ADAPTATION FUND

PART I: PROJECT/PROGRAMME INFORMATION

Title of Project/Programme:	Restoring marine ecosystem services by restoring coral reefs to meet a changing climate future
Countries:	Republic of Mauritius, Republic of Seychelles
Thematic Focal Area1:	Food Security and Disaster Risk Reduction.
Type of Implementing Entity:	MIE
Implementing Entity:	UNDP
Executing Entities:	Mauritius: Ministry of Ocean Economy, Marine Resources, Fisheries, and Shipping Seychelles: Ministry of Environment, Energy, and Climate Change
Amount of Financing Requested:	10,000,000 (in U.S Dollars Equivalent)

Project Overview

Climate change has intensified coral bleaching events and mortality in Mauritius and Seychelles over recent decades. Climate change projections predict that global coral bleaching events will increase in frequency and intensity. Therefore, to reduce the adverse impact of climate change on local communities and coral reef-dependent economic sectors in Mauritius and Seychelles, the proposed project will increase climate resilience at both regional and local levels by implementing coral reef restoration with thermal tolerant corals as adaptation to climate change. The proposed project objective will be achieved through the following outcomes: in Mauritius i) development of a sustainable partnership and community based approach to reef restoration, ii) establishment of coral farming and nursery facilities, iii) active restoration of degraded reefs; in Seychelles, iv) development of a sustainable partnership and business approach to reef restoration, v) establishment of coral farming and nursery facilities, vi) active restoration of degraded reefs; in both countries vii) improved understanding and knowledge management of using coral reef restoration as an adaptation to climate change viii) sharing regionally and globally the experienced learned in sustainable coral reef restoration, and ix) training to build capacity for long-term sustainable coral reef restoration. As such coral reef projection

[1] Thematic areas are: Food security; Disaster risk reduction and early warning systems; Transboundary water management; Innovation in adaptation finance.

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List of Abbreviations

AF	Adaptation Fund
AFCCP	Anse Forbans Community Conservation Programme
AFRC	Albion Fisheries Research Centre
AHC	Association des Hôtels de Charme
AHRIM	Association des Hôteliers et Restaurateurs de l'Ile Maurice
BBMP	Blue Bay Marine Park
BERI	Blue Economy Research Institute
CFPF	Catch per fisherman day
CITES	Convention on International Trade in Endangered Species
CLCS	Commission on the Limit of the continental shelf
COI	Commission de l'Océan Indien
CORDIO	Coastal Oceans Research and Development in Indian Ocean
CRIS	Coral Reef Information System
CSR	Corporate Social Responsibility
CTA	Chief Technical Advisor
FDI	Foreign Direct Investment
EbA	Ecosystem based Approach
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMPS	Environment Management Plan of Seychelles
ENSO	El Nino-Southern Oscillation
EPA	Environment Protection Act
ESA	Environmentally Sensitive Areas
EU	European Union
FSP	Full Size Project
GCCA	Global Climate Change Alliance
GDP	Gross Domestic Product
GEF	Global Environment Facility
GLISPA	Global Island Partnership
HDI	Human Development Index
HRBA	Human Rights Based Approach
IAS	Invasive Alien Species
ICRS	International Coral Reef Symposium
ICT	Information and Communication Technology
ICZM	Integrated Coastal Zone Management
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
ITCZ	Inter Tropical Convergence Zone
IW	Inception Workshop
JICA	Japan International Cooperation Agency
LPAC	Local Project Appraisal Committee
MCSS	Marine Conservation Society Seychelles
MDG	Millennium Development Goal
M&E	Monitoring and Evaluation
MEECC	Ministry of Environment, Energy and Climate Change
MDR	Ministry of Defence and Rodrigues
MIE	Multilateral Implementing Entity
MMCS	Mauritius Marine Conservation Society
MOEMRFS	Ministry of Ocean Economy, Marine Resources, Fisheries and Shipping
MOI	Mauritius Oceanography Institute
MoSSNSESD	Ministry of Social Security, National Solidarity, and Environment and Sustainable Development (Environment and

	Sustainable Development Division)
MPA	Marine Protected Area
MUR	Mauritian Rupees
MTE	Mid Term Evaluation
NBSAP	National Biodiversity Strategy and Action Plan
NDA	National Designated Authority
NEP	National Environmental Policy
NGO	Non-governmental Organization
NIE	National Implementing Entity
NISTI	National Institute of Science, Technology and Innovation
NPD	National Project Director
NPT	National Project Team
Nsey	Nature Seychelles
POPP	Programme and Operational Policies and Procedures of UNDP
RCP	Representative Concentration Pathway
RCU	Regional Coordinating Unit
R&D	Research and Development
PM	Project Manager
PMT	Project Management Team
PNCC	Project National Coordinating Committee
PPR	Project Progress Report
PSC	Project Steering Committee
RoM	Republic of Mauritius
RoS	Republic of Seychelles
RRA	Rodrigues Regional Assembly
SAPPHIRE (or WIO LME SAPPHIRE)	UNDP-GEF project, titled "Western Indian Ocean Large Marine Ecosystems Strategic Action Programme Policy Harmonization and Institutional Reform"
SCP	Sustainable Consumption and Production
SDG	Sustainable Development Goal
SEMPA	South East Marine Protected Area
SeyCCAT	Sey Debt-for Adaptation Swop funding mechanism
SFA	Seychelles Fisheries Authority
SGP	Small Grant Programme
SIDS	Small Island Developing State
SME	Small and Medium Enterprise
SNPA	Seychelles National Parks Authority
SSDS	Seychelles Sustainable Development Strategy
SST	Sea Surface Temperature
SWIO	South Western Indian Ocean
TNA	Technical Need Assessment
UNCSD	United Nations Commission on Sustainable Development
UNEP	United Nations Environment Program
UNDP	United National Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UoM	University of Mauritius
USAID	United States Agency for International Development
USD	United States Dollar
WIO	Western Indian Ocean
WIOCC	Western Indian Ocean Coastal Challenge
WIOMSA	Western Indian Ocean Marine Science Association
WIOSAP	UNEP-GEF project titled as "Implementation of the Strategic Action Programme for the protection of the Western Indian Ocean from land-based sources and activities"

A. Project / Programme Background and Context:

1. Geographic context

Both the Republic of Mauritius (RoM) and the Republic of Seychelles (RoS) are Small Island Developing States (SIDS) in the Western Indian Ocean, located off the eastern coast of Africa.

MAURITIUS[2]

The Republic of Mauritius (RoM) has an area of 2,040 km², comprising the mainland Mauritius (located 800 km east of Madagascar), Rodrigues Island, Agalega Islands, Tromelin Island, Cargados Carajos Shoals and the Chagos Archipelago. Its Exclusive Economic Zone (EEZ) is nearly 2.3 million km² as well as an Extended Continental Shelf of 396 000 km² managed jointly by RoM and RoS, outside the border of their respective EEZ (Fig. 1).

Figure 1 *Geographical location of Mauritius and Outer Islands with the EEZ (light red), Joint Management Area - Mauritius and Seychelles Extended Continental Shelf (light green), Extended Continental Shelf Submission to the UN Commission on the Limit of the continental shelf (CLCS) in the region of Rodrigues (yellow) and Preliminary Information in the Chagos Archipelago Region (light blue)*

The island of Mauritius is volcanic in origin and is almost entirely surrounded by coral reefs. Situated 619 km to the east of Mauritius, Rodrigues Island is hilly with a central spine culminating in its highest point, Mont Limon (393 m). Rodrigues is the only Mascarene Island with extensive

[2] Republic of Mauritius (2016). Third National Communication: Report to the United Nations Framework Convention on Climate Change. Republic of Mauritius, Port Louis. 210 pp.

limestone deposits and caves. Rodrigues is characterised by a drier climate than Mauritius and frequently faces droughts, which affect agricultural production.

The Republic of Mauritius is also situated in the tropical cyclone belt of the South Western Indian Ocean (SWIO) where rapid formations of high intensity tropical cyclones and super cyclones have been observed. The annual losses from cyclones and associated wind, flood and storm surge hazards are estimated to be USD 91 million, representing 8% of all natural hazards assessed for Mauritius[3]. It is therefore highly exposed to such extreme climatic phenomenon with serious risks to life and development progress including basic amenities and properties.

SEYCHELLES[4]

The Republic of Seychelles is an island archipelago located between latitudes 4° and 11° S and longitudes 46° and 57° E, about 1,600 km east of Kenya. It has a total landmass of 455 km^2, and an Exclusive Economic Zone (EEZ) covering 1.374 million km^2. The archipelago consists of 115 islands, of which 42 are granitic and the rest are of coralline origin. The main granitic islands, also known as the inner islands, are in descending order of size Mahé, Praslin, Silhouette and La Digue. The granitic islands are within a 56-km radius of the main island of Mahe. These islands are rocky, and most have a narrow coastal strip and a central range of hills up to 914 m high. Mahe is the largest island with 157 km^2 and is the site of Victoria, the capital. The coralline islands, rising only a few feet above sea level, are flat with elevated coral reefs at different stages of formation. These islands are largely waterless, and very few have a resident population. The main outer islands are, from north to south, Bird, Denis, the Amirantes group, Alphonse, Coetivy, and the Aldabra, Cosmoledo and Farquhar groups (Fig. 2).

Figure 2 *Geographical location of Seychelles. Top: Seychelles Archipelago. Bottom: Inner and Outer Islands.*

[3] Southwest Indian Ocean Risk Assessment and Financing Initiative "Disaster Risk Profile Mauritius" 2016

[4] Republic of Seychelles (2011) Second National Communication Under the United Nations Framework Convention on Climate Change. Ministry of Home Affairs, Environment, Transport and Energy Government of Seychelles, Victoria. 378 pp.

