lazare and 300m^3/d at Dame Le Roi.[42]

Caiman River Watershed

Caiman is an incised, relatively steep watershed located on the west side of Mahe with a narrow boulder-strewn main channel and several small tributaries. At several points the main channel disappears under large granite boulders. The built up areas in the watershed makes up 14.3% of the area, with the remaining mostly forested, but heavily degraded, with an estimated 96% infestation by woody IAS[43]. The lower slopes of the watershed were in the past a *Sandorium koetjape (an IAS)* plantation with almost 100% of the woody vegetation invasive. Mixed forest, dominated by IAS namely *Sandorium koetjape* and *Alstonia macrophylla* are found in the higher altitudes and make up 55% of the watershed. The riverine areas and most of the higher areas are currently invaded by Albizia Dominant Forest (15% of the entire watershed; DoE, 2011) with *Falcataria molluccana* dominant, but also good numbers of *Alstonia macrophylla* are present. Soil water retention potential (based on carbon content) is generally high; except in the upper slopes due to low groundcover/undergrowth. 18.3% of the soils of the Caiman Watershed are considered partly eroded. A substantial mangrove wetland occurs at the outlet of the river adjacent to the coastal road. The watershed encompasses about 2.8 km^2 (Table 3). There are various potential sites to expand small run of river or storage barrages. The current PUC barrage, which could be upgraded, serves a local community water system as well as some unauthorized water users. This watershed could be managed primarily for potable water supply serving residents in this part of south-west Mahe who currently face water shortages for two months of the year (discussion with resident) and depend upon inconsistent and untreated water sources. This is a river that has high annual variability in discharges and the potential to moderate these extremes.

Praslin Fond B'Offay/Nouvelle de Couvert River Watershed

The island of Praslin has been heavily affected by forest fires, most probably as a result of human conflicts. The island is prone to significant soil erosion and in many cases affected areas have developed a more fire-sensitive vegetation type, including vast thickets of the invasive bracken fern, *Dicranopteris linearis*. It is estimated that 1,500 ha (about 40% of Praslin) have been affected by wildfires. This includes about 1,240 ha of bush vegetation, i.e. recovering post-fire eco-units; about

[41] DoE. 2011. Coastal Environment GIS-Based Resource Mapping. European Union, through IOC under the ReCoMap project.

[42] Public Utilities Corporation, Ministry of Environment, Natural Resources & Transport, The Seychelles Water Development Plan 2008-2030, Final Report, May 2011, P. 3-2

[43] Robinson, J. *Watershed Needs Based Assessment of the Targeted Watersheds for Adaptation Fund proposa*l. DoE, MEE

100 ha (3% of Praslin) just starting the recovery process; and 160 ha (4.3% of Praslin) highly threatened by soil erosion. Of these, 53 ha are considered high priority, in need of immediate anti-erosion measures[44].

The targeted watersheds on Praslin include two adjacent micro-watersheds in central Praslin Island, both of which include portions within Praslin National Park. Novelle Decoverte River flows south and contains 1.160 km^2 catchment area above the upper PUC barrage (82m elevation) and 1.872 km^2 above the lower barrage. The Fond B'Offay River shares common headwaters within the national park. It contains 0.549 km^2 above the upper barrage (113m elevation) and 1.283 km^2 above the lower barrage (30m elevation). This is a total catchment area of 4.864 km^2, although additional watershed area occurs downstream below the PUC barrages. The entire watershed area encompasses about 12 km^2.

The combined watershed consists of 7% Built up/Residential area. The Mixed Forest (65% of the watershed) is made up of scenic mature palm forest (situated in the Praslin National Park but mainly concentrated in the Valle de Mai World Heritage Site) with little disturbance. Some invasive species do occur in the forests but are limited and mainly creeper species. The forest is dominated by the endemic Coco de Mer, *Lodoicea maldivica*, but there are also five other endemic species of palms (Millionaire's salad (*Deckenia nobilis*), Thief palm (*Phoenicophoricum borsigianum*); Seychelles stilt palm (*Vershaffeltia splendid*) Latanier millepatter (*Nephrosperma vanhoutteanum*) and Latanier palm (*Rosheria melanochaetes*)). The ancient palms form a dense forest, along with *Pandanus* screw palms and broadleaf trees. The organic matter of the soil in the palm forests is high, with a high soil-water retention rate. The rivers originating in the forests have never dried up[45]. 3.5% of the watershed area is Mahogany plantations. Fire-induced Bush Vegetation cover 20% of the area of the watershed with 5% of the watershed deforested - eroded and burnt and in need of immediate anti-erosion measures[46]. The Bush Vegetation mainly consists of IAS namely *Chrysobalanus icaco* and *Dicranopteris linearis* and is degraded due to fire, where after it gets invaded by these IAS. Few native plants (less than 1%) are found in these areas. Organic soil matter is relatively low, mainly concentrated in leave matter under the Bracken Fern (*Dicranopteris linearis*). This, however, is highly flammable and prone to fire. Some signs of erosion are found in the area, especially on the slopes with erosion gulleys visible. The Deforested areas consist of bare ground with visible signs of erosion. Pockets of vegetation are found in these areas, mainly consisting of *Chrysobalanus icaco* and *Dicranopteris linearis* (the vegetation in these areas consists of at least 80% IAS), with a few natives (*Pandanus multisplicatus, Paragenipa wrightii* and *Scleria sieberi*) present. The areas have at least 70% bare ground and the organic matter is very low, in many cases with no topsoil. It has very low water infiltration rates.

<u>Output 1.1: Management and rehabilitation of critical watersheds to enhance functional connectivity and the resilience of these areas to climate change and reduce water scarcity and watershed flooding</u>

The project will develop awareness and commitment of local residents and landowners in the five targeted watersheds, as well as institutional capacity in watershed management as these are considered critical to improving water management for water supply resilience to climate change in Seychelles. This will be implemented through the establishment of local watershed committees that will oversee the development of local watershed management plans and be responsible for its implementation. Involving stakeholders, appropriate forms of property rights and institutional

[44] Senterre, B. 2009. *Distribution and Determinants of Forest Fires and Land Degradation on Praslin, Seychelles*. Plant Conservation Group.
[45] Henriette, E. Pers. Comm.
[46] DoE. 2011. Coastal Environment GIS-Based Resource Mapping. European Union, through IOC under the ReCoMap project.

capacity are some requisites for sustainable management of ecosystems[47]. The many dispersed water systems and degraded catchment areas, the poorly regulated water withdrawals, the lack of understanding of downstream effects of land use and farming practices and the gradual uphill migration of development are key barriers to addressing the climate change risks. Clarity on tenure and governance arrangements will be increasingly important in a changing climate, when the likelihood of conflict over scarce resources, undermined by e.g. floods and droughts, could increase. Currently, access to stream water is a 'free for all', essentially unmanaged despite the efforts of PUC to protect the raw water supplies upon which they depend but have little authority and few resources to control. The support of communities and landowners is essential to developing climate resilient water systems and a culture of local stewardship toward watershed management. The project will further assist in the preparation and implementation of community-based watershed management plans and address water use conflicts and enforcement of unauthorized abstractions, and related issues linked to watershed use and the impacts of adjacent development on water resources. In preparation of the watershed management plan, Strategic Ecosystem Based Water Resource Adaptation Assessments will be conducted for each watershed. This will establish the water provisioning capabilities of the different watersheds under conditions of climate change, document the threats to ecosystem function and resilience from climate change, map critical ecosystems from a water provisioning perspective and lay out the measures to enhance their resilience. The rehabilitation of watersheds and guidelines on the rehabilitation will form an integral part of the management plans. Local watershed management plans will be critical in enhancing functional connectivity and increasing resilience. The management plans[48] will address objectives relevant to EbA, e.g. conserving genetic material, maintaining diverse landscapes, and respecting different practices for land-use, conservation of natural resources, ecosystem–scale management and water source protection. As in any adaptive process, monitoring and evaluation is critical in assessing successes and failures, and support will be provided by the project in this endeavor. Each local watershed will develop a monitoring and evaluation plan with clear indicators on functional connectivity, watershed integrity and water balance. A national watershed management and rehabilitation coordination function will be developed under the auspices of the Rivers Committee in conjunction with the watershed monitoring programme, as outlined in Output 3.2 below related to Capacity Development for ecosystem based methods. A mechanism to ensure local watershed committee representation on the Rivers Committee will be developed during the project period to ensure ownership.

Through the organization of local watershed committees and the establishment of monitoring and evaluation systems resulting in adaptive management, the project will enhance the social resilience of local communities to climate change. The establishment of systems of co-management will realise vertical shifts in rights and responsibilities from government to local resource users. By working together and consolidating spaces of dependence at a local level by the committees and their interactions with government departments and representation on the Rivers Committee, users of water will be generating secondary benefits by building community resilience to better cope with the impacts of climate change. Integrated learning and adaptive management relies on that

[47] Andrade Perez, A., Herrera Fernandez, B. and Cazzola Gatti, R. (Eds.) *Building resilience to Climate Change: Ecosystem-based adaptation and lessons learned from the field*. IUCN, Gland, Switzerland.

[48] The following principles will be used in the management plans to address ecosystem resilience and functional connectivity within the watersheds: (i) Maintain and create large, structurally complex patches of native forest vegetation, and maintain small areas of native vegetation keystone structures; (ii) Maintain structural complexity throughout the landscape, and mimic the matrix of natural vegetation patterns, (iii) Maintain or create corridors or stepping stones to improve connectivity; (iv) Maintain landscape scale heterogeneity and capture environmental gradients, and keep spatial patchiness and landscape pattern variability, including in highly productive, fertile soils; (v) Maintain key species interactions and functional diversity by identifying keystone species and key seed dispersal agents; (vi) Apply appropriate disturbance regimes (e.g. hydrological flow regimes); (vii) Control aggressive, over-abundant, process-altering and structure-altering and invasive species; (viii) Minimize threatening ecosystem-specific processes (e.g., chemical pollution, over-harvesting, fire).

resource stakeholders are fully engaged in decision-making. To be resilient, societies must generally demonstrate the ability to buffer disturbances, self-organise, and learn and adapt.[49].

This output will address certain aspects of the rehabilitation of the watersheds as indicated in the management plans developed under this output. AF resources will be used to rehabilitate forest in critical upstream contributing system in the Mare aux Cochons Watershed (400 hectares), Mont Plaisir Watershed (50 hectares), Baie Lazare Watershed (100 hectares), Caiman Watershed (100 hectares), and Praslin Fond B'Offay/Nouvelle Decouvert Watershed (50 hectares). The rehabilitation in the Mare aux Cochons, Mont Plaisir, Baie Lazarre and Caiman Watersheds will be targeted towards selective removal and control of woody IAS and replanting with native species[50]. It is now well recognized that invasive alien species, particular tree species, have increased water usage compared to native species. Increased catchment water yield is a major justification for the cost of clearing alien plants. Studies conducted in South Africa indicate that high rainfall catchment (as all Mahe catchments are) show the greatest streamflow enhancement potential from IAS removal (Calder et. al.2001)[51]. All studies done to estimate the impacts of IAS concur that IAS, inclusive of plantation forestry; have a measurable negative effect on streamflow. The invasion of riverine and mountainous catchment areas is the most important from a streamflow reduction perspective. Research has shown an inverse correlation between runoff and plant biomass and a link between changes in runoff and the occurrence of Invasive Alien Species[52]. Fast-growing invasive species impose huge water demands while slow-growing natives do not. The amount of water stored in soft wood (fast growing invasives) is substantially higher per unit plant matter than that stored in hard wood[53]. Various invasive tree species due to historic landscape management are present in large numbers in the forests of Seychelles especially in the riparian zones. Certain species, especially *Syzygium jambos* and *Psidium cattleianum*, introduced in the Seychelles invade forests as they are specifically adapted to low light and nutrient-poor soil[54]. IA tree species generate more biomass and experience substantially higher growth rates than native tree species, thus capturing a larger amount of water in a shorter time. All of the Experiments conducted in Seychelles show that fast growing IAS like *Falcataria molluccana*, *Alstonia macrophylla* and *Tabebuia pallid*a have a relative growth rate under high light availability of 25 – 50% higher than native species[55]. Schumacher et. al. 2009 also showed that invasives do not suffer from water stress under high light (i.e. open canopy) conditions. Forests with woody species invaders present also have a higher evapotranspiration rate (as high as 20%) than similar primary forests[56], which results in higher water use by forests containing high invasion rates of woody invasives versus the same forests without invasives. Creeper species add an additional layer in the forest, not common in native forest, also drawing water resources, especially during the dry season. These IAS disrupt natural processes and ecosystem functioning in watershed forests. Specifically, changes in the chemical composition of soils and increased below-ground competition between IAS and native species benefit IAS and result at times in limited undergrowth and soil erosion[57]. These processes impact on both total and dry season water yield. The rehabilitation of the forest ecosystems will focus on removing the IAS that affect function and include the following species: *Falcataria mollucana*, *Cinnamomum verum*,

[49] Tompkins, E. L.; Adger, W.N. 2004. *Does adaptive management of natural resources enhance resilience to climate change?* Ecology and Society 9(2).

[50] Annex 7 provides a list of plant species that have been considered suitable for ecosystem rehabilitation projects.

[51] Calder, I & Dye, P. *Hydrological Impacts of Invasive Plants*. Land Use and Water Resources Research 1 (2001).

[52] Blignaut, J.N.; Marias, C, & Turpie, J.K. 2007. *Determining a charge for the clearing of invasive alien plant species (IAPs) to augment water supply in South Africa.* Water SA Vol 53 No 1.

[53] Kaiser-Bunbury, C. Pers. Comm.

[54] Schumacher, E.; Kueffer, C.; Edwards, P. & Dietz, H. 2009. Influence of light and nutrient conditions on seedling growth of native and invasive trees in the Seychelles. Biol. Invas., 11.

[55] Schumacher, E.; Kueffer, C.; Edwards, P. & Dietz, H. 2009. Influence of light and nutrient conditions on seedling growth of native and invasive trees in the Seychelles. Biol. Invas., 11.

[56] Huddle, J.A.; Awada, T.; Martin, D. L.; Zhou, X.; Pegg, S. E.; & Josiah, S. J. 2011. *Do Invasive Riparian Woody Plants affect Hydrology and Ecosystem Processes?* Papers in Natural Resources. Paper 298.

[57] Kueffer, C.; Schumacher, E.; Fleischmann, K.; Edwards, P.J. & Dietz, H. 2007. Strong below-ground competition shapes tree regeneration in invasive Cinnamomum verum forests. Journal of Ecology and Indufor, O. 1993. *Seychelles forest management plan/sector study*. Ministry of Environment, Economic Planning and External Relations.

Alstonia macrophylla, *Pentadesma butyracea*, *Psidium cattleianum*, *Syzygium jambos*, *Adenanthera pavonina*, *Sandorium indicum*, *Tabebuia pallida*, *Anacardium occidentale* and *Helicona psittacorum*. The rehabilitation work will concentrate on riverine areas and adjacent areas between rivers and patches of high native biodiversity, thereby establishing important corridors between biodiversity rich areas and rehabilitated areas, resulting in increased functional connectivity of the watersheds. In addition to increased water provision, rehabilitation of watersheds will enable forests to serve as buffers of hydrological extremes, reduce the risk and speed of flooding, and confine the vulnerability of ecosystems and developed areas to such climate-change related events. By rehabilitating riverine areas and increasing forest cover (and diversity), wetlands and barrages will be less impacted from excess runoff and sedimentation that will occur during periods of high rainfall, water quality and water retention will be improved, resulting in increased resilience of the local population in water availability in the dry season.

IAS also have negative impacts on the biodiversity of the watersheds. By creating conditions for native species to return, actively increasing their population size, and controlling IAS, biodiversity values will be enhanced in these areas. Even when high diversity is not critical for maintaining ecosystem process under constant environmental conditions, biodiversity provides a buffer against environmental fluctuations (including climate change) because different species respond differently to these fluctuations. The functional roles different species in an ecosystem play are subject to the influences of local environmental conditions. Species may appear to perform the same function (and therefore considered functional redundant) under a restricted set of conditions, yet their functional roles may vary in naturally heterogeneous environments[58]. A minimum (threshold) number of species is essential for ecosystem functioning under constant conditions and a larger number of species is probably essential for maintaining the stability of ecosystem processes under conditions of climate change[59]. Ecological resilience in the context of this proposal can be defined as the ability of the forests in Seychelles to withstand (absorb) external pressures and re-organise, while undergoing some change, in such a way that it retains its biological, chemical and physical functions. A non-resilient ecosystem may eventually respond to disturbance by crossing a threshold and collapsing into a qualitatively different state, which is stable but is controlled by a new set of processes. When viewed over an appropriate time span, a resilient forest ecosystem is able to maintain its 'identity' in terms of taxonomic composition, structure, ecological functions, and process rates. The available scientific evidence strongly supports the conclusion that the capacity of forests to resist change, or recover following disturbance, is dependent on biodiversity at multiple scales. Maintaining and restoring biodiversity in forests promotes their resilience to human-induced pressures and is therefore an essential "insurance policy" against climate change impacts. Thompson et. al., 2009 writes that the resilience of a forest ecosystem to changing environmental conditions is determined by its biological and ecological resources, in particular (i) the diversity of species, including micro-organisms, (ii) the genetic variability within species; and (iii) the regional pool of species and ecosystems. Resilience is also influenced by the size of forest ecosystems (generally, the larger and less fragmented, the better) and by the condition and character of the surrounding landscape. The project will therefore increase the ecological resilience of the forest watersheds by (i) maintaining and increasing the structural complexity of the landscape, using natural forests and process as models; (ii) maintaining and increasing connectivity across forest landscapes by reducing fragmentation, recovering lost habitats and establishing ecological corridors; (iii) maintaining functional diversity and eliminate the conversion of diverse natural forest to reduced-species forests; (iv) reduce non-natural competition by controlling invasive species; (v) maintaining biodiversity at all scales (stand, watershed, landscape) and of all elements (genes,

[58] Wellnitz, T.A. LeRoy Poff, N. 2001. *Functional redundancy in heterogeneous environments: implications for conservation.* Ecology Letters.

[59] Nagelkerke, I. 2009. *Ecological Connectivity among Tropical Coastal Ecosystems*. Springer Science and O'Connor, N.E. 2005. *Biodiversity Loss and Ecosystem Functioning: Distinguishing between Number and Identity of Species*. Ecology 86(7)

species, communities) by, protecting native tree populations which are isolated or disjunct of other similar source habitats[60].

In addition to forest rehabilitation, AF resources will also be used to rehabilitate two wetlands in the Mare aux Cochons and Baie Lazare Watersheds that are degraded and not functioning optimally in terms of water provision. These upland wetlands have important functions and values including i) flood conveyance – wetlands form natural floodways; ii) Flood storage – wetlands store water during floods, then slowly release it downstream; iii) Sediment control – wetlands reduce floodwater velocity, causing suspended sediments to settle out in these areas rather than being carried downstream; iv) water quality – wetlands contribute to improving water quality by trapping suspended sediments and removing dissolved nutrients and other chemicals; and v) Water supply – wetlands are increasingly important as a source for replenishing surface water. Wetlands slowly discharge water into nearby streams to maintain a constant water supply in the streams. Rehabilitation of the wetlands will include blocking surface and sub-surface drainage systems, recreating water holding depressions; installing structures to control drainage/water level; re-vegetating entire wetland (vegetation diversity will be reestablished to increase biological diversity and interactions between species that are important to the wetland's functions. The Mare aux Cochons wetland is also a RAMSAR site. The protection of the wetland and the conservation of its diversity are of utmost importance and will be accounted for in the management plan.

Rehabilitation efforts in the Praslin Fond B'Offay/Nouvelle Decouvert Watershed will be targeted towards the increase of soil water infiltration rates and reduction of soil loss in degraded areas. Vegetation cover is the most important factor in reducing surface runoff and sediment movement as the canopy and litter fall intercept rain and reduce its kinetic energy. Plant succession can gradually increase vegetation coverage, accumulate litter fall mass, construct root networks and improve soil physiochemical properties, leading to reduced runoff and soil loss. Without active reforestation the transition from bare soil to forested land on Praslin would take a century[61]. Reforestation improves soil physiochemical properties reducing runoff and soil loss through increasing total porosity and infiltration rate, increasing soil organic carbon content, and decreasing soil bulk density[62]. Fifty hectares of bare ground and bush vegetation will be stabilized and reforested in the watershed concentrating on the most degraded areas (bare soils – 10 ha); areas within the riverine zone and degraded areas within intact natural palm forests. This will lead to the increase of resilience against increased frequency of intense rainfall events due to climate change (reduced erosion in degraded areas and reduced fire risks as degraded pockets in forests will be rehabilitated); reduction in water scarcity as a result of increased infiltration of water into soil and higher base flows in the dry season; and an increase in functional connectivity through an improved riverine system throughout the watershed.

	Outputs	Proposed Activities
1.1.1	Mare aux Cochons River Watershed Management	This output will include establishing a local watershed committee and related community consultation; Ecosystem based water resource adaptation assessment; development and implementation of a watershed management plan in conjunction with the District Land Use Plan. This output will also

[60] Thompson, I.; Mackay, B.; McNulty, S.; Mosseler, A. 2009. *Forest Resilience, Biodiversity, and Climate Change. A synthesis of the biodiversity/resilience/stability relationship in forest ecosystems*. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series no. 43.

[61] Senterre, B.; Lesperance, M.; Bunce, S. Henriette, E.; Jean-Baptiste, M. and Laboudallon, V. 2012. *Implementation of Post Fire Rehabilitation Trails on the Island of Praslin, Seychelles.* GOS-UNDP-GEF Capacity Development of Sustainable Land Management.

[62] Huang, Z.; Ouyang, Z.; Li, F.; Zheng, H. & Wang, X. 2010. Response of runoff and soil loss to reforestation and rainfall type in red soil region of southern China. Journal of Environmental Sciences.

		focus on rehabilitating the wetland (approximately 5 hectares) and forest rehabilitation at selected sites (removal of alien invasive species and replacement with native species in approximately 400 ha) in line with the watershed management plan developed under Output 1.1 In the rehabilitation of forests a gradual, selective process of changing the structure of the forests will be implemented. This will imply that within the rehabilitation areas, small patches of target IAS will be cut and planted with native species and then routinely remove invasive species seedlings and promote the growth of native species through water provision (either direct or through waterlog/rechargeable solid water) and nutrient provision. In areas where large IAS trees are present and cutting these will result in damage to surrounding forest, native species will first be planted and once established the large IAS trees will be ringbarked. In areas where native species are present its growth and dominance will be promoted through continual, selective removal of IAS to provide the optimum light and soil conditions for native species to flourish. Each year of implementation additional areas of rehabilitation will be added and maintained. The wetland (Mare aux Cochons) will be rehabilitated, through the excavation, land contouring, drainage control and replanting of the wetland in order to maximize its water provisioning services. A comprehensive monitoring and evaluation plan will be developed in order to measure and define progress and success. This monitoring system will be complemented by additional rigorous scientific studies and modeling where necessary.
1.1.2	Mt Plaisar River Watershed Management	This output will include establishing a local watershed committee and related community consultation; Ecosystem based water resource adaptation assessment; development of a water management plan for the watershed in conjunction with the District Land Use Plan. Forest will be rehabilitated at selected sites (removal of alien invasive species and replacement with native species in approximately 50 ha) in line with the watershed management plan developed under Output 1.1. In the rehabilitation of forests a gradual, selective process of changing the structure of the forests will be implemented. This will imply that within the rehabilitation areas, small patches of target IAS will be cut and planted with native species and then routinely remove invasive species seedlings and promote the growth of native species through water provision (either direct or through waterlog/rechargeable solid water) and nutrient provision. In areas where large IAS trees are present and cutting these will result in damage to surrounding forest, native species will first be planted and once established the large IAS trees will be ringbarked. In areas where native species are present its growth and dominance will be promoted through continual, selective removal of IAS to provide the optimum light and soil conditions for native species to flourish. Each year of implementation additional areas of rehabilitation will be added and maintained. A comprehensive monitoring and evaluation plan will be developed in order to measure and define progress and success. This monitoring system will be complemented by additional rigorous scientific studies and modeling where necessary.
1.1.3	Baie Lazare River Watershed Management	This output will include establishing a local watershed committee and related community consultation; Ecosystem based water resource adaptation assessment; development and implementation of a watershed management in conjunction with the District Land Use Plan. This output will focus on protecting and enhancing the wetland water storage functions in the upper reaches of the watershed, enhancing the forest retention of runoff, and reducing through increased infiltration of rainwater into the soil, the erosion in the watershed. Selective removal of alien invasive species and replacement with appropriate ground cover will be undertaken on 100 hectares of the watershed. In the rehabilitation of forests a gradual, selective process of changing the structure of the forests will be implemented. This will imply that within the rehabilitation areas, small patches of target IAS will be cut and planted with native species and then routinely remove invasive

		species seedlings and promote the growth of native species through water provision (either direct or through waterlog/rechargeable solid water) and nutrient provision. In areas where large IAS trees are present and cutting these will result in damage to surrounding forest, native species will first be planted and once established the large IAS trees will be ringbarked. In areas where native species are present its growth and dominance will be promoted through continual, selective removal of IAS to provide the optimum light and soil conditions for native species to flourish. Each year of implementation additional areas of rehabilitation will be added and maintained. The wetland will be rehabilitated, through the excavation, land contouring, drainage control and replanting of the wetland in order to maximize its water provisioning services. A comprehensive monitoring and evaluation plan will be developed in order to measure and define progress and success. This monitoring system will be complemented by additional rigorous scientific studies and modeling where necessary.
1.1.4	Caiman River Watershed Management	This output will include establishing a local watershed committee and related community consultation; Ecosystem based water resource adaptation assessment; development and implementation of a watershed management in conjunction with the District Land Use Plan. This output will focus on forest rehabilitation at selected sites (removal of alien invasive species and replacement with native species in approximately 100 ha) in line with the watershed management plan developed under Output 1.1. In the rehabilitation of forests a gradual, selective process of changing the structure of the forests will be implemented. This will imply that within the rehabilitation areas, small patches of target IAS will be cut and planted with native species and then routinely remove invasive species seedlings and promote the growth of native species through water provision (either direct or through waterlog/rechargeable solid water) and nutrient provision. In areas where large IAS trees are present and cutting these will result in damage to surrounding forest, native species will first be planted and once established the large IAS trees will be ringbarked. In areas where native species are present its growth and dominance will be promoted through continual, selective removal of IAS to provide the optimum light and soil conditions for native species to flourish. Each year of implementation additional areas of rehabilitation will be added and maintained. A comprehensive monitoring and evaluation plan will be developed in order to measure and define progress and success. This monitoring system will be complemented by additional rigorous scientific studies and modeling where necessary.
1.1.4	Praslin Fond B'Offay/Nouvelle Decouvert Watershed Management	This output will include community consultation; Ecosystem based water resource adaptation assessment; development of a watershed management plan in conjunction with the District Land Use Plan and the management plan for Praslin National Park; establishing protection measures over water supply catchment areas. This output will rehabilitate forest ecosystems on burnt, degraded land by first applying erosion control methods. This stabilization of the degraded areas will be followed by reforestation through plantation of selected indigenous species. A nursery for the propagation of indigenous seedlings will be established on Praslin. A comprehensive monitoring and evaluation plan will be developed in order to measure and define progress and success. This monitoring system will be complemented by additional rigorous scientific studies and modeling where necessary.

Output 1.2: Small-scale water storage and detention facilities designed and constructed or rehabilitated in critical waterways for communities to benefit from enhanced ecosystem functioning by forests

The project will also include appropriate water control structures to directly manage the flow regime on these small, steep streams. This could involve a variety of run of river structures and even small storage structures (check dams) in conjunction with catchment area soil and water conservation and forest management. The PUC manages 33 barrages on Mahe and 11 on Praslin which act to detain flows during peak flow periods. Many of these can be renovated and expanded along with appropriate small storage ponds where suitable to hold excess stormwater runoff and release it slowly to avoid flooding in downstream areas and to enhance water sources. There are also options to expand water storage structures which can be considered within an EbA framework and with environmental design parameters and EIA reporting (including any appropriate measures to accommodate migratory aquatic species where they may occur at specific sites).

	Outputs	Proposed Activities
1.2.1	Mare aux Cochons River control structures	This output will involve 'environmentally appropriate' water control structures that facilitate wetland status and hydrologic and biological functions. Stream flow control structures will be constructed as needed depending upon site investigations in Mornes Seychellois National Park to both serve biodiversity and water supply objectives. Environmental design and EIA to be integrated into the watershed management plan and wetland and forest rehabilitation programme. Downstream barrage renovation and development plans will be implemented and water supply protection zones established and implemented.
1.2.2	Mt Plaisar River control structures	This output will include barrage renovation plans and water source protection zones established and implemented; this will be linked to drainage controls under subcomponent 1.1; targeted rainwater harvesting assistance with local residents may be required to enable a reduction in illegal abstractions.
1.2.3	Baie Lazare River control structures	This output will involve additional barrages constructed to separate domestic and agricultural water uses; barrage renovation plans and water source protection zones established and implemented; water flow and control structures for development of engineered wetland treatment of livestock wastes will also be required to assist in local drainage management around the water supply areas.
1.2.4	Caiman River control structures	This output will, depending upon further site investigation, involve additional barrages or other minor water control structures constructed to enhance water holding capacity of upland wetlands and to manage flows during the wet season.
1.2.5	Praslin Fond B'Offay/Nouvelle Decouvert River water control structures	This output will involve small check dams and some minor gully control structures as needed depending upon site circumstances. Improved availability of fire suppression water supply may also require some construction of minor water control structures, as determined by the watershed management plan.

Component 2: Ecosystem-based adaptation approaches along the shorelines of the Granitic Islands reduce the risks of climate change induced coastal flooding.

Component 2 of the project is proposed on the basis that coastal ecosystems and particularly tidal wetlands, shorelines and reefs have an important role to play in climate change resilience and that,

in concert with soft engineering methods and regulatory measures, they can be strengthened in this role. The project component will promote and implement concrete ecosystem-based adaptation measures to deliver flood and saltwater intrusion protection and mitigation in selected sites by managing watershed, wetland and tidal water flows and by improving the ecosystem attributes and functions associated with wetlands, shorelines and reefs. Many of these wetlands have been identified as being vulnerable to climate change and are priority sites for the Government of Seychelles.

The project will develop and implement management plans for adaptation in high priority vulnerable areas (with particular attention to protecting roads, existing land uses and future shoreline development and drawing upon initial results of the Cuba and Japan coastal risk management projects) and apply selected ecosystem-based adaptation measures to supplement engineering structures and solutions such as addressing freshwater inputs, tidal exchange and salt water intrusion adaptation measures. The sub-components are outlined below and are also broken down into specific outputs in the project budget.

Output 2.1: Ecosystem based measures for flood protection on an urban shoreline

The objective of this set of outputs is to enhance the hydrological and biological attributes of the selected wetlands and beach berms, improve tidal exchange and provide for accelerated recovery of the coral reef on a section of Mahe shoreline that has flooding and erosion problems.

The NE Point site will be the focus of this output. It is a national priority for both wetland conservation and coastal erosion and reef degradation concerns. It is located north of Victoria adjacent to the coast road and a small community. The primary adaptation concern at this site is on increasing the flood buffering capacity of the wetland, the shoreline and the fringing reef. NE Point has a particular combination of characteristics and issues that make it a priority site for coastal ecosystem protection and rehabilitation. The wetland drains to the shore through at least one culvert and the hydrology and tidal exchange can be enhanced to strengthen wetland functions. The site comprises degraded fringing reef in close proximity to the shoreline adjacent to an important road that is one of two routes to the north east side of the Island. The reef is close inshore and whilst the fore reef slope is showing signs of recovery there is still a lot of rubble from the 1998 bleaching that is inhibiting faster recovery. The proposed activities can be delivered practically because of the size of the culvert, the shallow reef flat and the nearby reef. The site is relevant because it includes a priority wetland, a degraded reef and an important coastal road that is liable to flooding. There is also strong interest in this site from stakeholders. The overall size of the site is estimated at 220 ha, with its enhanced ecosystem functionality have a positive effect on ecosystems providing similar services deeper into the ocean and along the fringing reef.

The proposed activities include development of an integrated shoreline management plan for the project site, nourishment (addition of sand), landscaping and planting of beach berms to minimise overtopping and erosion. Also proposed is setback demarcation using bollards and walkways so that the vegetation in these areas is not disturbed following planting. The project will enhance hydrography, expand vegetation to benefit from and sustain this hydrography and install tidal sluice gates to help manage the water flows of the tidal wetland.[63]

The project will also (i) remove rubble from the fore-reef slope (seawards of the fringing reef surf zone) to enhance the possibility of coral recruitment which is inhibited by unstable rubble and; (ii) place a submerged breakwater[64] in the surf zone to reduce the wave energy reaching the shoreline

[63] Inshore tidal wetlands are those that exit behind a beach barrier. Tidal wetlands require a physical control on the movement of fresh and saltwater within the wetland and therefore tidal gates and shoreline enhancement are needed to maintain wetland functions.

[64] Breakwater module design: Marine quality re-enforced klinker based concrete with grid structure 30cmx3mx3m, square, interlink stacking possible with coral accretions, 45 degree rotation at each level, rough surface texture.

and provide a substrate that could be colonised by coral as sea-level rises. The breakwaters would be thin but sufficiently heavy units to remain in place and designed to maximise water exchange, wave energy dissipation and opportunity for coral settlement. The aim is to maximise the wave dampening function of the fringing reef surf zone and potential for sustainable "keep up" by providing a suitable substrate for natural colonisation and growth particularly of calcareous algae (note using live hermatypic coral and coralline algae for EbA is high risk in view of global warming and ocean acidification). An EIA would be completed. It is proposed that the coral reef enhancement activities are implemented by NGOs and local communities and supervised by the Seychelles National Parks Authority (SNPA). The activities will be linked to capacity building for community participation and on-going maintenance of the shoreline under Component 3 of the project.

	Outputs	Proposed Activities
2.1.1	Integrated Shoreline Management Plan	This output will involve the large-scale assessment of erosion and flood risk of the project area and the ecological integrity and functional connectivity within and between the different ecosystems that provide flood buffering environmental services to the coastal communities. It will involve the specification of coastal use and management regimes to ensure that integrity is enhanced in the long-term through providing adequate connectivity.
2.1.2	Wetland rehabilitation	This output will involve an assessment of hydrological balance in the inshore wetland, physical improvements to stream channels and tidal exchange functions and other measures to enhance the hydrological dynamics and productivity of the wetland, and to increase flood buffering capacity of the wetland body. Maintenance and management capacity will be strengthened.
2.1.3	Reef rehabilitation	This output will involve enhancing the fringing coral reef with clearance of rubble and construction of a submerged breakwater in the reef crest surf zone to protect the reef and to provide a substrate for coral colonization. Maintenance and management capacity will also be strengthened.
2.1.4	Beach berm enhancement	This output involves reshaping the beach berm, stabilizing and planting for ecosystem and flood protection, and sand nourishment of the beach. Setback demarcation using bollards and walkways so that the vegetation in these areas is not disturbed following planting. Maintenance and management capacity will also be strengthened. This will be implemented in conjunction with JICA project drainage improvement activities at NE Point.

Output 2.2: Ecosystem based measures for flood protection and mitigating salt water intrusion in an agricultural and tourism development area

The objective of this set of outputs is to rehabilitate and restore portions of the tidal wetland, protect and enhance the riparian conditions of wetland channels, improve tidal exchange, strengthen the beach berm and reduce the effects of salt water intrusion to the extent feasible.

The Anse Royale area will be the focus of a set of outputs involving wetland rehabilitation, shoreline rehabilitation and ecosystem-based efforts to reduce the effect of salt water intrusion. The site is located on the mid east coast of Mahe Island at the outlet of Mont Plaisir River. It extends along the coast to the south including Anse Forbans and Anse Marie-Louise, where important tourism development sites are found. The primary adaptation focus at this site is on increasing the flood buffering capacity of the wetland and shoreline. The site includes a large discharge channel from the University of Seychelles freshwater wetland and a complex set of small streams and associated wetland components and coastal agricultural and tourism development areas that can be improved through ecosystem rehabilitation measures. There are breaks in the hydrological

dynamics that can be addressed toward improving the integrity and connectivity of the wetland habitats. Community participation is essential. The proposed activities can be delivered practically due to accessibility, and will benefit from involvement of the University. Installation of tidal sluice gates (provided feasibility study) and relevant works in the wetlands would increase the buffering capacity of the University wetland and would provide a valuable site for mainstreaming climate change issues. The wetland is fed by Mont Plaisir River where watershed interventions are proposed. Farms exist in the area allowing for wetland rehabilitation from current marginal agricultural land and/or undertaking activities designed to minimise salinization issues in these agricultural lands. The activities will have a beneficial impact both directly in terms of rehabilitating wetland and raising the profile of ecosystem-based approaches to climate change adaptation.

The proposed activities involve include development of an integrated shoreline management plan for the project site, landscaping and planting of channels and beach berms to minimise overtopping and erosion, setback demarcation using bollards and walkways so that the vegetation in these areas is not disturbed following planting, and installing a small tidal sluice gate(s) and associated infrastructure to manage upstream and tidal water flows and water retention. The project also proposes to restore remnant agricultural land back to wetland status where site opportunities accommodate this intention. Capacity building for community participation and on-going maintenance will be provided under Component 3 of the project.

Watershed rehabilitation provides an opportunity to also enhance agricultural water supply in the coastal areas that have been badly affected by saltwater intrusion. The farms near Anse Royal area could benefit from the increased water provisioning services through a more intensive watershed and water management approach that links the freshwater resources in the surrounding hills to supplement salt-contaminated agricultural water sources at the coast, and to stimulate related changes in agricultural climate change adaptation practices. These elements – wetland rehabilitation and agricultural water supply will be jointly addressed in the Anse Royale area.

The salt water intrusion that is occurring at several locations on Mahe is a serious concern, especially to the agricultural community at those locations. This was key issue in stakeholder consultation. Building upon the approach in Component 1, this Component 2.2 proposes to provide added opportunity to mitigate the effects of increased coastal flooding and to reduce the effects of saltwater contamination of farm ponds. The rehabilitation of the streams and wetlands of Mont Plaisir River and adjacent Lammelles River will require addressing the watershed scale issues, and this can include watershed rehabilitation opportunities to enhance dry season supplementary water supply for agricultural operations in lower Anse Royale.

Agricultural water supply enhancement using an EbA approach to watershed rehabilitation and management provides a link between increasing freshwater resources during the dry season and addressing saltwater intrusion impacts that occur during the same critical period. The potential support to private farmers will be contingent on them cost-sharing and undertaking improvements to their farm ponds and also installing rainwater harvesting systems as a pre-condition to implementation of improved agricultural water supply.

	Outputs	**Proposed Activities**
2.2.1	Integrated Shoreline Management Plan	This output will involve the large-scale assessment of erosion and flood risk of the project area and the ecological integrity and functional connectivity within and between the different ecosystems that provide flood buffering environmental services to the coastal communities. It will involve the specification of coastal use and management regimes to ensure that integrity is enhanced in the long-term through providing adequate connectivity.

2.2.2	Stream channel and wetland rehabilitation	This output will enhance connectivity between streams and wetlands including rehabilitation of available land to wetland functions. It will include hydrological and topographic studies to determine the water flows to maintain hydrological wetland processes. Rehabilitation of input and output channels and channel and shoreline landscaping to regulate water flows. Design and location of tidal sluice gates and associated infrastructure; Channel clearing and improvements. Maintenance and management capacity strengthened.
2.2.3	Shoreline rehabilitation	This output will involve shoreline and beach berm reshaping and light stabilization measures, planting for ecosystem and flood protection. Maintenance and management capacity strengthened, Beach installation of bollards and walkways to protect vegetation.
2.2.4	Ecosystem based salinization control measures	This output will supplement agricultural water supply to mitigate the effects of increased coastal flooding and saltwater contamination of farm ponds. Hydrological assessment and interventions in coordination with Output 2.2.1 will increase freshwater during the dry season and assist to dilute the effects of flooding and groundwater contamination on the vegetable industry near Anse Royale. Support is contingent on farmer-funded improvements to ponds and rainwater harvesting systems.

Component 3: Ecosystem based adaptation mainstreamed into development planning and financing.

Component 3 of the project has been developed on the basis that climate change resilience is hindered by a fundamental lack of awareness of the importance of watershed as sources of drinking water and a lack of experience and authority with the range of ecosystem-based measures that can be used to respond to climate change stress. There is a need for greater awareness, policy, institutions and technical guidance and capacity for watershed and coastal management that incorporates ecosystem-based adaptation. The proposed project activities under this component recognize that in a small country of 90,000 people, government services depend upon an active civil society, communities and private sector to assist in programme delivery related to climate change adaptation. Accordingly, it is proposed to support a community-based approach to increasing awareness and engaging citizens in natural resources management in watersheds and coastal areas.

Water management is a priority in the Seychelles and the *Seychelles Sustainable Development Strategy 2012-2020* recognizes the various challenges including a need to integrate environmental considerations in cross-sectoral policies and to streamline national and international commitments such as those related to climate change adaptation. But water policy and watershed management remain largely unattended. Various initiatives have been proposed in the past – a water management board, integrated water management, but no action has been taken. For example, Goal 3 of the EMPS – 'Establish effective integrated water management system', has made little progress.[65] This may now be changing with the recent water shortages which have raised the profile of the catchment areas and the *Water Development Plan 2008-2030* which has described the acuteness of the problem and the added pressures from climate change.

The ongoing modernization of the land use planning system and the increased role of district councils also provides an opportunity to develop an initial management framework for watersheds. The proposed *Physical Planning Act* (2012) provides for 'forest reserves' that can be used to control development set backs and to establish watershed management objectives at the local level. The current reviews of the *State Land and Rivers Reserve Act* (1991) and the *Environmental Protection*

[65] The 2010 evaluation noted that Activity 6: monitoring and protection of watersheds and river reserves has not been implemented due to lack of funds. Andrew Jean-Louis and Philip Tortell, *Report on the Review of the Environment Management Plan for Seychelles (EMPS) 2000-2010*, Government of Seychelles, Oct. 2009, p. 134.

Act (1994) are also expected to lead to greater flexibility to apply reserve designations for the purposes of stream protection. Ensuring the means of compliance will also be an important element, especially given the limited resources within government. This will complement the recommendations of the *Water Development Plan 2008-2030* that include a recommended initiative for *integrated river basin management*, utilizing the current but dormant Rivers Committee as a focus for policy discussions. Water rights and water allocation processes are also key issues that need a policy framework to address competing demands for access to water and growing conflicts over water use. A recent drought demonstrated the intensity of these conflicts between domestic and agricultural water users. The management of floods on the coastal roads, increased beach erosion from storms, and the challenges faced by growing salt water intrusion present questions about the appropriate technologies and actions that are required to address climate change.

The capacity to effectively apply an ecosystem-based approach to the water supply and flooding problems will require an important training and support component. The experience in watershed rehabilitation and management is limited in the Seychelles and significant awareness and capacity building will be needed within government and civil society to carry out the planned physical activities, building upon the ecosystem rehabilitation and forest plantation activities to date.

There is also a clear gap in the institutional responsibilities for watersheds. The MEE has overall responsibility for state lands and environmental conditions including flooding concerns. The Planning Authority has responsibility for land and infrastructure development decisions, alongside the increasing role of District Councils who oversee community input into land uses and local services. The PUC has responsibility to deliver domestic water supply from many watershed sources. The project will therefore need to address some of these institutional issues within government. The pressure to address the urgent water problems in the Seychelles presents some important public policy issues and a need to create a new approach to community-based watershed stewardship, recognizing the limited capacity of government and PUC to manage such a large number of small watersheds that serve the water supply systems. This aspect will require strong links with civil society organisations and district authorities. Component 3 therefore proposes to develop the necessary policy and legal frameworks and the institutional and human capacity to implement ecosystem-based adaptation. Three subcomponents are described below.

<u>Output 3.1: Policy and legal frameworks for watershed and coastal climate change adaptation</u>

The objective of this set of outputs is to develop the legal and institutional framework for integrated watershed management, the protection of water supply sources, and climate change adaptation within coastal ecosystems.

A new water management framework is needed to guide the use and rehabilitation of water supply watersheds, including the roles of government, PUC and local communities in maintaining essential watershed processes and sustainably managing the watershed resources. This subcomponent will firmly establish and activate the Rivers Committee (or similar water management coordination group) and the process for designation and management of river, forest and wetland reserves, as well as the potential financing mechanisms for watershed management and stewardship.

PUC have few staff available to manage the raw water sources and no mandate to address the range of issues facing watersheds in Seychelles, most of which have water supply facilities. The institutional development focus should be on establishing distinct water source protection zones and managing the uses within these sites according to some defined maintenance standards and policy directives on the control of unauthorized water uses. Future investment in renovated and new barrages should be in accordance with management plans for these sites. Appropriate capacity development should be provided.

MEE can utilize forest reserves/river reserves and regulatory control of setbacks (15m either side of the channel) to protect riparian values once the legal issues are resolved. How these reserves are established and specific management objectives applied and implemented at the watershed and site scale needs to be addressed, in conjunction with local authorities and community organizations. The institutional home for stream protection is not completely clear and some assistance to increase this function will be needed.

Options for cost recovery for maintaining 'watershed services' to ensure raw water supply will be pursued through a review of alternative financing mechanisms and selected initiatives to increase funding for watershed rehabilitation and management in Seychelles, drawing upon *Payment of Ecosystem Services* experiences internationally. The project will pursue a modified payment for watershed services approach that seeks to recover the ongoing costs of watershed management from water supply customers and other potential funding sources.[66] The approach is based on the typical watershed services financing model that has been described as "an integrated supply-demand user pay tool to buy conservation and to generate sustainable funding".[67] The premise for watershed services compensation is that a *positive externality* exists where upland users/owners are providing a benefit to downstream users/beneficiaries that are also willing to pay for such services. In this case, the PUC, the National Parks Authority and community watershed committees can be viewed as 'sellers' of water supply services to PUC customers. There are many examples of water service fees (based on volumes or flat fees) providing funding for watershed protection and rehabilitation. The current 'environmental charges' on PUC bills are not directly linked to catchment area management programmes or to the actual costs of maintaining quality raw water supply.

	Outputs	**Proposed Activities**
3.1.1	Watershed management policy framework	The policy framework to be developed will address gaps in the institutional structures and management systems for water supply watersheds including the application of river reserves, protection of upland wetlands, and the management arrangements for watershed protection, involving district councils, district land use plans and drainage controls in new developments.
3.1.2	Legislative, regulatory and advisory measures	Specific legal and technical guidance measures to reduce development impacts on watersheds, wetlands, beach berms and reefs, such as flood elevation levels for buildings and roads, as appropriate based on Component 1 and 2 results[68] and the implementation of policy framework. This will include legal measures to secure the project investments in wetland conservation and enhancement. Technical standards and protocols will also be established for watershed and coastal rehabilitation.
3.1.3	Financing mechanisms for watershed protection	Options for cost recovery for maintaining 'watershed services' to ensure raw water supply will be pursued through a review of alternative financing mechanisms and selected initiatives to increase funding for watershed rehabilitation and management in Seychelles, drawing upon *Payment for Ecosystem Services* experiences internationally.

Output 3.2: Capacity development for ecosystem based adaptation methods

[66] Ferguson, Alan. 2012. Watershed Management technical Report for preparation of Adaptation Fund Proposal: Ecosystem Based Adaptation to Climate Change in Seychelles. UNDP Seychelles

[67] Wunder Sven, *Necessary Conditions for Ecosystem Service Payments*, in Economics and Conservation in the Tropic, Conference Proceedings, 2008, p.7

[68] This could include specific measures to promote building on pillars (open structures) to 3.5m above chart datum where the land surface is less than 3.5m and shoreline retreat is possible and/or flooding from the sea from climate change is a risk; enhanced legal recognition, policy and conservation management commitment of the fringing reef crest, sandy beaches, wetlands and wetland margins (including mangrove) in providing climate change resistance and resilience; and strengthened regulations to restrict access across the beach to marked areas to minimise damage to vegetation. See Dawson Shepherd, A.R., *Final draft technical report.* 2012.

The objective of this set of outputs is to strengthen and develop the technical tools and human skills for watershed management and coastal flood protection and sea level rise, including public awareness of adaptation requirements and methods and relevant capacity building for implementation of regulations, standards and guidelines.

The NGOs and government agencies that have been involved in ecosystems rehabilitation and degraded land recovery projects in the national park on Mahe, and on Praslin and other islands have experience in many of the biological interventions (e.g., removal of invasive species and replanting with indigenous and endemic species) but have limited expertise to carry out a full watershed rehabilitation programme and the water management aspects particularly would need to be strengthened. A training programme will be needed, potentially in conjunction with University of Seychelles, linked to the proposed plans for rehabilitation in the project watersheds. Gender equity will be a factor in selection of trainees.

Many residents have in clear stake in watershed management, as shown by the number of individual water users in rural areas (unauthorized historical water abstractions) and the growing recognition of more frequent water shortages and streams drying up in July-August. It was apparent during the project planning mission that addressing the critical water management problems is going to require greater public awareness of the importance of watershed processes and the linkages between land use, landscape and vegetation and water resources.

A national watershed monitoring system, including a “functional connectivity” monitoring system will be put in place in order to assess the effectiveness of the project interventions in the long-term and to ensure an adaptive management of the watershed systems. In order to operationalise such a monitoring programme, investments are needed and training provided in monitoring tools such as GIS, on-the-ground measurement methods, environmental planning tools, etc. and the long-term collection of key data that will be identified through the project. The system will be developed by the project implementation team, in conjunction with the MEE, PUC, the University of Seychelles, relevant partner NGOs, the local watershed committees and the Rivers Committee. Its sustainable financing can be assessed along with the options that will be explored under output 3.1.3. A national watershed management and rehabilitation coordination function will be developed under the auspices of the **Rivers Committee** in conjunction with the watershed monitoring programme, as outlined in Output 3.2 below related to Capacity Development for ecosystem based methods. The capacity development and monitoring systems will be integrated in the outputs described below.

	Outputs	**Proposed Activities**
3.2.1	Training programme development	The programme design will consolidate lessons and advise on forest, wetland and ecosystem rehabilitation protocols and training modules that are appropriate to Mahe and Praslin watersheds, wetlands and coastal ecosystems, to be developed in collaboration with University of Seychelles.
3.2.2	Training programme delivery	The training programme will provide field-based skills development to a range of stakeholders to improve the implementation of watershed, tidal wetland and beach and reef rehabilitation projects in Seychelles including application of the standards developed in Output 3.1.2. The training will to be implemented in conjunction with delivering investment activities under Components 1 and 2.
3.2.3	Institutional support	The Rivers Committee, along with project Watershed Committees and district authorities will undertake community based water management plans that support the watershed and coastal rehabilitation activities, including protection of water supply zones and rationalization of water abstractions. A *National Watershed Monitoring Programme* will be developed that will

		address ecosystem connectivity, watershed integrity and function and water balance, including related capacity development to oversee the status and technical inputs for the Rivers Committee ongoing management of watersheds in Seychelles. The monitoring programme will develop and apply relevant indicators of functional connectivity, watershed integrity and water balance within an adaptive management system that will assess and refine environmental interventions and their performance based on experiences. This monitoring programme will also be linked to the national Water Development Plan and to the Seychelles Sustainability Strategy.

Output 3.3: Lessons learned and Knowledge Dissemination

The main focus is to document the EbA methods and results derived from the project, prepare and disseminate knowledge products on the specific climate change adaptation issues and challenges in Seychelles and facilitate long term capacity building in ecosystem-based adaptation.

	Outputs	**Proposed Activities**
3.3.1	Communications strategy	A communication strategy will be developed to raise awareness about EbA measures and the project results
3.3.2	Knowledge products	Various public and professional materials and media products will be prepared and disseminated to promote the key messages and the technical learning derived from the project activities.
.3.3	Experiences exchange	Workshops for EbA participants to report on and discuss experiences and to refine the lessons learned and technical guidance to assist other projects.

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

The primary socio-economic benefits of the project relate to the expected increase in water availability and water quality as a result of more intensive protection and management of the watersheds that supply raw water to the PUC water supply system and to the households drawing water directly from streams (est. at 7%). The condition of the 32 water supply catchment areas that have been identified on Mahe has a direct bearing on the lives of most of the 78,539 residents of the island, 93% of which are connected to the PUC systems. Some watersheds provide no dry season water supply for up to two months; others have some water quality concerns, including difficulties for treatment plants to process the gritty ‘red earth’ soils associate with sedimentation in the upland areas. The project therefore aims to transform the approach to watershed management from one of general neglect to one of careful local stewardship, building upon a set of watershed rehabilitation and management technologies and concrete outputs within an EbA framework.

The benefits from coastal interventions will also contribute to reduced flooding risks in the project areas with a total population of around 8,800 residents. Local roads and buildings are under threat during storm events and sea level rise and the project aims to reduce these vulnerabilities.

The number of direct project beneficiaries is estimated as follows:

Component 1	Area:	Beneficiaries:
	Mare aux Couchons R.	1798 (486 PUC water consumers)[69]
	Baie Lazare R (incl Dame Le Roi R.)	2294 (620 PUC water consumers)
	Mont Plaisir R.	1091 (295 PUC water consumers)
	Caiman River (Anse Bolieau area)	2601(703 PUC water consumers)
	Nouvelle Decouverte R. (south)	4876 based on population of Baie St. Anne District, Praslin Island[70]
	Fond B'Offay R. (north)	
Component 2	NE Point (Anse Etoile District)	4717
	Anse Royale District	4168
Total		**21,545 persons**

The economic benefits will also include reduced flooding damage due to under-regulated and poorly managed watersheds and wetlands. Future flood damages can be reduced through better control of watershed and watercourse drainage with biological and related water management methods.

Alongside the substantial water supply and flood management benefits, the project will strengthen the ecosystem functions and biophysical integrity of the watersheds, wetlands and coastal habitats that are the focus of the project.

The most vulnerable community groups that will indirectly benefit from the project are:
Poorer Groups within the Community (25,000 people – 30% of the population lives under the Basic Needs Poverty Line)[71]: The poorest in the coastal communities are also the most vulnerable to water shortages. During periods of water restrictions, the most vulnerable members of the communities do not have the means to cart water by vehicle from elsewhere and therefore a large percentage of household income is spent on the purchase of bottled water. The lack of water leads to lack of sanitation. The project will directly tackle the provision of water to the most vulnerable through enhancing the water provision capacity of forests and water during extended dry periods and providing water of high quality throughout the year. Poorer groups will therefore be able to have accessible water for household sanitation as well as for drinking. Vulnerable groups will also benefit from the growth of the economy through receiving benefits through remuneration for work done, especially the continual growth of tourism. This will only be possible with increased water provision and reduction of flooding and erosion of coastal areas. The poorest members of the society normally are also the most vulnerable to coastal flooding as they either stay in vulnerable areas e.g. in reclaimed areas of wetlands or the structures they live in is not robust enough to withstand coastal flooding. With the reduction of coastal flooding through the implementation of this project, these members of the community will be safeguarded.

Farmers (2500 people – 600 farmers, 800 workers and dependents): Most farmers use irrigation for provide water to their crops. With the extended dry periods, and the restrictions on water use during these periods, farmers' livelihoods are affected. Further, due to poor soils and steep slopes, most agricultural activities takes place on the coastal plateau of the islands. The increase of flooding and increase of salinity of soils in the coastal zones as a result of flooding, crop failure is becoming more regular. Both through increased water provision throughout the year by forests and the reduction of coastal flooding through rehabilitating/managing coastal ecosystems, the vulnerable farmers will benefit and continue sustainable livelihoods.

[69] This is the number of PUC water customers in 2012, mostly households, but also commercial establishments. The beneficiary population has been estimated based on average Census household size of 3.7 persons.
[70] There are 2549 PUC 'water consumers' and a Census (2010) population of 8603 on Praslin Island.
[71] www.nsb.gov.sc

Urban and rural residents vulnerable to high flooding risks (+/- 40,000 people) that are at risk of losses of life and property from increased flooding, lack of sanitation and decreases in access to safe water. The losses from previous flooding events have been substantial.

Gender equality will be addressed in the project by (a) improving water supply and reducing the household burdens imposed on women during periods of drought, (b) ensuring equal opportunity for women and men to participate on local watershed committees, and (c) promoting gender balance in the proposed training programme.

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

The cost-effectiveness for the project centers on the value derived from better utilisation of watershed and coastal ecosystems to enhance water availability during the dry season and to reduce both watershed and marine flooding risks. The water supply and flood mitigation opportunities for EbA have yet to be considered in Seychelles. The avoided costs from water rationing, water trucking during drought, desalinisation infrastructure, seasonal closure of vegetable production due to high salinity, flooding events, and shoreline erosion and armouring are some of the key factors affecting the business case for EbA investment.

Component 1 of the project is estimated to costs $3.02 M. The adaptation benefits for the approximately 12,000 direct beneficiaries for this component involve more reliable water supply (and reduced water rationing) from a heavily stressed public water system, more public safety and fewer flood damages through better control of watershed drainage, and targeted forest re-vegetation measures that reduce wildfire potential and enhance water availability. The *Seychelles Water Development Plan 2008-2030* for example, notes that some additional water can be generated through investing in better management of water barrages alone. The long term issues that will be avoided from increased water use competition and conflict, and continual decline and neglect of the watersheds are significant. The potential alternatives to Component 1 investment are to rely on desalination water plants which are 50-100% more costly per unit of water, or to continue to cope with increasing water crises and flooding events. Desalination as an option is very expensive and has high-energy demands[72]. As all energy in Seychelles is derived from the combustion of imported fossil fuels, the addition of more desalination plants is sub optimal because of the cost, security of supply and because it is felt that projects to mitigate the emission of greenhouse gases and adaptation projects should reinforce each other.

Component 2 of the project is estimated to cost $ 1.995 M. The adaptation benefits for the more than 8900 beneficiaries involve increased flood protection from coastal storms and watershed stream flooding, greater protection of the coastal roads and infrastructure at NE Point and Anse Royale, and halting the continual degradation and loss of watercourses and wetland sites that serve to absorb, buffer or manage storm energy and flood flows. The combined effect of high tides and intense rainfall causes significant flooding crisis at certain sites and times. Avoided flood damage is therefore a primary benefit of Component 2. The alternative is to invest in expensive shore armouring, flood drainage canals, elevated roadways and embankments, and associated destruction of much of the natural beach and beach berm in the process. In addressing coastal erosion and flooding, structural engineering options were considered. Engineering options include artificial barriers constructed to diminish wave action out at sea, barriers on the beach and groynes out to sea. However these measures are costly[73]. Further, tourism is dependent on natural beauty

[72] Desalination plant – for 17,500 m3/day – the Seychelles PUC estimates total costs USD 69 million CAPEX, USD 3 million OPEX annually.
[73] Seawalls – for a 500 m stretch the cost can be anything between USD 40,000 – 80,000, plus annual maintenance costs.

and aesthetic values, which such artificial barriers will affect adversely. Scenic beauty can on the other hand be enhanced through careful ecosystem rehabilitation.

Component 3 of the project is estimated to cost $0.48 M. The adaptation benefits relate to development of a policy and institutional framework for sustainable watershed management, and increasing the long term skills and knowledge in EbA including the tested protocols for ecosystem rehabilitation. An alternative is to forgo this component but the sustainability and knowledge development elements associated with Component 1 and 2 would be greatly diminished. Component 3 is necessary to achieve a larger intent from the project: to establish a new approach to the protection and management of water supply watersheds and coastal ecosystems that is necessary for climate resilience in the Seychelles. A cost-effective approach is achieved through better management systems and watershed and wetland stewardship arrangements with local communities which ensure that investments in water supply infrastructure and flood control measures are sustained for the long term, and that the ecosystem based investments made by the project under Components 1 and 2 have a long term impact.

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 programmes of action, or other relevant instruments, where they exist.*

The proposed project is fully consistent with Seychelles's National development policies and programmes as reflected in the *Seychelles National Climate Change Strategy* (SNCCS – Table 4), *Seychelles National Action Plan (NAP) for Sustainable Land Management (2011 – Table 5)*, and the *Seychelles Sustainable Development Strategy 2012-2020 (Table 6)*. More specifically, the project will contribute to the implementation of these national policies and strategies as follows:

Table 4: Support for Seychelles National Climate Change Strategy (2009)

Climate Change Strategy relevant objectives:	***Proposed support for SNCCS:***
Objective 1 – to advance understanding of climate change, its impacts and appropriate response	*The project will increase government and public government and public awareness and knowledge on watershed and tidal wetland issues and threats.*
Objective 2 – To put in place measures to adapt, build resilience and minimize vulnerability to the impacts of climate change ▪ Develop and implement on a pilot scale effective adaptation measures and tools at community level, including coastal ecosystem rehabilitation approaches; ▪ Demonstration of adaptation technology implementation, with focus on nature-based methods;	*The project will develop and implement the strategies and methods for EbA in four project watersheds, at rehabilitation sites on Mahe and Praslin, and at several tidal wetlands on Mahe.*
Objective 4 – To mainstream climate change considerations into national policies, strategies and plans. ▪ Review of key procedure, guidelines and specifications to include climate change adaptation considerations into national planning. ▪ Engagement of government (including the executive and legislative) with the scientific community for input of climate risk information into the development of national development strategies, policies and laws. ▪ Identify key stakeholders and develop policy for	*Drawing upon the field experiences in applying EbA methods, the project will document and disseminate lessons from the project and train stakeholders; it will also develop local awareness and commitment toward watershed and wetland protection.*

involvement of key stakeholders in climate change adaptation through a multi-stakeholders coordination committee.	
Objective 5 – To build capacity and social empowerment at all levels to adequately respond to climate change. ▪ Promote ongoing stakeholder/community involvement in decision making regarding climate change education, awareness and training at national and district level. ▪ Integrate climate change education into all sectoral policies and strategies, i.e. tourism, fisheries, energy, agriculture, education, development, disaster response, etc. ▪ Develop communication and awareness strategies to engage the community in responding and adapting to climate change.	*The project will engage local residents in watershed rehabilitation activities including drainage controls and rainwater harvesting on their own properties. The watershed rehabilitation will be linked with development of an ecosystem rehabilitation course at University of Seychelles.*

The UNCCD NAP for Seychelles has noted that degraded lands[74] are primarily associated with soil erosion and sedimentation associated with logging and historical conversion of forest land to agricultural uses. The identified sector land degradation (NAP) issues that will be addressed at some level within the proposed project watersheds are as follows[75]:

Forestry	**Project watersheds**
Catastrophic forest fires	Praslin hillsides
Unsustainable harvesting of timber and non-timber products	Mahe watersheds
Invasion by creepers and biodiversity loss	Mont Plaisir, Baie Lazare, Mare aux Couchons
Agriculture	
Upland erosion	All Mahe watersheds
Loss of soil fertility	Baie Lazare
Coastal area flooding	Mont Plaisir, Anse Royale, Caiman, Anse Boileau
Managing new physical developments	
Housing	Mont Plaisir, Anse Royale
Tourism and recreation	Anse Royale, NE Point
Other	-
Other	
Wetlands loss and depletion	Mont Plaisir, Anse Royale
Food security	Baie Lazare, Anse Royale, lower Mont Plaisir
Climate change	All project watersheds
Water cycle and rainfall	All project watersheds
Landslides	Mont Plaisir, Anse Royale

[74] Defined by UNCCD as a "reduction or loss, in arid, semi-arid, and dry sub-humid areas, of the biological or economic productivity and complexity of rain-fed cropland, irrigated cropland, or range, pasture, forest, and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as: (i) soil erosion caused by wind and/or water; (ii) deterioration of the physical, chemical, and biological or economic properties of soil; and (iii) long-term loss of natural vegetation."

[75] Government of Seychelles, *National Action Plan for Sustainable Land Management*, UNDP, June 2011, Table 2.

Table 5: Support for National Action Plan (NAP) for Sustainable Land Management

Relevant sections of the Seychelles NAP:	***Proposed support for NAP implementation:***
Objective 1.1: Land use planning and management policy and institutional measures support SLM	*The project will develop model approaches to watershed management and controlling water capture and runoff*
▪ Raise awareness on the new Land Development Act among the general public;	
Objective 2.1: Policy and incentives for sustainable forest management	*The watershed management models will have implications for preparing and implementing the forest management plans*
▪ Prepare forest management plans for all forest land on Mahe, Prasline and Curieuse, including private land	
▪ Explore and if possible establish payments for ecological service schemes.	
Objective 2.2: Fighting forest fires	*Methods to demonstrate comprehensive rehabilitation of burned land will be implemented by the project. For protection, water supply could be integrated into the water supply infrastructure improvements*
▪ Install system of water storage near critical sites;	
▪ Undertake a thorough review of past approaches to rehabilitating burnt land;	
▪ Demonstrate rehabilitation through conversion to agro-forestry;	
▪ Widespread rehabilitation, based on successful demonstrations	
▪ Monitoring of rehabilitated sites	
Objective 2.5: Watershed management	
▪ Improve understanding of relationship between forest health and water quality and quantity;	*A whole watershed approach to EbA will emphasize aspects of forest health and effects on water quality and quantity. The project will establish the policy and mechanisms for watershed management.*
▪ Identify main components of water cycle;	
▪ Develop recommendations for improved watershed management and adapt other activities to this understanding.	
Objective 2.6: Climate change adaptation measures are adequate to protect forested land	*The effects of climate change on forest hydrology will be considered and the appropriate forest and wetland rehabilitation measures and costs will be generated for selected watersheds.*
▪ Monitor climate change models to determine the most likely impacts of climate change on forested land;	
▪ Estimate the costs of measures to adapt forested land management;	
▪ Mobilize finances to support adaptation in the forestry sector	
▪ **Objective 3.4: Sustainable management of agricultural water resources**	*The proposed site activities at farms that are adversely affected by salt water intrusion will demonstrate water management strategies during the dry season.*
▪ Design approach to overcoming water shortages for each site and incorporate into farm development plans	
Objective 3.5: Climate change adaptation measures are adequate to protect agricultural land	*This objective will be directly implemented at the targeted areas affected by saltwater intrusion*
▪ Introduce adaptation and mitigation measures to sustain agricultural production;	
▪ Estimate the costs of measures to adapt agricultural land use to climate change;	
Objective 4.4: Minimize coastal erosion	*The improvements to hydrological and ecological processes in the targeted tidal wetlands will contribute to this objective.*
▪ For priority areas, develop or sustain coastal protection plans;	

Seychelles Sustainable Development Strategy 2012-2020

The proposed project outcomes and outputs related to watershed rehabilitation and management are fully aligned with the Strategic Objective 2 under Goal 3 of the Sustainable Development Strategy, as outline below.

> ***Goal 3***: Achieve sustainable forest management using an ecosystem approach which further strengthens ecosystem services
>
> ***Strategic Objective 2***: Develop and implement forest rehabilitation and rehabilitation programme
>
> **Outcomes**:
>
> - Degraded forest areas restored and managed sustainably
> - Protection of watershed

The relevant planned activities under the *SSDS Action Plan* for this objective are presented below alongside the proposed project support for these activities.

Table 6: Support for Seychelles Sustainable Development Strategy

SSDS Goal 3 Activities	***Expected Results***	***Indicators***	***Project Support for SSDS***
1. To build capacity to undertake rehabilitations work	Skilled workers Successful rehabilitations work	Number of trained and skilful workers No of people involved in rehabilitation works	*The project will train government and NGO staff in watershed rehabilitation under Component 3*
2. To restore degraded land	Forests restored and new plantations established	20 hectares of degraded land restored	*The project will rehabilitate and restore >20 ha indicated*
3. To remove Alien Invasive Species	Habitats dominated by native species	Reduced number of alien invasive species in forest plantation	*Removal of alien invasive species will be integrated into the EbA approach to watershed rehabilitation*
4. To restore and rehabilitate areas destroyed by forest fires	Plants growing on burnt areas	30 hectares restored Number of species used in rehabilitation Decreased in IAS in selected forest areas	*The project will rehabilitate burnt areas on Praslin of at least 10 ha, and more depending upon proximity to project areas*
5. To develop cost effective techniques for forest rehabilitation.	Techniques developed Application of techniques Rehabilitation of degraded forest	Reports of best practices produced Used of techniques in forest rehabilitation works. Increased forest rehabilitation works	*The project will assess in a systematic way, the efficacy of alternative set of rehabilitation (rehabilitation) methods in combination with soil and water conservation*
6. To protect and manage watersheds	Removal of Alien Invasive Species along catchment areas Reduction in development in catchment areas Improved water quality	Improved water quality Improved water flow	*Increased base flows and enhanced water quality are expected outputs of the project. Efforts to control the effects of development on runoff will be implemented.*
7. Update and implement forest fire contingency plan	New plan in place	Improved coordination in fighting a forest fire	*Water supply for fire protection in the dry season could be improved.*

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

The project will comply with and facilitate the following relevant national legislation and regulations:

(a) *River Reserves (State Land and Forest Reserves Act)* – The Act provides for designation and conservation of riparian areas (although reserves have yet to be legally gazetted). The project will assist in further declaration and implementation of these reserves and related water supply protection zones in order to maintain riparian areas and their drainage control functions.

(b) *Public Utlitities Corporation Act* water supply standards – The PUC have responsibility to provide treated domestic water supply to all Seychellois in accordance with international standards for potable water. The project will enhance the ability to meet these standards and through the development of water supply protection zones around PUC barrages will assist the development of Drinking water Safety Plans that are recommended in the *Water Development Plan 2008-2030*. It will also develop national Water Policy that addresses the gaps in legal and institutional responsibilities for watershed management, including financing mechanisms for maintaining water supply services from watersheds.

(c) *Physical Planning Bill, 2012*, and regulations for District Land Use Plans – The proposed *Physical Planning Act* (preparation supported by the UNDP/GEF SLM Project) will supercede the *Town and Country Planning Act* and guide the District Land Use Plans which will have been completed by the end of 2012. Hillside development and realted conservation of forests and watersheds are key issues on Mahe. The project will provide technical inputs on watershed rehabilitation and management that will assist the implementation of these plans.

(d) *Environmental Protection Act 1994,* and Impact Assessment Regulations – The legislation requires that an EIA study be carried out and that an environmental authorisation is obtained if any person commences, proceeds with, carries out, executes or conducts construction/ development. The project will develop EbA measures that serve as impact mitigation technologies for environmental management associated with water supply developments that affect stream flows and catchment area runoff. Proposed construction of water control structures will comply with EIA requirements.

The environmental safeguards to be established by the project include:

- a Project Implementation Team that have the technical skills to design interventions and workplans consistent with international environmental management standards and good practices to avoid or mitigate the adverse effects of stream control structures and in-stream works;
- EIA requirements, review procedures and approval conditions for any major structures as required by Seychelles law;
- An ‘adaptive environmental management approach’ to the proposed reef rehabilitation and reforestation measures that involves careful, science-based design and oversight of the two elements any technical uncertainties – particularly (a) the proposed submerged breakwater, and (b) the replantation of alien invasive forest species with native species, through the development and implementation of a monitoring and learning plan that will maximize knowledge outputs from these activities.

All UNDP supported donor funded projects are required to follow the mandatory requirements outlined in the UNDP Programme and Operational Policies and Procedures (UNDP POPP). This includes the requirement that all UNDP development solutions must always reflect local circumstances and aspirations and draw upon national actors and capabilities.