Seychelles' vibrant but tranquil island society has lush tropical vegetation, beautiful beaches, and a wide variety of marine life; almost 50% of land area has been set aside as natural reserves. The climate is tropical oceanic, with little temperature variation during the year. Daily temperatures rise to the low 30° C in the afternoon and fall to the low 20° C at night. Precipitation levels vary greatly from island to island; on Mahé, annual precipitation ranges from 2,300 mm at sea level to 3,560 mm on the mountain slopes. Humidity is persistently high but is ameliorated somewhat in locations windward of the prevailing southeast trade winds. Seychelles is located within the equatorial region, and while the islands are extremely rarely directly impacted by tropical cyclones, they are indirectly affected by them via the intensification of the intertropical convergence zone and spinal rain bands associated with storms passing south. This leads to impacts through intense rains and swells and storm surges[5].

2. Socio-economic context

2.1. Mauritius

Mauritius has a population of 1.26 million, of which around 97% live on the main island and the rest on Rodrigues[6]. Population density on Mauritius island is high (641 people per km^2), and even higher when tourist arrivals are included: the country had over a million visitors in 2014. Rodrigues has a much lower density of 399 people/km^2, although this is still high in global terms. Cumulative economic growth over recent decades has meant that Mauritius has moved from classification as a Low Income to an Upper Middle-Income country with a 2016 Per Capita GDP of USD 9,627[7]; it is aiming to achieve High-Income status by 2020. The Mauritian economy has diversified since the mid-1990s, when the sugar and textile sectors were dominant and, although both these sectors are still important, the offshore financial sector, a rapidly growing information, communication and technology (ICT) industry and the expanding ports sector are now key to the national economy. Sustained growth of the economy has been possible due to several factors such as political stability; stable institutions; an outward market-driven strategy; prudent fiscal, exchange rate, trade, investment and monetary policies; and the careful overall planning, and policy choices.

Despite these successes, several important challenges remain. Mauritius has been facing increasing inequality levels in recent years, with the Gini coefficient rising from 0.388 in 2007 to 0.44 in 2015, indicating that prosperity is not equally shared in Mauritius and those at the bottom 4 percent of the population have seen their expenditures decrease and their living standard deteriorate over time[8]. Moreover, unemployment rate has stagnated at around 8 per cent over the past five years with an increasing proportion unemployed among the skilled youth.

Fisheries Sector in Mauritius.

Mauritius has an Exclusive Economic Zone of 2.3 million km^2 (including approx. 400,000 km^2 Extended Continental Shelf (ECS) jointly managed with Seychelles) supporting ocean-related economic activities including coastal tourism, marine leisure, seaport-related activities and seafood activities which contribute to 10.8 percent of GDP (2012)[9]. The total economic value of

[5] UNDP, 2008, "Disaster Risk Profile of the Seychelles"
[6] Mauritius in Figures 2015. Statistics Mauritius
[7] http://data.worldbank.org/country/mauritius
[8] World Bank Group. *Mauritius: Systematic Country Diagnostic.* (2015).
[9] World Bank Group. *Mauritius: Systematic Country Diagnostic. Systematic Country Diagnostic,* World Bank, Washington, DC. © World Bank. https://openknowledge.worldbank.org/handle/10986/23110 License: CC BY 3.0 IGO

coastal resources is estimated around USD 330 million[10]. Direct fisheries contribution is estimated at 1 to 2 percent, however the entire fisheries value chain brings the contribution of this sector to 4 percent of GDP with exports estimated at USD 460 million in 2013 and equivalent to 20 percent of all annual exports[11]. Artisanal fisheries remain an important coastal economic activity and are part and parcel of the social and cultural fabric of coastal communities with around 3,200 fishers registered in the Republic of Mauritius, out of which 44% are in Rodrigues. Although measures such as bad weather allowances and a Fishermen Welfare Fund have been put in place to improve the conditions of artisanal fishermen, their socioeconomic conditions remain precarious[12]. Mean monthly earnings are estimated at MUR 9,801[13] corresponding to the average income of households living in relative poverty in Mauritius in 2012[14]. Domestic fish production is estimated at 9,000 tons per year, insufficient to meet the local consumption rates of 30,000 tons per year or its export-processing industry of 169,000 tons[15].

Coastal area and tourism in Mauritius

Mauritius has 322 km of coastline and 243 km^2 of lagoon area enclosed by 150 km of fringing reef that surrounds part of the island. About 20% of the population resides in coastal areas. The total economic value of the coastal resources has been estimated to be about USD 330 M[16]. The revenue generated directly from activities in the coastal zone was equivalent to 36% of GDP in 2011 – out of which 99% was represented by tourism. This sector is considered to be a highly climate-sensitive economic sector[17].

The coastal areas of Mauritius are under constant threat. Increasing beach erosion has shrunk the width of the beaches around certain coastal areas by up to 20m over the last few decades. Assuming a constant rate of beach erosion, it was estimated that the cumulative 50-year value of beach tourism (USD 45.5 billion, assuming no increase in tourist numbers from 2010, to be conservative) would have a revenue loss per year ranging from USD 2 million in 2011 to USD 100 million/year in 2060 (in 2010 terms)[18].

2.2. Seychelles

The Seychelles has a population of just over 94,677 people (49.5 % male, 50.4 % female; 12 % total are migrant workers)[19]. Most people live on the narrow coastal plains of the three granitic islands of Mahé (79% of the population), Praslin (9% of the population) and La Digue (4% of the population), where economic activities are also concentrated. Seychelles has a high Human Development Index (HDI) value of 0.836 (the highest in Africa) and a 2016 Per Capita GDP of

[10] Ministry of Environment, Sustainable Development and Disaster and Beach Management "Third National Communication – United Nations Framework Convention on Climate Change", October 2016

[11] World Bank Group. *Mauritius: Systematic Country Diagnostic.* (2015).

[12] Truth and Justice Commission "Volume 1: Report of the Truth and Justice Commission", 2010, 255-260

[13] Indian Ocean Commission Smart Fish Programme "Value Chain Analysis of the Artisanal Fisheries Sector in Mauritius", 2012.

[14] Republic of Mauritius Ministry of Finance and Economic Development, Statistics Mauritius "Poverty Analysis", 2012

[15] World Bank Group. Mauritius: Systematic Country Diagnostic. (2015)

[16] ICZM Framework, 2010, Mauritius

[17] Ministry of Environment and Sustainable Development, 2012. *Mainstreaming Climate Change Adaptation in the Development Process in the Tourism Sector of the Republic of Mauritius in the context of the Africa Adaptation Programme (AAP),* Port Louis: Government of Mauritius.

[18] GoM, 2012. National Climate Change Adaptation Framework, Port Louis: Government of Mauritius

[19] Seychelles in Figures 2015. National Bureau of Statistics.

USD 15,072[20]; it ranks high on human development indicators such as life expectancy, primary school enrolment (100%), and adult literacy rate (over 90%). Absolute poverty is very low, with only 0.25% of the population living on USD 1.25 or less a day (2007 statistics), but inequality is significant (Gini coefficient of 0.47 in 2012). Once a largely agricultural economy (cinnamon and coconut), the Seychelles is now a dual economy, heavily dependent on tourism and fishing which are the main production sectors and, like Mauritius, it has a growing offshore financial sector.

Despite the positive development, Seychelles continues to face a number of challenges. Since the beginning of the 1990s, Official Development Assistance flows have fallen by over 90%. This situation and the increased need to borrow from commercial institutions, has led to a slowdown of the economy. Above all, the country suffers from insufficient economic diversifications and vulnerability to external shocks, including climate change.

Fisheries in Seychelles

Seychelles has a very large EEZ, which extends over almost 1.4 million km^2. The fisheries sector was and continues to be critically important for assuring food security and for generating local employment. Fish catches are valued at around 35 million USD per year, representing less than 10% of the GDP, but it provides an important 26% of foreign exchange earnings[21]. It generates around 6,000 jobs, amounting to about 17% of total formal employment. Although this sector is dominated by high-seas and export-oriented tuna fishing, the artisanal fisheries which are largely reef-based, are also vital for the local generation of income and employment, and for the local availability of protein.

In 2011, Seychelles was the 3rd largest consumer of fish per capita (59.3 kg) in the world, and the percentage of fish as a contribution to animal protein is 47.6%. A significant proportion of this is sourced from reef and coral associated areas (2011).[22] The submarine banks of the Seychelles, particularly the Mahé plateau where some 100 species of demersal fish are commonly caught, form the basis of the artisanal fishery providing vital food security, employment and high value trade commodities. Also important are the reef-based sea cucumber, lobster and octopus fisheries. Artisanal fishery catches peaked in 1991 and have declined steadily since, providing a very strong indication that the demersal stocks have been heavily overfished[23]. In this context, the Government of Seychelles embarked in 2013 in the development of the second phase mariculture master plan to diversity the economies of fishing communities and improve the resilience of their livelihoods in the face of climate change.

Coastal area and tourism in Seychelles

Tourism has followed a similar pattern in both countries. The Seychelles tourism industry expanded greatly after the opening of the airport in 1971. In 2016, tourism in Seychelles stood at 303,177[24] visitors a year, contributing 46.1% of the country's GDP, providing 56.4% of national employment and generating 33.2% (USD 382.5 million) of the country's foreign exchange earnings. In both countries, the contribution of tourism to the national economy is even greater

[20] http://data.worldbank.org/country/seychelles
[21] Republic of Seychelles, Country Strategy Paper 2016-2020.
[22] http://www.globefish.org/total-fish-c onsumption-per-capita-kg-and-fish-contribution-to-total-proteins-percent.html
[23] GoS (2014). Seychelles Biodiversity Strategy and Action Plan 2015-2020.
[24] National Bureau of Statistics, Seychelles. Visitor arrival data 2000 to 2017

than these figures indicate if one takes into account the economic multiplier effect created by the industry and the value added in other sectors.