In addition, all UNDP supported donor funded projects are appraised before approval. During appraisal, appropriate UNDP representatives and stakeholders ensure that the project has been designed with a clear focus on agreed results. The appraisal is conducted through the formal

meeting of the Project Appraisal Committee (PAC) established by the UNDP Resident Representative. The PAC representatives are independent in that they should not have participated in the formulation of the project and should have no vested interest in the approval of the project. Appraisal is based on a detailed quality programming checklist which ensures, amongst other issues, that necessary safeguards have been addressed and incorporated into the project design.

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

A review of ongoing projects shows that there is no duplication of the proposed project with other ongoing or planned interventions (see **Table 7** below). The project will particularly complement the implementation of the recent Seychelles Water Development Plan 2008-2030 and assist in merging watershed and wetland conservation and development objectives.

There are several projects aiming to protect the Seychelles' rich biodiversity. The emphasis of biodiversity management in Seychelles has largely been on strengthening management of protected areas and on species conservation. Some impressive bird species reintroductions have been undertaken e.g. Seychelles white-eye and Seychelles magpie robin. Interesting work has also been conducted on eradication of alien invasive species from private islands e.g. rat eradication on Denis and North Islands. These alien invasive species had a negative effect on the biodiversity of islands, and their removal also allowed for reintroduced species to re-establish. The Government of Seychelles is currently undertaking an initiative to mainstream biodiversity in the tourism and fisheries sectors, to reduce the threats proposed by these production activities on Biodiversity. However, the focus of these investments is on reducing threats to intact ecosystems, rather than on restoring areas or on enhancing ecosystem service functionality. These investments do not have a specific focus on climate change risk management—i.e. gearing ecosystem management to reduce the vulnerability to climate change.

In support of the Government policies and programmes on climate change adaptation, several external partners are planning inititatives. However, none has the explicit focus on enhancing the resilience of ecosystems as an adaptation measure. A special effort will be made to coordinate with the GEF-funded project "Implementing Integrated Water Resource and Wastewater Management in Atlantic and Indian Ocean SIDS". The project will employ IWRM principles on the island of La Digue, and hence provide an ideal interface for coordination and cooperation.

Bilateral projects that will be complemented by the proposed project include the JICA-funded Project for *Coastal Erosion and Flood Control in the Republic of Seychelles*, and the *Assesment of rising mean sea level and extreme events on the islands Mahé, Praslin, La Digue.*[76] Initial project planning and subsequent design of interventions will be carefully coordinated with the results of these projects.

The proposed project will build on the experiences and lessons learned from past and on-going initiatives that are addressing certain elements of the ecosystem-based adaptation and catalyse them into a larger-scale resilience approach. Moreover, it wil take into account the lessons learned in other countries in this sphere, and seek to apply appropriate good management practices locally.

[76] Mendez, H.S., Favier, L., Cutie, F., and Lopez, E.P., (2010). Preliminary assessment report of vulnerability to rising mean sea level and extreme events on the islands Mahé, Praslin, La Digue. Ministry for Science, Technology and Environment, Environmental Agency, Hazard, Vulnerability and Risk Group.

Table 7: Relevant Ongoing and Upcoming Initiatives in Seychelles

Project/Funding Institution	Objective	Potential Synergies
Ongoing Projects		
GOS/UNDP/GEF Mainstreaming Biodiversity Management into Production Sector Activities	To integrate biodiversity conservation objectives into key production sectors of the economy.	Work done on the project will complement the work of the proposed project as activities focus basically the same production sectors. The one project will integrate biodiversity concerns into development while the other climate change concerns, using ecosystem based adaptation as the entry point, assuring synergies and efficient use of funds.
GOS/UNDP/GEF Mainstreaming Prevention and Control Measures for Invasive Alien Species into Trade, Transport and Travel across the Production Landscape	Increased capacities to prevent and control the introduction and spread of Invasive Alien Species through Trade, Travel and Transport across the Production landscape.	Invasive Alien Species has the ability to modify community structure and/or species composition of natural systems, thereby potentially increasing the impacts and effects of climate change. By controlling the influx of Invasive Alien Species into Seychelles, the ecosystems will be more resilient, thereby assisting in the adaptation of Climate Change.
GOS/UNDP/GEF Capacity Development for Sustainable Land Management in Seychelles	Capacity enhanced in Sustainable Land Management (SLM) and SLM principles applied in national policies, plans, processes and practices.	Climate Change and especially sea-level rise will change soil fertility of the coastal zone and at times these plateau areas will be flooded resulting in a rise in the salinity levels of the soil. The agricultural water management practices in Seychelles through this project will greatly assist in the adaptation of the agriculture sector to climate change, through change in practices as well as crop species and rotation.
GOS/UNDP/GEF Enabling Seychelles to prepare its Second National Communication as a response to its commitments under the UNFCCC	Strengthen technical and institutional capacity to assist Seychelles in mainstreaming climate change concerns into sectoral and national development priorities.	Information on the national circumstances provided in the Initial National Communication (INC) will be updated. Special attention will be paid on new information and data related to the water supply and flood management issues.
GOS/UNDP/GEF Capacity Development for Improved National and International Environmental Management in Seychelles	To integrate local and global environmental management and enhance the capacity to implement global environmental management objectives within national programmes.	Awareness and capacity are developed for mainstreaming global environmental conventions (this includes the UNFCCC) into national programmes. Capacity for local implementation of global environmental conventions will be developed, applied and disseminated.
UNDP/GEF Strengthening Seychelles' protected area system through NGO management modalities	Facilitate working partnerships between diverse government and non-government partners in the planning and management of the protected area system in Seychelles.	The synergies will focus on the forest management plan for Mornes Seychellois Forest Management Plan and the implementation of wetland conservation policies alongside climate change adaptation measures.
GOS/EU Climate Change Support Programme	To support sustainable development policies and	These two projects will both support to the implementation of the National Climate

Project/Funding Institution	Objective	Potential Synergies
	the implementation of the priority areas of the Seychelles National Climate Change Strategy, in a coordinated effort with other donors.	Change Strategy, with the EU project focusing on technology-based approaches and mitigation strategies and the Adaptation Fund project on ecosystem-based adaptation approaches.
CUBA/GoS, Assesment of rising mean sea level and extreme events on Mahé, Praslin, La Digue	To provide technical support to the government on climate change hazards	Technical information and mapping has provided assistance in project planning
JICA/GoS, Project for Coastal Erosion and Flood Control in the Republic of Seychelles	To address site specific flooding, drainage and shoreline erosion issues on Mahe	Potential collaboration at NE Point where the JICA project will be undertaking measures to secure and improve flood protection on the road
Upcoming projects		
GEF/UNDP/UNEP/UNOPS Implementing Integrated Water Resource and Wastewater Management in Atlantic and Indian Ocean SIDS	Protection of a coastal gravel aquifer through integrated land and water management measures demonstrated in the island of La Digue.	Project will employ IWRM principles, and hence an ideal interface for coordination and cooperation. The two projects work in different islands—with this project focusing on ecosystem based adaptation to reduce vulnerabilities to water scarcity in the main population centre of Mahé.
GEF/UNDP Expansion and Strengthening of the Protected Area Subsystem of the Outer Islandsand its Integration into the broader Land and Seascape	To promote the conservation and sustainable use of coastal and marine biodiversity in the Seychelles' Outer Islands by integrating a National Subsystem of Coastal and Marine Protected Areas (CMPAs) into the broader land- and seascape while reducing the pressures on natural resources from competing land uses.	The project will rehabilitate degraded ecosystems in the Outer Islands through the removal of Invasive Alien Species and introducing indigenous species. An area of 60 ha will be rehabilitated on Desroches and Alphonse Islands. Sustainable Land Management Plans will be developed for these two islands.

The Seychelles Water Development Plan focuses on water supply infrastructure and demand side management, rather than the watershed management of raw water sources themselves. However, there are several areas of complementarity, summarized as follows:

Water Development Plan	AF EbA Proposal
Recommends Integrated River Basin management: - "The current Rivers Committee should act at a strategic level setting policy and ensuring that the actions required are implemented - All the stakeholders should be engaged in the process of improving the current situation and setting goals for the future - Setting-up of a small enforcement team by the Min of Environment to monitor and control the various aspects of IRBM"	The project proposes to strengthen the institutional capacity for watershed management in the project watersheds, and to develop national policy on watershed management through a re-activated River Committee. See Output 3.1. It also proposes to set up local watershed committees in the project watersheds to promote local engagement in stewardship of the water resources. In addition, a national coordination function will be established through the Rivers Committee. The project also proposes to implement enforcement action through rationalization of water abstractions in the project watersheds.

The Plan recommends; "the preparation of Drinking Water Safety Plans to minimize contamination of water sources, reduce or remove contamination by using appropriate treatment and to prevent contamination as the water passes through the distribution system to the point of supply (p. 81). "	The project proposes to identify and designate "water supply protection zones" that can be implemented through updated river reserves legislation, aimed at protecting the quality of raw water at source. It also proposes to address a water quality problem related to agricultural wastewater drainage in Baie Lazure watershed.
The Plan recommends "increasing the storage capacities of supply zones by construction of new reservoirs."	The project proposes to increase the water holding capacity within the project watersheds through EbA and other small scale engineering and rehabilitation of existing barrages on the river systems.

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

Learning and knowledge management is recognised as an important component of the project, reflecting one of the key themes of the Adaptation Fund. The project will act as the knowledge window for the government, resource users, and private sector regarding Ecosystem Based Adaptation approaches, bringing in appropriate international experiences to the Seychelles. Awareness raising activities targeting decision makers and local communities will be an integral part of knowledge management and civil society organisations will be involved in their design and roll out. Furthermore, lessons learned by the project will be disseminated with wider stakeholders.

The project will promote knowledge sharing and coordination among practitioners through three existing mechanisms, namely: (a) **Project Implementation Team:** a knowledge sharing and coordination platform for the climate change adaptation initiatives established with the representation of Government, external partners, academia, NGOs and CSOs; (b) the **National Climate Change Committee**, a broader policy level coordination mechanism; and (c) **Local Coordinating Bodies**: stakeholder assemblages to "learn by doing" such as 'River Committee' and the 'Community Watershed Committees'. The monitoring data from project implementation will be used to consolidate the lessons and to refine the protocols for ecosystem rehabilitation that is aligned with watershed rehabilitation.

Inter-community learning and dissemination of knowledge and experience will be fostered through experience sharing exchanges. Workshops will be organised at both district and central levels, in order to disseminate findings and lessons learnt from implementation initiatives that will yield policy briefs to decision makers. A training course will be developed in collaboration with the University of Seychelles. The project will produce information materials in a form of brochures introducing the ecosystem-based adaptation approach. In addition to regular information dissemination and experience sharing through various media (print, radio, TV etc.), project inception and closing workshops will be organised with a strong media presence and a joint project terminal report will be produced and disseminated to stakeholders. A handbook, training modules, and website content capturing best coastal adaptation practices and alternative livelihood options in the Seychelles' context will be produced.

H. *Describe the consultative process, including the list of stakeholders consulted, undertaken during project preparation, with particular reference to vulnerable groups, including gender considerations.*

Annex 4 provides a summary of the two workshops held and a list of stakeholders involved in the project planning. The project design missions also involved many individual meetings and site visits with stakeholders. More than 21,000 water users reside in the proposed project areas. 'Vulnerable groups' could include lower income residents amongst these users particularly those who depend solely on stream sources. Some residents were informally consulted during the field visits, and the community water systems with priority concerns have been selected based on advice from PUC. However, it is generally not possible to distinguish a vulnerable sub-group within the potential water supply and flood management beneficiaries. Gender equality is well integrated within the Seychellois society. Gender equality will be addressed in the project by (a) improving water supply and reducing the household burdens imposed on women during periods of drought, (b) ensuring equal opportunity for women and men to participate on local watershed committees, and (c) promoting gender balance in the proposed training programme. A recent study (2011), undertaken by Plan International and the Royal Commonwealth Society, ranked Seychelles high on gender equality (fifth highest among the 54 Commonwealth member countries). Based on this ranking, it is assured that both men and women are well represented by government representatives and NGO representatives. The attendance of planning meetings as well as individual meetings was well represented by both genders (20% of the first workshop attendees and 30% of the second were women). The strategy for stakeholder involvement recognizes the government's commitments to engaging a wide cross section of civil society, private sector and communities in the implementation of climate change adaptation initiatives. The project has also been designed to support decentralization and involvement of District authorities in water and wetland management efforts. Promoting greater community ownership and involvement in river reserves and the protection of rehabilitated or restored ecosystems is a key element of the project design.

The goal for stakeholder involvement in the project is to ensure that all stakeholders who are affected by, have a role in, or are interested in project themes have the opportunity to be involved and develop a sense of "ownership" of the project. The objectives of stakeholder involvement are to:

1. Promote multi-stakeholder collaboration in the design and implementation of project activities, including effective use of Government, NGO, private sector and community expertise and resources, improved communication channels, and innovative partnerships.
2. Ensure that the laws, policies, plans and strategies for watershed and coastal ecosystem rehabilitation that produced during the project are developed and implemented effectively with the support and collaboration of stakeholders;
3. Develop the mechanisms for community involvement in their local watersheds including participation in good water management practices and gender equity; and
4. Engage stakeholders in experiences-sharing and dissemination of the results of the project activities and expanding the knowledge base and ongoing training on EbA to climate change.
5. Promote good environmental governance mechanisms, including transparency, accountability, cooperation and collaboration among stakeholders.

In order to achieve these objectives, a participatory approach was used to develop the proposal. The scope of this initiative was defined in close consultation with the relevant officials at the MEE through meetings, including the Designated National Authority for the Adaptation Fund and the operational focal points for UNFCCC, UNCBD and GEF, as well as other Government Departments, notably the Ministry of Land Use and Housing, the Planning Authority and the Public Utilities Corporation and other external partners. The initiative is based on analysis and recommendations of a number of official reports and studies such as the Second National Communication report and the Seychelles National Climate Change Strategy that were finalised

after thorough stakeholder consultation processes. It also draws heavily on lessons learnt from implementing other projects and Governments priorities related to water supply and flooding issues.

The issues that have been identified by stakeholders include the following highlights:

- The Morne Seychellois watershed is an important protected area that also contains some water supply development potential which needs to be considered in an environmentally sustainable manner recognizing the biodiversity wetland attributes;
- Wildfire is a major concern that relates to vegetation types, fire break measures in the landscape and availability of water especially in the dry season, and this concern for water supply, not only for domestic and agricultural purposes but also fire protection, should be addressed in the project;
- There are a large number of issues and responses associated with adaptation to climate change, many of which may not be readily suited to ecosystem based approaches;
- The discussions suggested that Component 1 on watershed management was the highest priority public concern that warrants EbA investment and that Component 3 increased public awareness of the issues should be a key part of the solutions being proposed;
- It was suggested that the National Wetland Policy be re-assessed under the project to incorporate EbA initiatives and that the present policy is too weak to be effectively implemented in the face on ongoing development applications;
- EbA strategies for the watersheds are also affected by urban development pressures and issues related to how far development is allowed to expand up the hillsides of Mahe Island;
- There are also development pressures on sand dunes (berms) that are linked to coastal erosion and loss of dune vegetation that is cleared to accommodate developer requirements, all of which need practical measures and enforcement of standards;
- Setbacks from streams and shorelines and standards with regard to development impact and elevations and runoff from developments are a major source of the problems for protection of ecosystem functions that support water supply and flood management;
- Community involvement, on-the-job training and skills development should be integrated with the implementation of field activities by the project, which also complements community ownership and sustainability.

The following stakeholders have been consulted during the project planning.

Table 8: Project stakeholders

Stakeholder	***Anticipated roles***
Government entities	
Cabinet	Final level of approval of decisions
National Assembly	A Member of the National Assembly (MNA) is elected in each district by the adult population. The MNA is the democratically elected representative of the district inhabitants. Some other MNAs are representing their party on the proportional basis.
District Administration	Under the aegis of the ministry responsible for Local Government a district administration operates in each of the districts in Seychelles. The primary role of the district administration is to serve as an interface between the community in the affairs of the district and promoting access to public service at the local level. It operates in partnership with local representative groups and associations, community-based and non-governmental agencies, the Member of the National Assembly, the District Community Council.
Planning Authority 12 members: 5 Principal Secretaries (PS), chaired by PS MLUH, 5 technical + Seychelles Chamber of Commerce	Deals with planning and building applications, setting urban guidelines and preparing land use plans.
EMPS Steering Committee	Multi-stakeholder body with over 40 members, which oversees

Stakeholder	*Anticipated roles*
	implementation of 2000- 2010 Environmental Management Plan Seychelles (EMPS) and will oversee the third generation EMPS Plan 2010 – 2020 currently being drafted.
Ministry of Environment and Energy (MEE)	Overall conservation of nature and implementing UNCCD. It is Project implementing partner and its implementing agencies, Policy and Planning Services, Legal Unit, Pollution Control & Environmental Impact Assessment, Nature and Conservation, National Parks and Forestry will be main counterparts.
Auditor General (AG)	The AG Office will be actively involved in the legislative and regulatory reform processes in the project.
Seychelles Fishing Authority	Authority responsible for management of renewable marine resources.
Department of Tourism and Transport	Deals with the Government-related tourism and transport portfolio. It has a primary focus on tourism policy development, while operational matters are dealt with by Seychelles Tourism Board
Ministry of Land Use and Housing	Main partner in land use planning and management including natural resources such as sand and gravel extraction, quarrying etc.
Ministry of Local Government, Culture and Sport (MLGCS), Department of Local Government	Its mission is to empower local communities to be involved in determining their needs to promote social and economic well-being. District administrators, who live and work in the district, are appointed by the governing party and are officials of MLGCS.
Seychelles Tourism Board	Multi-sectoral Board mandated to look at development and marketing local tourism.
Seychelles National Park Authority (SNPA)	Responsible for all National Parks and Marine National Parks. SNPA will actively participate in the legislative and regulatory processes of the project.
Seychelles Agricultural Authority (SAA)	Responsible for providing policy and regulatory framework to, as well as capacity development services to, the agricultural community.
Public Utilities Corporation (PUC)	Responsible for the provision of electricity and water to all end users.
Academia	
University of Seychelles	Departments of Geography, Biology, Meteorology and Hydrology are partners in baseline and feasibility studies and continued monitoring of indicators.
Communities and private sector	
Communities	Project implementers and direct beneficiaries in the target islands.
Marine Conservation Society Seychelles (MCSS), Nature Seychelles (NS), Seychelles Islands Foundation (SIF), Plant Action Conservation (PAC) group, Sustainability for Seychelles (S4S), Island Conservation Society (ICS) Terrestrial Restoration & Action Society of Seychelles (TRASS) Green Island Foundation	NGOs with experience in implementing various environmental projects, some with conservation area management experience and others with land and watershed rehabilitation experience. Potential technical assistance in rehabilitation of degraded coastal zones as they have gained experience in rehabilitation of areas.
Islands Development Company (IDC)	Responsible for the development of the Outer Islands and Silhouette Island.
Private sector	Project implementers and direct beneficiaries in the target islands.
National media	Information dissemination

The expertise of stakeholders includes the following:

Watershed Rehabilitation:

- Seychelles National Parks Authority – responsible for national park management but also for forestry issues in general e.g. forest fire. Has a lot of experience in forest rehabilitation and have a few small nurseries in operation on the main islands.
- TRASS (Terrestrial Restoration Action Society of Seychelles) – this NGO has experience in Post Fire Rehabilitation Work, Creeper Eradication and general forest rehabilitation.
- Green Island Foundation – NGO involved in the vegetation rehabilitation on North Island and forest rehabilitation on Denis Island.
- Plant Conservation Action Group – very involved in the rehabilitation of natural forests and conservation of wetlands.
- Department of Biological Sciences, Aarhus University, Denmark – research associate doing research on alien species eradication and forest rehabilitation.

Design and Maintenance of Barrages:

- Public Utilities Corporation – parastatal responsible for water provision to citizens, extensive experience in construction and maintenance of water supply systems, some experience in dam construction but might need to bring in international experience.

Wetland/Mangrove Rehabilitation:

- Environmental Engineering & Wetlands Section, Department of Environment – responsible for managing all wetlands and some rehabilitation experience
- Nature Seychelles – NGO that restored an important wetland in the centre of Victoria (Roche Caiman)
- Sustainability for Seychelles (S4S) – experience in mangrove rehabilitation
- Mangroves for the Future (MFF) – projects implemented in Seychelles in coastal ecosystem conservation for sustainable development. Experience in wetland/mangrove rehabilitation since 2004, could use their extensive international expertise on project
- Plant Conservation Action Group – experience in wetland conservation.

Coral Reef Rehabilitation:

- Nature Seychelles – currently implementing a coral reef rehabilitation project around Cousin Island – in process of setting up a coral nursery from where they transplant corals onto degraded areas
- Marine Conservation Society of Seychelles – some coral transplant experience
- University of Seychelles – some experience in reef systems.

Sand Dune Rehabilitation:

- Division of Risk and Disaster Management, Department of Environment – has implement some dune rehabilitation projects e.g. planting of native species on disturbed sand dunes
- Green Island Foundation – dune rehabilitation work on Denis Island and some work in Mahe and Praslin, mainly on planning
- Marine Conservation Society of Seychelles- some coastal dune planning experience.

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

Component 1: Ecosystem-based adaptation approach to enhancing freshwater security and flood control in Mahé and Praslin under conditions of climate change

Baseline (without AF Resources)

Seychelles is not fully equipped with a climate-resilient water supply and management system. This has led to the imposition of numerous water restrictions and emergency measures to provide water to citizens. During the next five years, the Government of Seychelles will address existing water shortages through managing both the demand and supply side of the water equation. Demand for water will be managed through 1) public awareness campaigns implemented by the Public Utilities Corporation (PUC); and 2) drafting and enforcement of legislation and implementation of tariffs bands. The supply of water to Seychellois will be addressed through the replacement/improvement of existing infrastructure e.g. replacing pipelines. Major investments are proposed through the Water Development Plan 2008-2030 to raise the La Gogue reservoir and other infrastructure development allocated by Ministry of Finance to PUC. The current supply system only operates at 56% efficiency with major losses due to old infrastructure (pipelines and meters) and inadequate monitoring. The country is seeking to reduce current water shortages by reducing leakage and installing new pressure and metering systems, and also through the planned demand side management measures. This effort will not be sufficient to address the expected climate change induced dry season water shortages, caused by the reduction and cessation of stream base flows, particularly given the high dependence on a large number of very small watersheds that have proven difficult to manage.

Under the business as usual scenario, the Mahé water catchment areas (essentially the entire island except the coastal plateau zone) will be managed in a fragmented and uncoordinated manner and degraded uplands on Praslin will continue the process of decline. Focus will continue to be on the extraction of water from these watersheds rather than on enhancing the water provisioning services of ecosystems under climate change. The importance of watershed management and forest ecosystem functionality as a provider of quality raw water for water supply will go unrecognized, and the dependence on expensive water transfer methods and desalination will grow. Land resource management will not be dealt in a coordinated, integrated manner, with full recognition of the complexity of interaction between different biotic and non-biotic elements of ecosystems. Alien high water-use species will increase and forests will also be lost due to developments, landslides, fires etc, which also directly affects provision of quality water. Residents in the watersheds will remain disengaged in watershed decisions, illegal water abstraction will expand and the conflicts between domestic and agricultural water users will increase. This will reduce the adaptive capacity of Seychelles to climate change.

Additionality (with AF Resources)

This proposed project will implement an EbA approach to enhance ecosystems' resilience in water catchment areas of Mahé and Praslin in order to maximize the supply of water resources, and reduce climate change induced water scarcity. A new approach will be introduced by the project – better utilizing and sustaining the natural ecosystem functions to enhance water quantity and quality, and to re-orient the water supply planning to include the catchment areas above the water intake sites. Watersheds will be evaluated on their water provisioning potential and a range of rehabilitation and other ecosystem enhancing interventions will be implemented at sites that show the highest potential for water provision. This will include rehabilitation of upland wetlands and forests to enhance water-soil infiltration and water storage capacities. It will also address the impacts of wildfires—expected to grow in frequency and intensity under conditions of climate change, in the dry season. This will lead to forest degradation if left unchecked, and will have an adverse effect on hydrological functioning. The EbA approach will promote a landscape, *whole watershed* strategy that combines ecosystem functions, small-scale water detention and storage

facilities (barrages) and changes to the management systems for the many dispersed water supply watersheds, including water source protection zones, enacting river reserves and mobilizing local involvement in forest rehabilitation and watershed and wetland protection.

Component 2: Ecosystem-based adaptation approaches along the shorelines of the Granitic Islands reduce the risks of climate change induced coastal flooding.

Baseline (without AF Resources)
The coastal strip of the granitic islands is extremely vulnerable to the projected impacts of climate change especially coastal erosion and flooding. Under the business as usual scenario, coastal erosion will be addressed by continual upgrading of the infrastructure and by continual reclamation of lost land. This will result a largely fragmented ad-hoc approach dealing with problems as they arise. The hard structural technologies that will be employed to protect the shoreline include (1) rock armouring; (2) sea-walls; (3) break-water/piers; and (4) groynes. Tourism developments will mainly finance such structures to protect beaches, while Government will finance structures to safeguard public infrastructure. Private owners will safeguard their own investments. In extreme cases, infrastructure will be moved away from the shoreline e.g. roads. Reclaimed areas on the coast will be exposed to continual erosion. Floods will be dealt as a disaster when it happens. Drainage will be designed to redirect water in some urban areas. At times when flooding as a result of intense rainfall and wave/ocean flooding occur simultaneously, large financial losses will result. The economic costs of these measures will not be factored in, as is often the case with disasters.

In selected areas under the status quo, mangroves will be protected for their biodiversity values, but as is the case in the past, not specifically to protect the shoreline from erosion and flooding. In areas outside protected areas the degradation of mangroves will likely continue. Sand dunes and 'beach berms' will continue to be seen as recreational areas, and developed into tourism resorts or private residences. Coral reefs will be conserved in marine protected area, for biodiversity reasons and for the promotion of recreational diving and artisanal fisheries. These sites for protection were not chosen on the basis of the potential ecosystem services they can provide—i.e. buffering services to protect coastal infrastructure.

Additionality (with AF Resources)
This project will demonstrate an EbA approach to enhance ecosystems' resilience in the granitic islands so that they will be able to provide a continuous buffering services against erosion and floods while providing for or enhancing economic activities. A range of rehabilitation and other ecosystem resilience enhancing interventions will be undertaken to strengthen the role of ecosystems in adapting to climate change. This will include efforts to expand the buffering services of wetlands, shoreline beach berms and coral reefs against erosion and floods. The role of wetland ecosystems in facilitating flood attenuation alongside infrastructure and development will be highlighted as a key adaptation opportunity in the coastal plateau that has been overlooked to date. A participatory approach involving local communities in the design, implementation and monitoring of coastal adaptation measures will be made at each site. The project will refine the EbA methods at two priority areas which will provide a platform for raising the awareness about EbA opportunities and encouraging replication in other areas.

Component 3. Ecosystem based adaptation mainstreamed into development planning and financing.

Baseline (without AF Resources)
Since Seychelles ratified the Kyoto Protocol in 1993, the government has taken considerable steps towards the implementation of the UNFCCC, by implementing the required commitments such as the Initial National Communication and Technology Needs Assessment. There has been a growing awareness amongst the decision-makers and government officials that climate change risks to Seychelles are very high and that this is an issue that significantly affects almost all sectors of the

national economy. There is a good awareness about the need for comprehensive adaptation measures that will be required to reduce the anticipated negative impacts of climate change. The *Seychelles National Climate Change Strategy* approved by the Cabinet in 2009 echoes this awareness among the major decision-makers of Seychelles. Two of the five objectives aim *"to mainstream climate change considerations into national policies, strategies and plans"* and *"to build capacity and social empowerment at all levels to adequately respond to climate change"*. The Strategy recognizes a lack of capacity and knowledge to address emerging issues as well as limited financial resources for adaptation. Furthermore, existing adaptation efforts have not adequately incorporated EbA approaches. The Government has recognized this shortcoming and that concrete methodologies and actions for the EbA approach are lacking. The Government has identified EbA it as its priority for adaptation fund financing—seeking to put in place the requisite management systems.

Given that various government agencies are responsible for different aspects of water and coastal zone management, tackling these issues under the expected conditions of climate change would lack a coordinated approach within government, private sector, NGOs and individual citizens. In the business as usual scenario, the government's institutional capacity for planning and implementing adaptation approaches will remain insufficient at the national and local levels with limited access to tools and information for internalizing climate change risks into land, water and coastal resource planning. Land use planning will largely be focused on physical development and urban development, with biodiversity conservation objectives incorporated in high biodiversity areas, and the links between watershed and wetland systems and development plans generally overlooked. There will be little substantive consideration of climate change risks and comprehensive measures for enhancing ecosystem resilience. Climate change will not be internalized in land use management, increasing the likelihood of ecosystems being degraded to a point where they are no longer resilient to climate change. Adaptation actions will remain fragmented and uncoordinated. No systematic knowledge management system with EbA elements will be developed and instituted. Up-scaling of best practices will therefore be unlikely to happen.

Additionality (with AF Resources)

With financing provided by the Adaptation Fund, watershed and coastal risk management will be mainstreamed in the country's legislative framework and sector policies, particularly in developing a policy on watershed management that explicitly addresses climate change risks. The project will establish a new process for community-based management of rehabilitated watersheds and coastal sites that will raise awareness of the role of the ecosystems in addressing climate-related water shortages and coastal flooding. Institutional mechanisms will also be strengthened in support of climate resilience in district land, water and coastal use plans, as well as development plans. In order to support an informed decision making process, environmental assessments will be conducted, which is expected to yield much needed detailed information on threats to ecosystem functions and resilience from climate change as well as various sectors and land uses. Protocols for ecosystem rehabilitation in context with watershed and coastal rehabilitation will be developed and stakeholders will be trained in EbA. The land use planning system and environmental impact assessment and mitigation framework will be applied to ensure that EbA considerations are taken into account and an effective mitigation hierarchy (avoid, reduce, mitigate and offset) is applied for the purposes of securing ecosystem services. Mechanisms will also be provided to involve local authorities and communities in watershed and ecosystem management.

E. *Describe how the sustainability of the project/programme outcomes has been taken into account when designing the project.*

The strong commitment of the Government of Seychelles to sustainably address climate change and its social, economical, environmental and financial impacts has been evident through several initiatives from the country's leadership. This clear intention is reflected in the country's National

Climate Change Strategy and the establishment of the National Climate Change Committee as well as the Climate and Environmental Services Division in the Ministry of Environment and Energy.

AF funds are sought to support the Government of Seychelles in fulfilling these high ambitions and to facilitate the integration of climate-change adaptation into the relevant policies and decision making processes. AF resources will be used to ensure that the relevant institutions are equipped with the capacity to turn the policies into sustainable and positive impacts on the ground. At the same time, the programme's water provision and coastal and watershed flooding components and adaptation measures put in place will clearly demonstrate the social, economic, financial and environmental benefits of adapting to the hazards of climate change under a climate-compatible policy and decision-making framework that will support the resiliency of longer-term development efforts beyond the programme cycle.

The project has been designed to sustain ecosystem-based adaptation by (a) proposing watershed protection and management policy that explicitly recognises the role of ecosystems in adapting to climate change, (b) activating and strengthening the Rivers Committee and establishing local watershed management committees that promote ongoing community stewardship of the water supply watersheds, (c) establishing specific water supply protection zones around PUC barrages and water intakes that will become a management focus for PUC staff, (d) developing the technical standards, protocols and guidelines for ongoing rehabilitation of forests, wetlands, beach berms and fringing reefs, (e) linking the training programme to an ecosystem rehabilitation course at the university and (f) implementing a financing framework to directly recover the costs of watershed management from the water supply users and other sources of funding.

The outputs of this proposed project serve to increase the targeted beneficiaries' resilience to climate change and the most pressing climate hazards, that remain insufficiently addressed to date. The activities for the implementation of adaptation measures are conducted on a community level and aim at building an understanding and awareness of the issues at hand while including the communities in the development and maintenance of the adaptation measures. The participation of the targeted communities is, for example, an instrumental part of the watershed management and adaptation measures related to flooding and water provisioning. To a large part, the measures implemented under this project will be designed in a way that they can be maintained and replicated in using locally and nationally built capacity and locally available material. The focus on community-led initiatives and support to community-led replication of the best practice adaptation measures also ensures that the risk of insufficient community support endangering the effective use of the programmes' resources and sustainability of the impact is effectively mitigated.

Trainings and participatory processes as well as the establishment of local processes and institutions (e.g. watershed committees) aim at creating the local capacity to make informed decisions in regards adapting to climate change-related floodings and water shortages. The implemented measures will protect the well-being, health and assets of individuals, households and towns, which in turn is a basis for further sustainable development of the targeted areas.

The project also integrates a specific component on awareness raising and knowledge management as key part of the sustainability and replicability strategy of the initiative. Through systematically documenting and disseminating good practices, it is ensured that lessons learnt from other initiatives are integrated in this project's implementation while providing a wide dissemination of project results and lessons learnt.

PART III: IMPLEMENTATION ARRANGEMENTS

A. *Describe the arrangements for project / programme implementation.*

The project aims to have a substantial impact at a technical, policy and community level. The effects of climate change on water supply and watershed and coastal flooding are a national concern with real consequences that are being felt by Seychellois today. The project implementation structure therefore is important given the profile of the climate change related watershed and coastal management issues in Seychelles.

Upon the request of the Government of Seychelles, UNDP will be the Multilateral Implementing Entity (MIE) for this project. The Project will therefore be implemented following UNDP's **National Implementation Modality (NIM)**. The designated Implementing Partner of the project will be the Environment Department (ED) of Ministry of Environment and Energy. ED is responsible for implementing UNFCCC and will hold the responsibility of the senior supplier. ED is ultimately responsible for the timely delivery of inputs and outputs and for coordination of all other Responsible parties including other line ministries, relevant agencies, and local government Authorities. The ED will appoint the **National Project Director** as the focal point for the project.

The proposed project builds upon national experience with ecosystem rehabilitation and with water supply source infrastructure but it adds a new dimension by introducing watershed-scale rehabilitation and management of forests, wetlands, stream channels and catchment area drainage systems. This is a substantive shift in policy, water management practices and community involvement in watersheds that requires greater project implementation support than simply the services of a project manager and administrative/finance officer. The project organisation distinguishes between project management functions involving the National Project Director (NPD), the Project Manager (PM) and the Administrative/Finance Officer (AFO) and the project implementation functions involving a Project Implementation Team (PIT) and Activity Contractors. The technical elements of the project and the scope of change proposed in watershed and wetland management warrant a more intensive approach to implementation partnerships, results and environmental management. The PIT will provide a technical coordinator and a community coordinator (senior consultant or NGO staff) to organize and manage the diverse field activities. The policy-related activities and overall management of these teams and the implementation modalities will be the responsibility of the Project Manager.

The proposed organisation is presented on **Figure 6**. The roles of each party are outline below.

The National Climate Change Committee - responsible for making management decisions for the project and plays a critical role in project monitoring and evaluation and the quality of processes and products, and using evaluations for performance improvement, accountability and learning. The NCCC represents national interests within government and civil society in responding the climate change risks. The NCCC will serve the functions of a Project Board, as required under UNDP management systems.

National Project Director – The NPD will serve as the designated MEE responsible officer and focal point for the project who will provide liaison and reporting to the National Climate Change Committee.

Project Assurance - UNDP Mauritius/Seychelles will support project implementation by assisting in monitoring project budgets and expenditures, recruiting and contracting project personnel and consultant services, subcontracting and procuring equipment. The UNDP Mauritius/Seychelles will also monitor the project implementation and achievement of the project outcomes/outputs and ensure the efficient use of donor funds through an assigned Programme Manager.

Rivers Committee – This revitalized body, made up of not more that six members, will include key representatives from government, PUC and civil society and have a broad mandate to facilitate policy level responses to critical issues that are being addressed in the project, and to provide technical advice and support to the Project Manager and the Project Implementation Team. (The title of this committee could be changed to Water Management Committee if deemed useful)

Project Coordination Unit – (PCU) The PM will be supported by a core government support staff located within the MEE who will provide day-to-day operations of the project, and the overall operational and financial management and reporting requirements. The PCU has the duty to appoint the Project Manager and Project Implementation Team.

Project Manager – (PM) He/she will be a national professional designated for the duration of the project. The PM's prime responsibility is to ensure that the project produces the results specified in the project document to the required standard of quality and within the specified constraints of time and cost, and provide guidance and supervision of the Project Implementation Team. The PM will also directly lead the policy initiatives under Component 3 of the project.

Project Implementation Team – (PIT) A small operations team is proposed of key government staff facilitated by technical and community advisors employed by a managing contractor. This team will be responsible for developing the technical specifications for and overseeing the implementation of subproject activities that will be largely delivered by Activity Contractors through UNDP procurement processes. The team may involve technical and community subgroups, or similar division that will oversee the project field implementation strategy and performance including environmental design and assessment of the interventions and linking the investment activities under Component 1 and 2 with related capacity and knowledge development under Component 3.

Activity Contractors - Packages of work activities (or 'subprojects') will be procured through competitive bidding processes managed by the PCU, with specifications approved by the Rivers Committee and the PIT.

The key project management staff positions include:

> **Project Manager:** A senior MEE representative or appointee responsible for all project operations and progress and reporting to the Project Board, and with the capacity to coordinate the various government and non-government partners in the project. The Project Manager will also be responsible for leading the policy-related elements of the project.
>
> **PIT Contractor:** The Project Implementation Team will be organized and guided by a managing contractor with expertise in watershed, wetland and related water and coastal management fields to be appointed through a competitive bidding process. The contractor will be responsible for field-based management of the activities and technical guidance on the work plan specification and quality of the work implemented. It will have the primary duty, firstly, to ensure that the interventions are well designed and appropriate for the site context and designed on an 'adaptive environmental management' basis where opportunities exist to maximize the lessons that can be drawn from implementation; and secondly, to ensure that the field implementation is operating effectively, on time and budget, and adjusting the work as necessary to address implementation issues as they arise.

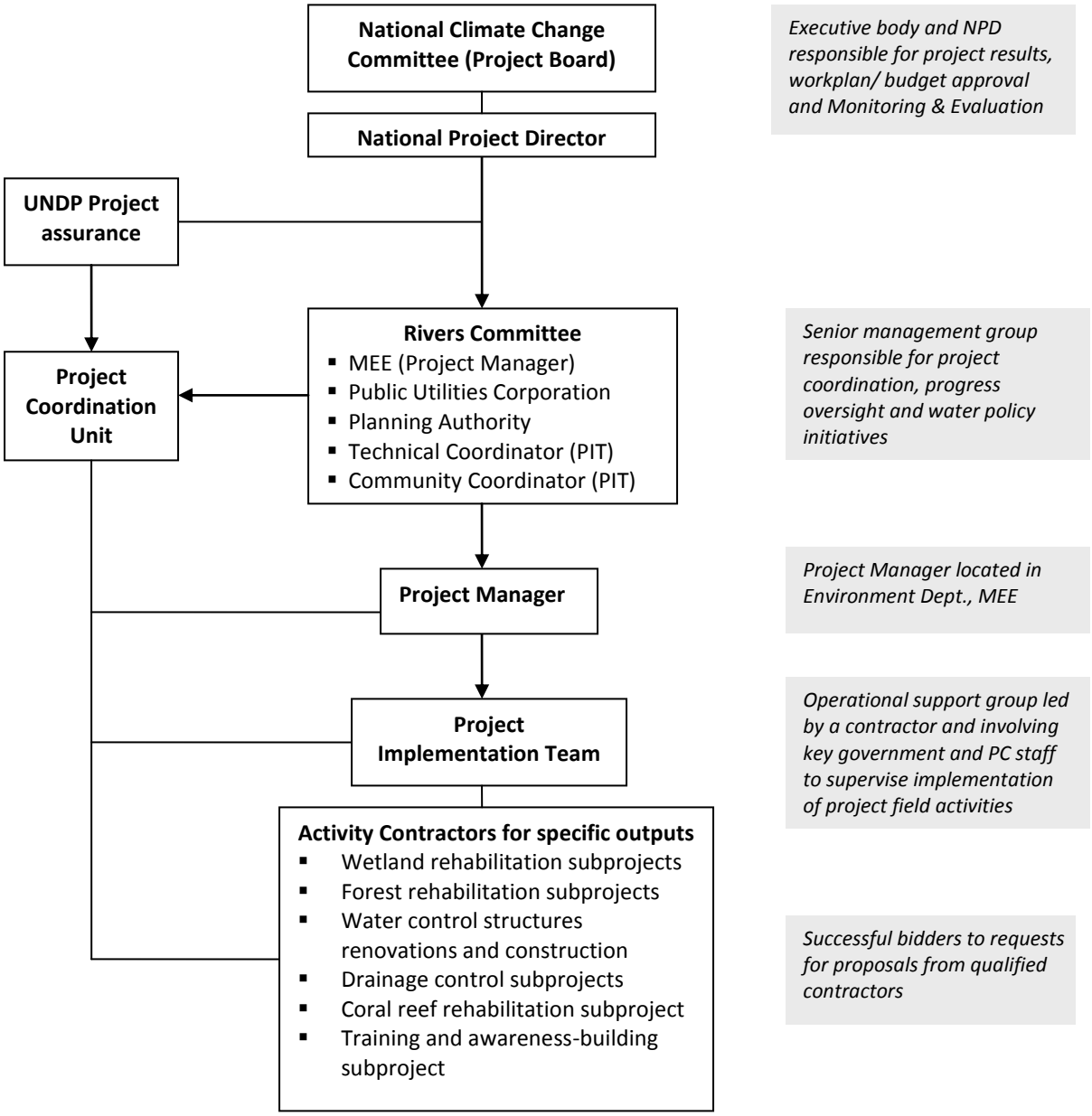
Administrative Coordinator: The GoS-UNDP Project Coordination Unit officer responsible for management, administrative and reporting functions and facilitating coordination and cooperation within the project organization and between the project and external parties. Responsible for timely procurement of services of the Activity Contractors in accordance with UNDP standards.

The budget for Project Management is shown on Table 9 below and also included in **Annex 6**.

Table 9: Project Management Costs

Items	Mths	$/Mth	
Project Manager	70	2500	175,000
Administrative & Finance officer	70	1000	70,000
Driver	60	800	48,000
Office rent	72	-	UNDP/government
Equipment, supplies, miscellaneous	72	250	18,000
Vehicles and travel	70	800	59,000
Monitoring & evaluation			80,000
Total			450,000

Figure 6: Project Organisation



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

Key risks underlying the project have been analyzed during the formulation phase in connection with the target sites of the project. Over the course of the project, a UNDP risk log will be regularly updated in intervals of no less than every six months in which critical risks to the project have been identified.

The risks facing the project and the risk mitigation strategy (countermeasures) are summarized below:

Table 10: Risks and risk management

No	Type	Description	Management strategies	Rating
1	Institutional	Policy makers prioritize economic benefits over sustainable and resilient ecosystems	Project will also build capacity of the relevant national stakeholders at central and local levels. Moreover, awareness raising activities will be implemented at the target sites to convince and change behavior of decision makers towards ecosystem roles in climate change adaptation.	Medium
2	Environmental	Extreme natural disasters affect confidence of local community to adaptation measures	Timing of the period of field activities and design of the interventions will take account of weather conditions and extreme rainfall and storm events that can sometimes overwhelm ecosystem rehabilitation projects and these risks will be incorporated into the operational contingencies.	Medium
3	Environmental	Environmental impact of structures in watercourses and reefs	Environmental factors will be part of the project activity and water structure designs, particularly in considering water supply development and upland wetland conservation at Mare aux Couchons and other sites, and improving reef integrity and functions consistent with international standards for reef enhancement.	Medium
4	Environmental	Methods of ecosystem rehabilitation need better testing for hydrological impacts	Ecosystem rehabilitation experiences will need to be adjusted and refined to address hydrological variables, including informed understanding of forest cover change and watershed runoff and infiltration using biological technologies as well as other methods. Intensive discussion on the selection of appropriate methods and species, and the monitoring systems to assess performance will be designed into the process.	Low
5	Social	Adaptation measures increase inequity	The project will ensure that the adaptation measures are gender sensitive and demonstrate at the local level that they do not limit the participation of women and the disabled as beneficiaries. Disconnection of illegal water abstractions may create some resentment but the issue will be managed within a community-based water planning process in collaboration with local authorities.	Low
6	Financial	The cost of the proposed measures may be higher than expected.	Project activities have been designed and costed as accurate as possible in its development stage. MEE (including the Project Management Unit) and UNDP will provide permanent support for the contracting, monitoring and financial reporting in order to determine spending levels versus achievement against the results framework. The project will also strengthen the	Low/Medium

			institutional basis for accessing public and private sources of Climate Change finance for EbA approaches in the future to attract additional funding. The key strategy is to internalize management in the public works programmes and forest management in Seychelles, and the necessary recurrent costs should be brokered. The scale of interventions can also be reduced if additional funds cannot be raised in time.	

A comprehensive risk management strategy will be a core component of project management activities. This is in line with UNDP's stringent risk management approach which is corporate policy. The respective UNDP CO provides support to the project team and executing agency for constant and consistent risk monitoring, and the results are tracked and reported in UNDP's internal risk monitoring system. Risks will be entered into the UNDP's Atlas (project management system) and will be systematically monitored as part of the M&E process by UNDP staff carrying out their oversight related tasks. The results are also reported in the yearly evaluation undertaken for each project.

In addition to this, and again in keeping with UNDP practice, a dedicated budget line exists for Monitoring and Evaluation (M&E), to ensure that the necessary resources are allocated to execute the M&E framework.

C. *Describe the monitoring and evaluation arrangements and provide a budgeted M&E plan. Include break-down of how Implementing Entity's fees will be utilized in the supervision of the monitoring and evaluation function.*

The monitoring and evaluation (M&E) scheme will be applied in accordance with the established UNDP procedures throughout the project lifetime. As an implementing partner, MHAETE, together with the UNDP Mauritius/Seychelles will ensure the timeliness and quality of the project implementation. The M&E plan will be implemented as proposed in **Table 11**. Technical guidance and oversight will be also provided from the UNDP's Regional Bureau for Southern Eastern Africa, as well as the Project Board (PB). Audits on the project will follow UNDP finance regulations and rules and applicable audit policies.

Monitoring Strategy

(1) Project monitoring and reporting

A monitoring plan will be prepared during the inception phase that how, who and when monitoring of activities and Results Framework Indicators will occur including responsibilities for data collection, compilation and reporting by the project staff. Monthly, quarterly and annual reporting systems will accord with AF, UNDP and Government of Seychelles requirements. The oversight of this monitoring and reporting will be integrated with the management responsibilities as set out in the Project Organisation to meet the adaptive management expectations and standards of UNDP.

Given the technical rigor that will be required to finalize and to supervise the interventions, the **Project Implementation Team** (PIT) has been designed to ensure an effective adaptive management and M&E system. This implementation structure involves much greater operational support and oversight than normally applied to international projects in Seychelles. The PIT contractor will be responsible for field-based management of the activities and technical guidance on the work plan specifications and quality of the work implemented. It will have the primary duty, firstly, to ensure that the interventions are well designed and appropriate for the site context and designed on an *'adaptive environmental management'* basis where opportunities exist to maximize the lessons that can be drawn from implementation; and secondly, to ensure that the field implementation is operating effectively, on time and budget, and adjusting the work as necessary to address implementation issues as they arise.

The Project Implementation Team is intended to provide technical and field level supervision of the detailed specifications and implementation of the various project activities. This is an investment in project delivery which is expected to provide enhanced quality assurance. It is proposed in light of the limited experience in watershed management and water management in general and uncertainties in the optimum forest rehabilitation prescriptions that can best contribute toward watershed management. Careful assessment and design will be needed along with some level of pilot testing and refinement of the EbA measures. This approach of an implementation team also seeks to bridge the current gap between government and NGOs in mobilizing national action on EbA measures. It is intended as a mechanism for enhanced working partnerships between government staff and civil society groups.

The PIT is a means for ensuring both effective results in the Project Activities and effective partnerships and synergies between government/PUC, Activity Contractors and the community participants. It should complement and facilitate the functions of the Project Manager, to which it will report. The Project Implementation Team will be organized and guided by a managing contractor with expertise in watershed, wetland and related water and coastal management fields to be appointed through a competitive bidding process. The PIT will focus on three process outcomes:

- Technical and environmental quality assurance in the implementation of individual Activity Contractors;
- Effective communication and collaboration between government, communities and Activity Contractors; and
- Development of a *National Watershed Monitoring Programme* that tracks the long term effectiveness of the management strategies and plan for water supply watersheds.

(2) Adaptive environmental management of strategic issues

In order to address certain risk management and knowledge development objectives, it is proposed to adopt an "adaptive environmental management" approach to implementing some of the activities, under the supervision of the PIT. Adaptive environmental management is about 'learning by doing' using scientific methods in a systematic way to identify, test and refine environmental interventions and the assumptions associated with them, and adapting the interventions based on experiences.[77]

There are two proposed project activities that lend themselves to this type of intensive, structured, scientific assessment of current uncertainties and potential effects:

- **Forest replantation for hydrological and biodiversity objectives**. The effects of different forest plant species and management strategies on hydrological systems and the appropriate protocols for replacement of alien invasive plant species with native species need to be better understood, aimed at improving the control and retention of overland runoff and the associated use of soil and water conservation measures in conjunction with the vegetative barriers and other methods. A structured, randomized control trial approach to monitoring and learning from alternative interventions to address this problem could be designed into the project watershed programmes. The parameters that require further consideration in the forest rehabilitation prescriptions could include: i) forest species mix particularly with regard to canopy height and density, ii) ground cover water holding capacity, iii) water consumption rates of selected species to be removed and planted, and iv) understory forest fire fuel characteristics under different replanting protocols.

- **Coral reef restoration for flood protection and biodiversity objectives.** The effects of reef rehabilitation methods on coral populations and density including lessons from a

[77] See for example, *Open Standards for the Practice of Conservation, Version 2.0*., 2007, www.conservationmeasures.org;

proposed submerged barrier should be part of the technical components of the project monitoring plan. Comparative monitoring and assessment of different methods of restoring degraded coral reefs and the testing and refinement of assumptions related to natural recolonization of submerged structures could provide important information for future climate change adaptation strategies in Seychelles.

Project start: A *Project Inception Workshop* (IW) will be held within the first 3 months of project start with those with assigned roles in the project management, AF, UNDP CO and where appropriate/feasible, regional technical advisors as well as other stakeholders. The IW is crucial to building ownership for the project results and to plan the first year annual work plan.

Annual Progress Report. An Annual Progress Report (APR) shall be prepared by the Project Manager, shared with the Project Board and submitted to the Donor. The APR will be prepared with progresses against set goals, objectives and targets, lessons learned, risk management and detailed financial disbursements.

Mid-term of the project cycle: The project will undergo an independent Mid-Term Evaluation (MTE) at the mid-point of project implementation (September 2015). The MTE 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 project implementation; will highlight issues requiring decisions and actions; and will present initial lessons learned about project design, implementation and management. The findings of this review will be incorporated as recommendations for enhanced implementation during the final half of the project's term.

Periodic Monitoring through site visits: UNDP Mauritius/Seychelles will conduct visits to project sites based on the agreed schedule in the project's Annual Work Plan to assess, at first hand, project progress. Other members of the PB may also join these visits.

Project Closure: An independent Final Evaluation will be undertaken 3 months prior to the final PB meeting. The final evaluation will focus on the delivery of the project's results as initially planned and as corrected after the mid-term evaluation, if any such correction takes place. The final evaluation will look at impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental benefits/goals.

Table 11. Monitoring and evaluation plan of the proposed project

Type of M&E activity	Responsible Parties	Budget US$	Time frame
Inception Workshop and Report	▪ Project Manager ▪ UNDP CO, RBAP, AF	3,000	Within first two months of project start up
Measurement of Means of Verification for Project Progress on *output and implementation*	▪ Oversight by Project Manager ▪ Project team	n/a	Annually prior to ARR/PIR and to the definition of annual work plans
ARR/PIR	▪ Project manager and team ▪ UNDP CO	0	Annually
Periodic status/ progress reports	▪ Project manager and team	0	Quarterly/ Annually
Mid-term Evaluation	▪ Project manager and team ▪ UNDP CO ▪ UNDP RBAP ▪ External Consultants (i.e. evaluation team)	30,000	2015
Final Evaluation	▪ Project team, ▪ UNDP CO ▪ External Consultants (i.e. evaluation team)	30,000	2018, at least three months before the end of project implementation
NEX Audit	▪ UNDP CO ▪ Project manager and team	2,000	As per UNDP regulations
Visits to field sites	▪ UNDP CO ▪ Government representatives ▪ Project Unit	15,000	Yearly

▪ UNDP RBAP	
TOTAL indicative COST	**US$ 80,000**

Note: The costs indicated here do not include the costs associated with UNDP staff. Those UNDP related costs are covered by the MIE fee.

The costs of MIU involvement in the M&E process are estimated in **Table 12** below.

Table 12: UNDP (Multilateral Implementing Entity) support for and supervision of M&E

Project Monitoring and Evaluation;		
a) Inception Phase organisation and operations staff time and related expenses	4 mths @$5,000/mth	20,000
b) Quarterly reporting discussions and submission	18 x $2,000	26,000
c) Annual reporting discussions and submission	6 x $3000	18,000
d) Mid Term Evaluation process organisation and participation	preparation ToRs, appt, briefing and oversight	10,000
e) Terminal Report and Final Evaluation	preparation ToRs, appt, briefing and oversight	10,000
Total		**$ 84,000**

D. *Include a results framework for the project proposal, including milestones, targets and indicators and sex-disaggregate targets and indicators, as appropriate. The project or programme results framework should align with the goal and impact of the Adaptation Fund and should include at least one of the core outcome indicators from the AF's results framework that are applicable.*

The dominant results expected from the project are an increase in dry season stream flows and a decrease in peak flows. It is difficult to predict the scale of effects but the general view of technical staff is that improvement in low flows as well as water supply production could be in the order of 20-30% particularly given the barrage renovation effects (de-silting and soil and water conservation), the enhanced upland wetland management and the efforts to increase ground cover vegetative barriers to runoff. The relatively small volumes of water, despite the run-of-river watershed characteristics, are considered within the scope of manageability and influence by watershed rehabilitation. Significantly, the introduction of a policy and institutional framework for watershed management is also expected to have a timely impact on the public recognition of the relationship between watershed land and water use, and water supply availability and quality under climate stress.

On the coastal side, the flood attenuation services provided by wetlands at NE Point and Anse Royale have gradually declined due to development pressures and there are recognized opportunities to intervene before the natural stream functions and wetland connectivity attributes reach a point of irretrievability. Rehabilitating the streams and restoring portions of wetlands will require some upstream treatment of the runoff and sediment loading, and in the case of Anse Royale provides an opportunity to enhance water supply for a limited number of farms in the lowland. While potential flood and tidal surge buffering effects are difficult to quantify without further study, the current critical state of many of the watercourses and wetlands to accommodate flooding events is apparent in field visits. The ingredients for an active community-based approach to ecosystem-based adaptation are present at these sites.

Results Framework for Ecosystem Based Adaptation to Climate Change in Seychelles

Objective & Components	Indicators	Baseline	Targets	Source of Verification	Risks and Assumptions
Project Objective: To incorporate ecosystem based adaptation into the country's climate change risk management system to safeguard water supplies, threatened by climate change induced perturbations in rainfall and to buffer expected enhanced erosion and coastal flooding risks arising as a result of higher sea levels and increased storm surge.	Ecosystem services and natural assets maintained or improved under climate change and variability-induced stress	Project watersheds and coastal areas are regularly subject to water shortages and flooding events	Reduced water shortages and flooded area involving about 4,000 ha of watershed and coastal ecosystems	Project Monitoring Reports on the Status of Project Watershed and Coastal Ecosystems	Impacts of climate change do not outpace project adaptation responses (this will be alleviated by the project's interventions targeted build resilience)
	August mean daily discharge on two rivers (Mare aux Couchons & Baie Lazare) with increased base flows[78]	Mare aux Couchons August Avg Mean Daily Discharge: 261.1 L/S Baie Lazare August Mean Daily Discharge: 33.4 L/S	Mare aux Couchons and Baie Lazare: Aug. baseline flows +20 – 30%	PUC stream gauge data	Annual variability in rainfall and discharge can mask improvements PUC stream gauges stay functional
	January mean daily discharge on two rivers with decreased flood flows	Mare aux Couchons January Avg Mean Daily Discharge: 595.4 L/S Baie Lazare January Mean Daily Discharge: 173.1 L/S	Mare aux Couchons and Baie Lazare: January baseline flows -20%	PUC stream gauge data	Annual variability in rainfall and discharge can mask improvements PUC stream gauges stay functional
Component 1: Ecosystem-based adaptation approaches along the shorelines of the	Number of water users with more reliable water supply	10% of PUC water supply customers in project watersheds without fully reliable surface water supply	• 100% of PUC customers in target watersheds with more reliable water supply	Water use directives and reports by PUC	Continued high dependence on catchment area water resources
	Number of days per	Number of days per year	0 days of no water availability	PUC stream	PUC stream

[78] Baseline streamflow data for Mare aux Couchons are averages for 9 years available data within 2000 – 2011 stream flow records; baseline data for Baie Lazare are averages for available 2007 – 2011 stream flow records. Seychelles Publis Utilities Corporation

Objective & Components	Indicators	Baseline	Targets	Source of Verification	Risks and Assumptions
Granitic Islands reduce the risks of climate change induced coastal flooding	year water supply is not available at two sites: Baie Lazare and Mare aux Cochons[79]	when stream flows at critical low: Baie Lazare: avg. 18 days Mare aux Cochons: avg. 75 days (2010 – 2011)	per year in project watersheds	flow gauge data	gauges stay functional
	Volume of raw water production from PUC facilities in project watersheds	Annual water production at: • Mare aux Couchons: 614,336 KL • Baie Lazare: 191,232 KL	Annual water production figures increase by 20%	PUC stream flow gauge data	PUC stream gauges stay functional
	Number of hectares of watersheds covered by site-based water management plans	0 hectares	3,000 ha of critical watersheds	Ministry of Environment and Energy reports on water management planning process	Water use conflicts are resolvable
	Area of rehabilitated water provisioning and watershed flooding attenuation ecosystems	Total hectares of watershed with increased resilience to climate change: 0 Total area of watershed that has undergone total rehabilitation: 0	Total hectares of watershed with increased resilience to climate change: 3000 ha Total area of forest that has undergone total rehabilitation: at least 60 ha	Field reports from project and PUC staff	Forest rehabilitation has not been tested in Seychelles previously
	Active community watershed committees (with gender balance)	No watershed committees established	At least 4 watershed committees established with gender balance	Minutes of committee meetings	Communities are mobilised and committed
Outputs 1.1: Technology application to rehabilitate critical watershed so as to enhance stream base flows and control erosion to reduce climate change induced water scarcity and watershed flooding 1.2: Management and rehabilitation of critical watersheds to enhance functional connectivity and the resilience of these areas to climate change and reduce water scarcity and watershed flooding					

[79] Days below 'Dry weather flow' threshold for the stream: Baie Lazare dwf = 7.1 L/S; Mare aux Cochons dwf = 25.8 L/S; the baseline numbers are based on available PUC records – i.e. 1999 – 2010 annual average for Baie Lazare River and 2010 – 2011 (only available) annual average for Mare aux Couchons River. Seychelles Public Utilities Corporation

Objective & Components	Indicators	Baseline	Targets	Source of Verification	Risks and Assumptions
Component 2: Ecosystem based adaptation approaches along the shorelines of the Granitic Islands reduce the risks of climate change induced coastal flooding	Area of rehabilitated coastal ecosystems	# of tidal sluice gates installed: 0 Little wave energy attenuation provided by reef (5% of the pre-1998 bleaching event reef size) Total hectares of wetlands rehabilitated to provide flood attenuation services: 0 ha Total km of rehabilitated beach berms providing a barrier for coastal floods: 0 km Total hectares of mangroves, wetlands, fringing reef, beach berms and other ecosystems with increased resilience to climate change impacts: 0	# of tidal sluice gates installed: 2 by end of project 150 m of artificial breakwater providing substrate for coral growth and wave energy attenuation and more than 10% of original reef area rehabilitated at NE Point Total hectares of wetlands rehabilitated to provide flood attenuation services: 17 ha Total km of rehabilitated beach berms providing a barrier for coastal floods: 5 km Total hectares with increase resilience: 1,000 ha	Project reporting Follow-up field surveys	Local communities are active participants in the project Effects of flood attenuation are measurable at the project sites
	Farm pond salinity levels reduced	Up to 6.0 ppt salinity levels in farm ponds during dry season	70% less salinity levels in farm ponds during the dry season	Discussion with residents and farmers	Farmers are involved in cost sharing
	Number of hectares of coastal ecosystems covered by Integrated Shoreline Management Plans	0 hectares	1,000 ha of coastal ecosystems	Ministry of Environment and Energy reports on coastal management planning	Local stakeholders and administration participate in project implementation

Objective & Components	Indicators	Baseline	Targets	Source of Verification	Risks and Assumptions
				process	
Outputs 2.1: Ecosystem based measures for flood protection on an urban shoreline 2.2: Ecosystem based measures for flood protection and mitigating salt water intrusion in an agricultural and tourism development area					
Component 3: Ecosystem-Based Adaptation mainstreamed into development planning and financing	Approved water management policy framework being implemented for watershed areas	No policy and financing framework	Approved water management policy for watershed areas Core annual funding for local watershed management provided by tariffs and fees: $ 500,000[80]	Policy documents approved by Cabinet Funds collected by PUC for watershed management	Government is committed to policy development Funds allocated or generated for watershed management are targeted at relevant programmes
	Capacity developed for EbA methods: • Rivers Committee meet regularly • A National Watershed Monitoring System developed, applied and influences watershed management decisions • Technical standards established for watershed, tidal	No institutional mechanisms Little information available regarding functional connectivity, watershed integrity and water balance of watersheds Incomplete and ad hoc specifications for ecosystem rehabilitation	River Committee meets every quarter to discuss and address issues Institutionalised and operational watershed monitoring system ensures adaptive management of watershed systems. Technical standards are established and provide the basis for training	Records of meetings of Rivers Committee Data on key indicators regarding functional connectivity, watershed integrity and water balance available Survey of methods to	Local residents committed to watershed and coastal ecosystem management Technical standards are adequately tested in the project interventions.

[80] This figure is based on approximately 23,000 households served by PUC x 26 rps/mth = 598,000/mth income ($43,490) based on fixed monthly water "environmental charge" established by the PUC Schedule on Water & Sewerage Charges.

Objective & Components	Indicators	Baseline	Targets	Source of Verification	Risks and Assumptions
	wetland and beach and reef rehabilitation • Number of trainees by gender skilled in EbA methods	Few government or NGO staff experienced in watershed or wetland rehabilitation	50 persons (gender balanced) trained in watershed, tidal wetland and beach and reef rehabilitation	rehabilitate forests and ecosystems Manuals and protocols produced to guide practitioners Post training surveys	
	Number of knowledge products on watershed and coastal ecosystem-based adaptation	Limited awareness of EbA methods related to watersheds and coastal ecosystems	10 knowledge products produced to assist awareness building	Project reporting Experience sharing workshops	The knowledge products address user needs and practical methods appropriate for local communities
Outputs 3.1: Policy and legal frameworks for watershed and coastal climate change adaptation 3.2: Capacity development for ecosystem based adaptation methods 3.3: Lessons learned and Knowledge Dissemination					

E. *Include a detailed budget with budget notes, a budget on the Implementing Entity management fee use, and an explanation and a breakdown of the execution costs*

Table 13: Project Budget		
No.	**Outputs**	**Cost est. USD**
1. ECOSYSTEM-BASED ADAPTATION APPROACH TO ENHANCING FRESHWATER SECURITY AND FLOOD CONTROL IN MAHÉ AND PRASLIN UNDER CONDITIONS OF CLIMATE CHANGE.		
Output 1.1 Management and rehabilitation of critical watersheds to enhance functional connectivity and the resilience of these areas to climate change and reduce water scarcity and watershed flooding.		
1.1.1	Mare aux Cochons River Watershed	710,000
1.1.2	Mt Plaisar River Watershed	195,000
1.1.3	Baie Lazare River Watershed	355,000
1.1.4	Caiman River Watershed	275,000
1.1.5	Praslin Fond B'Offay/Nouvelle Decouvert Watershed	550,000
	Subtotal	2,085,000
Output 1.2 Small-scale water storage and detention facilities designed and constructed or rehabilitated in critical waterways for communities to benefit from enhanced ecosystem functioning by forests.		
1.2.1	Mare aux Cochons River Control Structures	240,000
1.2.2	Mt Plaisar River Control Structures	140,000
1.2.3	Baie Lazare River Control Structures	220,000
1.2.4	Caiman River Control Structures	70,000
1.2.5	Praslin Fond B'Offay/Nouvelle Decouvert Watershed Control Structures	120,000
	Subtotal	790,000
1.3	Project Implementation Team	150,000
Component 1 Total		***3,025,000***
COMPONENT 2: ECOSYSTEM-BASED ADAPTATION APPROACHES ALONG THE SHORELINES OF THE GRANITIC ISLANDS REDUCE THE RISKS OF CLIMATE CHANGE INDUCED COASTAL FLOODING.		
Output 2.1 Ecosystem based measures for flood protection on an urban shoreline		
2.1.1	Integrated Shoreline Management Plan	30,000
2.1.2	Wetland Rehabilitation	468,000
2.1.3	Reef Rehabilitation	357,000
2.1.4	Beach Berm Enhancement	240,000
	Subtotal	1,095,000
Output 2.2 Ecosystem based measures for flood protection and mitigating salt water intrusion in an agricultural and tourism development area		
2.2.1	Integrated Shoreline Management Plan	30,000
2.2.2	Stream Channel and Wetland Rehabilitation	475,000
2.2.3	Shoreline Rehabilitation	100,000
2.2.4	Ecosystem Based Salinization Control Measures	170,000
	Subtotal	775,000
2.3	Project Implementation Team	125,000
Component 2 Total		***1,995,000***
COMPONENT 3: ECOSYSTEM BASED ADAPTATION MAINSTREAMED INTO DEVELOPMENT PLANNING AND FINANCING.		
Output 3.1 Policy and legal frameworks for watershed and coastal climate change adaptation		
3.1.1	Watershed Management Policy Framework	25,000
3.1.2	Legislative, Regulatory and Advisory Measures	30,000
3.1.3	Financing Mechanisms for Watershed Protection	25,000
	Subtotal	80,000
Output 3.2 Capacity Development for Ecosystem Based Adaptation Methods		

3.2.1	Training Programme Development	20,000
3.2.2	Training Programme Delivery	150,000
3.2.3	Institutional Support	25,000
	Subtotal	195,000
Output 3.3 Lessons learned and Knowledge Dissemination		
3.3.1	Communications Strategy	20,000
3.3.2	Knowledge Products	20,000
3.3.3	Experiences Exchange	40,000
	Subtotal	60,000
3.4	Project Implementation Team	125,000
Component 3 Total		***480,000***
PROJECT MANAGEMENT		
	Project Manager	175,000
	Administrative & Finance Officer	70,000
	Driver	48,000
	Equipment, Supplies, Workshops, Miscellaneous	19,000
	Vehicles and Travel	40,000
	Monitoring & Evaluation	80,000
	Annual Financial Audit	18,000
	Subtotal	450,000
	TOTAL PROJECT	**5,950,000**

Note:
Total Project Cost excludes Implementing Agency Fee

Note 1: Forest rehabilitation costs in Seychelles are estimated at an average $30,000/ha on Mahe Island and $25,000/ha on Praslin Island
Note 2: The Project Implementation Team cost ($400,000) is allocated into Components 1-3.

The execution costs (Project Management) are presented below.

Table 14: Project Execution (Management) Costs

	2013	2014	2015	2016	2017	2018	Total
National Consultants	48,833	48,833	48,833	48,833	48,833	48,835	293,000
Travel	4,000	4,000	4,000	4,000	4,000	4,000	24,000
Service Contracts (Workshops, M&E)	4,000	0	1,000	30,000	2,000	30,000	67,000
Service Contracts (Financial audit)	3,000	3,000	3,000	3,000	3,000	3,000	18,000
Materials and Goods	2,000	2,000	2,000	2,000	2,000	2,000	12,000
Vehicle	15,000	0	0	0	0	0	15,000
Miscellaneous	4,000	4,000	4,000	4,000	4,000	1,000	21,000
							450,000

A preliminary Project Schedule is provided in **Annex 8** and the budget of the Implementing Agency in **Annex 1**.

F *Include a disbursement schedule with time-bound milestones.*

Disbursement schedule

	Upon Agreement signature (Jan 2013: 1st Disbursement)		One Year after Project Start: 2014[a/]	Year 3	Year 4	Year 5	Year 6	Total
Scheduled Date	Jan. 1, 2013		1-Jan-14	1-Jan-15	1-Jan-16	1-Jan-17	1-Jan-18	
Project Funds		1,017,999	1,081,999	1,117,499	1,122,499	1,003,499	606,505	5,950,000
Implementing Entity Fee	202,300	51,918	55,182	56,992	57,247	51,178	30,932	505,750
Total	202,300	1,069,917	1,137,181	1,174,491	1,179,746	1,054,677	637,437	6,455,750

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

A. RECORD OF ENDORSEMENT ON BEHALF OF THE GOVERNMENT

The proposed project is in line with Government of Seychelles's policies and priorities. Hence it has been endorsed with the approval of competent authority. A copy of the endorsement letter is attached in **Annex 2**.

Didier Dogley Special Advisor to Minister Ministry of Environment and Energy Government of Seychelles	Date: August 09, 2012

B. IMPLEMENTING ENTITY CERTIFICATION

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/programme.	
 Yannick Glemarec Director Environmental Finance UNDP	
Date: October 8, 2012	Tel. and email:+1-212-906-6843 yannick.glemarec@undp.org
Project Contact Person: Johan Robinson, (LECRDS)	
Tel. And Email: + 421 2599337299; johan.robinson@undp.org	

ANNEX 1 - UNDP Environmental Finance – Specialized Technical Services

The implementing entity fee will be utilized by UNDP to cover its indirect costs in the provision of general management support and specialized technical support services. The table below provides an indicative breakdown of the estimated costs of providing these services. If the national entity carrying out the project requests additional Implementation Support Services (ISS), an additional fee will apply in accordance with UNDP fee policy regarding ISS and would be charged directly to the project budget.

Stage	Specialized Technical Services Provided*	Estimated Costs of Providing Services**
Identification, Sourcing and Screening of Ideas	Provide information on substantive issues and specialized funding opportunities (SOFs)	25,287.50
	Verify soundness and potential eligibility of identified idea	
Feasibility Assessment / Due Diligence Review	Technical support: provide up-front guidance; sourcing of technical expertise; verification of technical reports and project conceptualization; guidance on SOF expectations and requirements	75,862.50
	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	
Development & Preparation	Technical support, backstopping and troubleshooting	101,150
	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	
Implementation	Technical and SOF Oversight and support	227,587.50
	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.	
	Technical support, validation, quality assurance	
	Return of unspent funds	
Evaluation and Reporting	Technical support, progress monitoring, validation, quality assurance	75,862.50

Stage	Specialized Technical Services Provided*	Estimated Costs of Providing Services**
	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	
Total		505,750

** This is an indicative list only. Actual services provided may vary and may include additional services not listed here. The level and volume of services provided varies according to need.
** The breakdown of estimated costs is indicative only.