Coral reefs are well developed around the main groups of granitic islands located on the Mahé plateau, as well as around the satellite coral islands, with a total cover of 1,700 km^2. 65% of tourists choose to visit Seychelles for the predominantly pristine nature of their coastal resources and the natural beauty in general. The effects of climate change on tourism in small islands are expected to be largely negative, especially on the health of the coral reef systems and the islands' fisheries and conservation of biodiversity. Increased coral mortality would also accelerate coastal erosion, as demonstrated by the effects of coral mortality over the past decade in the Seychelles[25].

3. Environmental context

Mauritius and Seychelles lie within the Indian Ocean centre of diversity for corals. The most recent analysis[26], incorporating earlier studies[27], indicates that the reefs of the two countries fall into three ecoregions on account of their different coral faunas: the Mascarene Islands, the northern Seychelles (predominantly the granitic islands surrounded by nearshore fringing reefs) and the southern Seychelles (predominantly the outer islands, which are largely atolls). The northern Seychelles and the Mascarenes have a slightly lower diversity than the southern Seychelles, but nevertheless, have over 350 species (Fig. 3). Further work is required to fully understand the coral diversity and taxonomy of these countries.

Figure 3 *Global diversity indicated by all records of occurrences. Colours indicate number of coral species found in each area (see bar below map)* [8]

[25] Seychelles National Climate Change Strategy

[26] JVeron, M Stafford-Smith, Lyndon DeVantier1 and Turak, E. 2015. Over view of distribution patterns of zooxanthellae Scleractinia Frontiers *in Marine Science* 1(81).

[27] Obura D (2012) The Diversity and Biogeography of Western Indian Ocean Reef-Building Corals. *PLoS ONE* 7(9): e45013. doi: 10.1371/journal.pone.0045013

Reef building corals are made of millions of tiny animal polyps living in symbiosis with microscopic algae. The algae (zooxanthellae) live inside the gut of the animal polyp. During daylight hours, zooxanthellae produce sugars through photosynthesis, which feed the animal polyp providing 90 % of its energy needs. At night, the polyp extends its tentacles and feeds on plankton. The algae give their host corals their unique colours (Fig. 4). It is this animal-algae symbiosis that allows corals to live in the nutrient poor waters of the tropics and speeds up the production of calcium carbonate to form reefs. However, when the water temperature rises 2° C above the maximum temperatures normally experienced by the corals, the polyps expel the zooxanthellae turning the coral white. This event is known as coral bleaching. If the warming is brief, corals can reabsorb the zooxanthellae and survive. If the warming event lasts for more than two weeks, corals die of starvation.

Figure 4 *Close-up of coral polyps (translucent white), with symbiotic zooxanthellae (golden green dots) living inside the gut of the polyps. The calcium carbonate chalice where coral polyps hide during the day is shown on the lower left corner. Photo credit: Smithsonian Institution*

Following a bleaching event, and depending on its intensity, coral colonies die rapidly and become algal covered, with the reef's structure, topography and productivity declining and even disappearing. The long-term impact of bleaching events and the extent of recovery of corals also depend on local pressures that negatively affect coral reefs such as over-fishing, nutrient enrichment, increased turbidity and sedimentation, and damage from boats and visitors.

Coral reefs are the foundation of food security and coastal livelihoods in both Mauritius and Seychelles. They are the basis of artisanal fisheries and the tourism industry. The artisanal fishery of each country relies primarily on catches of reef-associated species and, although not necessarily of high monetary value, these fisheries are a key to the health, and food and income security of coastal communities. The total abundance of demersal fish (and hence potential fisheries productivity) is strongly associated with the amount of live hard coral cover.[28] Similarly, the tourism industry in each country has developed primarily on account of the reefs, which not only provide the snorkelling and diving experiences that visitors specifically seek out, but also the white sandy beaches that in many parts of these islands are formed from the natural erosion of coral colonies. In both countries, the overwhelming majority of capital investments in the tourism sector are located on the coast for this reason; for example, in Mauritius, of the total 115 hotels in 2015, over 90% were on the coast[29].

Coral reefs, through the protection they give to the shorelines, also provide a key disaster risk reduction measure for some of the most damaging consequences of climate change: rising sea levels, increased frequency and intensity of storms and coastal erosion. An estimated 100 million or more people globally benefit directly from the risk reduction that coral reefs provide. If coral reefs were degraded, the costs of hazard mitigation and adaptation would significantly increase. Healthy coral reefs play a major role in coastal protection by serving as natural breakwaters that

[28] e.g. Komyakova V, Munday PL, Jones GP (2013) Relative importance of coral cover, habitat complexity and diversity in determining the structure of reef fish communities. *PLoS ONE* 8(12): e83178. doi: 10.1371/journal.pone.0083178

[29] Ministry of Tourism and External Communications

shield coastlines, coastal populations, properties and infrastructure against storms, flooding and erosion. The live hard coral structures on fore reef slopes and shallow reef crests dampen oncoming waves, thus sheltering the lagoons to increase beach protection (a highly valued resource in tourism) and allowing the growth of other critical habitats, including seagrass beds and mangroves. These sheltered habitats further reduce the risk of coastal erosion, through stabilizing sediments, while also providing nursery habitats for the juveniles of economically important fish and invertebrate species.

The value of coastal protection provided by coral reef ecosystems is difficult to measure but is considered significant. The value has been estimated at USD1.2 million per year in the Virgin Islands[30] and USD265.9 million a year in Bermuda[31]. Compared with other coastal habitats such as mangroves and salt marshes, coral reefs have been found to have the greatest potential for coastal protection[32]. Coral reefs reduce wave energy impacting shorelines by an average of 97%, with reef crests dissipating most (86%) of this energy[33] and reef flats dissipating approximately half of the remaining wave energy. This means that even narrow coral reef flats effectively contribute to wave attenuation. They have also been estimated to reduce wave height by on average 70%.

Furthermore, research has shown that coral reefs are critical not just for low-frequency, high-energy events such as storms and cyclones, but also for reducing coastal erosion from high-frequency, daily small wave events. Another key factor in wave attenuation is bottom friction, which is a function of bottom "roughness" and which is being reduced worldwide by coral reef degradation. For example, the loss of branching corals in the Caribbean has significantly reduced both the height and roughness of reefs, particularly the reef crests[34]. Thus, a reduction in the amount of live hard coral cover and the loss of reef framework that occurs when a reef is degraded by anthropogenic or climate change related impacts, directly threatens the food security and livelihoods of communities, dependent on reef fisheries, and puts these same people and property at further risk from climate related coastal hazards. As vulnerable SIDS, both Mauritius and Seychelles must explore all possibilities to protect food security and reduce disaster risk from climate change induced events.

Unfortunately, coral reefs and their associated coastal and marine ecosystems in Mauritius and Seychelles have been threatened by continued habitat destruction and fragmentation caused by coastal development, overexploitation of fisheries resources, destructive fishing practices, pollution, invasive alien species and bleaching events especially in 1998 and 2016. In Mauritius, coastal development has led to backfilling of wetlands, with 90% of all wetlands having been destroyed[35]. Soil runoff and erosion leading to excess nutrients from fertilizers and domestic sewage augment eutrophication in the lagoon. This is coupled with a threat of contamination and deterioration in water quality by industrial wastes. It has been estimated that metal pollution has caused a decline in coverage of live corals of 10 to 30 percent in coastal lagoons around Mauritius

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[30] BT. van Zanten, PJH. van Beukering, AJ. Wagtendonk 2014. Coastal protection by coral reefs: A framework for spatial assessment and economic valuation. *Ocean and Coastal Management* 96: 94-103

[31] Sarkis, S., van Beukering, PJH, McKenzie, E. (eds.), 2010. Total Economic Value of Bermuda's Coral Reefs: Valuation of Ecosystem Services. Technical Report, Department of Conservation Services, Government of Bermuda, Bermuda. 199 p.

[32] Narayan S, Beck MW, Reguero BG, Losada IJ, van Wesenbeeck B, Pontee N, et al. 2016. The Effectiveness, Costs and Coastal Protection Benefits of Natural and Nature-Based Defences. *PLoS ONE* 11(5): e0154735. doi:10.1371/ journal. pone.0154735

[33] Ferrario F, Beck MW, Storlazzi CD, Micheli F, Shepard CC, Airoldi L. 2014. The effectiveness of coral reefs for coastal hazard risk reduction and adaptation. Nature Communications 5.

[34] Alvarez-Filip, L., Dulvy, N. K., Gill, J. A., Cote, IM. & Watkinson, AR. 2009. Flattening of Caribbean coral reefs: region-wide declines in architectural complexity. Proc. Biol. Sci. 276, 3019–3025.

[35] Republic of Mauritius Ministry of Agro-Industry and Food Security "Fifth National Report to the Convention on Biological Diversity" April 2015

in 2012[36]. The existence of invasive alien species in the lagoon has not been recorded except for the occurrence of *Caulerpa taxifolia* – an invasive marine algae – the growth of which has been stimulated by wastewater effluents which prevents the presence of almost all native marine life and affects the livelihoods of fishermen[37]. Overfishing and destructive fishing practices are also prevalent, although a recent increase in total fishery catches are noted. These are compounded by the effects of tourism and leisure boating activities and underwater activities such as diving, snorkelling and underwater tours leading to anchor damage and other direct impact by users.