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

ANNEX 2: Letter of Endorsement- Government of Seychelles

Republic of Seychelles
Ministry of Environment and Energy

Special Advisor's Office

9th August 2012

The Adaptation Fund Board
c/o Adaptation Fund Board Secretariat
Email: Secretariat@Adaptation-Fund.org
Fax: 202 522 3240/5

SUBJECT: Endorsement for Ecosystem Based Adaptation to Climate Change in Seychelles Project

In my capacity as designated authority for the Adaptation Fund in Seychelles, I confirm that the above national project/programme is in accordance with the government's national priorities in implementing adaptation activities to reduce adverse impacts of, and risks, posed by climate change in the Seychelles.

Accordingly, I am pleased to endorse the above project/programme proposal with support from the Adaptation Fund. If approved, the proposal will be coordinated and implemented by UNDP and executed by Ministry of Environment and Energy, Environment Department.

Yours sincerely

Didier Dogley
Designated Authority
Special Advisor to the Minister

Botanical Gardens, Mont Fleuri, P.O Box 445, Victoria, Mahé, Seychelles
Tel: (248) 4670568 – Fax (248) 610648 – E mail: d.dogley@env.gov.sc

ANNEX 3: Seychelles Climate Change Scenario Assessment

Citations from "Chang-Seng, D. 2007. Climate Change Scenario Assessment for the Seychelles, Second National Communication (SNC) under the United Nations Framework Convention on Climate Change (UNFCCC), National Climate Change Committee, Seychelles."

"The MAGICC SCENGEN tool is used extensively to construct two climate scenarios for Mahé and the Aldabra area based on the A1 high-range emission with a high climate sensitivity and the B2 mid-range emission with a mid climate sensitivity at seasonal and annual time scales. A range of seven General Circulation Models (GCMs) [CMS, ECHS, ECH4, GFD, HAD2, HAD3, MODBAR] at 5° (~500 km) resolution are employed to assess the regional climate change patterns. The GCM-Guided Perturbation Method (GPM) and the Regional Climate-Change Projection from Multi-Model Ensembles (RCPM) technique provide an alternative assessment for comparing with the different scenario results. Scenario uncertainties are also explored as a means of quantifying regional climate change patterns and the choice of model selection. This will offer a range of policies and strategies for climate change adaptation. The local parameters assessed are rainfall, maximum and minimum temperatures, and regional sea level."

"A1 high range emission and high climate sensitivity simulates more extreme climate changes compared to the B2 mid-range emission with mid-range climate sensitivity (BM). The BM climate scenario shows that the mean air temperature for both Mahé and the Aldabra area is *more likely than not* to warm by +3.0 ° C by the end of this century. The relative rate of warming will occur mainly during the cooler southeast monsoon. The warming ranges are +0.4 to +0.7; +0.9 to +1.4 and +1.8 to +2.9 ° C respectively for the years 2025, 2050 and 2100. Consequently, the maximum increase in seasonal rainfall for Mahé is +12.4 %(+38.6 mm) in the DJF [December, January, February] season while a decrease of -36.3% (-31.1 mm) is expected during the southeast monsoon of the year 2100. The range of percentage change in annual rainfall is -2.4 to +5.0 %; - 4.8 to +8.5 %; -8.6 to +16.3 % respectively for the years 2025, 2050 and 2100. Thus, the rainy season is *more likely than not* to be wetter, while the dry season is *more likely than not* to be dryer with the exception of the JJA [June, July, August] season of the year 2050. It is suggested that the projected upward trend in the multi-decadal 30 year-cycle in rainfall variability (Chang-Seng, 2007) could possibly balance the expected deficit during the JJA season of the year 2050 forced by anthropogenic climate changes. Scenario uncertainties methods such as change in model variability and probability of an increase in precipitation analyses support quantitatively that the DJF season will *likely* be wetter while the JJA season is *unlikely* to be wetter and the annual rainfall will *likely* be higher than the 1972-1990 base periods.

The Regional Climate-Change Projection from Multi-Model Ensembles RCPM shows seasonal precipitation rates are *more likely than not* (45-55%) to increase in the rainy season of up to +1.0 mm per day by the year 2100.On an annual basis it is *likely* (80%) that rainfall rate will be greater and equal to +0.5 mm per day."

"Global sea level is expected to rise from +7-8, +15-17 and +35-40 cm according to the policy best guess scenario by the years 2025, 2050 and 2100 respectively. Regional sea level in the southwest Indian Ocean is expected to rise between +40 to +60 cm according to the UK Meteorological Office model. On the other hand, tropical cyclone scenario remains a major challenge, but recent modeling studies in the US, have suggested that peak winds may increase by 5 to 10 % and peak rainfall rates may rise by 20 to 30 %."

ANNEX 4: Project Planning Workshops, Stakeholders and Consultation

Seychelles Adaptation Fund Proposal
Stakeholder Consultation Project Planning and Design Workshop

Date: Tuesday 28th February 2012
Time: 8.30 a.m. to 12.30 p.m.
Venue: SFA Training Room Victoria, SEYCHELLES

MEETING NOTES

(1) Attendance – refer to Annex 1

(2) Opening of meeting

i. The meeting started with Mrs. Veronique Herminie, Programme Coordinator for the GOS/UNDP/GEF Programme Coordination Unit welcoming all participants to the workshop.

ii. This was followed by opening statements from Mr. Didier Dogley, Principal Secretary for the Environment Department, and a summary of whose intervention is found below:

Man has always depended on its natural environment for his basic needs, for example food, medicine, shelter from the impacts of extreme weather and – main source of water for his daily needs. Sustainable use of these natural resources - maintaining a healthy natural environment is of paramount importance in ensuring our immediate environments ability to provide necessary ecosystem services. Intensive use of fossil fuel since the beginning of the industrial revolution has created dangerous changes to our climate. Climate change is happening and we do not need to go very far to see the signs of it happening. We are today most vulnerable to weather catastrophes, desertification and rising sea level. The coral bleaching events of 1998 plus subsequent bleaching events have wiped out over 90% of our coral reefs, affecting our coasts ability to protect it from storm surges. The increased frequency occurrence of extended droughts has led to extended lack of water for potable uses. Impacts of climate change on food production and maintaining forest covers because of salt intrusion at the coast and frequent forest fires have also led to land degradation patterns. What is it we can do to build resilience while reducing our vulnerability to the changing climate? How can we mainstream ecosystem based climate change adaptation into development planning and financing?
The project at hand seeks to enhance watershed regulation functions as a climate change adaptation measure to provide 1) high dry season flow and 2) regulate peak flows to reduce the risks of flooding. If our forests are to regulate runoffs during the extreme weather, what is it that needs to be done to improve their ability to play a vital role in reducing flood volumes and flooding risks? How can restoring mangroves, sand dunes, wetlands and fringing reefs assist in building resilience of our coasts to storm surges and coastal degradation?

(3) Presentation of the project

i. Mrs Herminie proceeded to acknowledge the presence of Mr Roland Alcindor the UNDP Programme Manager and Mr Didier Dogley, Principal Secretary for the Environment Department and introduced the consultant team working on the project design as follows:

1. Mr Alan Ferguson – Lead Consultant and Watershed Specialist
2. Dr Alexander Dawson Shepherd – Coastal Ecosystems Rehabilitation Specialist, and
3. Mr Joseph Rath – Lead Local Formulation Consultant

ii. The consultants then presented their project design strategy and expected outcomes from the consultation workshop.

(4) <u>Outcomes of the consultative meeting</u>

i. Further to the presentation of the lead coastal zone specialist and some of the proposed measures to attenuate coastal erosion, questions were raised on the impact of offshore breakwaters on increased erosion along other adjacent shorelines not directly benefitting from the intervention measure.

ii. Clarifications were also sought on any existing policies or strategies vis-a-vis observed mangrove infestation or re-growth on the landward side of past reclamation projects, especially along the east coast of Mahe.

iii. It was clarified by the Seychelles Agricultural Agency that contrary to the depiction in the presentation slides for coastal zone management, that most areas inland between intertidal wetland and the foot of the hills on the granitic islands, usually slopes downhill and not uphill as had been observed on most agricultural areas along the coast.

iv. It was reiterated that the project design should seriously look into the issue of salt water intrusion and the increased salinity of farm lands, as this is a proven phenomena occurring in the lowlands of the granitic islands and that the SAA has data and information that they have collected through their routine monitoring exercises to prove such and that interventions should be planned to address the issue

v. It was insisted through the consultation process that coastal erosion is a serious issue around the main granitic islands especially Mahe, Praslin and La Digue. Whilst it was established fact that the phenomenon was serious and needed urgent attention, it was also recognised that there is a lack of capacity to really understand what was really happening and as such further investigation through modelling and predictions needs to be considered.

vi. It was acknowledged that whilst demand side management of watershed services is not necessarily included in EbA approaches, the agriculture sector would like to put forward three main domains for further investigation by the project design team for coming up with specific activities to address these issues which are as follows:

- The agricultural sector increasingly has to compete with the public utilities corporation for water demand for domestic consumption, as was the case during the recent drought. SAA is presently managing some 15km of irrigation water supply network to farm lands that are under their purview and management. They would like to see introduced through the project such technologies that would reduce water use on farms e.g. through drip irrigation. The representative was adamant that the paradigm of talking to farmers to educate them about the issue of water scarcity is over and that the farmers' urgent present need is actually concrete actions on the ground that would help in alleviating the hardships that they are encountering in meeting the water requirements for their farms. The second domain for intervention that was raised was that of food security to ensure food output, which is likely to increase. The third intervention priority that the agricultural sector wanted to put forward was that of present existing technologies to address the issue of waste disposal from farms which seems to be increasingly polluting watersheds and stream flows. The project should thus look at opportunities to assist in the introduction of proven technology transfers for farm waste management with regards to renewable energy production such as biogas systems on selected pilot test sites, especially for pig farms. This, it was explained would be an ideal opportunity to sell the case for upland farms as farming areas along the coasts are under

increased pressure for relocation for varying social reasons including the case of sea level rise through climate induced pressures.

a. <u>Task 1: Plenary identification of potential activities and sites</u>

- **<u>Coral Reef Restoration</u>**

The following issues were raised with regards to the above:

- Queries were raised as to why coral reef restoration would not work as suggested in the presentation
- It was suggested that using coral reefs as breakwaters had its merits. It was explained that in certain areas there had been observed disadvantages from bleached reef fringes that had turned into rubbles and disintegrated over the years which had exacerbated coastal erosion on the adjoining coastline. It was thus important to consider the introduction of breakwater structures within reef areas to provide for colonization through artificial substrates in those areas.
- It was advised that prior to undertaking any coral reef restoration initiatives that detailed hydro dynamic studies and modelling are carried out using decision support tools before any major investment is placed into such undertakings.
- To that effect any modelling approaches that are adopted need to be carefully looked at especially with the intended duration of studies that the modelling approach would entail.
- The project design team was requested to draw on examples worldwide where artificial reefs had been successfully implemented e.g. in New Zealand and Durban, South Africa.
- When determining critical sites for intervention the need to conserve what is already found at those sites should be primordial.
- Whilst the natural ecosystem based approaches to coral reef restoration was encouraged, it was deemed extremely important that these are complemented with other engineering approaches if the interventions are to be effective.
- It was proposed when doing the project design for reef restoration, that alternative uses of the wave energies being attenuated be looked at for example in harnessing the wave energy for renewable energy production.
- There was also a call for caution in the selection of pilot sites for reef restoration and that the project can, in the first instance, only establish and propose the necessary conditions for these sites which will require further investigation during the first to second years of the project implementation cycle prior to coming up with specific locations for interventions.

- **<u>Watershed Management and Forest Cover Areas</u>**

The following issues were raised with regards to the above:

- There was a general consensus that the project should have a much stronger focus on watershed management issues within Component 1. However, there is a need to have very clear directions on the selection of watershed area for pilot actions.
- Whilst emphasis might be placed on the management of areas within existing national parks whereby active management is ongoing, it was also deemed important to look at other adjoining land use areas such as active agricultural sites or urbanized areas that are having direct impacts on existing watershed areas.
- The removal of *Albizia* tree species within catchment areas was not seen as such a bad idea. However, prior to undertaking such in target sites it was important to analyse replanting of the barren areas with some other tree species, most preferably native plant species to Seychelles that would adapt to the same ecosystem, as experience from practitioners in the field has shown that the removal of *Albizia* usually leads to the infestation and spread of other unwanted invasive plant species.

- In considering the plant species to be used in managing watersheds, the issue of species that are more likely to withstand predicted stronger winds with climate induced pressures was also raised, as falling trees usually leads to increased landslide risks which may further contaminate stream flows.
- It was pointed out that existing barrages within the watershed areas need to be looked at and also upstream land uses which are impacting on water storage locations. There is an urgent need to rehabilitate some upstream catchment areas and further strengthen law enforcement on upper catchment contamination.
- The impact of proliferation of the *Albizia* tree species in the watershed areas was largely debated. It was pointed out that most arguments to date are anecdotal and no real study on the impact of the species on watershed flows had been done to date to prove or disprove any theory brought forward.
- It was noted that there are ongoing rehabilitation of degraded lands – e.g. activities being undertaken on Praslin by the non-governmental organization TRASS. However, these interventions need to incorporate more control of run offs initiatives in their project design and implementation.
- It was stressed that watershed management should be translated in its wider scope of watershed protection as presently several stream water courses are being lost and some having their flows considerably decreased.

- **Land Use**

The following issues were raised with regards to the above:

- It was queried as to whether the adaptation project would be looking at other land use characterization other than protected areas. There was a call to request the Planning Authority to ban any blasting activities above all watershed areas.

- **Governance and Management**

The following issues were raised with regards to the above:

- It was raised that the governance structure vis-a-vis the management of rivers and water catchment areas for enforcement purposes is presently very unclear.
- The re-institution of the Rivers Committee or some similar multi-stakeholder institutional set up was deemed very necessary to further watershed management

- **Education, Awareness and Sensitization of Communities**

The following issues were raised with regards to the above:

- It was highlighted that it is of paramount importance that the project considers substantial fund allocation for community sensitization and awareness raising on issues related to climate change adaptation to build resilience of those communities to predicted adverse climate impacts. To that effect the need to determine an appropriate balance between ecosystem conservation and resilience building within the general populations needs to be a primary focus.
- Efforts should also be made to incorporate community based capacity building on beach conservation, coastal replanting and rain water harvesting amongst other measures.

- **Capacity Building**

The following issues were raised with regards to the above:

- Capacity building efforts under the project need to divert from the traditional in class sessions or workshops to more hands on approaches of on the job capacity building within focal institutions.

- It was mentioned during several interventions that the knowledge about what the problems are when it comes to climate change is widely known and that interventions under this project should focus on doing pragmatic interventions at problem sites to build the ability of those most affected to adapt to the changing climate.
- The project should also look at the issue of brain drain in addressing capacity building needs, especially on how trained individuals are kept within the country and continue to contribute to the issues being addressed.
- A strong focus should be placed on monitoring and management programmes under the project when it comes to capacity building.
- It was pointed out that the University of Seychelles should be the favored institution for the delivery of any capacity building programme to avoid personalization of expertise.

- **<u>Salt Water Intrusion on Lowland Farms and Food Security</u>**

The following issues were raised with regards to the above:

- Need to consider the impacts of salt water intrusions on low land plateau agricultural areas as an impact of rising sea level as a major issue in ensuring food security.
- In considering impacts of climate change the issue of food security should be a focal one and it should be emphasized under Component 1 of the project. It was pointed out that the latest national census had demonstrated an increase in subsistence farming within communities and that the project may look at providing initial start up kits or other forms of assistance to promote domestic water conservation and rain water harvesting schemes. Some existing non-governmental organizations like S4S has an existing rain water harvesting programme and have also produced several communication aids like DVDs and handbooks on how to promote and further the initiative.
- In ensuring that food security remains a central theme in the implementation it was proposed that the project considers a revolving fund of some sort by injecting seed money from the project to establish a micro financing scheme. Local models that could be furthered already exist within the agricultural sector.
- Under output 2.4 when considering salt water intrusion on lowland farms the project should include a combination of both comparative field and laboratory assessments. To that effect it would be necessary to build capacity of the Seychelles Agricultural Agency to ensure this undertaking.
- The use of existing expertise at ICBA in Dubai was suggested as a centre of excellence for capacity building in the field of salt water intrusion on farms
- In addressing the issue of salt water intrusion on lowland farms bio remediation techniques as well as chemical methods for reducing salinity on farms e.g. use of halophytes should be considered in a holistic manner.

- **<u>Waste Management on Farms</u>**

The following issues were raised with regards to the above:

- The issue of waste management from the agricultural sector and its impacts on water quality in the watershed needs to be looked at.
- It was raised that the agricultural sector is often accused of wasting a lot of water in its management practices. To that effect it would be highly desirable if the project could look at ways of introducing and implementing new technologies on farms that could assist to dispel this myth or to assist farmers in reducing any wastage that may be taking place, particularly when it comes to their waste management. Rain water harvesting should also form part of solutions on agricultural farms.

- **<u>Potential Priority Interventions Sites</u>**

The following issues were raised with regards to the above:

- The water catchment area serving the Val D'En D'Or area was mentioned as one of the problematic areas, especially from agricultural activities' impacts, in the project design.
- The Cap Samy watershed on Praslin was also raised as being another problematic area that needs to be looked at as quarrying activities in its vicinity are leading to lose of water in its riparian zones.
- The Morne Seychellois Watershed was also depicted as being a major area for possible interventions and that its consideration should entail detailed hydrological assessments. It would be more effective to equally consider extending interventions into areas, especially agricultural areas, bordering the National Park. To that effect the optimal allocation of catchment flows for conflicting uses especially agriculture and domestic use needs to be of primary consideration.
- It was stressed that when identifying potential intervention sites, the issues of livelihood and coastal inundation should form part of the selection criteria.

- **Duplication of Interventions**

The following issues were raised with regards to the above:

- It was stressed that it was important for the project to vigorously consider other ongoing national initiatives so as not to duplicate activities under other funding sources.

- **Project Components**

The following issues were raised with regards to the above:

- It was generally agreed by the forum that more focus in the project design should be placed on Component 1.
- It was stressed that under Component 3 increased public awareness of the issues at hand should be placed such that communities become aware and be part of the solutions being proposed.

- **Policy Frameworks**

The following issues were raised with regards to the above:

- It was strongly suggested that the National Wetland Policy be re-looked at under the project to modernise it to incorporate EbA initiatives and that the present policy is too weak to be effectively implemented.
- It was pointed out by another participant that the National Wetland Policy is currently under review and one of the proposals being put forward that may have bearings on the project is the development of a Water Code to establish set back limits for developers from water bodies of ecological importance.

- **Flooding and Drainage Issues**

The following issues were raised with regards to the above:

- Tackling flooding issues under the project should not limit itself to areas on Mahe but should also be extended to areas on Praslin. Drain de-silting should be up-scaled and emphasized as an ongoing requirement in any public awareness.
- In order to address the flooding issues raised, it was proposed that more roadside drainages are tailored to be directed into existing wetland areas to make more effective use of wetlands as a natural buffer in combating flooding.
- It was also proposed that more modern technologies are adopted for roadside drainage designs that are more in tandem with run off control as opposed to the classic models presently being promoted.

- **Coastal Erosion and Protection**

The following issues were raised with regards to the above:

- The protection of the sand dunes (berms) needs serious consideration. It was pointed out that past activities had been undertaken at several sites around the islands to prevent sand poaching and other undesirable activities that lead to coastal erosion. However, policing to ensure the effectiveness of these interventions is almost nonexistent which is undermining the effectiveness of the interventions.
- More emphasis should be placed on monitoring and evaluation of existing and ongoing programmes to tackle coastal erosion. More public awareness needs to be undertaken about ongoing programmes such that communities are aware on what is being done as at present the public displays little respect for potential interventions that may be successful. There is increased pressure for dune vegetations to be cleared to accommodate developer requirements in detriment to past interventions and EbA approaches to coastal protection.
- It was requested that there be stronger regulation with regards to coastal urbanization to further limit coastal degradation with the introduction of tighter set back limits. This was proposed especially for the North East Point coast line where coastal erosion is very evident.

- **Wetland and Mangroves**

The following issues were raised with regards to the above:

- The need to further the conservation of mangroves and wetlands should be a strong focus under the project across the main islands. It will be important to heighten the conservation status of these existing water bodies.
- It was pointed out that most coastal wetlands have no capacity to flush out saline intrusion. At some sites sluice gates are being used to reduce sea water intrusion onto low land plateaus.
- There was a request for the project to look further into the present Wetland Adoption programmes being implemented as a means of engaging more stakeholders in wetland conservation.

b. Task 2: Plenary Discussions on project implementation options

- It was advised that there should be very careful considerations when looking at the implementation arrangements for the project.
- The use of long term international expertise embedded within focal institutions was proposed as a favored modality for capacity building as compared to shorter term consultancies.
- The need to ensure transparency in the delivery of activities was stressed.
- Competitive tendering in delivery of services under the project was another concern that was raised.
- It was reiterated that the project should strongly look at ways to involve community groups in programme implementation as a capacity building and awareness raising strategy.

Adaptation Fund
Seychelles Ecosystem-based Adaptation to Climate Change Project
Validation Workshop for Full Proposal Preparation Phase

Date: Tuesday April 10th 2012
Time: 9.00 a.m. to 3.00 p.m.
Venue: Room 2, International Conference Centre, Victoria, SEYCHELLES

I. Initial Discussions:

a) A question was raised as to the status of the full proposal formulation process to date.
b) It was pointed out that the project formulation should take note of ongoing works at the North East Point site at the moment being carried out by the Environment Department and the Seychelles Land Transport Agency.
c) Some reservations were raised regarding the extent of hard engineering interventions, especially to address the issues of coastal erosion being proposed as part of the project activities.
d) There was agreement with regards to the strategic approaches being proposed in the overall project, but however, the sustainability of the approaches to be undertaken was questioned.
e) It was also highlighted that the project should ensure that objectively verifiable indicators are included in the project document to ensure the monitoring of the achievement of results.
f) It was observed that whilst the proposal did make mention of forest fire prevention and suppression interventions in its outlook, it did not however make it more explicit in its narrative how these were going to be implemented. It was suggested that an additional output under Component 1 be added to address the issue.
g) A concern was raised as to spreading of activities across several intervention sites, and the feasibility of ensuring the achievement of results within the limits of the funds available.
h) It was insisted that this project should ensure the visibility of anticipated impacts from the proposed interventions.
i) It was proposed that the project should look at co-opting the existing National Climate Change Committee to steer its implementation.
j) It was highlighted that the role and involvement of NGOs in the overall management and implementation of the project should be clearly spelt out.

II. Group 1 report: Component 1 - Watershed Management and Component 3 – Policy & Capacity Building

Watershed Management

a) Queries were raised regarding the selection criteria for the chosen watershed areas to form part of the project intervention sites.
b) Proposed barrages – it was queried if what were being proposed under the project are for new constructions or renovation of existing ones. For the construction of new barrages across river flows, it was highlighted that these should ensure that they do not interrupt the migration routes of fresh water species such as eels.
c) It was requested that any proposed creek diversion should target the reactivation of abandoned marshlands, especially along the Caiman River.
d) Environmental Impact Assessments should be mandatory for all proposed off-channel river diversions planned under the Component.

e) For the Baie Lazare watershed it was requested that the re-afforestation of an abandoned farm be considered.
f) There were some clarifications as to whether the proposed measures were engineering based or based on ecosystem rehabilitation.
g) It was reiterated that for the Praslin interventions sites, forest fire risks attenuation should be made a central focus and that covering the Vallee de Mai site should be a priority due to the ecological sensitivity of the area.
h) It was further suggested that the Fond Ferdinand, Vallee de Mai and Fond Azore Rivers on Praslin be included as part of the intervention sites.
i) It was also suggested that the Fond B'Offay and Nouvelle Decouverte watersheds on Praslin be the chosen intervention sites.

Policy and Capacity Building

j) It was brought to the attention of the forum that the installation of Rainwater Harvesting mechanisms to new buildings is to become mandatory as part of the new Building Regulations review presently being undertaken by the Town and Country Planning Authority.
k) It was requested that the practice of recycling and re-using of grey water be included in the project narrative to ensure that it receives due attention in awareness raising activities.
l) For the proposed rehabilitation and restoration of any privately owned properties, it was proposed that obligations and restrictions be imposed on the land owners as to how and in what manner they should develop these properties in the future.
m) It was insisted that local communities' capacity building should remain a central theme in the project implementation, in close collaboration with established NGOs.

III. Group 2: Component 2 – Coastal Areas and Component 3 – Policy & Capacity Building

Coastal Areas

a) Output 2.1.1 – it was agreed by the group that the output as proposed was achievable and appropriate and that the selected site for the interventions was appropriate.
b) Output 2.1.2 – whilst it was generally agreed by the group that wave energy attenuation measures needed to be considered as a means of slowing down the coastal erosion processes, there were still some uncertainties as to the proposed methodology anticipated under the project for reef rehabilitation, especially with regards to the hard-engineering approaches being envisaged. Concerns were raised that any hard-engineering interventions might actually lead to more harm than good in the long term. To minimize foreseen risks it was stressed that the EIA process required prior to any intervention should be explicit about the evaluation of several technological alternatives within a wider stakeholder consultation process to be undertaken.
c) Output 2.1.3 – again concerns were raised regarding the suitability of beach nourishment as a mean to combat coastal erosion, since such activities had never been undertaken in the past in Seychelles and there was a perceived sense of a lack of know-how in the country to undertake such. It was again stressed that the EIA process, prior to realizing this intervention, should be explicit about the source of sand, water quality and supply as well as shallow environment digital evaluation modeling in its preparation.
d) Output 2.2.1 - it was agreed by the group that the output as proposed was achievable and appropriate and that the selected site for the interventions was appropriate. For the site, it was necessary to ensure water control further inland and not just within the coastal belt and to seriously consider the issues of salt water intrusion being faced by the farm lands within the context of the rehabilitation works.
e) Output 2.2.2 - it was agreed by the group that the output as proposed was achievable and appropriate and that the selected site for the interventions was appropriate.

f) Output 2.2.3 – the seriousness of the salinity issues for the coastal farms in the low lying plains was further stressed. It was felt very important to consider the flow of fresh water from the streams and wetlands as a means of supplementing fresh water availability to offset the salinity problems being encountered on the sites. Additional activities were proposed in terms of installation of real time monitoring sensors and data loggers, especially for the dry periods when precipitation is very sparse.
g) It was recommended that a fourth output be included under this component to address issues of monitoring and evaluation of water quality

Policy and Capacity Building

h) It was agreed that the outputs are generally achievable as presented but that the budget allocated for their implementation should be increased from US$200,000 to US$300, 000 as there was a need for the procurement of specialized equipment for information technology hardware and software for image processing and GIS, high resolution satellite imagery (spectral and spatial) and specialized data collection and recording field note books for the implementation of activities under Outcome 2.
i) Output 3.1.1 – it was requested that the budget allocation for this output be increased to US$60, 000.
j) Output 3.1.2 – it was requested that the budget allocation for this output be increased to US$75,000. Some further activities proposed under this output are specialized training on bio-engineering and beach profiling; local hands on training on field practices; training of trainers; the development of a diploma programme with the University of Seychelles; community based empowerment and awareness to heighten their responsiveness to climate change issues.
k) It was also added that the project should look at developing a legal framework for the protection of wetlands on a national basis.

Seychelles Adaptation Fund Proposal Stakeholder Consultation Project Planning and Design Workshop Seychelles Fishing Authority Training Room Tuesday 28th February 2012, 8.30 a.m. to 12.30 p.m.			
List of Participants			
No.	**Name**	**Organization**	**Contact Details**
1	Mermedah Moustache	Department of Natural Resources	mermedah@gov.sc 2723461
2	Antoine-Marie Moustache	CEO Seychelles Agricultural Agency	2722009
3	Florian Rock	Ministry of Land Use and Housing	2548874
4	Betty Seraphine	Project Manager – Mainstreaming Biodiversity Project, Project Coordination Unit	2785899
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34	Didier Dogley	Principal Secretary - Environment Department	d.dogley@gov.sc 4670500
35	Jason Jacqueline	Seychelles National Parks Authority	

Validation Workshop for the Adaptation Fund EbA Project Proposal, Seychelles Room2, International Conference Center Tuesday 10th April 2012, 9.00 a.m. to 3.00 p.m.			
List of Participants			
No.	**Name**	**Organization**	**Contact/Email address**
1	Herve Barois	Sustainability for Seychelles	hbarois@yahoo.com
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32	Veronique Herminie	Programme Coordination Unit	v.herminie@pcusey.sc

Stakeholder Consultation itinerary and list of contacts

Date	Location	Start	Finish	Name	Title
2/16/2012	Department of Environment, Mahe'	11.00	12.30	Didier Dogly	Principal Secretary
				Wills Agricole	Director General
				Joseph, Alan, Alec	Consultants
	UNDP, Mahe'			Veronique Bonnelame	Coordinator, Small Grants Programme
				Alan	
2/17/2012	Climate and Environmental Services Division	14.00	15.00	Hendrich Figaro	Inspector, Environmental Engineering Section
				Shuji Kaku	JICA Consultant
				Tomomi Fujita	JICA Consultant
				Joseph, Alan, Alec	Consultants
2/20/2012	UNDP-PCU, Mahe	10.15	11.00	Veronique Herminie	Programme Coordinator
				Joseph, Alan, Alec	Consultants
	Seychelles Land Transport Agency, Mahe'	14.15	14.45	Parinda Herath	Ag. Chief Executive Officer
				Nicholas Hoareau	Senior Project Officer
				Joseph, Alan, Alec	Consultants
	Public Utilities Corporation, Mahe'	15.00	16.00	Joel Velmont	Chief Operating Officer
				Philippe Morin	Chief Executive Officer
				Antoine Alcindor	Hydrologist
				Alan, Alec, Joseph	Consultants
2/21/2012	UNDP, Mahe' University of Seychelles	11.00	12.16	Dr Elvina Henriette	Degree Development Coordinator
				Sherley Marie	A/G Dean, Faculty of Sciences
				Indra Persaud	Geography lecturer
	Brilliant field visit - constructed/engineered wetland Mahe	14.45	15.20	Rose Annie Barreau	Environment Police, Env. Dept.,
				Kenneth Antat	Environment Police, Env. Dept.,
				Joseph, Alan, Alec	Consultants
2/22/2012	Nature Seychelles Mahe'	9.00	10.20	Dr Nirmal Jivan Shah	Chief Executive Officer
				Kerstin Henri	Director of strategic Operations
				Alice Mascarenhas	Projects Coordinator
				Dr Martin Varley	Coordinator, Community & Stakeholder Action
				Joseph, Alan, Alec	Consultants
	Green Islands Foundation	10.40	11.30	Marlon Naiken	
				James Chang-Tave	Project Manager
				Joseph, Alan, Alec	Consultants
	Sustainability for Seychelles	12.00	13.30	Michele Martin	Educational Consultant
				Iris Carolus	Legal consultant
				Joseph, Alan, Alec	Consultants

	Site visits	14.00	19.00	Joseph, Alan, Alec	Anse Builleau, Anse a la Mouche, Anse Louis, Grande Anse, Port Launay, Baie Ternay
2/23/2012	Mahe', Forest Management Plan and Sustainable Harvest Guidelines Workshop	10.00	12.00	Alan	
	Mahe', Site visits			Joseph, Alan, Alec	Upper Bougainville and Mont Plaisir
2/24/2012	Mahe', Town and Country Planning Authority	9.00	10.00	Florian Rock	Land use planner
				Joseph, Alan, Alec	
	Mahe', Seychelles National Parks Authority	11.00	12.00	Denis Matatiken	CEO, Seychelles National Parks Authority
				Rodney Quatre	Research Officer, Seychelles National Parks Authority
				Jason Jacquelide	Director Forestry, Seychelles National Parks Authority
				Joseph, Alan, Alec	
	Site visits	14.00	15.30	Joseph, Alec	Anse Royale, Pointe aux Sel, Isle Soleil, Anse Faure
	Mahe', Seychelles Fishing Authority	16.15	17.24	Jude Bijoux	Researcher (doing PhD on fisheries)
					Joseph, Alan, Alec
2/25/2012	Praslin, Site visit Anse Kerlan	AM		Alan, Mr Beluche	Long-time local resident
		AM		Patrick Godley	Resident, hotelier
		AM		Emile Poole	Environmental coordinator, DoE
		AM		Victorin Laboudallon	Senior Conservation Officer, DoE
		13.00	16.00	TRASS	Elvina Henriette, Victorin Laboudallon, Marvel
				Joseph, Alan, Alec	Consultants
	Praslin, Site visit Anse Kerlan	16.00	18.00	Joseph, Alan, Alec	Consultants
2/26/2012	Praslin, Site visit Anse Kerlan	7.00	7.30	Alec	Consultants
	La Digue, La Passe Beach	9.00	12.00	Joseph, Alan, Alec	Consultants
	La Digue, Source d'Argent	13.00	16.00	Joseph, Alan, Alec	Consultants
	La Digue, Tarosa restaurant	16.00	16.30	Johan Mendez	Hydrogeologist
				Joseph, Alan, Alec	Consultants
2/27/2012	Seychelles Agricultural Agency	10.00	12.00	Antoine Marie-Moustache	Chief Executive Officer
				Barry Nourrice	Senior Laboratory Officer
				Joseph, Alan	Consultants
	Site visits			Grand Anse Farms	

2/28/2012	Mahe, Seychelles Fishing Authority	8.30	13.00	EbA Stakeholder Consultation Workshop	See separate meeting minutes/attendance
2/29/2012	Mahe', Climate and Environmental Services Division	8.45	9.23	Nimhan Senaratne Elvina Hoarau Hendrick Figaro Alec	Director Environmental Engineering and Wetlands Section Coastal Coordinator Drainage Inspector Consultant
3/1/2012	Mahe', Ministry of Land Use & Housing Mahe', Ministry of Land Use & Housing	8.30 8.40	8.40 9.00	Francis Coeur de Lion Alec Cynthia Adrianne	Director GIS and IT support services Consultant GIS Officer, Centre for GIS
3/2/2012	Mahe', North East Point	14.00	16.00	Joseph, Alan, Alec	Site visit
3/3/2012	La Digue, Anse Severe	8.00	18.00	Alec	Site visit
3/6/2012	Ministry of Land Use and Habitat	1.00	2.00	Florian Rock	Land Use Planning Coordinator
		2.00	3.00	Alan, Joseph Patrick Lablache	Consultants Special Advisor/ Consultant
3/8/2012	Climate and Environmental Services Division	10.00	11.00	Hiroshi Hashimoto Shuji Kaku	JICA Consulting Engineering Advisor
				Alan, Joseph	Consultants

ANNEX 5: Alignment of Project Objectives/Outcomes with Adaptation Fund Results Framework

Any project or programme funded through the Adaptation Fund (AF) must align with the Fund's results framework and directly contribute to the Fund's overall objective and outcomes outlined. Not every project/programme outcome will align directly with the Fund's framework but at least one outcome and output indicator from the Adaptation Fund's Strategic Results Framework must be included at the project design stage.