One measure to support the conservation of corals has been the establishment of Marine Protected Areas (MPAs) in strategic sites around Mauritius and Rodrigues covering 155 square kilometres, namely two marine parks and nine fishing reserves around the island of Mauritius and one MPA, six fishing reserves and four marine reserves in Rodrigues protected under the Marine Resources Act 2007 and the Marine Protected Areas Regulation 2001. Management plans have been developed for the two marine parks and the MPA in Rodrigues under the UNDP-GEF project *Partnerships for Marine Protected Areas in Mauritius and Rodrigues.*

Seychelles also faces numerous challenges[38] related to the preservation and management of its marine ecosystems and coral reefs. Overall, these threats represent a barrier to achieving sustainable development in Seychelles. These include:

- Chronic coastal erosion from increased demand for construction in the marine environment or on sandy beaches
- Coastal flooding from poorly planned coastal development
- Destruction and alteration of marine and coastal habitats from increase human use of marine and coastal areas
- Over-fishing from unsustainable level of fishing effort
- Invasive alien species (IAS) from lack of education, awareness and concern, and ineffective border control
- Marine and coastal littering due to increased use of non-biodegradable products and improper management of solid waste
- Coral reef degradation from anchor damage and outbreak of plague organisms

The Government of Seychelles has been addressing the above through a series of national initiatives as well as partner-supported projects, including a number of UNDP projects. Most notably, the Seychelles established five Marine National Parks in the 43 inner islands that make up the 'inner islands' of the Seychelles, Sainte Anne Marine National Park, Baie Ternay Marine National Park, Curieuse Marine National Parks, Silhouette island Marine National Park and Port Launay Marine National Park, covering 24.63 km^2, one Marine Protected Areas (0.01 km^2), 4 Shell Reserves (7.3 km^2) and several Special Reserves, including Cousin Island Special Reserve (0.27 km^2).

Additionally, marine protected areas in Mauritius and Seychelles form part of a network of MPAs of the Western Indian Ocean comprising also the MPAs of the Comoros, Madagascar and Reunion. This network was established to enhance the effectiveness of conservation through a regional approach in addition to the efforts already undertaken by each country in order to encourage a regional ecological vision and cooperation beyond the geographic, economic, social

[36] Ibid.
[37] Ibid.
[38] MFF Resilience Analysis 2015

and cultural diversity of these countries[39]. This is complemented and reinforced by regional approaches and initiatives in integrated coastal zone management (ICZM).

Unfortunately, climate change poses a significant risk to the long-term viability of these marine conservation interventions due to the effects of rising sea-surface temperatures leading to coral bleaching. Coral reef restoration offers promise as a means to adapt to rising sea temperatures leading to more frequent coral bleaching events, increased extreme weather events and eroding coastlines.

4. Climatic change context

Mauritius and Seychelles are highly vulnerable to climate change in several ways, specifically the impact that elevated sea surface temperature is having on their coral reefs. Environmental pressures are significant, compounded by climate change and the specificity of being a Small Island Developing State (SIDS). Coral reefs provide a wealth of ecosystem services including food, coastal protection, recreational use, biodiversity benefits, and regulating services, all of which are vital to the local economies and food security of human populations living in vulnerable Small Island Developing States (SIDS) such as these two countries. Healthy and robust coral reefs, through the provision of these ecosystem services, ensure that coastal populations of tropical countries have increased resilience to the adverse impacts of climate change.

4.1. Past and current climate change:

The adverse impacts of climate change are already being experienced in terms of temperature rise, changes in rainfall/precipitation patterns, ocean acidification, sea level rise, accentuated beach erosion and increase in frequency and intensity of extreme weather events such as flash floods.

Climate records over the period 1951-2014 show a significant **warming temperature trend** of about 1.2°C in Mauritius and Rodrigues. Analysis of temperature records indicate that the observed rate of temperature change is on average 0.020°C/yr. and 0.023°C/yr. for Mauritius for the period 1951-2014 and for Rodrigues for the period 1961-2014 respectively.

The warming in the Seychelles region, over the period 1972-1997, is estimated to be of the range of 0.25°C. The number of very warm days and nights is increasing dramatically, while the number of very cool days and nights are decreasing. The annual maximum temperature warming in the past 34 years is estimated to be +0.33°C and is linked to the southern summer season. The annual minimum temperature warming in the past 34 years is estimated to be +0.82°C. The minimum temperature is warming faster than maximum temperature as a result of the 'urban heat island' effect and the warming is higher during the southeast monsoon.

The **sea surface temperature** observations at the Seychelles International Airport, Pointe Larue, show that SST is characterised by two maxima and minima linked to the transition period associated with the reversal of the monsoon winds and the equatorial ocean currents. The extreme minimum occurs in August at a time when the southeast monsoon is at its peak with the sun in the northern hemisphere. The extreme minimum temperature dropped from 25.8°C in August 2000 to 24.9°C in August 2005. In contrast, the extreme maximum of SST in April 2000 has warmed up to a maximum of 30.1°C in April 2001 following the 1999-2000 La Nina event. In

[39] Commission de l'Océan Indien. "Network of the AMP". Retrieved from http://commissionoceanindien.org/publications/archives/aires-marines-protegees/marine-protected-area/the-network/

Mauritius, sea surface temperature anomalies have led to coral bleaching events in 1998, 2003, 2004, 2009 and 2015[40].

Sea level rise has been observed to be accelerating at an average rate of 5.6 mm/year in the last decade for both Mauritius and Rodrigues, much higher than the global average of 3.2 mm/yr. The Republic of Mauritius is also situated in the tropical cyclone belt of the South Western Indian Ocean (SWIO) where rapid formations of high intensity tropical cyclones and super cyclones have been observed. It is therefore highly exposed to such extreme climatic phenomenon with serious risks to life and hard-won development gain, which includes basic amenities and properties. In Seychelles, an annual sea-level trend anomaly of +0.146 has been observed on one monitoring station[41].

Analysis of rainfall over the period 1951-2014 shows a **decreasing trend in rainfall** amount of about 8% for Mauritius. For Rodrigues, a water scarce island, a downward trend has also been observed in the rainfall. Over the same period, the central plateau, the main recharge zone of the island, has witnessed a decrease in annual precipitation from a maximum of 4000 mm/year to 3800 mm/year with drying being more pronounced to the north and west.

Extreme precipitation and flooding is now of great concern for Seychelles. However, only few studies are available mainly because of an absence of a network of rainfall intensity observation instruments. The existing manual voluntary network of rain gauge only measures 24 hours rainfall. Heavy rainfall events have been the major contributor to the increase in rainfall (Lajoie, 2004). However, further observations and rainfall intensity analysis are recommended to draw firm conclusions. Infrastructure properties, buildings and roads have been affected or damaged due to flooding, erosion and landslide in Mauritius. For instance, the Port's operations were suspended for 10 days in 2014 due to adverse weather conditions leading to USD 54M loss.

Accentuated **beach erosion** has shrunk the width of beaches around certain coastal areas in Mauritius by up to 10 meters over the eight years. Coral reefs are in a state of deterioration. Sea level has been rising at a rate of 5.6 mm per year since 2003. Most of the exposed locations in Seychelles are being affected by coastal erosion. Coastal erosion may be classified as a major problem especially to those properties, infrastructure and people situated on the coastal plains and shoreline. Some coastlines have been retreating for a long time. At Anse Kerlan (Praslin) for instance, old resident's estimate that approximately 10,000 square metres of coastlines have been washed away. Erosion-sensitive sites on Mahe and Praslin are being lost at an average of 1-3 m per year (Tsunami Disaster Task Force, 2005; Seychelles Nation, 1998). Increased recession of the coastline also takes place because of the destabilising nature of the high tide levels. Flooding in the low-lying areas becomes more pronounced with the occurrence of storms coinciding with the annual spring tides.

4.2. Future climate change

Mauritius

[40] Mauritius Third National Communication.
[41] Seychelles Second National Communication.

The projected changes in climate in Mauritius include an increase in mean annual temperature but no significant variations in rainfall pattern. Projections made on the basis of RCP 4.5 and RCP 8.5 (the business as usual scenario and the worst-case scenario respectively) indicate an increase in temperature of up to 2°C over both Mauritius and Rodrigues for the period 2051-2070. Projections for RCP 4.5 and RCP 8.5 scenarios do not show significant variation with respect to the present rainfall pattern.

A series of projections have been made for the future effect of climate change in Mauritius and Rodrigues, as follows:

- Reduction in rainfall and an increase in evapotranspiration may lead to as much as 15 to 25% decline in agricultural production by 2050. With a decrease in rainfall of 10 to 20 % and an increase in temperature of 2°C, reductions in cane yield is expected to range from 34 to 48% while reductions in sugar yield is expected to range from 47 – 65 %.

- An increase in mean annual temperature extremes coupled with beach erosion can lead to a reduction in tourist arrivals accounting for a revenue loss of up USD 50 million by 2050. In Rodrigues, more severe bleaching may lead up to 75% mortality of corals at some sites resulting in a decline in fish population, loss of the protective function of the reef, and loss of sandy beaches of the order of about 5 m every decade.

- Utilizable water resources may decrease by up to 13 % by 2050 if no action is taken to restore catchment areas.

- There will be a greater proliferation of invasive alien species at the expense of native species, a decrease in pollinator activity due to shifts in plant phenology and coastal vegetation, turtle nesting, and wader visitation on low lying islets will be affected.

- Increase in the occurrence of coral bleaching, would reduce coral biodiversity and fish species for both Mauritius and Rodrigues while algal blooms due to high sea surface temperature would result in mass mortality of marine biodiversity and resources.

- Climate change may increase the vulnerability of the health sector in the coming decades leading to higher disease burden with associated health cost and impaired socio-economic development in the Republic of Mauritius.

- There will be accelerated softening and deterioration of bituminous pavement, surface and thermal cracks to concrete, increased corrosion of steel, scouring of foundations and embankment collapse and damage to buildings and power transmission masts in both Mauritius and Rodrigues.

Seychelles

Projections made with climate models suggest the following future climate change scenarios. Air temperature for both Mahe and Aldabra area warming by +3.0°C. The relative warming will occur mainly during the cooler southeast monsoon. Rainfall patterns will be more extreme, with extreme dry (i.e. prolonged dry spells) during the dry season and more wet (i.e. likely flooding) and hot episodes during the wet season. An annual sea level trend anomaly of +1.46 mm (± 2.11 mm) per year is suggested for Mahe Island. These results are in line with the global measured average mean sea level rise (from 1961 to 2003) of 1.8 ± 0.5 mm/year.

Of relevance to both Mauritius and Seychelles, the frequency of mass coral bleaching events is predicted to increase in the coming decades as seawater temperatures will continue to rise. It has

been estimated that, by 2100, live coral cover globally could be reduced by 30-88% through impacts such as bleaching and reduced calcification in the event of 1.1°C to 2.6°C rise in temperature (RPC4.5 scenario)[42]. Climate change is predicted to increase the frequency of high-intensity storms in selected ocean basins depending on the climate model. However, the tropical cyclone damage from climate change tends to be concentrated in North America, East Asia and the Caribbean–Central American region[43]

In the future, it is projected that the sea level rise will affect almost all of the economic sectors of the Seychelles. The main granitic islands rise up to 300m, have steep hill slopes which are prone to landslides, and have a very narrow strip of coastal plain. According to the IPCC Fourth Assessment Report, 2007, the average rate of sea-level rise is 1.6 mm/year; the global average sea-level rise for the end of the 21st century (2090-2099) ranges from 0.19 to 0.58 m.

Sea level rise is expected to affect Seychelles in the following ways:

- Destroy properties and infrastructure located on the coastal plains and reclaimed land;
- Inundate agricultural areas, wetlands and the lowlands;
- Cause several low-lying islands, especially the sand cays to disappear;
- Erode the shorelines and beaches;
- Enhance coastal flooding, especially during severe rainstorms and high tides;
- Increase salinity of mangrove swamps and raise groundwater level thus affecting plant growth;
- Threat groundwater aquifers and coral island fresh water lens;
- Alter tidal ranges in the rivers and bays;
- Alter sediment deposition patterns; and
- Affect the coastal and the marine ecosystems.

4.3. Coral reef and climate change

Coral reefs in the Western Indian Ocean (WIO), as elsewhere in the world, have suffered from a range of negative human-induced impacts but climate-change associated bleaching has caused particularly serious degradation, notably in the islands. The WIO was severely affected by the first major global bleaching episode caused by the 1997/1998 El-Niño/Indian Ocean Dipole event, which resulted in extensive and sustained high seawater temperatures. Coral mortality ranged from 10% in Mauritius to 80-95% on the worst affected coral reefs in the Seychelles[44], with live coral cover reduced to less than 3% in some areas[45]. While some coral reefs recovered naturally within 5-10 years, others remained as rubble wastelands even within well-established MPAs, often impacted by other local factors. Further outbreaks of coral bleaching occurred in 2004 and 2009 and although in many sites bleached corals recovered, many others have died[46].

[42] IPCC 2014: Arent et al. 2014: Cross-chapter box on the water–energy–food/feed/fiber nexus as linked to climate change. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.*

[43] Mendelsohn R., Emanuel K., Chonabayashi S., Bakkensen L. (2012). The impact of climate change on global tropical cyclone damage. Nature Climate Change 2, 205–209

[44] Obura D (2005) Resilience and climate change: lessons from coral reefs and bleaching in Western Indian Ocean. Estuarine, Coastal and Shelf Science 63: 353–601 372.

[45] Graham NAJ, Wilson SK, Jennings S, Polunin NVC, Bijoux JP, Robinson J (2006) Dynamic fragility of oceanic coral reef ecosystems. Proc. Nat. Acad. Sci. USA 103 (22): 8425–8429. doi:10.1073/pnas.0600693103.

[46] Moothien-Pillay, S., Bacha Gian, S., Bhoyroo, V. and Curpen, S. 2012. Adapting coral culture to climate change: the Mauritian experience. *Western Indian Ocean J. Mar. Sci*. 10(2): 155-167.

Figure 5 shows the trends in live coral cover since 1997, up to 2007[47]. Mauritius showed a major reduction (up to 70%) in live coral cover between 1997 and 2007, with a slightly smaller decline for Rodrigues. Coral cover at monitoring sites on Rodrigues in 2008 averaged just under 40%, and on Mauritius in 2009, between 10-20%[48], with a range of local impacts impeding recovery[49]. Although not shown on this graph, there was also a major decline in Seychelles, particularly in the inner granitic islands[50]. Coral cover declined by 50–90% after 1998, such that many reefs had cover of less than 10% while others had moderate recovery but experienced further coral mortality after bleaching in 2002–2003. The loss of live coral was so extensive and widespread that sources of coral larval influx for recruitment were greatly reduced and the spread of algae coverage limited coral recruitment and development. The increase in coral cover shown in Figure 5 for Seychelles is largely due to the recovery of reefs in the outer islands, which are subject to fewer local impacts.

Figure 5 *Trends in live coral cover in the COI countries, 1997-2007. Legend: Red line= Mauritius; yellow line = Rodrigues; brown line – Seychelles*

In 2015-2016, the largest and most intense El Niño-coral bleaching event on record occurred worldwide[51]. Coral monitoring on bleaching extent, mortality and recovery potential is currently underway, but preliminary information from Mauritius and Seychelles indicates that coral reefs in both countries were badly affected, and that the initial recovery from the 1998 mass bleaching was reversed in many locations. At two monitored sites in Mauritius (Ile aux Benitiers and Flic en Flac) live coral cover was about 70% in 2012 but dropped to 32-38% in 2015[52]. In Seychelles, on the inner granitic island reefs, which by 2012 were in many places dominated by macroalgae, coral recovery has been shown to be constrained by unsuccessful settlement or poor post-

[47]Hamada, S.; Bijoux, J.; Cauvin, B.; Hagan, A.; Harris, A.; Koonjul, M.; Mercier, S.; Quod, J. P. 2008. Status of coral reefs of the South-West Indian Ocean Island States: Comoros, Madagascar, Mauritius, Reunion, Seychelles. In: *Status of Coral Reefs of the World*. p 105-118.

[48] Cauvin et al, 2010. Synthèse régionale 2010. Suivi de l'état de santé des récifs coralliens des Îles du Sud -Ouest de l'Océan Indien. COI/ReCoMap.

[49] Moothien-Pillay, S., Bacha Gian, S., Bhoyroo, V. and Curpen, S. 2012. Adapting coral culture to climate change: the Mauritian experience. *Western Indian Ocean J. Mar. Sci*. 10(2): 155-167

[50] Chong-Seng KM, Graham NAJ, Pratchett MS (2014) Bottlenecks to coral recovery in the Seychelles. Coral Reefs 33 (2): 449–461. doi:10.1007/s00338-014-1137-2.

Harris A, Wilson S, Graham NAJ, Sheppard C (2014) Scleractinian coral communities of the inner Seychelles 10 Years after the 1998 Mortality Event. Aquatic Conservation 24 (5): 667–679. doi:10.1002/aqc.2464.

[51] Eakin, CM et al., 2016. Global coral bleaching 2014-2017 – status and appeal for observations. *Reef Encounter* 31(1): 20-26.

[52] MOI 2016. Presentation by MOI during consultant's mission.

settlement survivorship; and equally on rubble dominated reefs high densities of juvenile corals failed to translate into high cover of adult corals because of the lack of a conducive environment[53]. By 2014, the inner Seychelles hard coral communities were assessed as having lower generic diversity and lower abundance of adult hard corals than other coral reef regions of the Indian Ocean for which comparable data were available[54].

Coral bleaching is now recognized as one of the major threats to coral reefs and their associated communities. The frequency of such events is predicted to increase in coming decades as seawater temperatures continue to rise. It has been estimated that, by 2100, live coral cover globally could reduce by 30-88% through impacts such as bleaching and reduced calcification in the event of 1.1°C to 2.6°C rise in temperature (RPC4.5 scenario)[55]. In both countries, over-fishing, land-based sources of sediments from erosion of agricultural land and deforested slopes, nutrients from sewage and fertilisers, and tourism-based activities and anchor damage have also prevented recovery. Natural threats include cyclones and tropical storms and sporadic outbreaks of the coral predator, the Crown of Thorns Starfish, *Acanthaster planci*. The combination of these threats is resulting, as on reefs globally, in progressive replacement of reef building corals with soft corals and algae that have less ecological and socio-economic value[56]. Seychelles is planning to address this problem (at a pilot scale) through the upcoming *GEF-6 Ridge-to-Reef project*.

The recurrence of mass bleaching events means that securing a future for coral reefs ultimately requires urgent and rapid action to reduce global warming [57]. However, waiting for worldwide action to reduce global warming before implementing coral reef restoration is a luxury that cannot be afforded. In the Anthropocene era, there are corals that survive bleaching events, and these corals offer an opportunity to restore coral reefs to maintain ecological function, while the human population drastically reduces burning of fossil fuels[58].

5. Selection of coral reef restoration sites

Mauritius

The **Blue Bay Marine Park** (fig.6) has been earmarked as a site for the implementation of the project. Blue Bay Marine Park was among two of the first marine parks to be declared in Mauritius, and enjoys a high number of visitors with an active management in place; with coast guards and fisheries officers patrolling the area, a newly-built marine park centre providing a venue for education and research, and a management committee which includes NGOs and other major stakeholders. Blue Bay has also been the site of pilot projects in coral reef restoration.