Project Objective(s)[81]	**Project Objective Indicator(s)**	**Adaptation Fund Strategic Outcomes**	**Adaptation Fund Outcome Indicators**
To incorporate ecosystem based adaptation into the country's climate change risk management system to safeguard water supplies, threatened by climate change induced perturbations in rainfall and to buffer expected enhanced erosion and coastal flooding risks arising as a result of higher sea levels and increased storm surge.	a) Ecosystem services and natural assets maintained or improved under climate change and variability-induced stress b) Mean August discharge on two rivers (Mare aux Couchons & Baie Lazure), with increased base flows c) Mean January discharge on two rivers with decreased flood flows	***Outcome 5***: Increased ecosystem resilience in response to climate change and variability-induced stress ***Outcome 4***: Increased adaptive capacity within relevant development and natural resource sectors	5. Ecosystem services and natural assets maintained or improved under climate change and variability-induced stress 4.1. Development sectors' services responsive to evolving needs from changing and variable climate 4.2. Physical infrastructure improved to withstand climate change and variability-induced stress
Project Outcome(s)	**Project Outcome Indicator(s)**	**Fund Output**	**Fund Output Indicator**
Outcome 1: *Vulnerable coastal communities benefit from enhanced ecosystem resilience and water harvesting capabilities in water catchment areas covering 3000 hectares*	a) Est. number of water users with more reliable water supply b) Number of days per year water supply is not available at two streams: Baie Lazare and Mare aux Couchons c) Volume of raw water production from PUC facilities in project watersheds	***Output 2.2:*** Targeted population groups covered by adequate risk reduction systems ***Output 5:*** Vulnerable physical, natural, and social assets strengthened in response to climate change impacts, including variability ***Output 4:*** Vulnerable physical, natural, and social assets strengthened in response to climate	2.2.2 Number of people affected by climate variability 5.1. No. and type of natural resource assets created, maintained or improved to withstand conditions resulting from climate variability and change (by type of assets) 4.1.2. No. of physical assets strengthened or constructed to withstand conditions resulting

[81] Identical to Project Results Framework

		change impacts, including variability	from climate variability and change (by asset types)
Outcome 2 *Enhanced ecosystem integrity and functional connectivity covering 1000 hectares in the coastal areas of Seychelles.*	a) Area of rehabilitated coastal ecosystems b) Number of hectares of coastal ecosystems covered by Integrated Shoreline Management Plans	***Output 5:*** Vulnerable physical, natural, and social assets strengthened in response to climate change impacts, including variability	5.1. No. and type of natural resource assets created, maintained or improved to withstand conditions resulting from climate variability and change (by type of assets)
Outcome 3 *Coastal communities throughout the granitic islands actively support and benefit from the enhanced ecosystem water provisioning and flood buffering services, provided across 20,000 hectares.*	a) Approved water policy framework being implemented for watershed areas	***Output 7:*** Improved integration of climate-resilience strategies into country development plans	7.1. Number of policies introduced to address climate change risks or adjusted to incorporate climate change risks

Project Component	UNDP Atlas No	Project Budget Line	2013	2014	2015	2016	2017	2018	Total
1 - Ecosystem-based adaptation approach to enhancing freshwater security and flood control in Mahé and Praslin under conditions of climate change	71600	Travel	5,000	5,000	5,000	5,000	5,000	5,000	30,000
	72100	Service Contracts - Project Impl. Team	30,000	30,000	30,000	30,000	30,000	0	150,000
	72150	Service Contracts - Activity subprojects	400,000	500,000	425,000	409,000	340,000	250,000	2,324,000
	72200	Equipment	100,000	25,000	25,000	10,000	0	0	160,000
	72300	Materials and Goods	20,000	20,000	20,000	20,000	20,000	5,000	105,000
	73400	Rental (Vehicles)	9,000	6,000	6,000	6,000	6,000	3,000	36,000
	74200	Audiovisual & Printing	500	500	500	500	2,000	1,000	5,000
	74500	Miscellaneous	10,000	5,000	5,000	5,000	5,000	5,000	35,000
	75700	Training	10,000	10,000	50,000	50,000	50,000	10,000	180,000
		SUBTOTAL COMPONENT 1	584,500	601,500	566,500	535,500	458,000	279,000	**3,025,000**
2 - Ecosystem-based adaptation approaches along the shorelines of the Granitic Islands reduce the risks of climate change induced coastal flooding	71600	Travel	3000	3000	3000	3000	3000	3000	18000
	72100	Service Contracts - Project Impl Team	20,833	20,833	20,833	20,833	20,833	20,835	125,000
	72150	Service Contracts - Activity subprojects	185,000	300,000	325,000	370,000	350,000	150,000	1,680,000
	72200	Equipment	30,000	10,000	10,000	10,000	0	0	60,000
	72300	Materials and Goods	10,000	10,000	10,000	10,000	10,000	3800	53,800
	73400	Rental (Vehicles	2,000	1,500	1,500	1,500	1,500	700	8,700
	74200	Audiovisual & Printing	500	500	500	500	2,000	1,000	5,000
	74500	Miscellaneous	4,000	2,000	2,500	2,500	2,500	1,000	14,500
	75700	Training	5,000	5,000	5,000	5,000	5,000	5,000	30,000
		SUBTOTAL COMPONENT 2	260,333	352,833	378,333	423,333	394,833	185,335	**1,995,000**
3 - Ecosystem based adaptation mainstreamed									
	71300	National Consultants	20,000	25,000	25,000	25,000	25,000	25,000	145,000
	71600	Travel	3,000	3,000	3,000	3,000	2,000	0	14,000
	72100	Service Contracts - Project Impl Team	20,833	20,833	20,833	20,833	20,833	20,835	125,000

into development planning and financing	72150	Service Contracts - Activity Subprojects	10,000	15,000	30,000	50,000	35,000	25,000	165,000
	72200	Equipment	1,000	500	500	500	0	0	2,500
	72300	Materials and Goods	4,000	2,000	2,000	2,000	2,000	2,000	14,000
	73400	Rental (Vehicles)	1,500	1,000	1,000	1,000	1,000	500	6,000
	74200	Audiovisual & Printing	1,000	500	500	500	3,000	3,000	8,500
		SUBTOTAL COMPONENT 3	61,333	67,833	82,833	102,833	88,833	76,335	**480,000**
4 - Project Management									
	71300	National Consultants	72,833	48,833	48,833	48,833	48,833	24,835	293,000
	71600	Travel	8,000	4,000	4,000	4,000	4,000	4,000	28,000
	72100	Service Contracts (Workshops, M&E)	4,000	0	30,000	1,000	2,000	30,000	67,000
	72300	Materials and Goods	8,000	3,000	3,000	3,000	3,000	3,000	23,000
	73400	Vehicle	15,000	0	0	0	0	0	15,000
	74500	Miscellaneous	4,000	4,000	4,000	4,000	4,000	4,000	24,000
		SUBTOTAL PROJECT MANAGEMENT	111,833	59,833	89,833	60,833	61,833	61,835	**450,000**
TOTAL			1,017,999	1,081,999	1,117,499	1,122,499	1,003,499	606,505	**5,950,000**
5. UNDP supervision & management fee		based on AF Disbursement Matrix	254,218	55,182	56,992	57,247	51,178	30,932	505,750
AF Request			1,272,,217	1,137,181	1,174,491	1,179,746	1,054,677	637,437	**6,455,750**

Budget Notes:

Component 1 a) The forest and wetland rehabilitation works under Output 1.1. are a combination of reforestation and soil and water conservation measures to control surface runoff and increase infiltration. A cost of USD 1,820 per hectare is calculated for the rehabilitation of areas affected by IAS and a cost of USD 8,500 per hectare for the areas affected by fire (Praslin). Efficiency of scale was also considered with rehabilitation of larger areas made cheaper and smaller areas made more expensive. USD 50,000 is allocated to the preparation of

management plans for each watershed and USD 75,000 for the rehabilitation of each watershed.

b) The water control structures under Output 1.2 will be selected in conjunction with the Outputs 1.1 and may involve basic instream and off-channel (overflow) works such as weirs, barrages, or check dams depending upon the initial surveys and discussions. The first priority is to renovate the existing barrages and the second is to determine sites for additional streamflow control structures. For budgeting purposes the costs per structure is estimated in the range of $20,000-30,000 per structure based on discussions with PUC.

Component 2 a) The costs are estimated based on the measures costed in Dawson Shepherd, A.R., (2012). "Final draft technical report V3 on coastal assessments, sites selection and detailed investment plans for proposed investment sites on and around the three main granitic islands of Seychelles. 30th March 2012." Note that sand nourishment is included in NE Pt site (22.2) but not Anse Royale site (2.2). Also the full costs of NE Pt shoreline revegetation are expected to be shared with JICA project although yet to be negotiated.

b) The costs of including supplementary irrigation water supply to coastal farms (Output 2.2.4) as part of the stream channel/wetland rehabilitation (2.2.2) at Anse Royale which will coincidentally require a microwatershed rehabilitation scheme are considered only as part of the overall catchment area treatment on the hillsides above Lamalle Creek and lower Plaisir R. streams. Total costs, including distribution systems, will need to be cost-shared with government and beneficiaries.

Component 3 a) The training programme costs are a low estimate based on $3000 x 50 trainees = $150,000

b) Project Implementation Team: This is a project field activity design, delivery and supervision mechanism under the Contract Services budget line in each of the Components.

ANNEX 7: Plants suitable for Ecosystem Rehabilitation in Seychelles

This is a list of potential plants for ecosystem rehabilitation projects. Some of the species on the original list are indigenous or probably introduced. Indigenous species are good to plant as part of rehabilitation too and may be more useful at the start as they are more common

Scientific Name	Common Local Name	Suitable for rehabilitation
Achyrospermum seychellarum	Bwa sevret?	X
Allophylus sechellensis	Bwa kafoul trwa fey	o.k.
Angraecum eburneum??	Orkid Payanke	Most probably indigenous - not easy
Aphloia theiformis subsp…	Bwa merl	Mostly higher altitude
Barringtonia racemosa	Bonnen karedrivyer	INDIGENOUS - rivers
Begonia sechellensis	Lozey maron	X
Brexia madagascariensis subsp.	Bwa kato	o.k.
Campnosperma seychellarum	Bwadmontanny	Very difficult
Canthium carinatum	Bwa dir blan	? maybe
Canthium bibracteatum	Bwa dir rouz	INDIGENOUS - good
Carissa edulis var.sechellensis	Bwa sandal	maybe
Colea seychellarum	Bilenbi maron	? not easy
Craterispermum microdon	Bwa dou	Very difficult
Curculigo sechellensis	Koko maron	o.k.
Gynura seychellensis	Zakobe	? o.k. in shade
Deckenia nobilis	Palmis	good
Dillenia ferruginea	Bwa rouz	o.k.
Diospyros seychellarum	Bwa sagay	good
Dodonea viscosa	Bwa de renet	INDIGENOUS - o.k.
Dracaena reflexa	Bwa sandel	INDIGENOUS - o.k.
Drypetes riseleyi	Bwa mare pti fey	Difficult
Erythroxylum sechellarum	Kafe maron pti fey	good
Euphorbia pyrifolia	Bwa dile	Currently considered indigenous
Excoecaria benthamiana	Bwa zasmen	?
Ficus bojeri	Neant?? Lafous	Higher altitude
Ficus reflexa seychellensis	Lafous pti fey	o.k.
Garnotia seychellensis	Lerb montanny	X
Gastonia crassa (several subsp)	Bwa bannann	Higher altitude
Glionnetia sericea	Mangliyedgranbwa	Higher altitude
Grisollea thomassetii	Bwa grolapo	?
Guettarda speciosa	Bwa kasan bordmer	INDIGENOUS - good coastal
Hypoxidia rhizophylla	Pti koko maron	X
Mimusops sechellarum	Bwadnat	o.k.
Impatiens gordonii	Belzamin sovaz	X
Ixora pudica	Ikzora blan	Higher altitude
Justicia gendardussa	Lapsouli	INTRODUCED
Lodoicea maldivica	Kokodmer	o.k.

Lophoschoenus horneii	Lerb razwar	?
Ludia mauritiana	Pti prin maron	o.k.
Lumnitzera racemosa	Mangliye pti fey	INDIGENOUS - back of mangrove only
Medusagyne oppositifolia	Bwa mediz	Very difficult
Memecylon eleagni	Bwa kalou	good
Nepenthes pervillei	Lalyann potao	X
Nephrosperma vanhoutteana	Latannyen milpat	Good in shade
Northea hornei	Kapisen	? not too easy
Pandanus balfourii	Vakwa bordmer	good
Pandanus hornei	Vakwa parasol	Good in wetter areas
Pandanus multispicatus	Vakwa montanny	o.k. rocky areas
Pandanus seychellarum	Vakwa maron	o.k. rocky slopes
Paragenipa wrightii	Kafe maron gran fey	o.k.
Phoenicophorium borsigianum	Latannyen fey	Good in shade
Pittosporum senacia wrightii	Bwa zoli ker	Good
Pouteria obovata	Bwa mon per	INDIGENOUS - o.k.
Premna serratifolia	Bwa siro	INDIGENOUS - good
Protarum sechellarum	Larout de lenn maron	X
Psychotria pervillei	Bwa koulev	o.k. shade
Rapanea sechellarum	Bwa klate	X
Roscheria melanochaetes	Latannyen oban	ONLY higher altitudes
Rothmannia annae	Bwa sitron	o.k. if get from Aride
Scleria sieberi	Lerb koupan	Indigenous - ?
Secamone schimperiana	Lalyann dile?	X
Seychellaria thomassetii	Lafisel mov	X
Soulamea terminaloides	Kolofant	?
Syzygium wrightii	Bwa ponm	?
Tarenna sechellensis	Bwa dir ble	o.k. in shade
Timonius seychellensis	Bwa kasan-d-montanny	Higher altitudes
Vanilla phalaenopsis	Lavannir maron	o.k. (care)
Vateriopsis seychellarum	Bwadfer	?
Verschaffeltia splendida	Latannyen lat	Good in damp shade
Wielandia elegans	Bwa fourmi	Good in shade

Source: Katy Beaver, Plant Conservation Group, n.d.

There are other endemic species and subspecies but none are probably good or easy for rehabilitation projects. Many of the above endemics are not necessarily effective for rehabilitation at certain sites and should be carefully selected.

ANNEX 8: Project Implementation Schedule/Gantt Chart

Project Outputs		2013				2014				2015				2016				2017				2018			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1. Ecosystem-based adaptation approach to enhancing freshwater security and flood control in Mahé and Praslin under conditions of climate change																									
Output 1.1 Management and rehabilitation of critical watersheds to enhance functional connectivity and the resilience of these areas to climate change and reduce water scarcity and watershed flooding																									
1.1.1	Mare aux Cochons River Watershed																								
1.1.2	Mt Plaisir River Watershed																								
1.1.3	Baie Lazare River Watershed																								
1.1.4	Caiman River Watershed																								
1.1.5	Praslin Fond B'Offay/Nouvelle Decouvert Watershed																								
Output 1.2 Small-scale water storage and detention facilities designed and constructed or rehabilitated in critical waterways for communities to benefit from enhanced ecosystem functioning by forests.																									
1.2.1	Mare aux Cochons River Control Structures																								
1.2.2	Mt Plaisar River Control Structures																								
1.2.3	Baie Lazare River Control Structures																								
1.2.4	Caiman River Control Structures																								
1.2.5	Praslin Fond D'Offay/Nouvelle Decouvert																								

Project Outputs		2013				2014				2015				2016				2017				2018			
	Watershed Control Structures																								
2. Ecosystem-based adaptation approaches along the shorelines of the Granitic Islands reduce the risks of climate change induced coastal flooding																									
Output 2.1 Ecosystem based measures for flood protection on an urban shoreline																									
2.1.1	Integrated Shoreline Management Plan																								
2.1.2	Wetland Rehabilitation																								
2.1.3	Reef Rehabilitation																								
2.1.4	Beach Berm Enhancement																								
Output 2.2 Ecosystem based measures for flood protection and mitigating salt water intrusion in an agricultural and tourism development area																									
2.2.1	Integrated Shoreline Management Plan																								
2.2.2	Stream Channel and Wetland Rehabilitation																								
2.2.3	Shoreline Rehabilitation																								
2.2.4	Ecosystem Based Salinization Control Measures																								
3. Ecosystem based adaptation mainstreamed into development planning and financing																									
Output 3.1 Policy and legal frameworks for watershed and coastal climate change adaptation																									
3.1.1	Watershed management policy framework																								
3.1.2	Legislative, regulatory and advisory																								

Project Outputs		2013				2014				2015				2016				2017				2018			
	measures																								
3.1.3	Financing mechanisms for watershed protection																								
Output 3.2 Capacity development for ecosystem based adaptation methods																									
3.2.1	Training programme development																								
3.2.2	Training programme delivery																								
3.2.3	Institutional support																								
Output 3.3 Lessons learned and Knowledge Dissemination																									
3.3.1	Communications strategy																								
3.3.2	Knowledge products																								
3.3.3	Experiences exchange																								
4. Project Management																									
	Project staff recruited																								
	Equipment procured, office established																								
	PMU operational and managing programme implementation																								
	Project Monitoring and Evaluation																								
	Inception report																								
	Quarterly reports																								
	Annual Progress Report																								
	Steering																								

Project Outputs		2013				2014				2015				2016				2017				2018			
	Committee Meetings																								
	Mid-Term Evaluation																								
	Final Project Evaluation																								
	Project Terminal Report																								
	Audits																								

Annex 9: Comments and Response Matrix for the Project Concept Approved June 2011

Point for Clarification	Response
CR1: There are no scientific bases to believe that restoring riparian areas in watersheds will result in more regular water yields. While increasing forest cover along water ways reduces soil erosion, there is no rationale to think that seasonal water runoff will change. Furthermore, the proposed changes in forest cover on only ~7% of the islands area (1,090 ha on a ~15,500 ha island) is very unlikely to have a measurable impact on stream-flow, the simplest and less costly method to measure stream flow (no measurement technique provided in the project proposal). The fact that the island of Mahé appears to already be naturally well vegetated, again raises the question if modest forest cover enhancements will have any adaptation benefit. Please demonstrate the effectiveness of the proposed scale and types of interventions. Please provide peer-reviewed scientific justification for the scale and type of intervention.	The Government has reviewed the area targeted for rehabilitation, in response to the comments from the Adaptation Fund Secretariat, and has agreed to increase it to 3,000 ha. As a result of successive human activities, the forests of Seychelles have become highly degraded. Even though forests cover a large percentage of the land area of the Granitic Islands (Kueffer et. al. 2004[82]) natural forest now exists only as relict vegetation (i.e. at the highest altitudes and on glacis). Sixty-three percent of the forests are secondary forests, and most have been invaded by alien exotic species. It is acknowledged that the rehabilitation of watersheds will not lead to an increase in total water yield, and total water yield may actually fall as a result of such rehabilitation as trees draw additional water. A review of studies looking at the relationship between forest cover and water yields undertaken by Bosch et. al. (1982)[83] found that forest removal usually leads to increased water yield (other things being equal—i.e. not accounting for the micro climatic effects engendered by such removal, which can reduce precipitation). As the Seychelles currently only captures 3% of the total rainfall for domestic water consumption, there is no need to increase total yield and this is not the purpose of the project. Due to the topography of the island, the country is unable to construct large water storage facilities—to store water captured in the wet season for use in the dry season. Therefore the country needs to ensure steady stream flows in water catchments in the dry season to meet water demand during that period. Climate change models predict that rain will fall in more intense downpours, primarily during the wet season. While precipitation is expected to increase overall, rainfall during the dry season is likely to decrease, and the length of the dry season is also likely to be subject to high perturbation (becoming longer in some years). This situation will place considerable stress on dry season water availability. The project seeks to enhance watershed regulation functions as a climate change adaptation measure to provide 1) high dry season flow, and 2) regulate peak flow—to reduce the risk of flooding. In this regard, there is ample evidence to prove that watershed rehabilitation is a relevant adaptation option. Forests play a critical role in regulating stream flows: i.e. producing a more steady flow even during dry periods by ensuring that precipitation percolates into the ground and is discharged to streams gradually over an extended period. Forest soils have a higher water-storage capacity than non-forest soils and the more complex structure of the forest ground-surface and underlying soil allows more efficient soil water infiltration. By slowing the water runoff rate following heavy rainfall, forests play a role in increasing ground storage capacity and recharge (www.conservationfinance.org)[84]. By regulating runoffs, forests also play a role in reducing flood volumes and flooding risks. Forests are thus often referred to as a "green reservoir" owing to their osmosis functions and watershed protection capacity.

[82] Kueffer, C., Vos, P., Lavergne, C. & Mauremootoo, J. 2004. *Case Studies on the Status of Invasive Woody Plant Species in the Western Indian Ocean. 1. Synthesis.* Forest Health and Biosecurity Working Papers FBS/4-1E. Forestry Department, Food and Agriculture Organisation of the United Nations, Rome, Italy.

[83] Bosch, J.N. & Hewlett, J.D. 1982. *A Review of Catchment Experiments to determine the Effect of Vegetation Changes on Water Yield and Evapotranspiration*. Journal of Hydrology, 55, p.3 – 23.

[84] *Payments for Watershed Services*. www.conservationfinance.org/guide/images/payments.doc accessed 12/05/2011

	These specific watershed regulation services are well documented. Bennagen *et. al.* (www.prem-online.org)[85] showed that deforestation and forest degradation in the Pinacanauan Watershed in the Philippines resulted in a reduction in dry season streamflows, attributed to a reduction of the soil water infiltration capacity of the watershed. Johnson *et. al.* (www.forest-trends.org)[86] state: *"Although forests (may) reduce total annual water flow… they can increase minimum flows during the dry season (known as base flows)"*. Aylward *et. al.* (1995)[87] show that forest conversion and subsequent uses may lead to increased soil compaction and surface run-offs (as opposed to infiltration) following rainfall events. Locatelli *et. al.* (2009)[88] undertook a meta analysis of studies comparing water flows in tropical watersheds under different land uses (natural forest/ planted forests and non-forest lands) to evaluate the linkage between forest cover, total water yield and base flows. This showed that natural forests reduced total flow but resulted in higher base flow during the dry season when compared to non-forested land. Bruijzeel (1990) cites a number of reports documenting the links between deforestation and reduced dry season stream flows. Daniel & Kulasingam 1974[89]; Eckholm 1976[90]; Hardjono 1980[91]; RIN 1985[92]; Nooteboom 1987[93]; Maduma Bandara & Kurupuaracchi 1988[94]; Bartarya 1989[95]). He mentions the work of Hardjono (1980) whose data can be taken as evidence that restoring degraded forest land restores dry season flow. Bruijnzeel (1990)[96] also attributes the loss of water soil infiltration potential following forest loss or degradation as the reason for diminishing dry season flows. It is now well recognized that invasive alien species, particular tree species, have increased water usage compared to native species. Increased catchment water yield is a major justification for the cost of clearing alien plants. Studies conducted in South Africa indicate that high rainfall catchment (as all Mahe catchments are) show the greatest potential streamflow enhancement potential from IAS removal ((Calder et. al.2001)[97]. Various invasive tree species have entered the forests of Seychelles especially in the riparian zones. The woody trees have a higher biomass than the native forest, capturing large amounts of water. Creeper species add an additional layer in the forest, not common in native forest, also drawing water resources, especially during the dry season. This all impacts on the water yield—in this case both the total water yield and the dry season yield. Upper catchment cloud interception can also contribute to increased dry season flows. All

[85] Bennagen, M.E., Indab, A., Amponin, A., Cruz, R, Folledo, R., van Beukering, P.J.H., Brander, L., Hess, S., van Soesbergen, A., van der Leeuw, K & de Jong, J. *Designing Payments for Watershed Protection Services of Phillipine Upland Dwellers*. (www.prem-online.org accessed 12/05/2011).

[86] Johnson, N., White, A. & Perrot-Maitre. *Developing Markets for Water Services from Forest Issues and Lessons from Innovators*. Forest Trends, World Resource Institute (www.forest-trends.org/documents/files/doc_133.pdf accessed 12/05/2011).

[87] Aylward, B., Echeveria, J & Barbier, E.B. 1995. *Economic Incentives for Watershed Protection: A Report on an ongoing Study of Arenal, Costa Rica.* CREED Working Paper Series No. 3. International Institute for Environment and Development, London. Institute for Environmental Studies, Amsterdam. (www.prem-online.org/archive/17/doc/creed03e.pdf accessed 12/05/2011).

[88] Locatelli, B & Vignola, R. 2009. *Managing Watershed Services of Tropical Forests and Plantations: Can Meta-analysis help?* Forest Ecology and Management 258 (2009) 1864 – 1870.

[89] Daniel, J.G. & Kulasingam, A. 1974. *Problems arising from Large-scale Forest Clearing for Agricultural Use – the Malaysian experience.* Malaysian Forester 37: 152 – 160.

[90] Eckholm, E. 1976. *Losing Ground*. W.W. Norton, New York, 223pp.

[91] Hardjono, H.W. 1980. *Influence of a Permanent Vegetation Cover on Streamflow.* Pp. 280 – 297 in Proceedings of the Seminar on Watershed Management, Development and Hydrology, Surakarta, Indonesia, 3 – 5 June 1980 (in Indonesian).

[92] RIN 1985. *Evaluation of Forest Land. Kali Konto Upper Watershed. II Area, Methods and Organisation*. Research Institute for Nature Management (RIN) Leersum, the Netherlands, 30 pp.

[93] Nooteboom, H.P. 1987. *Further Views on "Environmental Impacts of (de)forestation in the Humid Tropics"*. Wallaceana 47: 10 – 11.

[94] Madduma Bandara, C.M. & Kurupuarachchi, T.A. 1988. *Land Use Change and Hydrological Trends in the Upper Maheweli Basin*. Paper presented at the Workshop on Hydrology of Natural and Man-made Forests in the Hill Country of Sri Lanka. Kandy, October 1988, 18 pp.

[95] Bartarya, S.K. 1989. *Hydrogeology, Geoenvironmental Problems and Watershed Management Strategies in a Central Himalayan River Basin, Kumaun, India.* Pp. 308 – 318 in J. Krecek et. al. (eds.). Headwaters Control, Volume 2. IUFRO/WASWC/CSVIS, Plzen, Czechoslovakia.

[96] Bruijnzeel, L.A. 1990. *Hydrology of Moist Tropical Forests and Effects of Conversion: a State of Knowledge Review*. IHP-UNESCO Humid Tropical Programme, Paris, 224 pp.

[97] Calder, I & Dye, P. *Hydrological Impacts of Invasive Plants*. Land Use and Water Resources Research 1 (2001).

	forested areas above 500 m are considered mountain mist forests and like other cloud forests are important sources of water during dry periods (Bruijnzeel & Proctor, 1995[98]; Hamilton & King, 1983[99]; Zadroga, 1981[100]). The literature shows that to have a major impact on water flows, large scale interventions are necessary. As illustrated in Map 3 in the proposal, critical watersheds cover only part of the island of Mahe. The project will undertake rehabilitation work over an area of 3,000 hectares (covering approximately 50% of Mahé's catchment areas).
CR2: While "restoring" mangroves (20 ha), sand dunes (5 ha), wetlands (30 ha) and fringing reefs (0.5 ha) have been done in other places with variable results, it is not clear that the recovery of such small areas will have a desired impact of reducing climate change induced coastal flooding. Please also provide peer-reviewed scientific justification for the scale of these other coastal restorations. In addition, please elaborate on the baseline analysis of the sea level raise, to fully understand the scale and speed of the restoration activities and the long term sustainability of the project.	UNEP-WCMC (2000)[101] show that 70 – 90% of the energy of wind-generated waves may be absorbed by mangroves and reefs, but that the buffering capacity depends on ecosystem integrity and physical characteristics. The project is designed to enhance the ability of ecosystems to supply this buffering function. It is acknowledged that the area of the rehabilitation sites is small, given the potential for climate change induced flooding. Nevertheless, the measures have considerable potential to reduce flooding vulnerability at the local level—in flooding hotspots. This is well documented in the scientific literature. Devisscher (2010)[102] notes that rehabilitation across a mosaic of ecosystems (larger scale) can further achieve enhancement of services. Restoring mosaics of inter-connected ecosystems can ensure that if some very degraded areas are only slowly recovering, other functioning ecosystems will provide services and structure to build on. Therefore, rehabilitation can be improved by harnessing positive interactions between ecosystems that stabilize community dynamics, ecosystem functions, and the structure of neighboring ecosystems. Halpern et. al. (2007)[103] argue that by broadening the scale of intervention through the spatial arrangement of ecosystems these positive interactions can be optimized. Component 2 applies this principle, seeking to combine rehabilitation of different environments (tidal wetlands/ reefs/ dunes) to reduce the flooding risk in coastal flooding hotspots. The intention is to rehabilitate degraded areas within larger environments—thus enhancing overall ecosystem functioning. For mangrove rehabilitation, Lewis (2009)[104] and Brockmeyer et. al. (1997)[105] describe successful rehabilitation projects, ranging from 2.1 ha to 4.05 to 73 ha to large rehabilitation areas of 50,000 ha, which mitigated the level of flooding in specific areas. Stevenson et. al. (1999)[106], Milano (1999)[107]; Weishar et. al.[108], WetlandCare Australia[109], Williams et. al. (2001)[110] and Erwin (2009)[111] present evidence documenting the success of small wetland

[98] Briujnzeel, L.A. & Procter, J. 1995. *Hydrology and Biogeochemistry of Tropical Montane Cloud Forests: What do we really know?* Ecological Studies. 110: 38 – 78.
[99] Hamilton, L.S. & King, P.N. 1983. *Tropical Forested Watersheds: Hydrologic and Soil Response to Major Uses or Conversion.* Westview Press, Boulder, Colorado, pp.168.
[100] Zadroga, F. 1981. *The Hydrological Importance of a Montane Cloud Forest Area of Costa Rica.* Tropical Agriculture Hydrology. Pp. 59 – 73.
[101] UNEP-WCMC (2006). *In the Front Line: Shoreline Protection and other Ecosystem Services from Mangroves and Coral Reefs*. UNEP-WCMC, Cambridge, UK, 33pp.
[102] Devisscher, T. 2010. *Ecosystem-based Adaptation in Africa. Rational, Pathways, and Cost Estimates*. Sectoral Report for the AdaptCost Study. Stockholm Environment Institute.
[103] Halpern, B.S., Silliman, B.R., Olden, J.D., Bruno, J.P. & Bertness, M.D. 2007. *Incorporating Positive Interactions in Aquatic Restoration and Conservation.* Front. Ecol. Environ. 2007:5(3):153 – 160.
[104] Lewis, R.R. 2009. *Methods and Criteria for Successful Mangrove Forest Restoration*. In Perillo, G.M.E., Wolanski, E., Cahoon, D.R., Brinson, M.M. (Eds). Coastal Wetlands: An Integrated Ecosystem Approach.
[105] Brockmeyer, M.E., Rey, J.R., Virnsteain, R.W., Gilmore, R.G., Ernest, L. 1997. *Rehabilitation of impounded Estuarine Wetlands by Hydrologic Reconnection to the Indian River Lagoon, Florida (USA).* Wetl. Ecol. Manage. 4, 93 – 109.
[106] Stevenson, N.J., Lewis, R.R. & Burbridge, P.R. 1999. *Disused Shrimp Ponds and Mangrove Rehabilitation*. In: Streever, W.J. (Ed). An International Perspective on Wetland Rehabilitation. Kluwer Academic Publishers, Dordrecht, pp. 277 – 297.
[107] Milano, G.R. (1999). *Restoration of Coastal Wetlands in Southeastern Florida*. Wetland Journal 11(2):15 – 24.
[108] Weishar, L.L.; Teal, J. & Hinckle, R. *Development of Marsch Hydrogeomorphology and Marsh Vegetation within a Salt Hay Farm Wetland Restoration Site*. (http://images.library.wise.edu/EcoNatRes/Wetlands?Wetlands27/reference/econatres.wetlands27.lweishar.pdf accessed 14/05/2011)
[109] www.wetlandcare.com.au/projects_archived.asp
[110] Williams, P.B. & Flair, P.B. (2001). *Salt Marsh Restoration Experience in San Francisco Bay*. Journal of Coastal Research, Special Issue No. 27, 203 – 311. Royal Palm Beach (Florida).

	rehabilitation projects in mitigating flood damages. Chang et al. 2006[112], found in a comparison of villages on the Andaman coast of Thailand after the 2004 tsunami, that houses in villages behind intact mangrove forests experienced significantly less flood damage than those in unprotected villages. A survey of households in the Bhitarkanika Conservation Area in India by Badola & Hussain 2005[113] following the 1999 cyclone found that residents of villages protected by mangroves reported lower levels and duration of flooding, less damage to homes and assets, and higher crop yields than people in villages unprotected by mangroves, or villages with a seaward embankment. The literature also provides evidence of numerous successful coral reef rehabilitation projects (e.g. Hudson et. al. (2007)[114], www.globalcoral.org[115], Edwards et. al. (2007)[116]). Successful reef rehabilitation has mostly taken place on a small scale – covering a few hectares. (Edwards et. al (2007)[117]). The technology for large scale rehabilitation has yet to be proven. The Government of the Seychelles does not intend as a consequence to invest in large scale rehabilitation, but rather in small scale rehabilitation as a complement to other rehabilitation (i.e. dune stabilization). The effect of small-scale sand dune rehabilitation in controlling flooding is documented in the literature (see Roze, F., & Lemauviel, S. (2004)[118] and Gomez-Pina et. al. (2002)[119]. The Government has reviewed the area targeted for rehabilitation, in response to the comments from the Adaptation Fund Secretariat, and has agreed to the following targets Enhanced ecosystem integrity and functional connectivity covering a total area of 1,000 hectares in the coastal areas of Seychelles. It should be noted that the project is designed to ensure that the planned EbA measures are implemented over a wider scale over time, with other sources of funding (i.e. joint management with the private sector; requirements for rehabilitation and offsets as part of development permitting requirements). This approach is already successfully being applied in the Seychelles in the case of species conservation (through the GEF-funded project "Mainstreaming Biodiversity Conservation into the Production Sectors of Seychelles"). Component 3 has been specifically designed with this in mind. The focus of component 1 and 2 will be to learn from, adapt and scale up the known and proven technologies from other parts of the world. It will be important to bring in the expertise to assist Seychelles to implement these technologies, and build capacity to apply these measures at larger scale. In order to create a continuity between strategic policy relating to climate change and action 'on the ground', Few et. al. (2004)[120] suggest there is a need to invest resources in local adaptive capacity, strengthen local long-term planning mechanisms and establish genuinely cross-scale institutions on coastal management to take and support what may be difficult decisions. This

[111] Erwin, K.L. 2009. *Wetlands and Global Climate Change: The Role of Wetland Restoration in a Changing World.* Wetlands Ecological Management (2009) 17: 71 – 84.
[112] Chang, S.E., Adams, B.J, Alder, J., Berke, P.R., Chuenpagdee, R., Ghosh, S. & Wabnitz, C. 2006. *Coastal ecosystems and tsunami protection.* Earthquake Spectra 22(S3): S863-S887.
[113] Badola, R. and Hussain, S.A. 2005. *Valuing ecosystem functions: an empirical study on the storm protection function of Bhitarkanika mangrove ecosystem, India.* Environmental Conservation 32(1): 85-92.
[114] Hudson, J.H.; Franklin, E.C.; Schittone, J.; Stratton, A. 2007. *M/V Wellwood Coral Reef Restoration Monitoring Report, Monitoring Events 2004 – 2006.* Florida Keys National Marine Sanctuary Monroe Country, Florida. Marine Sanctuaries Conservation Series NHSP-07-02. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Sanctuary Program, Silver Springs, MD. 50pp.
[115] www.globalcoral.org/pemuteran_coral_reef_restoration.html (accessed 15/05/2011).
[116] Edwards, A.J & Gomez, E.D. 2007. *Reef Restoration Concepts and Guidelines: Making Sensible Management Choices in the Face of Uncertainty.* Coral Reef Targeted Research & Capacity Building for Management Programme: St. Lucia, Australia. iv + 38pp.
[117] Edwards, A.J & Gomez, E.D. 2007. *Reef Restoration Concepts and Guidelines: Making Sensible Management Choices in the Face of Uncertainty.* Coral Reef Targeted Research & Capacity Building for Management Programme: St. Lucia, Australia. iv + 38pp.
[118] Roze, F. & Lemauviel, S. 2004. *Sand Dune Restoration in North Brittany, France: A 10-year Monitoring Study.* Restoration Ecology, Vol. 12, No 1, pp. 29 – 35.
[119] Gomez-Pina, G., Munoz-Perez, J.J., Ramirez, J.L. & Ley, C. 2002. *Sand Dune Management Problems and Techniques, Spain.* Journal of Coastal Research.
[120] Few, R., Brown, K., Tompkins, E.L. 2004. *Scaling Adaptation: Climate Change Response and Coastal Management in the UK.* Tyndall Centre Working Paper No. 60.