The Blue Bay Marine Park is a RAMSAR Site, which covers a marine area of 353ha between Pointe Corps de Garde and Pointe Vacoas along the coast, from the lagoon to 1 kilometre seaward from the reef crest. The site provides a habitat for mangroves, algae, sea grasses, 38

Figure 6 *Location of Blue Bay Marine Park and coastal villages concerned by the project*

[53] Chong-Seng KM, Graham NAJ, Pratchett MS (2014) Bottlenecks to coral recovery in the Seychelles. Coral Reefs 33 (2): 449–461. doi:10.1007/s00338-014-1137-2

[54] Harris A, Wilson S, Graham NAJ, Sheppard C (2014) Scleractinian coral communities of the inner Seychelles 10 Years after the 1998 Mortality Event. Aquatic Conservation 24 (5): 667–679. doi:10.1002/aqc.2464.

[55] IPCC 2014: Arent et al. 2014: Cross-chapter box on the water–energy–food/feed/fiber nexus as linked to climate change. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.*

[56] Thomassin A. 2011. No 5. Recommandations finales. Etude de faisabilité pour la mise en place d'une ou plusieurs AMP sur la côte sud-ouest de Maurice. MMCS/ProGeCo.54p

[57] Hughes TP et al (45 authors) (2017). Global warming and recurrent mass bleaching of corals. Nature 543:373-378

[58] Hughes TP et al (12 authors) (2017). Coral reefs in the Anthropocene. Nature 546: 82-90

species of corals, 72 species of fish and other marine organisms including occasional visits of a few specimens of marine turtles. Blue Bay Marine Park acts as a refuge, feeding, spawning and breeding grounds to various species of marine organisms.

Figure 7 *Location of SEMPA and Marine Reserves in Rodrigues*

In Rodrigues, the **South East Marine Protected Area (SEMPA)** (fig. 7), established 2009, is the largest MPA to date in Mauritius and is the second site of operation. The MPA operates through

a co-management framework between local authorities, fisher representatives and NGOs. During ecological monitoring carried out between 2009 and 2011, patchy coral bleaching was observed both inside and outside SEMPA, corresponding with higher seawater temperatures at the time. In 2016, the worst coral bleaching event was observed, with an average dead coral cover due to bleaching estimated at 51.40% and a remaining mean live coral cover of only 15.63%. Live coral cover has decreased from >35% in 2010 to 15% in 2016. Strengthening MPA management measures and using an ecosystem-based approach to adaptation is a high priority for Rodrigues.

SEMPA is situated in the South East of Rodrigues. It covers an area of approximately 80km^2 of marine environment (lagoon and off lagoon). It is very diverse and highly productive ecosystem, but remain relatively shallow, which make the ecosystem vulnerable to climate change.

Seychelles

In Seychelles, coral reef restoration works will be effected at Curieuse Marine National Park, Cousin Special Reserve, Ste Anne Marine National Park and at Anse Forbans.

Curieuse Island (fig. 8) is a small granitic island 2.9 km^2 in the Seychelles close to the north coast of the island of Praslin. In 1979, Curieuse and surrounding waters were declared the Curieuse Marine National Park in order to protect the native wildlife. It is managed by the Seychelles National Parks Authority. It is the home to a number of indigenous plants, including the rare coco de mer palms as well as a plethora of animals. Between 1978 and 1982, there have been a conservation project to relocate Aldabra giant tortoise from Aldabra to Curieuse. Today there is a volunteer group that focuses on conservation of the island and survey local fish, coral, turtle and coco de mer number.

Cousin Island (fig. 8) is a small (34 ha) granitic island of the Seychelles, lying 2 km west of Praslin. It is a nature reserve protected under Seychelles law as a Special Reserve and is managed by Nature Seychelles, a non-profit organisation. The island was formerly a coconut plantation that had been stripped of much of its native vegetation. The island was declared special reserve in 1975, thus protecting coral reefs, which extends 400 m (1,300 ft.) into the sea from the shoreline. It is used by international research organisations and universities as a research base. It is a demonstration site for the International Coral Reef Action Network (ICRAN). The reserve attracts around 10,000 visitors each year.

Sainte Anne Marine National Park (fig. 9) lies about 5 km from Victoria, the capital city of the Seychelles. It was declared Marine National Park in 1973 and is one of the largest park of Seychelles (2 km^2) It extends over six islands (Cerf, Ile Cachée, Long, Moyenne, Round and Sainte Anne), with the main island of Sainte Anne acting as the centre for administration. Ste. Anne Marine National Park contains one of the largest area of seagrass meadows in the granitic islands. Nowadays, the island is occupied by a five-star hotel and access is restricted. The island remains one of the most important nesting sites for hawksbill turtles in the granitic islands, requiring restriction of some beaches during nesting season.

Additionally, a pilot site (Anse Forbans) has been selected as restoration and which is outside an MPA. This site has been selected to evaluate feasibility of restoration effort outside a protected area. This coastal region has a local community that is quite dependent on artisanal fisheries. There has been also a perceived increase in beach erosion during the last decade.

Figure 9 Location of Ste Anne Marine National Park and Anse Forbans

***Figure 8** Location of Curieuse Marine National Park and Cousin Special Reserve*

Socioeconomic context around selected sites

In Mauritius, the Marine Protected Area's legal framework came into effect in 1997 first through the National Parks Act of 1993 and Blue Bay was subsequently declared a Marine Park in 2000 through the Fisheries and Marine Resources Act of 1998. Blue Bay consists mostly of a tourist village, with beach bungalows used by Mauritians and some rented out to tourists, a public beach which accommodates a large number of Mauritians on the weekends, approximately 100 boat operators registered in the park carrying out glass bottom visits in the park and other outings - though not all every day - and currently two main hotels directly adjacent to the Park: Shandrani Resort and Spa, a five star hotel, Le Peninsula Bay Resort and Spa, the construction of a new hotel on La Cambuse beach and last, a number of smaller guesthouses in the near vicinity.

In the greater SEMPA region, fishing is a core economic activity and households heavily depend on their catch for their own consumption. A socio-economic survey carried out in 2008 revealed that within the villages surrounding the SEMPA area, 66% of households responded that at least one household member is involved in fishing activities; registered fishers are present in 52% of households. The importance of fishing in the region is further accentuated by local consumption, and a vast majority of respondents of the same survey indicated that they consume seafood on a daily basis. Household use was the most important use of their catch, however 60% of households also sell seafood for income. The most important fishery is the octopus fishery; other common fishes caught are 'Cordonnier', 'Capitaine', 'Vielle' and other reef fish.

As per the Mauritian Republic's Regional Development Index, Rodrigues was estimated at 0.557 which was on par with the least developed areas of mainland Mauritius. Fishing is one of the largest employment sector on the island and is part and parcel of the island's culture, with 13% of the workforce dedicated to this activity, and the same amount engaged in fishing on a casual basis. The villages that are in the immediate vicinity of the proposed restoration site include Graviers, Mourouk, Port Sud Est and Songes, with and estimated population of 2,700. With fisheries in serious decline, fishers have suffered from a loss of income and many have turned to other sources of income to make ends meet. Rodriguans are much more dependent on their lagoon fishery than in Mauritius, both in terms of employment, cultural practice and protein intake.

Protected Areas in the Seychelles have been established since the 70's for multiple reasons. Mostly, however, they are to protect biodiversity where it is most abundant or vulnerable and/or to protect land and sea scape values. To date, more than 47% of the total land area of the Seychelles in under legal protection. These protected areas currently fall under different pieces of legislation. Protected areas are regulated under different pieces of legislation, notably the National Parks and Nature Conservancy Act (1969, as amended), the Wild Animals and Birds Protection Act (1961), the Wild Birds Protection (Nature Reserves) Regulations (1966), Fisheries Act (1987), Environment Impact Assessment (1994) and the Protected Areas Act (1967). Some

of these protected areas have management plans. Activities are regulated, and no fishing is allowed in the Protected Areas. Seychelles is envisaging to increase and re-organise their Protected Area System (PAS) to include a range of protective mechanisms, provide a focus for the protection and restoration of both terrestrial and marine endemic species and their respective habitats in efforts to restore the representative ecosystems of the archipelago.

The inshore domestic fisheries of the Inner Islands of the Republic of Seychelles are currently fully exploited and may be locally overexploited. In response to this, MPAs have been advocated as buffers against overfishing. However, lack of fisheries enforcement is a problem common to all fisheries in Seychelles and most of the MPAs are poached to some degree, despite all being subject to no-take regulations. This is especially true for fishers based in regions in close proximity to existing MMPAs and due to the perception that there is a decline in 'legal' fish available[59].

Vulnerable groups

In Mauritius 8.5% of the population is below the national poverty line[60]. Many of these groups are the most vulnerable to coastal flooding either because they live on the shoreline or in reclaimed areas of wetlands at risk of flooding or because the structures they live in are not robust enough to withstand flooding. Artisanal fishers have long been recognized as a vulnerable group[61], with national average income ranging from Rs. 5,123 per month for fishers in non-motorized hand boat units to Rs. 23,770 per month over six months for seine net fishers[62].