	has informed project design. Under the barriers section of the proposal it is described that the limited experience and know-how in Seychelles in ecological rehabilitation work and the sub-optimal availability of knowledge on such rehabilitation that has been accumulated in other countries hinders the application of ecosystem based climate change adaptation measures in areas where ecosystem rehabilitation is required. Some work on coastal rehabilitation has been done and some of the national technicians are aware of the benefits of implementing ecosystem-based approaches but the general public and the most vulnerable communities are unaware of the opportunities provided by such approaches. This includes expanding the networks of practitioners and research capacity, better information and co-generation of knowledge. Of importance here is the educational and awareness raising these implementation sites provide – including for private sector operators. Information can raise general public awareness on the intrinsic and immutable relationship between ecosystems and human well-being, highlighting the critical link between ecosystem health and human health (Silvestri et. al. 2010)[121] and the protection against natural disasters. On the sustainability of project in the light of sea-level rise, Ong and Tan (2008)[122] asserted that mangroves have survived sea-level changes through geological time. The difference now is that man-made barriers along the coast will prevent mangroves from migrating inland. Zhu et. al (2010)[123] writes *"In contrast to hard defences, wetlands are capable of undergoing 'autonomous' adaptation to SLR, through increased accumulation of sediments to allow the elevation of the wetland to keep pace with changes in sea level (Nicholls & Klein, 2005). Provided wetlands are not subjected to coastal squeeze, and the rate of SLR is not too rapid to keep pace, wetlands are capable of adapting to SLR without further investments."* It is therefore not expected that this will have a negative effect on the sustainability of the project as this will be addressed under Component 3 in the integration of ecosystem-based adaptation processes into land use planning and development regulations. The following was added to the section on Coastal Flooding, p.6: Shore wave heights are limited by water depths, so with the increase in sea level, the height of waves will increase. Nicholls et. al. (2002)[124] estimate that without adaptation a 1 meter rise in sea level will produce a 14-fold increase in flooding compared to the situation without sea-level rise. Under a lower sea-level rise scenario of 38cm by the 2080s, the global increase in flooding will be seven-fold compared with the situation without sea-level rise. They also forecast that large relative increases in flooding will be felt in the small island region of the Indian Ocean, which includes the Seychelles.
CR3: The outputs associated with "Ecosystem based climate change adaptation into development planning and financing" are opaque. They do not allow seeing what will actually happen on the ground at the community level, and how the interventions will translate into actual and	The outputs of Component 3 have been changed to read as: 3.1 Policy and legal frameworks for watersheds and coastal climate change adaptation. 3.2 Capacity development for ecosystem based adaptation methods. 3.3 Lessons learned and knowledge dissemination. The description of the "Expected Outcome" has been changed to read: Coastal communities throughout the granitic islands actively support and benefit from the enhanced ecosystem water provisioning and flood buffering services provided across 40,000 hectares These are estimates of the areas that can realistically be addressed during the period of the project. The three main granitic islands are the only populated islands in Seychelles, with some of the other islands being used for tourism and conservation purposes. The project is not envisaged to mainstream activities on these islands although certain activities e.g. legislation

[121] Silvestri, S.; Kershaw, F. (eds). 2010. *Framing the Flow: Innovative Approaches to Understand, Protect and Value Ecosystem Services across Linked Habitats*. UNEP World Conservation Monitoring Centre, Cambridge, UK.
[122] Ong, J.E. & Tan, K.H. 2008. *Mangrove and Sea-level Change*. In: Chan, H.T. & Ong, J.E. (Eds.) Proceedings of the Meeting and Workshop on Guidelines for the Rehabilitation of Mangroves and other Coastal Forests damaged by Tsunamis and other Natural Hazards in the Asia-Pacific Region, ISME and ITTO Mangrove Ecosystems Proceedings No. 5, pp. 89 – 96.
[123] Zhu, X., Linham, M & Nicholls, R.J. 2010. Technologies for Climate Change Adaptation – Coastal Erosion and Flooding. GEF-UNEP.
[124] Nicholls, R.J. & Hoozemans, F.M.J. 2002. *Global Vulnerability Analysis*. In Schwartz, M. (Ed). Encyclopedia of Coastal Science, Kluwer Academic Publishers.

measurable environmental deliverables. Also, are the areas listed for the ecosystem the expected targets of the "mainstreaming" activities? Do these areas cover the entirety of the granitic islands or only partial coverage? It is also unclear if mainstreaming will include any of the coralline islands (if they are populated).	and policy will take a national perspective and will definitely impact on the management and development of the outer islands.
CR4: Although it was explained that the proposed measures have either been implemented elsewhere or tested at a smaller scale in Seychelles, please specify if the technical expertise (NGOs, research centres, universities, consultants firms) that will be called upon to implement and build capacities in Seychelles for these technologies, has been already identified. A number of NGOs and other potential stakeholders were mentioned in Table 3.	An mapping exercise has been undertaken to identify institutions in the Seychelles able to implement different project activities: <u>Watershed Rehabilitation:</u> - Seychelles National Parks Authority – responsible for national park management but also for forestry issues in general e.g. forest fire. Has a lot of experience in forest rehabilitation and have a few small nurseries in operation on the main islands. - TRASS (Terrestrial Restoration Action Society of Seychelles) – this NGO has experience in Post Fire Rehabilitation Work, Creeper Eradication and general forest rehabilitation. - Green Island Foundation – NGO involved in the vegetation rehabilitation on North Island and forest rehabilitation on Denis Island. - Plant Conservation Action Group – very involved in the rehabilitation of natural forests and conservation of wetlands. - Department of Biological Sciences, Aarhus University, Denmark – research associate doing research on alien species eradication and forest rehabilitation. <u>Design and Maintenance of Barrages:</u> - Public Utilities Corporation – parastatal responsible for water provision to citizens, extensive experience in construction and maintenance of water supply pipes, some experience in dam construction but might need to bring in international experience. <u>Wetland/Mangrove Rehabilitation:</u> - Environmental Engineering & Wetlands Section, Department of Environment – responsible for managing all wetlands and some rehabilitation experience - Nature Seychelles – NGO that rehabilitated an important wetland in the centre of Victoria (Roche Caiman) - Sustainability for Seychelles (S4S) – experience in mangrove rehabilitation - Mangroves for the Future (MFF) – projects implemented in Seychelles in coastal ecosystem conservation for sustainable development. Experience in wetland/mangrove rehabilitation since 2004, could use their extensive international expertise on project - Plant Conservation Action Group – experience in wetland conservation. <u>Coral Reef Rehabilitation:</u> - Nature Seychelles – currently implementing a coral reef rehabilitation project around Cousin Island – in process of setting up a coral nursery from where they transplant corals onto degraded areas - Marine Conservation Society of Seychelles – some coral transplant experience - University of Seychelles – some senior lecturers have extensive experience in reef

	systems. Sand Dune Rehabilitation: - Division of Risk and Disaster Management, Department of Environment – has implement some dune rehabilitation projects e.g. planting of native species on disturbed sand dunes - Green Island Foundation – dune rehabilitation work on Denis Island and some work in Mahe and Praslin, mainly on planning - Marine Conservation Society of Seychelles- some coastal dune planning experience.
CR5: Please elaborate on the consultation that have already taken place to develop the PWS scheme and on the feasibility of this scheme to be implemented during the project lifetime.	The Government of Seychelles through funding from the African Development Bank drafted the Seychelles Water Development Plan 2008 – 2030. In this draft plan, the consultants recommended the implementation of a new banded tariff plan. The draft plan has undergone extensive consultation. The tariff plan will be implemented soon but was aimed at an operational expenditure cost recovery for the Public Utility Corporation (PUC). PUC provides water to 95% of the Seychelles population and the implementation of such a scheme will require the recalculation of tariffs based on the agreed payment. The Government of Seychelles believes this is feasible. The implementation of this component is only envisaged at the end of the project after the collection of pre-rehabilitation and post-rehabilitation results with respect to stream flow. Other services e.g. biodiversity will not be incorporated in these Payments. Experience in the implementation and development of Payment for Environmental Services schemes shows the importance of broad participation in the early stages to ensure their long-term legitimacy and sustainability (Russo et. al. 2006)[125]. An accelerated institutionalization of PES schemes can generate restrictions that are difficult to overcome. This wide consultation and cautious approach will be implemented during the full proposal development and implementation phases. Further, similar systems have been developed in other countries, most notably in Mexico under the Payment of Hydrological Environmental Services Programme. It was designed by the federal government to pay forest owners for the benefits of watershed protection. Funding comes from a fee charged to federal water users, from which a percentage is earmarked for environmental services (Munoz-Pina et. al. 2005)[126].
CR6: A separate Component will need to be added to accommodate output 1.3, as installation of barrages does not meet the proposed outcome of Component 1 (i.e. 1090 ha wetlands and rests restored).	Expected Outcome of Component 1 was changed to "Vulnerable coastal communities benefit from enhanced ecosystem resilience and water harvesting capabilities in water catchment areas covering 3,000 hectares." Wording of output 1.3 was changed to "Small-scale water storage and detention facilities designed and constructed or rehabilitated in critical waterways for communities to benefit from enhanced ecosystem functioning by forests".
CR7: Please provide more information on the benefits to vulnerable communities.	The following was added to Section B: Describe how the project/programme provides economic, social and environmental benefits, with particular reference to the most vulnerable communities: Particular Focus on the Most Vulnerable Groups among Coastal Communities: Poorer Groups within the Community (25,000 people – 30% of the population lives under the Basic Needs Poverty Line)[127]: The poorest in the coastal communities are also the most vulnerable to water shortages. During periods of water restrictions, the most vulnerable members of the communities do not have the means to cart water by vehicle from elsewhere and therefore a large percentage of household income is spent on the purchase of bottled water. The lack of water leads to lack of sanitation. The project will directly tackle the provision of water to the most vulnerable through enhancing the water provision capacity of forests and water during extended dry periods and providing

[125] Russo, R.O & Candela, G. 2006. Payment of Environmental Services in Costa Rica: Evaluating Impact and Possibilities. Tierra Tropical 2(1): 1 – 13.
[126] Munoz-Pina, C., Guevara, A., Torres, J.M. & Brana, J. 2005. Paying of Environmental Services in Costa Rica: Evaluating Impact and Possibilities. Tierra Tropical 2(1): 1 – 13.
[127] www.nsb.gov.sc

	water of high quality throughout the year. The construction of the barrages to capture the water and the delivery to communities are addressed by the project. Poorer groups will therefore be able to have accessible water for household sanitation as well as for drinking. Vulnerable groups will also benefit from the growth of the economy through receiving benefits through remuneration for work done, especially the continual growth of tourism. This will only be possible with increased water provision and reduction of flooding and erosion of coastal areas. The poorest members of the society normally are also the most vulnerable to coastal flooding as they either stay in vulnerable areas e.g. in reclaimed areas of wetlands or the structures they live in is not robust enough to withstand coastal flooding. With the reduction of coastal flooding through the implementation of this project, these members of the community will be safeguarded. Farmers (2500 people – 600 farmers, 800 workers and dependents): Most farmers use irrigation for provide water to their crops. With the extended dry periods, and the restrictions on water use during these periods, farmers' livelihoods are affected. Further, due to poor soils and steep slopes, most agricultural activities takes place on the coastal plateau of the islands. The increase of flooding and increase of salinity of soils in the coastal zones as a result of flooding, crop failure is becoming more regular. Both through increased water provision throughout the year by forests and the reduction of coastal flooding through restoring/managing coastal ecosystems, the vulnerable farmers will benefit and continue sustainable livelihoods. Small Businesses (+/-200 businesses): Small business especially tourism enterprises which tend to be near the beach/waterfront investment will be at risk from the flooding resulting from sea level rise and increased storm surges. Small business owners needing water e.g. fish processing plants or construction will also be negatively affected by the water shortages during the dry season. This vulnerable group will directly benefit from the implementation of the project. Urban dwellers (+/- 40,000 people) that are at risk of losses of life and property from increased flooding, lack of sanitation and decreases in access to safe water.

Annex 10: Response Matrix on Observations made by the Adaptation Fund Board on the Project Concept Approved June 2011

AF Comments on Concept Proposal	Responses to comments
The proponent should review the budget for the planned activities, to reflect the estimation of the costs associated with an increase in the size of the target areas;	Two international experts, a Water Resource Management Specialist and a Coastal Rehabilitation Specialist, were recruited during the Project Development Phase to assist in the estimation of realistic costs of the rehabilitation of the ecosystems. For Component 1, the project strategy has been refined to adopt a multi-dimensional approach to watershed rehabilitation that not only relies on forest cover alterations to influence stream flows and runoff but utilizes a combination of instream and catchment area soil and water conservation and drainage controls. The target areas remain at 3,000 ha after estimation of costs. For Component 2, the sizes of areas have been reduced to that envisaged in the project concept. In consultation with the Government of Seychelles, it was decided that doing a little everywhere does not necessarily have a beneficial effect unless it exceeds a certain threshold. Two particular vulnerable target areas, with large economic benefit to the Seychelles, were selected based on the presence of tidal wetland, beach berm, the proximity of the road, the presence of a suitable culvert and proximity of the reef[128], (therefore rehabilitation resulting in a larger rehabilitated area as a result of functional connectivity) but also on the economic impacts of not adapting these sites to effects of climate change and the number of beneficiaries as a result of the interventions. These sites were determined by the Government of Seychelles as priority sites. Linkages to Component 1 were also considered as a selection criteria in order to further enhance the functional connectivity of the ecosystems. As accurate estimates of costs as possible have been provided in the proposal based on the expert advice of a number of experts and local stakeholders.
Unless clear evidence of the cost effectiveness of restoration as an adaptation option is demonstrated, the proponent should look into the rehabilitation of the targeted ecosystems, which has been demonstrated to provide tangible results in a more reasonable timescale;	In consideration of this observation, the following definitions of restoration and rehabilitation from Aronson et al. (1993)[129] were used: *"The Society of Ecological Restoration (SER) defines restoration as "the intentional alteration of a site to establish defined indigenous, historic ecosystem. The goal of this process is to emulate the structure, functioning, diversity, and dynamics of the specified ecosystem."* *"… the primary goal of … restoration is the conservation of indigenous biodiversity and ecosystem structure and dynamics. They thus differ from a third possible response to ecosystem degradation, which we call rehabilitation."* *"Rehabilitation, in our sense, seeks to repair damaged or blocked ecosystem functions, with the primary goal of raising ecosystem productivity for the benefit of local people. Moreover, it attempts to achieve such changes as rapidly as possible."* In view of these definitions, the proposal was designed around rehabilitation, rather than restoration. This is because climate change adaptation should primarily involve the enhancement of ecosystem functions, rather than the return of the ecosystems to its original structure and dynamics e.g. biodiversity values.
The proponent should describe more clearly and translate it into relevant outputs, the way	Ecological connectivity refers to interactive pathways that link organisms and ecological processes with land/seascape elements. Land/seascapes contain barriers to movement, detrimental habitat, and areas that contain patches with higher and lower quality habitat, which

[128] Dawson Shepherd, A.R., (2012). *Final draft technical report V3 on coastal assessments, sites selection and detailed investment plans for proposed investment sites on and around the three main granitic islands of Seychelles*. 30th March 2012.

[129] Aronson, J., Floret, C., Le Floc'h, E., Ovalle, C. and Pontanier, R. 1993. Restoration and Rehabilitation of Degraded Ecosystems in Arid and Semi-Arid Lands. I. A View from the South. Society for Ecological Restoration.

the functional connectivity of the targeted ecosystems will be ensured;	result from a variety of causes including biotic and abiotic interactions, natural disturbances, and patterns of human activities and stressors, and such heterogeneity, will have profound consequences on species distributions and ecological processes. Thresholds of habitat availability appear to occur, with habitat becoming either connected or disconnected at some unknown threshold of habitat abundance. Resource managers should therefore manage the entire land/seascape mosaic, which offers an effective means of preserving connectivity. Functional connectivity defines how the structure of the land/seascape interacts with the properties of organisms, disturbances, or materials to influence how they move[130]. Therefore ecological integrity can be improved through the improvement of functional connectivity – that is as long as there is opportunity for different ecosystems to interact across the land/seascape, it will be beneficial to the ecosystems. Devisscher (2010)[131] notes that rehabilitation across a mosaic of ecosystems (larger scale) can further achieve enhancement of services. Rehabilitating mosaics of inter-connected ecosystems can ensure that if some very degraded areas are only slowly recovering, other functioning ecosystems will provide services and structure to build on. Therefore, rehabilitation can be improved by harnessing positive interactions between ecosystems that stabilize community dynamics, ecosystem functions, and the structure of neighboring ecosystems. Halpern et. al. (2007)[132] argue that by broadening the scale of intervention through the spatial arrangement of ecosystems these positive interactions can be optimized. The project applies this principle, seeking to combine rehabilitation of different environments (tidal wetlands/ reefs/ dunes/forests) to reduce the flooding risk in coastal flooding hotspots and increase the water provisioning services. The intention is to rehabilitate degraded areas within larger environments—thus enhancing overall ecosystem functioning through enhancing functional connectivity of the ecosystems. Enhanced ecosystem services from a wetland, for example absorbing nutrients from agricultural land, will have a beneficial effect of coral growth. Defining the scale of functional connectivity is very difficult and depends on specific species. Results indicate that the scale (average distance) of dispersal of coral larvae in the Pacific for example is in the order of 50 – 150 km. [133] More conservative estimates of scale were used in the proposal with direct connectivity e.g within watershed or coastal bay. Functional connectivity in the proposed project will be ensured through improvements to hydrological systems and tidal exchange, maintaining forest cover integrity and hydrological balance, and expanding the area and density of coral reefs. The *watershed connectivity* (Component 1) is based on greater forest landscape integrity, more vegetated barriers to rainfall runoff and a more balanced flow regime that enhances ecosystem functions and productivity while reducing runoff and sedimentation rates. The *coastal connectivity* (Component 2) is based on intervening in the gradual loss of freshwater inputs into the lowland wetlands by enhancing stream flow and habitat conditions (including reduced sedimentation), increased wetland revegetation and rehydration, and rehabilitation or enhancing tidal flushing over the wetlands, as well as increasing the area and density of the fringing coral reef. The following was added to the Project Proposal to describe more clearly the way functional connectivity of targeted ecosystems will be ensured and integrated into the project strategy and the different outputs: These are joint EbA measures aimed at **strengthening the functional connectivity of ecosystems** by (a) maintaining essential *hydrological and inter-tidal processes* that support ecosystems, (b) maintaining the integrity and contiguity of forest landscapes with plants species that are suited to improving *watershed processes*, including runoff/infiltration and fire prevention, and (c) enhancing the *functional and spatial linkages* between ecosystem types – wetlands, forests, beach berms, reefs and their specific roles in providing for water supply and/or flood attenuation amidst the surrounding development pressures in the landscape. Functional connectivity will be addressed in Component 1 by enhancing the vegetated groundcover and the watercourses that effect both ecosystem functions and hydrological

[130] Grober-Dunsmore, R,; Pittman, S.J.; Caldaw, C.; Kendall, M.S. and Frazer, T.K. 2009. A Landscape Ecology Approach for the Study of Ecological Connectivity Across Tropical Marine Seascapes. In Nagelkerken, I. (ed.) *Ecological Connectivity among Tropical Coastal Ecosystems*.

[131] Devisscher, T. 2010. *Ecosystem-based Adaptation in Africa. Rational, Pathways, and Cost Estimates*. Sectoral Report for the AdaptCost Study. Stockholm Environment Institute.

[132] Halpern, B.S., Silliman, B.R., Olden, J.D., Bruno, J.P. & Bertness, M.D. 2007. *Incorporating Positive Interactions in Aquatic Restoration and Conservation.* Front. Ecol. Environ. 2007:5(3):153 – 160.

[133] Treml, E.A.; Halpin, P.N.; Urban, D.L. and Pratson, L.F. 2008. *Modelling population connectivity by ocean currents, a graph-theoretic approach for marine conservation.* Landscape Ecology 23: 19 – 36.

	processes, and thereby the landscape connectivity of the targeted watersheds. The outputs from a habitat perspective will include revegetated wetlands and forest stands with altered species mix and forest canopy that increase watershed landscape integrity. In Component 2, this connectivity will be addressed by enhancing the stream channels and flows necessary to maintain effective wetlands, expanding the wetland and shoreline berm vegetation, improving tidal influence on wetlands at Anse Royale and NE Point and endeavoring to expand the fringing reef at NE Point. The outputs from a habitat perspective will include revegetated riparian stream sides, revegetated or restored wetland areas, intertidal complexes due to greater tidal exchange, revegetated beach berm areas and an expanded coral reef." [Project Proposal, p. 12]. Specific outputs that will ensure the functional connectivity of targeted ecosystems are: 1.1 Management and rehabilitation of critical watersheds to enhance functional connectivity and the resilience of these areas to climate change and reduce water scarcity and water flooding [Project Proposal, p. 20] 2.1. Ecosystem based measures for flood protection on an urban shoreline 2.1.1. Integrated Shoreline Management Plan [Project Proposal, p. 29] 2.2. Ecosystem based measures for flood protection and mitigating salt water intrusion in an agricultural and tourism development area 2.2.1. Integrated Shoreline Management Plan [Project Proposal, p. 30]
Provided the proponent decides to go further with the output related to establishing a payment for ecosystem services (PES) scheme through the project, much more detail is needed on the basis of such scheme, the seller-buyer model, the stakeholders and the existing policy framework and enabling environment in general, to implement it.	The following text was added to explain the financing mechanisms to be pursued by the project: "Options for cost recovery for maintaining 'watershed services' to ensure raw water supply will be pursued through a review of alternative financing mechanisms and selected initiatives to increase funding for watershed rehabilitation and management in Seychelles, drawing upon *Payment of Ecosystem Services* experiences internationally. The project will pursue a modified payment for watershed services approach that seeks to recover the ongoing costs of watershed management from water supply customers and other potential funding sources. The approach is based on the typical watershed services financing model that has been described as "an integrated supply-demand user pay tool to buy conservation and to generate sustainable funding".[134] The premise for watershed services compensation is that a *positive externality* exists where upland users/owners are providing a benefit to downstream users/beneficiaries that are also willing to pay for such services. In this case, the PUC, the National Parks Authority and community watershed committees can be viewed as 'sellers' of water supply services to PUC customers. There are many examples of water service fees (based on volumes or flat fees) providing funding for watershed protection and rehabilitation. The current 'environmental charges' on PUC bills are not directly linked to catchment area management programmes or to the actual costs of maintaining quality raw water supply."

[134] Wunder Sven, *Necessary Conditions for Ecosystem Service Payments*, in Economics and Conservation in the Tropic, Conference Proceedings, 2008, p.7

Annex 11: Comments and Response Matrix on the Adaptation Fund Board Secretariat Technical Review of Full Proposal

Comment May 14, 2012	Response and Comments on May 30, 2012
CR1: To ensure the success of this output, a strong engagement of private farmers is expected. Please demonstrate that such engagement has been secured. Otherwise, and this relates to the point made in CR2 below, please explain what alternative option will be considered during project implementation.	Component 2 will involve rehabilitation of streams and wetlands in the coastal plateau around Anse Royale to improve hydrology, ecosystem functions and flood management. This also provides an opportunity to develop small scale agricultural water supply in selected tributaries of the lower Mont Plaisir River. Upland soil and water conservation measures will be needed in these small streams to reduce the runoff and sedimentation which has adversely affected the lower stream reaches in the floodplain. As an added value to stream and wetland rehabilitation (Output 2.2.2), within an overall management plan for the lower river, a small reservoir could be developed to also address the local priority of climate-related salt water intrusion on agricultural lands and the lack of fresh water to dilute the seasonal increases in salinity (Output 2.2.4). Addressing the water shortage problem alongside the ecosystem rehabilitation objectives will help to generate local support for a more comprehensive approach to water management in the lower Plaisir River area. Following consultations with local farmers and with Seychelles Agricultural Agency, a modest budget ($170,000) has been proposed to assist in addressing the local issue of severe water shortages for the agricultural sector during the dry season. There are only 10-15 commercial farmers in this area but they are important to the vegetable supply in the country. Preliminary discussions with local farmers indicated that they are willing to contribute toward a solution. The concept is that the project would assist water availability/storage on the hillside (in conjunction with works for Output 2.2.2) while water distribution and on-farm measures would be provided by the farmers themselves. There are various agronomic and water harvesting/management methods that can be introduced to reduce the salinization effects. Ideally, a local agricultural water management group should be established by the farmers under the direction of SAA. The issue is so severe for local farmers that the commitment and conditionality are not considered barriers to implementation, although the costs and viability of this sub-component still need to be assessed. *[AFSec: Addressed]*
CR2: Also, it is not clear under Output 1.1, what actual activities on the ground will be carried out in the different watersheds. There is repeated use of the expressions that do not shed any light as of what will be done on the ground. Some of these are *"strategic ecosystem-based water resource adaptation assessment"*, "*Activities will include hydrological assessment and rehabilitation objectives*, *"Specific ecosystem-based*	The potential activities will include: a) Desilting, erosion control and selective replanting measures at existing water supply barrages to increase water holding capacity; b) Designation, demarcation and protection of existing upland wetlands that play an important role in watershed management; c) Excavation, land contouring, drainage controls and replanting at selected wetlands to increase water holding capacity (with or without outlet control gates); d) Soil and water conservation and replanting of burned, logged and other degraded lands; e) Soil and water conservation and replanting of selected forest sites with high soil erodability and runoff rates; f) Drainage controls and bioengineering treatments of wastewater discharges from livestock operations in the Baie Lazare River watershed to improve nonpoint water quality from agricultural runoff; g) Selective removal of alien invasive species and replacement with indigenous species with appropriate ground cover; h) Application of 'sustainable forest harvesting guidelines' (various soil stabilization and runoff control measures) at active logging or silviculture sites where they may occur (currently little or no logging operations).[135]

[135] These guidelines are intended to assist forest hydrology by:
- Managing harvest openings (cut blocks) and methods to minimize overall effects on rainfall runoff and on fire hazards;
- Establishing rainfall runoff controls with identified fire breaks;
- Protecting streams and wetlands from disturbance of riparian areas by forestry activities;
- Protecting endemic and indigenous plant species that enhance ground cover;
- Specifying stream crossing standards and rules for working in and around watercourses;
- Specifying fire prevention and suppression measures;
- Specifying management of harvest debris to maximize rainfall infiltration;
- Defining the requirements for post-harvest rehabilitation and forest regeneration;

adaptation measures will include restoring the natural processes of wetlands and assisting the natural rehabilitation of degraded areas" (a circular argument), "*enhance their storage capacity -of upland valleys* " (how do you do that?), *"sustainable harvesting guidelines*" (what and where?), "*reforestation measures...*" (in the same paragraph as "harvesting guidelines") (planting or cutting trees?), *"restoring and rehabilitating the wetlands*" (how?), etc. Please describe more clearly the activities that will be carried out on the ground. It is not clear if this is about planting or cutting trees, where and how.	'Soil and water conservation measures' include those recommended in the *National Action Plan for Sustainable Land Management,* including a wide variety of techniques to capture rainwater, prevent or contain runoff and sedimentation, and re-establish soil stability and vegetation cover, such as gully plugs to halt gully formation at the top of the hills; staggered (or continuous on lower slopes) trenches to capture rainfall on the height of land, check dams and vegetated barriers on minor drainage lines, informal terracing/contour bunding to control runoff and grass seeding or cover crops to stabilize soils in short term, planting native trees in crescent pits and trenches, farm pond to assist irrigation of seedlings, and mulch and green manure to reduce moisture loss and enhance soil fertility. The overall strategy is to identify and exploit the EbA opportunities to: ▪ increase upland wetland storage of water; ▪ modify forest stands and canopy at strategic locations; ▪ enhance vegetation ground cover and related soil and water conservation controls; ▪ improve and expand in-stream and off-channel water control structures that detain or store flow; ▪ reduce uncontrolled drainage and sediment inputs at key sites (rural, agricultural, urban); and ▪ better manage the competition for water abstractions and disturbances to the PUC water barrages. Please note that there is no field survey information on the watershed landscapes and stream channels that provide for raw water supply. An initial watershed assessment is proposed to determine the appropriate set of cost-effective interventions in each watershed based on the methods listed above. The activities were described more clearly on pages 24, 25 and 26. *[AFSec: Not addressed: The necessary field surveys need to be carried out in the target watersheds in order to assess the current level of targeted ecosystem services, through the measurement of different parameters (level of vegetation cover, soil erosion etc). This will help to determine the appropriate interventions that will take effect in each watershed]*
CR3: Under Output 1.2, it is not clear how the "management of watersheds to enhance functional connectivity and the resilience of these areas to climate change and reduce water scarcity" will be achieved with activities such as "local watershed committee and related community consultation", "water use assessment and rationalization of abstractions ", "watershed management plans", "monitoring and evaluation reports".	Developing the awareness and commitment of local landowners along with the institutional capacity is critical to improving water management for water supply resilience to climate change in Seychelles. Involving stakeholders, appropriate forms of property rights and institutional capacity are some requisites for sustainable management of ecosystems[136]. The many dispersed water systems and catchment areas, the poorly regulated water withdrawals, the lack of understanding of downstream effects of land use and farming practices and the gradual uphill migration of development are key barriers to addressing the climate change risks. Improved and negotiated management arrangements will lead to better managed natural resources and more productive agricultural landscapes. This is based on local empowerment and facilitates locally driven informal and formal decision making structures. A recent survey for example found 39 unauthorized connections on Baie Lazure River and 21 on the adjacent Dame Le Roi River. This is simply not sustainable and undermines any effort to expand infrastructure or to promote water use efficiency. Public neglect of these watersheds is a major problem. Clarity on tenure and governance arrangements will be increasingly important in a changing climate, when the likelihood of conflict over scarce resources, undermined by e.g. floods and droughts, could increase. Infrastructure and ecosystem enhancement/ rehabilitation may in themselves be secondary to the broader objective of establishing an ecosystem-based, watershed scale approach that is supported by communities and the emerging district authorities. Currently, access to stream water is a 'free for all', essentially unmanaged despite the efforts of PUC to protect the raw water supplies upon which they depend but have little authority and few resources to control. The support of communities and landowners is essential to developing climate resilient water systems and a culture of local stewardship toward watershed management. Local watershed management plans will be critical in enhancing functional mconnectivity and

[136] Andrade Perez, A., Herrera Fernandez, B. and Cazzola Gatti, R. (Eds.) Building resilience to Climate Change: Ecosystem-based adaptation and lessons learned from the field. IUCN, Gland, Switzerland.

	increasing resilience. The management plans will address objectives relevant to EbA, e.g. conserving genetic material, maintaining diverse landscapes, and respecting different practices for land-use, conservation of natural resources, ecosystem–scale management and water source protection. The following principles[137] will be used to address ecosystem resilience and functional connectivity within the management plans: (i) Maintain and create large, structurally complex patches of forest vegetation, and maintain small areas of native vegetation keystone structures; (ii) Maintain structural complexity throughout the landscape, and mimic the matrix of natural vegetation patterns, (iii) Maintain or create corridors or stepping stones to improve connectivity; (iv) Maintain landscape scale heterogeneity and capture environmental gradients, and keep spatial patchiness and landscape pattern variability, including in highly productive, fertile soils; (v) Maintain key species interactions and functional diversity by identifying keystone species and key seed dispersal agents; (vi) Apply appropriate disturbance regimes (e.g. hydrological flow regimes); (vii) Control aggressive, over-abundant, process-altering and structure-altering and invasive species; and (viii) Minimize threatening ecosystem-specific processes (e.g., chemical pollution, over-hunting). Support will be provided to the implementation of certain elements of the management plans. As in any adaptive process, monitoring and evaluation is very important in order to evaluate successes and failures and support will be provided by the project in this endeavor. *[AFSec: Not addressed. Once activities are selected (based on the field survey) please articulate how these activities allow achieving the "management of watersheds to enhance functional connectivity and the resilience to these areas to climate change and reduce water scarcity" In addition, activities under output 1.2 are implemented at the watershed level and do not include the supra-local coordination level that is needed to monitor and assess that this functionality is enhanced. See also comment on CR4 below.]*
CR4: Finally, due to the uncertainties related to the outcomes of the hydrological studies and EIAs that will be needed before deciding on the implementation of many of the project activities, the proposal should show a strong adaptive management system in its governance, which generally includes a strong monitoring component, which is currently lacking in the document.	Given the technical rigor that will be required to finalize and to supervise the interventions, the Project Implementation Team structure has been designed to ensure an effective adaptive management and M&E system. This implementation structure involves much greater operational support and oversight than normally applied to international projects in Seychelles. The PIT contractor will be responsible for field-based management of the activities and technical guidance on the work plan specifications and quality of the work implemented. It will have the primary duty, firstly, to ensure that the interventions are well designed and appropriate for the site context and designed on an 'adaptive environmental management' basis where opportunities exist to maximize the lessons that can be drawn from implementation; and secondly, to ensure that the field implementation is operating effectively, on time and budget, and adjusting the work as necessary to address implementation issues as they arise. The uncertainties, as noted in the risk management section, are well within the scope of manageability and involve three key issues: a) policy and technical issues related to the scale and type of water supply development options within the National Park (as suggested in Water Dev Plan) and the manner in which wetland attributes can be sustained within the design and operational parameters of any proposed water storage or flow regulation structures; these are very small flows and may not in fact impose tradeoffs within the wetland ecosystems of Mare aux Couchons that occur upstream of potential sites; indeed wetland values may well be enhanced since this area appears to be in rapid succession toward mixed forest status; b) Some technical uncertainties related to the specific mix of native species and appropriate planting protocols for replacement of alien invasive plant species with native species, aimed at improving the control and retention of overland runoff and the associated use of soil and water conservation measures in conjunction with the vegetative barriers; further technical discussion and pilot testing of specific prescriptions will be required. c) The lack of experience in Seychelles with submerged breakwaters and the related limited experience with natural recolonization of coral species on fringing reefs that is expected to be facilitated by the reef clean-up and the proposed structure at NE Point.

[137] Fischer, J., et al., 2006. Biodiversity, Ecosystem Function, and Resilience: Ten Guiding Principles for Commodity Production Landscapes. *Frontiers in Ecology & the Environment*, *4*(2), 80-86.

	These issues are fully recognized and have been further highlighted in the M&E system that is proposed for the project. The proposed interventions are considered to be relatively less risky than the no works option. Local community participation, support for the EIA process and an M&E framework (a requirement of EIA) are in the Project design and costings. Stakeholders in the April Project validation workshop indicated acceptance of these checks and balances for interventions that have some inherent risk. The project work planning process under the Project Implementation Team and the EIA process will address these risks in conjunction with a strong adaptive management governance system. Public consultation through public meetings and public review of documents is required under the law. The following was added to Part III, B: Key risks underlying the project have been analyzed during the formulation phase in connection with the target sites of the project. Over the course of the project, a UNDP risk log will be regularly updated in intervals of no less than every six months in which critical risks to the project have been identified. The risks facing the project and the risk mitigation strategy (countermeasures) are summarized below: A comprehensive risk management strategy will be a core component of project management activities. This is in line with UNDP's stringent risk management approach which is corporate policy. The respective UNDP CO provides support to the project team and executing agency for constant and consistent risk monitoring, and the results are tracked and reported in UNDP's internal risk monitoring system. Risks will be entered into the UNDP's Atlas (project management system) and will be systematically monitored as part of the M&E process by UNDP staff carrying out their oversight related tasks. The results are also reported in the yearly evaluation undertaken for each project. In addition to this, and again in keeping with UNDP practice, a dedicated budget line exists for Monitoring and Evaluation (M&E), to ensure that the necessary resources are allocated to execute the M&E framework. The following was added to Part III, C: **Monitoring Strategy** **(1) Project monitoring and reporting** A monitoring plan will be prepared during the inception phase that how, who and when monitoring of activities and Results Framework Indicators will occur including responsibilities for data collection, compilation and reporting by the project staff. Monthly, quarterly and annual reporting systems will accord with AF, UNDP and Government of Seychelles requirements. The oversight of this monitoring and reporting will be integrated with the management responsibilities as set out in the Project Organisation to meet the adaptive management expectations and standards of UNDP. Given the technical rigor that will be required to finalize and to supervise the interventions, the **Project Implementation Team** (PIT) has been designed to ensure an effective adaptive management and M&E system. This implementation structure involves much greater operational support and oversight than normally applied to international projects in Seychelles. The PIT contractor will be responsible for field-based management of the activities and technical guidance on the work plan specifications and quality of the work implemented. It will have the primary duty, firstly, to ensure that the interventions are well designed and appropriate for the site context and designed on an *'adaptive environmental management'* basis where opportunities exist to maximize the lessons that can be drawn from implementation; and secondly, to ensure that the field implementation is operating effectively, on time and budget, and adjusting the work as necessary to address implementation issues as they arise. The Project Implementation Team is intended to provide technical and field level supervision of the detailed specifications and implementation of the various project activities. This is an investment in project delivery which is expected to provide enhanced quality assurance. It is proposed in light of the limited experience in watershed management and water management in general and uncertainties in the optimum forest rehabilitation prescriptions that can best contribute toward watershed management. Careful assessment and design will be needed along with some level of pilot testing and refinement of the EbA measures. This approach of an

	implementation team also seeks to bridge the current gap between government and NGOs in mobilizing national action on EbA measures. It is intended as a mechanism for enhanced working partnerships between government staff and civil society groups. The PIT is a means for ensuring both effective results in the Project Activities and effective partnerships and synergies between government/PUC, Activity Contractors and the community participants. It should complement and facilitate the functions of the Project Manager, to which it will report. The Project Implementation Team will be organized and guided by a managing contractor with expertise in watershed, wetland and related water and coastal management fields to be appointed through a competitive bidding process. The PIT will focus on two process outcomes: ▪ Technical and environmental quality assurance in the implementation of individual Activity Contractors; and ▪ Effective communication and collaboration between government, communities and Activity Contractors. **(2) Adaptive environmental management of strategic issues** In order to address certain risk management and knowledge development objectives, it is proposed to adopt an "adaptive environmental management" approach to implementing some of the activities, under the supervision of the PIT. Adaptive environmental management is about 'learning by doing' using scientific methods in a systematic way to identify, test and refine environmental interventions and the assumptions associated with them, and adapting the interventions based on experiences.[138] There are two proposed project activities that lend themselves to this type of intensive, structured, scientific assessment of current uncertainties and potential effects: ▪ **Forest replantation for hydrological and biodiversity objectives**. The effects of different forest plant species and management strategies on hydrological systems and the appropriate protocols for replacement of alien invasive plant species with native species need to be better understood, aimed at improving the control and retention of overland runoff and the associated use of soil and water conservation measures in conjunction with the vegetative barriers and other methods. A structured, randomized control trial approach to monitoring and learning from alternative interventions to address this problem could be designed into the project watershed programmes. The parameters that require further consideration in the forest rehabilitation prescriptions could include: i) forest species mix particularly with regard to canopy height and density, ii) ground cover water holding capacity, iii) water consumption rates of selected species to be removed and planted, and iv) understory forest fire fuel characteristics under different replanting protocols. ▪ **Coral reef restoration for flood protection and biodiversity objectives.** The effects of reef rehabilitation methods on coral populations and density including lessons from a proposed submerged barrier should be part of the technical components of the project monitoring plan. Comparative monitoring and assessment of different methods of restoring degraded coral reefs and the testing and refinement of assumptions related to natural recolonization of submerged structures could provide important information for future climate change adaptation strategies in Seychelles. *[AFSec: Partially addressed. Apart from the project monitoring system, and to ensure the achievement of the project objective beyond its lifetime, the project should help put in place a national monitoring system, including a ―functional connectivity‖ monitoring system in order to assess the effectiveness of the project interventions in the long-term and to ensure an adaptive management of the watershed systems. Such monitoring system entails investments and training in monitoring tools such as GIS, on-the-ground measurement methods, environmental*

[138] See for example, *Open Standards for the Practice of Conservation, Version 2.0.*, 2007, www.conservationmeasures.org;

<table>
<tr><td></td><td>planning tools etc, and the monitoring of key indicators and long-term collection of key data that will be identified through the project. This can be complemented by additional rigorous scientific studies and modeling where necessary. The system should be developed by the project implementation team, in conjunction with the MEE, PUC, the University of Seychelles, relevant partner NGOs, the local watershed committees and the Rivers committee. It should be institutionalized and operational by the end of the project. Its sustainable financing can be assessed along with the options that will be explored under output 3.1.3.]</td></tr>
<tr><td>CR5: Please elaborate on the environmental safeguards that will be put throughout the project outputs' timeline in order to avoid any functional disturbance of the ecosystem, with disastrous effects in the vulnerable communities.</td><td>The following was added to Part II, E: <u>The environmental safeguards include:</u>
- <u>a Project Implementation Team that have the technical skills to design interventions and workplans consistent with international environmental management standards and good practices to avoid or mitigate the adverse effects of stream control structures and in-stream works;</u>
- <u>EIA requirements, review procedures and approval conditions for any major structures as required by Seychelles law;</u>
- <u>An 'adaptive environmental management approach' to the proposed reef rehabilitation and reforestation measures that involves careful, science-based design and oversight of the two elements any technical uncertainties – particularly (a) the proposed submerged breakwater, and (b) the replantation of alien invasive forest species with native species, through the development and implementation of a monitoring and learning plan that will maximize knowledge outputs from these activities</u>.
There is absolutely no potential for risks that could lead to "disastrous effects in vulnerable communities". Domestic water supply sources are highly dispersed and under-managed with little community involvement. The project will be strengthening the water supply systems and will not be undertaking large scale dismantling or alteration of the existing water supply systems or introducing any non-conventional approaches to watershed management. The proposed interventions are relatively small scale and well proven, with the possible exception of the proposed submerged breakwater at NE Point which is new in Seychelles. The project targets specific opportunities that have been discussed at some length and that will receive further scrutiny during the implementation process with PIT, PUC and other technical reviewers in an effort to select and implement practical measures to strengthen and enhance watershed and coastal management at priority sites under climate change stress.

[AFSec: Addressed]</td></tr>
<tr><td>CAR1: Please provide a table showing the complementarity of this project with the investment and policy activities that will be implemented through the Water Development Plan 2008-2020.</td><td>The following was added to Part II,F:
<u>The Seychelles Water Development Plan focuses on water supply infrastructure and demand side management, rather than the watershed management of raw water sources themselves. However, there are several areas of complementarity, summarized as follows:</u>
<table>
<tr><th>Water Development Plan</th><th>AF EbA Proposal</th></tr>
<tr><td>Recommends Integrated River Basin management:
- "The current Rivers Committee should act at a strategic level setting policy and ensuring that the actions required are implemented
- All the stakeholders should be engaged in the process of improving the current situation and setting goals for the future
- Setting-up of a small enforcement team by the Min of Environment to monitor and control the various aspects of IRBM"</td><td>The project proposes to strengthen the institutional capacity for watershed management in the project watersheds, and to develop national policy on watershed management through a re-activated River Committee. See Output 3.1.
It also proposes to set up local watershed committees in the project watersheds to promote local engagement in stewardship of the water resources.
The project also proposes to implement enforcement action through rationalization of water abstractions in the project watersheds.</td></tr>
<tr><td>The Plan recommends;
"the preparation of Drinking Water</td><td>The project proposes to identify and designate "water supply protection zones"</td></tr>
</table></td></tr>
</table>

	<table><tr><td>Safety Plans to minimize contamination of water sources, reduce or remove contamination by using appropriate treatment and to prevent contamination as the water passes through the distribution system to the point of supply (p. 81). “</td><td>that can be implemented through updated river reserves legislation, aimed at protecting the quality of raw water at source. It also proposes to address a water quality problem related to agricultural wastewater drainage in Baie Lazure watershed.</td></tr><tr><td>The Plan recommends “increasing the storage capacities of supply zones by construction of new reservoirs.”</td><td>The project proposes to increase the water holding capacity within the project watersheds through EbA and other small scale engineering and rehabilitation of existing barrages on the river systems.</td></tr></table> *[AFSec: Addressed]*
CAR2: Please include a list with the names of the stakeholders that were consulted and the date of consultation, not does it specify if vulnerable groups were consulted and gender taken into account.	The minutes of the two project planning workshops and list of stakeholders (with dates of meetings) has been included in Annex 4. The following was added to Part II, H: More than 21,000 water users reside in the proposed project areas. ‘Vulnerable groups’ could include lower income residents amongst these users particularly those who depend solely on stream sources. Some residents were informally consulted during the field visits, and the community water systems with priority concerns have been selected based on advice from PUC. However, it is generally not possible to distinguish a vulnerable sub-group within the potential water supply and flood management beneficiaries. Gender equality is well integrated within the Seychellois society. Gender equality will be addressed in the project by (a) improving water supply and reducing the household burdens imposed on women during periods of drought, (b) ensuring equal opportunity for women and men to participate on local watershed committees, and (c) promoting gender balance in the proposed training programme. A recent study (2011), undertaken by Plan International and the Royal Commonwealth Society, ranked Seychelles high on gender equality (fifth highest among the 54 Commonwealth member countries). Based on this ranking, it is assured that both men and women are well represented by government representatives and NGO representatives. The attendance of planning meetings as well as individual meetings was well represented by both genders (20% of the first workshop attendees and 30% of the second were women). *[AFSec: Addressed]*
CR6: What is the “no-regret” scenario for this project, given the risk that feasibility studies can show that some of the interventions may lead to negative environmental, including hydrological, impacts?	There is no evidence or expectation that the project interventions will lead to negative environmental effects that cannot be mitigated. Rather, the project will help to resolve key policy and technical issues related to water supply development and the appropriate, cost-effective ecosystem interventions that can facilitate water availability and flood protection alongside biodiversity conservation. There are uncertainties about the reforestation prescriptions and the effectiveness of coral reef restoration but these will be managed through careful site design. The main uncertainties relate to costs and whether detailed activity planning may reduce the scale of the interventions. The opportunity costs of not intervening to address the climate change risks in Seychelles and the development of a new EbA approach to watershed and coastal management, regardless of the success of specific technologies that are generated, are part of the “no regret” scenario. There is a wide array of watershed rehabilitation measures that can be used as alternatives if some of the proposed interventions are deemed to be financially unviable or otherwise unacceptable (e.g., water supply development in the national park). The specific interventions will be custom-designed for each watershed from a menu of biological and engineering options to control runoff and to increase rainfall infiltration. The opportunity costs of doing nothing or awaiting absolute certainty about intervention strategies are significant in the case of Seychelles’ water supply. Part of the ‘no-regrets’ scenario includes the knowledge that will be gained from determining, for example, the efficacy of removing alien forest species and the combinations of water management and vegetative controls that can best influence runoff and sedimentation rates. Even if the dry season minimum flow and other targets are not met, the project will still have contributed toward more sustainable watershed and coastal management.

	[AFSec: Addressed]
CR7: Also, there is a risk related to the costs of the proposed measures, which may be higher than expected.	Thank you for pointing out this important aspect. We have added a new risk item in the risk matrix in Part III, B, Table 10. This risk is considered low/ medium as the cost estimates have been compared with similar activities in other projects and are in the realm of viability based on international and national experiences. As mitigation measures, the MEE (including the Project Management Unit) and UNDP will provide permanent support for the contracting, monitoring and financial reporting in order to determine spending levels versus achievement against the results framework. The project will also strengthen the institutional basis for accessing public and private sources of Climate Change finance for EbA approaches in the future to attract additional funding. The key strategy is to internalize management in the public works programmes and forest management in Seychelles, and the necessary recurrent costs should be brokered. The scale of interventions can also be reduced if additional funds cannot be raised in time. *[AFSec: Addressed]*
CAR3: Please note that the project inception workshop date, which is considered as the date of project start by the AF, is different from the date of the agreement signature. Therefore, please revise the dates of second disbursement and onwards.	The date for agreement signature was revised to August 2012, and the start of project implementation to October 2012. The dates of second disbursement and onwards were corrected as well as the Projected Calendar table updated. *[AFSec: Addressed]*

Annex 12: Comments and Response Matrix on the Observations made by the Adaptation Fund Board on the Full Project Proposal dated June 2012

Point for Clarification	Response
Field surveys need to be carried out in the target watersheds in order to assess the current level of the targeted ecosystem services, through the measurement of different parameters, inter alia, levels of vegetation cover and soil erosion, species diversity, current soil water retention capacity etc. This would help to determine the appropriate interventions that will take effect in each watershed.	Field surveys to the targeted watersheds were conducted twice, first by the team of consultants that developed the project proposal and the secondly by an interdisciplinary team assembled by Government to assess the needs of the watersheds based on the Adaptation Fund Board's comments. The consultant team visited all the watersheds during the period 22 February – 8 March 2012 and developed the basic set of interventions for the first submission of the proposal. The watersheds and suggested interventions by consultant team, led by Alan Ferguson, are described in the report *"Ferguson, A. 2012. Watershed Management Technical Report for preparation of Adaptation Fund Proposal: Ecosystem Based Adaptation to Climate Change in Seychelles. UNDP Seychelles."* An interdisciplinary team comprising of water management; environmental management; protected area management and ecology experts with national and international experience was constituted by the Government of Seychelles to further investigate the watersheds and conduct the needed surveys and their findings were articulated in a Report *"Watershed Needs Assessment of the targeted Watersheds for the Adaptation Fund Proposal"*. The team first conducted an intensive literature review; collating all information and data on the targeted watersheds. Various reports and studies have been conducted in regards to Seychelles' forests, its management and the influence of IAS on the forests. These include *"Indufor, 1993. Seychelles Forest Management Plan/Sector Study. Division of Environment, Ministry of Environment, Economic Planning and External Relations."*; "*Schumacher, E.; Kueffer, C.; Edwards, P. & Dietz, H. 2009. Influence of light and nutrient conditions on seedling growth of native and invasive trees in Seychelles. Biol. Invas. 11"*; *"Kueffer, C.; Schumacher, E.; Fleischmann, K.; Edwards, P.J. & Dietz, H. 2007. Strong below-ground competition shapes tree regeneration in invasive Cinnamomum verum forests. J. Ecol. 95", "Unique Forestry and Land Use. 2012. Strategy for sustainable forest management and guidelines for forestry practice with special regard to: Morne Seychellois National Park and sustainable use of forests on the main Islands. GoS/UNDP.", "Senterre, B. 2009. Distribution and Determinants of Forest Fires and Land Degradation on Praslin, Seychelles. Plant Conservation Group", "Senterre, B. 2009. Forest Fire Risk Assessment on Seychelles Main Granitic Islands. GoS-UNDP-GEF Capacity Development for Sustainable Land Management (SLM) project", "Murtland, R. 2009. Rehabilitation of Post Fire Degraded Lands in the Seychelles. Mission Report. GoS-UNDP-GEF Capacity Development for Sustainable Land Management (SLM) project", "Senterre, B., Lesperance, M., Bunce, S., Henriette, E., Jean-Baptiste, M. & Laboudallon, V. 2012. Implementation of Post Fire Rehabilitation Trails on the Island of praslin, Seychelles. Consultancy Report. Terrestrial Restoration Action Society of Seychelles (TRASS). Ministry of Environment-UNDP-GEF project", "Joseph, M. P., Samson, P. & Mondon, J. 2011. Compilation of Information in view of Developing a Geological Risk Map of the Islands of Mahe, Praslin and La Digue. SLM Project, Gos_UNDP-GEF", "Fleischmann, K. 1997. Invasion of alien woody plants on the islands of Mahe and Silhouette, Seychelles. Journal of Vegetation Science, Volume 8, Issue 1.","Kueffer, C. And Vos. P. 2003. Woody Invasive Species: A regional assessment. Regional Workshop on Invasive Alien Species and Terrestrial Ecosystem Rehabilitation for Western Indian Ocean Island States. Workshop proceedings. 13 – 17 October 2003", "Kueffer, C., Vos, P., Lavergne, C. And Mauremootoo, J. 2004. Case studies on the status of invasive woody plant species in the Western Indian Ocean. 1. Synthesis. FAO Forest Health & Biosecurity Working Papers. FAO, Rome, Italy" and "Kueffer, C. And Vos, P. 2004. Case studies on the status of invasive woody species in the Western Indian Ocean. 5. Seychelles. FAO Forest Health & Biosecurity Working Papers. FAO, Rome, Italy"*. A Coastal Environmental GIS-based Resource Mapping[139] was published in 2011 in which vegetation classes and soil types were noted. This information was transferred onto the most recent orthophotos available to establish current vegetation and soil categorisation classes in the targeted watersheds. Field surveys were then conducted to all the watersheds between the 6th and the 13th of August 2012. The vegetation classes were ground-truthed by the team in the field and level of degradation, level of invasiveness by large woody IAS; wetland functioning and percentage of forest cover recorded. Selection of site interventions was based on the following

[139] Department of Environment, 2011. *Coastal Environmental GIS-Based Resource Mapping*. European Union, through Indian Ocean Commission under the ReCoMap project, Ministry of Home Affairs, Environment, Transport and Energy.

	criteria: i) Levels of degradation of natural resources which influenced the natural functioning of ecosystems regarding water provision and watershed flooding; (ii) Information available regarding the impacts of certain elements in the watersheds. For example, no information was available on the impact of roads on ecosystem functioning, and the role it plays in watershed flooding, although it is assumed it must have a major impact, the intervention was not further investigated; (iii) Practical experience regarding the technology to address the degradation and its cost-effectiveness in Seychelles. A number of local residents were also interviewed during the field surveys to better understand the dynamics of the watersheds. The interventions were also discussed in detail with Government officials (Didier Dogley, Technical Advisor to the Minister) and with researchers (Dr Christopher Kaiser-Bunbury – scientist specialising on invasive species impact on the Seychelles Forests). From the basis of the field surveys, it was decided that the most effective measures to reduce water scarcity and watershed flooding will be to invest in the following interventions: i) Rehabilitation of forest heavily invaded by IAS through selective removal of IAS and replanting with native species – this intervention will lead to increase water provision as the IAS of the targeted forests have far higher biomass and growth rate that native species and to a reduction of watershed flooding as native vegetation are denser and undergrowth under trees are common; and ii) Rehabilitation of the two degraded wetlands that will reduce watershed flooding (through flood conveyance and flood storage) and water scarcity (improved water quality and water supply); iii) Rehabilitation of fire-degraded areas in watershed on Praslin that will reduce water flooding (through increased vegetative cover and barriers to runoff) and water scarcity (by improving soil-water infiltration rate resulting in slower release of water and increasing river base flows in the dry season). The project was therefore designed with the best possible information available, and the ground truthing of the information. Little information is available of individual IAS tree species influence on water balance versus that of native species, but the project is developed to address the impact of a plant community with many invasive species, all of which grow fast and require a large amount of water per time and area (compared to a native community)[140]. Given the risk of uncertainty, the monitoring and evaluation aspects at the watershed level as well as at Rivers Committee-level have been strengthened in the project proposal. This monitoring system will be able to assess the effectiveness of the interventions in the long-term and thereby ensure the adaptive management of the watersheds. The descriptions of the watersheds were improved in the proposal to better describe the level of degradation in the five targeted watersheds. [Project Proposal, p. 17 - 20]:
Once activities are selected, based on the field surveys, the proposal should articulate how these activities allow for achieving the "management of watersheds to enhance functional connectivity and the resilience of these areas to climate change and reduce water scarcity".	As the rehabilitation activities referred to fell under Output 1.1 and "management of watersheds to enhance functional connectivity and the resilience of these areas to climate change and reduce water scarcity" is the heading for Output 1.2, the two outputs were merged to accommodate the comment. The heading of Output 1.1 now reads "Management and rehabilitation of critical watersheds to enhance functional connectivity and the resilience of these areas to climate change and reduce water scarcity and watershed flooding". The following was added to the proposal to articulate how the rehabilitation activities allow for achieving the "management of watersheds to enhance functional connectivity and the resilience of these areas to climate change and reduce water scarcity": *Increase in Social Resilience:* Through the organization of local watershed committees and the establishment of monitoring and evaluation systems resulting in adaptive management, the project will enhance the social resilience of local communities to climate change. The establishment of systems of co-management will realise vertical shifts in rights and responsibilities from government to local resource users. By working together and consolidating spaces of dependence at a local level by the committees and their interactions with government departments and representation on the Rivers Committee, users of water will be generating secondary benefits by building community resilience to better cope with the impacts of climate change. Integrated learning and adaptive management relies on that resource stakeholders are fully engaged in decision-making. To be resilient, societies must generally demonstrate the ability to buffer disturbances, self-organise, and learn and adapt.[141].

[140] C. Kaiser-Bunbury. Pers. Comm.

[141] Tompkins, E. L.; Adger, W.N. 2004. *Does adaptive management of natural resources enhance resilience to climate change?* Ecology and Society 9(2).

	Rehabilitation of IAS-degraded Forests: This output will address certain aspects of the rehabilitation of the watersheds as indicated in the management plans developed under this output. AF resources will be used to rehabilitate forest in critical upstream contributing system in the Mare aux Cochons Watershed (400 hectares), Mont Plaisir Watershed (50 hectares), Baie Lazare Watershed (100 hectares), Caiman Watershed (100 hectares), and Praslin Fond B'Offay/Nouvelle Decouvert Watershed (50 hectares). The rehabilitation in the Mare aux Cochons, Mont Plaisir, Baie Lazarre and Caiman Watersheds will be targeted towards selective removal and control of woody IAS and replanting with native species[142]. It is now well recognized that invasive alien species, particular tree species, have increased water usage compared to native species. Increased catchment water yield is a major justification for the cost of clearing alien plants. Studies conducted in South Africa indicate that high rainfall catchment (as all Mahe catchments are) show the greatest streamflow enhancement potential from IAS removal (Calder et. al.2001)[143]. All studies done to estimate the impacts of IAS concur that IAS, inclusive of plantation forestry; have a measurable negative effect on streamflow. The invasion of riverine and mountainous catchment areas is the most important from a streamflow reduction perspective. Research has shown an inverse correlation between runoff and plant biomass and a link between changes in runoff and the occurrence of Invasive Alien Species[144]. Fast-growing invasive species impose huge water demands while slow-growing natives do not. The amount of water stored in soft wood (fast growing invasives) is substantially higher per unit plant matter than that stored in hard wood[145]. Various invasive tree species due to historic landscape management are present in large numbers in the forests of Seychelles especially in the riparian zones. Certain species, especially Syzygium jambos and Psidium cattleianum, introduced in the Seychelles invade forests as they are specifically adapted to low light and nutrient-poor soil[146]. IA tree species generate more biomass and experience substantially higher growth rates than native tree species, thus capturing a larger amount of water in a shorter time. All of the Experiments conducted in Seychelles show that fast growing IAS like Falcataria molluccana, Alstonia macrophylla and Tabebuia pallida have a relative growth rate under high light availability of 25 – 50% higher than native species[147]. Schumacher et. al. 2009 also showed that invasives do not suffer from water stress under high light (i.e. open canopy) conditions. Forests with woody species invaders present also have a higher evapotranspiration rate (as high as 20%) than similar primary forests[148], which results in higher water use by forests containing high invasion rates of woody invasives versus the same forests without invasives. Creeper species add an additional layer in the forest, not common in native forest, also drawing water resources, especially during the dry season. These IAS disrupt natural processes and ecosystem functioning in watershed forests. Specifically, changes in the chemical composition of soils and increased below-ground competition between IAS and native species benefit IAS and result at times in limited undergrowth and soil erosion[149]. These processes impact on both total and dry season water yield. The rehabilitation of the forest ecosystems will focus on removing the IAS that affect function that include the following species: Falcataria mollucana, Cinnamomum verum, Alstonia macrophylla, Pentadesma butyracea, Psidium cattleianum, Syzygium jambos, Adenanthera pavonina, Sandorium indicum, Tabebuia pallida, Anacardium occidentale and Helicona

[142] Annex 7 provides a list of plant species that have been considered suitable for ecosystem rehabilitation projects.

[143] Calder, I & Dye, P. *Hydrological Impacts of Invasive Plants*. Land Use and Water Resources Research 1 (2001).

[144] Blignaut, J.N.; Marias, C, & Turpie, J.K. 2007. *Determining a charge for the clearing of invasive alien plant species (IAPs) to augment water supply in South Africa.* Water SA Vol 53 No 1.

[145] Kaiser-Bunbury, C. Pers. Comm.

[146] Schumacher, E.; Kueffer, C.; Edwards, P. & Dietz, H. 2009. Influence of light and nutrient conditions on seedling growth of native and invasive trees in the Seychelles. Biol. Invas., 11.

[147] Schumacher, E.; Kueffer, C.; Edwards, P. & Dietz, H. 2009. Influence of light and nutrient conditions on seedling growth of native and invasive trees in the Seychelles. Biol. Invas., 11.

[148] Huddle, J.A.; Awada, T.; Martin, D. L.; Zhou, X.; Pegg, S. E.; & Josiah, S. J. 2011. *Do Invasive Riparian Woody Plants affect Hydrology and Ecosystem Processes?* Papers in Natural Resources. Paper 298.

[149] Kueffer, C.; Schumacher, E.; Fleischmann, K.; Edwards, P.J. & Dietz, H. 2007. Strong below-ground competition shapes tree regeneration in invasive Cinnamomum verum forests. Journal of Ecology and Indufor, O. 1993. *Seychelles forest management plan/sector study*. Ministry of Environment, Economic Planning and External Relations.

	psittacorum. The rehabilitation work will concentrate on riverine areas and adjacent areas between rivers and patches of high native biodiversity, thereby establishing important corridors between biodiversity rich areas and rehabilitated areas, resulting in increased functional connectivity of the watersheds. In addition to increased water provision, rehabilitation of watersheds will enable forests to serve as buffers of hydrological extremes, reduce the risk and speed of flooding, and confine the vulnerability of ecosystems and developed areas to such climate-change related events. By rehabilitating riverine areas and increasing forest cover (and diversity), wetlands and barrages will be less impacted from excess runoff and sedimentation that will occur during periods of high rainfall, water quality and water retention will be improved, resulting in increased resilience of the local population in water availability in the dry season. IAS also have negative impacts on the biodiversity of the watersheds. By creating conditions for native species to return, actively increasing their population size, and controlling IAS, biodiversity values will be enhanced in these areas. Even when high diversity is not critical for maintaining ecosystem process under constant environmental conditions, biodiversity provides a buffer against environmental fluctuations (including climate change) because different species respond differently to these fluctuations. The functional roles different species in an ecosystem play are subject to the influences of local environmental conditions. Species may appear to perform the same function (and therefore considered functional redundant) under a restricted set of conditions, yet their functional roles may vary in naturally heterogeneous environments[150]. A minimum (threshold) number of species is essential for ecosystem functioning under constant conditions and a larger number of species is probably essential for maintaining the stability of ecosystem processes under conditions of climate change[151]. Ecological resilience in the context of this proposal can be defined as the ability of the forests in Seychelles to withstand (absorb) external pressures and re-organise, while undergoing some change, in such a way that it retains its biological, chemical and physical functions. A non-resilient ecosystem may eventually respond to disturbance by crossing a threshold and collapsing into a qualitatively different state, which is stable but is controlled by a new set of processes. When viewed over an appropriate time span, a resilient forest ecosystem is able to maintain its 'identity' in terms of taxonomic composition, structure, ecological functions, and process rates. The available scientific evidence strongly supports the conclusion that the capacity of forests to resist change, or recover following disturbance, is dependent on biodiversity at multiple scales. Maintaining and restoring biodiversity in forests promotes their resilience to human-induced pressures and is therefore an essential "insurance policy" against climate change impacts. Thompson et. al., 2009 writes that the resilience of a forest ecosystem to changing environmental conditions is determined by its biological and ecological resources, in particular (i) the diversity of species, including micro-organisms, (ii) the genetic variability within species; and (iii) the regional pool of species and ecosystems. Resilience is also influenced by the size of forest ecosystems (generally, the larger and less fragmented, the better) and by the condition and character of the surrounding landscape. The project will therefore increase the ecological resilience of the forest watersheds by (i) maintaining and increasing the structural complexity of the landscape, using natural forests and process as models; (ii) maintaining and increasing connectivity across forest landscapes by reducing fragmentation, recovering lost habitats and establishing ecological corridors; (iii) maintaining functional diversity and eliminate the conversion of diverse natural forest to reduced-species forests; (iv) reduce non-natural competition by controlling invasive species; (v) maintaining biodiversity at all scales (stand, watershed, landscape) and of all elements (genes, species, communities) by, protecting native tree populations which are isolated or disjunct of other similar source habitats[152]. *Rehabilitation of Wetlands:* AF resources will also be used to rehabilitate two wetlands in the Mare aux Cochons and Baie Lazarre Watersheds that are degraded and not functional optimally in terms of water provision.

[150] Wellnitz, T.A. LeRoy Poff, N. 2001. *Functional redundancy in heterogeneous environments: implications for conservation.* Ecology Letters.

[151] Nagelkerke, I. 2009. *Ecological Connectivity among Tropical Coastal Ecosystems*. Springer Science and O'Connor, N.E. 2005. *Biodiversity Loss and Ecosystem Functioning: Distinguishing between Number and Identity of Species*. Ecology 86(7)

[152] Thompson, I.; Mackay, B.; McNulty, S.; Mosseler, A. 2009. *Forest Resilience, Biodiversity, and Climate Change. A synthesis of the biodiversity/resilience/stability relationship in forest ecosystems*. Secretariat of the Convention on Biological Diversity, Montreal. Technical Series no. 43.

	These upland wetlands have important functions and values including i) flood conveyance – wetlands form natural floodways; ii) Flood storage – wetlands store water during floods, then slowly release it downstream; iii) Sediment control – wetlands reduce floodwater velocity, causing suspended sediments to settle out in these areas rather than being carried downstream; iv) water quality – wetlands contribute to improving water quality by trapping suspended sediments and removing dissolved nutrients and other chemicals; and v) water supply – wetlands are increasingly important as a source for replenishing surface water. Wetlands slowly discharge water into nearby streams to maintain a more constant water supply in the streams. *Rehabilitation of Fire-Degraded Land (former forests):* Rehabilitation efforts in the Praslin Fond B'Offay/Nouvelle Decouvert Watershed will be targeted towards the increase of soil water infiltration rates and reduction of soil loss in degraded areas. Vegetation cover is the most important factor in reducing surface runoff and sediment movement as the canopy and litter fall intercept rain and reduce its kinetic energy. Plant succession can gradually increase vegetation coverage, accumulate litter fall mass, construct root networks and improve soil physiochemical properties, leading to reduced runoff and soil loss, but this will take a century or more if unaided from bare soil to forested land on Praslin[153]. Reforestation improved soil physiochemical properties reducing runoff and soil loss through increasing total porosity and infiltration rate, increasing soil organic carbon content, and decreasing soil bulk density[154]. Fifty hectares of bare ground and bush vegetation will be stabilized and reforested in the watershed concentrating on the most degraded areas (bare soils – 10 ha); areas within the riverine zone and degraded areas within intact natural palm forests. This will lead to the increase of resilience against climate change intense rainfall events (reduced erosion in degraded areas and reduced fire risks as degraded pockets in forests will be rehabilitated); reduction in water scarcity as a result of increased infiltration of water into soil and higher base flows in the dry season); and an increase in functional connectivity through an improved riverine system throughout the watershed.
In addition to the local watershed management committees, the activities under output 1.2 should also include the establishment of a supra-local coordination group that would monitor and assess that the watersheds functional connectivity was enhanced.	The following was added to Output 1.1: A national watershed management and rehabilitation coordination function will be developed under the auspices of the Rivers Committee in conjunction with the watershed monitoring programme, as outlined in Output 3.2 below related to Capacity Development for ecosystem based methods. A mechanism to ensure local watershed committee representation on the Rivers Committee will be developed during the project period to ensure local ownership.
To ensure the achievement of its long term project objective, the project should help put in place a national monitoring system, including a "functional connectivity" monitoring system in order to assess the effectiveness of project interventions in the long-term and to	The following was added to Output 3.2: A national watershed monitoring system, including a "functional connectivity" monitoring system will be put in place in order to assess the effectiveness of the project interventions in the long-term and to ensure an adaptive management of the watershed systems. In order to operationalise such a monitoring programme, investments are needed and training provided in monitoring tools such as GIS, on-the-ground measurement methods, environmental planning tools, etc. and the long-term collection of key data that will be identified through the project. The system will be developed by the project implementation team, in conjunction with the MEE, PUC, the University of Seychelles, relevant partner NGOs, the local watershed committees and the Rivers Committee. Its sustainable financing can be assessed along with the options that will be explored under output 3.1.3. A national watershed management and rehabilitation coordination function will be developed under the auspices of the **Rivers Committee** in

[153] Senterre, B.; Lesperance, M.; Bunce, S. Henriette, E.; Jean-Baptiste, M. and Laboudallon, V. 2012. *Implementation of Post Fire Rehabilitation Trails on the Island of Praslin, Seychelles.* GOS-UNDP-GEF Capacity Development of Sustainable Land Management.

[154] Huang, Z.; Ouyang, Z.; Li, F.; Zheng, H. & Wang, X. 2010. Response of runoff and soil loss to reforestation and rainfall type in red soil region of southern China. Journal of Environmental Sciences.

ensure an adaptive management of the watershed systems. Such a monitoring system entails investment and training in monitoring tools, inter alia geographic information system (GIS), on-the-ground measurement methods, environmental planning tools, and the monitoring of key indicators and long-term collection of key data that will be identified through the project. That could be complemented by additional rigorous scientific studies and modeling where necessary. The system should be developed by the project implementation team, in conjunction with the Ministry of Environment and Energy, Public Utilities Corporation, the University of Seychelles, and relevant partner non-governmental organizations, the local watershed committees and the Rivers committee, and should be institutionalized and operational by the end of the project. Its sustainable financing could be assessed along with the options that will be explored under output 3.1.3.	conjunction with the watershed monitoring programme, as outlined in Output 3.2 below related to Capacity Development for ecosystem based methods. The capacity development and monitoring systems will be integrated in the outputs described below. Under Output 3.2.3 Institutional Support, the following was added: A *National Watershed Monitoring Programme* will be developed that will address ecosystem connectivity, watershed integrity and function and water balance, including related capacity development to oversee the status and technical inputs for the Rivers Committee ongoing management of watersheds in Seychelles. The monitoring programme will develop and apply relevant indicators of functional connectivity, watershed integrity and water balance within an adaptive management system that will assess and refine environmental interventions and their performance based on experiences. This monitoring programme will also be linked to the national Water Development Plan and to the Seychelles Sustainability Strategy. The following was also added to the Results Framework for Ecosystem Based Adaptation to Climate Change in Seychelles in order to ensure the monitoring system is operational by the end of the project: Indicator: A National Watershed Monitoring System developed, applied and is influencing watershed management decisions. Baseline: Little information available regarding functional connectivity, watershed integrity and water balance of watersheds Targets: Institutionalized and operational watershed monitoring system ensures adaptive management of watershed systems Sources of verification: Data on key indicators regarding functional connectivity, watershed integrity and water balance available.