Many people who work in and around Blue Bay Marine Park are Mahébourg residents, a larger town with an important fisher population. Mahébourg has been designated as a vulnerable coast, with 1442 persons likely to be affected by coastal inundation by 2065[63]. A proportion of these fishermen reside in Résidences La Chaux. The latter neighbourhood is located directly on the coast and its socio-economic structure is intimately tied to the sea. Résidences La Chaux commonly referred to as "Cité La Chaux" has been designated a pocket of poverty by the National Empowerment Foundation. Income sources in Cite La Chaux are not very varied, and the majority of its residents (54 % of men and 61% of women) earn between Rs. 4,000 and 8,000 per month, being at or below the national poverty line. Other vulnerable areas (fig.6) include Cité EDC in Beau Vallon and Cité Tôle, an extension of Cité La Chaux occupied by squatters for several decades. The latter area counts approximately 30 registered fishermen who operate at fish landing stations in both Mahébourg and Pointe d'Esny. The total number of registered fishermen in Mahébourg including Cité La Chaux and Cité Beau Vallon is 164. Fisherfolk living in these neighbourhoods have expressed degrading fishing conditions, with some attributing decline in fish catch to illegal fishing and others to instability and climate[64].

Coastal villages further north of the project site are also considered, as their inhabitants are heavily dependent on the marine environment adjacent to Blue Bay Marine Park and Grand Port Fishing Reserve for their livelihood. These include Ville Noire, Grand Port, Grand Sable, Bois des Amourettes, Quatre-Soeurs in addition to the Blue Bay area itself. The villages north of the Park described above, namely Vieux Grand Port, Grand Sable, Bois des Amourettes have been

[59] Wood L (2004) "Motives for poaching in Marine Protected Areas in the Seychelles", Western Indian Ocean, J. Mar. Scie Vol 3, No 2, pp 199-208

[60] https://www.undp-aap.org/countries/mauritius

[61] Truth and Justice Commission "Volume 1: Report of the Truth and Justice Commission", 2010, 255-260

[62] Indian Ocean Commission "Value Chain Analysis of the Artisanal Fishery in Mauritius". Smartfish Programme for the implementation of a regional strategy for the Eastern and Southern Africa and Indian Ocean Region. 2012.

[63] JICA "Guideline for Climate Change Adaptation Strategy - Coastal Setback" (2016) The Republic of Mauritius

[64] EPCO "Feasibility study: developing community-based mariculture in the Barachois of Residences la Chaux/Mahebourg: final report" 2016

listed among the most deprived and vulnerable in the country. They rely heavily on fishing and micro-scale farming for subsistence as well as seasonal work and cash from informal labour[65].

Moreover, at Blue Bay, an important number of coastal inhabitants who are not on the official list of registered fishermen depend on fishing in the lagoon for their livelihoods as the lagoon is open access and restrictions exist only for net fisheries and on marine protected areas. The number of such individuals has been estimated to be around 25,200 in 2003[66]. This access has contributed to the overexploitation of lagoon resources and remains a management challenge due to the undocumented nature of the activity. At the same time, these fishermen do not receive the same benefits provided by the State as for registered fishermen, and often live and work in precarious conditions. Providing reliable and sustainable alternative livelihood options for all fishermen remains a priority to decrease fishing pressure on the lagoon and help lift fishermen out of poverty traps in the context of a changing climate and decreasing coral cover. Coral reef restoration efforts provide an opportunity for fisherfolk and other vulnerable groups to receive income on restoration work while ensuring that the ecosystem services providing the basis for their livelihood as fishers can be sustained.

Most of the Marine Protected Areas in Seychelles are un-inhabited but are highly visited by tourists every year (approximately 57,000/year), which represents a significant source of income and sustainable livelihoods for the islands. The nearest coastal inhabitants to the proposed restoration sites are from Praslin Island (population 8900), Victoria (population 26,450), and Takamaka (population 2,825). In Seychelles, the poorer groups within the community comprise 39.3% of the population who live under the Basic Needs Poverty Line[67]. Around 10% of the households are to some extent dependent on small-scale artisanal fisheries. However, at present, socio-economic information is not well integrated in fisheries monitoring. The social systems and dynamics have been poorly understood or studied.[68]

6. Barriers to be removed by the proposed project

Over recent decades, in both Mauritius and Seychelles, corals have suffered heavy mortalities from bleaching events caused by sustained warmer than usual periods. These warmer than usual periods have been intensified by climate-change. The global bleaching event of 2015/2016 has been the largest and most intense ever recorded. It has caused extensive coral bleaching, and has contributed to scientific consensus that climate change is now the pre-eminent threat to the future survival of coral reefs and the ecosystem services that they provide. Without taking targeted actions to protect and restore coral reefs, the adaptation capacity of communities in tropical countries will be weakened through the degradation of reefs.

An important and innovative option available for both countries to recover reef health is to use active coral reef restoration in order to regenerate the structure and productivity of these ecosystems. Natural recovery processes on coral reefs often fail after large scale disturbances, such as bleaching caused by climate-change induced ocean warming. The loss and degradation of coral colonies leads to a reduced supply of coral larvae and often results in the substrate becoming unsuitable for settlement and/or survival of coral spat. Such failure in new coral recruitment after major loss due to coral bleaching explains why the positive impact on coral reefs

[65] Rambaree, Komalsingh. *A Case Study of Empowerment Interventions for the Eradication of Absolute Poverty in Southeast Rural Coastal Villages of Mauritius.* Leon Ginsberg. Social Work in Rural Communities. Alexandria: Council on Social Work Education, 2011.
[66] Indian Ocean Commission "Value Chain Analysis of the Artisanal Fishery in Mauritius".
[67] www.nsb.gov.sc National Bureau of Statistics, Seychelles. Poverty Report for the Household Budget Survey 2013
[68] ASCLME, Coastal Livelihoods in the Republic of Seychelles 2013

of commonly used conservation interventions, such as the establishment of marine protected areas (MPAs), generally do not occur fast enough to allow recovery before a further damaging event occurs. Climate change-induced bleaching events now tend to occur at a frequency and intensity that preclude natural recovery between each event. This results in increasingly poor health of the reef and reduced resilience to both further climate-induced events and to local anthropogenic impacts. In such situations, "active" restoration becomes the only option to initiate the recovery of degraded reefs and protection of their ecosystem services (see Annex 1). Coral reef restoration, once considered a controversial intervention, is now recognized by the scientific community as an important complementary activity to more passive conservation measures, in order to both promote reef recovery and improve reef resilience.[69] Research shows that some corals (certain species, or colonies with clades of resilient zooxanthellae) are resilient or resistant to bleaching and if these are used for restoration there is a strong potential for recovering some of the key functions of reef ecosystems.

Within the Western Indian Ocean (WIO), coral bleaching has undermined existing conservation reef efforts and many countries have been unable to respond using conventional passive conservation practices. The SIDS in particular urgently need to develop new capacities to restore the ecosystem services lost after coral bleaching and build resilience. Both Mauritius and Seychelles have a number of measures underway that will indirectly or passively improve coral reef health as a part of the broader ecosystem, including the establishment of networks of MPAs, pollution mitigation projects, fisheries management, introduction of Integrated Coastal Zone Management (ICZM) and coastal development regulation activities. Despite these passive measures, however, coral reefs continue to be degraded, through the increasing frequency of climate change-induced events. Without implementing active restoration, coral reefs will continue to degrade beyond their natural ability to recover, and passive measures alone will remain unable to create an adequate environment for recovery to occur. It has become clear that if coral reefs are to be able to continue providing the key ecosystem services of fisheries, tourism and coastal protection, active coral reef restoration should be implemented.

A regional approach will be essential, given the comparatively recent development of coral reef restoration technologies (see Annex 1 for terminology and a summary of progress to date globally

Active vs. _Passive_ Coral Restoration

Active coral restoration activities to be promoted by this project is actual in-situ coral planting and all other processes associated with it for the successful artificial coral nursing and planting.

Passive coral restoration activities are all other marine and costal ecosystem conservation measures, many of which are in fact quite proactive as conservation measures, that will not involve active nursing and planting of corals. These activities include MPA establishment, better management of MPAs, coral conscious fishing activities, and all conservation efforts to protect existing corals and their habitats in the ocean. They are considered _passive_ as they don't directly plant corals to restore coral reefs but rely largely on the coral's natural recruitment process and capacity by reducing external stresses on the existing corals.

It is critically important that passive coral restoration efforts continue and are increased in order for any active coral restoration efforts to be effective, as newly planted corals are much more vulnerable and sensitive to external stresses. Where active coral restoration activities are planned, passive coral restoration work should be strongly encouraged for better success.

[69] Gomez ED, Cabaitan PC, Yap HT, Dizon RM (2014) Can coral cover be restored in the absence of natural recruitment and reef recovery? Restoration Ecology 22 (2): 142–150. doi:10.1111/rec.12041.

and within each country). Sharing experiences and expertise between the two countries will help to accelerate progress. However, it will be important to take account of national differences. Research indicates that coral reefs in the two countries have different susceptibilities to bleaching[70]. Those in the Seychelles have amongst the highest susceptibilities to bleaching, out of five WIO countries that have been assessed: over 70% of the Seychelles coral reefs lie in moderate to highly susceptible geographical areas and are exposed to low currents and high solar radiation, which makes them more prone to thermal stress. In contrast, susceptibility estimates for reefs in Mauritius are low compared to the rest of the region, attributed to the comparatively high temperature fluctuations and wind velocities experienced in this country, with cool periods caused by storms and cloudy periods, a consequence of the country's more southern geographical location.

A regional project provides an opportunity to test out different responses to the implementation of coral reef restoration. Country-specific responses will need to be integrated into the regional approach. The socioeconomic and ecological conditions as well as long-term climate predictions in each country must be well understood because they will dictate the range of interventions that are feasible. Research suggests that although Seychelles has high adaptive capacity[71], the high susceptibility of its coral reefs to bleaching means that passive conservation measures may be too slow for reefs to recover before a further damaging event; therefore, implementing an active and innovative technologically advanced coral reef restoration programme to recover the ecosystem and provide adaptation to climate change may be appropriate here. Mauritius has moderate adaptive capacity which, combined with its low environmental susceptibility to bleaching, means that protectionist conservation policies, such as MPAs, can be effective coral reef restoration measures even under the climate change scenario and greater effort should be made to ensure these are put in place. Nevertheless, the current situation is such that more active measures, such as coral reef restoration, are needed as well, oriented also to helping to improve livelihoods.

The project will take account of such insights and ensure that the two countries learn from each other's strengths and weaknesses. The proposal is that Mauritius should develop a more community-based management and low tech coral reef restoration approach while Seychelles should build on its field experience to date and undertake wider scale, tech-based coral reef restoration that could potentially be mainstreamed into productive sectors. Both countries aim to involve tourism, on an innovative commercial basis.

In both countries, resilient corals will be propagated in nurseries in various partnership arrangements to supply a cost effective and continuous stock of corals for transplantation into areas degraded by climate change with the long-term aim of restoring the ecosystem services that healthy coral reefs normally deliver. The restoration efforts will provide alternative employment for local fishers, thus reducing current fishing pressure on the coral reefs, and for others providing improved livelihoods[72]. The project will capture lessons from these activities and

[70] Maina J, Venus V, McClanahan TR, Ateweberhan M. 2008. Modeling ecological susceptibility of coral reefs to environmental stress using remote sensing, GIS and in situ observations: a case study in the Western Indian Ocean. *Ecol Mod* **212**, 180–199,

[71] McClanahan TR, Cinner JE, Maina J, Graham NAJ, Daw TM, Stead SM, Wamukota A, Brown K, Ateweberhan M, Venus V, & Polunin NVC. 2008. Conservation action in a changing climate. *Conservation Letters* 1: 53–59.

[72] If the government(s) successfully manage to establish a system through which propagated corals nurtured at nurseries by fishermen and community members are bought by those whose business are dependent on the healthy coral reefs, such as hotels, dive operators, and alike; then, it would be a Payment-for-Ecosystem-Services (PES) scheme for coral restoration, which would be ideal to bring in private investments and partnership in coral restoration efforts and reduce financial burden born by the governments. The project will explore this PES potential.

disseminate them to the wider region and will provide the opportunity to upscale and mainstream the experiences to date.

Initially, the restored areas will have a lower coral diversity than prior to bleaching events, and it will take a number of years for a comprehensive coral reef community to develop. However, research is showing that some species, particularly fish, return quickly to restored coral reefs. It must also be understood that coral reefs have changed, are changing and will continue to change. Scientific consensus is that it is unlikely that future coral reefs will return to historical conditions[73] and it is becoming clear that the "restored 'reefs of tomorrow' will be different from reefs of the recent and more distant past[74].

However, as was agreed by the 2,500 scientists attending the 13th International Coral Reef Symposium (ICRS) in 2016, restoring coral reefs with resilient corals is a better strategy than leaving them to extinction. The analogy is with forest and wetland restoration, which are now well-established interventions bringing a range of conservation and socio-economic benefits and the restoration of essential ecosystem services.

7. Barriers to ensuring that coral reefs provide an effective ecosystem-based adaptation measure

Both countries have developed national frameworks for climate change mitigation and adaptation responses (Part II, section E) and have paid increasing attention to the role that coastal ecosystems play in determining the vulnerability of communities to climate change and mitigating its adverse impacts. Nevertheless, unless further action is taken, barriers remain that will prevent degraded reefs recovering sufficiently to ensure food security and shoreline protection for coastal communities. The speed with which climate change is resulting in negative impacts means that additional interventions are required to ensure sufficient adaptive capacity. Despite the current major investments in protecting coral reefs, including the creation and improved management of MPAs and the improved regulation of coastal development, this is still insufficient to maintain the role of coral reefs in food and income security and disaster risk mitigation. For example, in Mauritius, in 2009 only 14% of coral reefs fell within Fishery Reserves and 2% within Marine Parks, leaving over 83% with no protective designation[75].

The limited experience in and the lack of knowledge on coastal ecosystem restoration both in these countries and more widely hinders the application of ecosystem-based climate change adaptation measures. Lack of knowledge and insufficient awareness of climate change impacts and the urgency of addressing ecosystem restoration and resilience as an adaptation measure are further barriers. Therefore, the main barrier the project is targeting is the lack of standardized technical capacity between Mauritius and Seychelles to implement large-scale coral reef restoration

B. Project / Programme Objectives:

[73] Rinkevich B (2015) Climate Change and Active Reef Restoration—Ways of Constructing the "Reefs of Tomorrow." J. Mar. Sci. Eng. 3:111–127

[74] Rinkevich B (2014) Rebuilding coral reefs: Does active reef restoration lead to sustainable reefs? Curr. Opin. Environ. Sustain. 7:28–36

[75] NWFS Consultancy 2009. Environmentally Sensitive Areas Classification Report, Republic of Mauritius. Final Report.

The overall objective is to reduce the impact of climate change on local communities and coral reef-dependent economic sectors in Mauritius and Seychelles by implementing coral reef restoration with thermal tolerant corals as adaptation to climate change.

There are three specific objectives, the first two objectives are addressed by each country, and the third objective is regional:

1. To improve food security and livelihoods and mitigate disaster risk through active restoration of coral reefs degraded by coral bleaching as a result of climate change in Mauritius, in order to restore their essential ecosystem services.
2. To improve food security and livelihoods and mitigate disaster risk through active restoration of coral reefs degraded by coral bleaching as a result of climate change in Seychelles, in order to restore their essential ecosystem services
3. To generate knowledge and understanding about the use of coral reef restoration as an adaptation measure for dissemination within the two countries, to other SIDS and also countries within the WIO and other regions, and to build capacity for this intervention in the WIO. By adopting a regional approach, it is expected that the stakeholders involved will develop technical and scientific partnerships as well as a common understanding that will enable them to promote the use of effective natural solutions in adaptation and disaster risk reduction.

The project responds to two of the three thematic focal areas: food security and disaster risk reduction.

Food security:

Both Mauritius and Seychelles produce fish for its own consumption and for exportation. There are four main types of fisheries in Mauritius and Seychelles, namely: coastal/artisanal, aquaculture, offshore demersal, and tuna. Although the majority of the fish produced are from offshore demersal and tuna fishing, an important number of coastal inhabitants depend on fishing in the lagoon for their livelihoods and as a source of food. In Mauritius, the total fish production in 2014 was 12 329t and coastal/artisanal catch represent 13.4%[76] and in Seychelles the total artisanal catch was 3,632.5 tonnes (84.3% in Mahe and 15.7 % in Praslin and La Digue).

The fisheries sector is indirectly influence by climate change. It is documented that live coral cover provides habitat for coastal fishes. Observed dynamics include variations in meteorological parameters (e.g. water temperature and ocean acidification) that affect ecosystem which eventually disturb fisheries dynamics. The increased sea surface temperature (SST) are mostly responsible for coral bleaching that reduces coral biodiversity and fish species, with only resilient species surviving. Algal blooms due to high SST and nutrient rich seepage into lagoons are also known to be the cause of mass mortality of coral and fish. More frequent and intense rainfall is expected to cause increased sedimentation of the lagoons thus smothering the corals.

This correlation has been observed through the long-term data collected by Government of Mauritius, whereby it was noted that between 1995 to 2016, there has been a 50% decrease in artisanal fish catch s (from 1443t to 614t) and that during the same period, the mean percentage of live cover has halved, i.e. from 45% to around 20% cover. In Seychelles, prior to the bleaching of 1998, species targeted by the artisanal fisheries such as Snapper (Lutjanidae), Groupers (Epinephelinae) and Emperors and Breams (Lethrinidae) were found to be more common at

76 Government of Mauritius, Third National Communication 2016

Cousin Island than in other MPAs indicating predatory high trophic levels were present at Cousin Island and enforcement of the no-take reserve was being effective, as these species are usually the first to disappear or diminish in abundance when fishing occurs. After the 1998 mass bleaching event, major reductions in fish populations were found at the reserve.

The restoration of degraded reefs will increase coral cover and thus restore fish habitats and spawning/nursery sites, thereby encouraging the recovery of reef associated fish communities which are important as food to the local communities in Mauritius and, in Seychelles, to the national economy as a whole. As the corals grow in the ocean nurseries, and they eventually get transplanted to the reefs under restoration, both the coral nurseries and transplantation sites themselves facilitate the recruitment of new fish and aggregate fish species contributing to the protection of fish populations which can contribute to the local fishery.

For example, research in Seychelles has shown that density of blue-yellow damselfish *Pomacentrus caeruleus* was 12–16 times higher when corals were present at a coral nursery than in nurseries with no corals; furthermore, fish assemblages recruited into the nurseries were diverse in that they included three trophic levels, from herbivores to omnivores, in six families[77].

During a previous coral reef restoration project in Seychelles (2012), it was observed that one year after the first coral transplantation phase, fish density (as number of fish counted per in 154 m^2 circles) increased by 100 % compared to the control sites. By the end of the transplantation phase in 2014, fish diversity (number of species and abundance) in the restored reef became similar to the fish diversity at the control healthy reef. The reef fish community structure at the restored site resembled the structure found at a healthy coral reef. These results confirm that the coral reef restoration action increased the richness, diversity and abundance of fish communities and restored the fish community structure to a level similar to a healthy coral reef.

If the same coral transplantation density (4-5 corals per square meter) and coral size at transplantation (20 cm diameter) is maintained and the reef sites respond in the same way in Mauritius as in Seychelles, it is expected that the fish population and density will be increased with the restoration of coral reef at all project sites and thus will enhance fish catch in the area in the medium to long term.

In Mauritius, the proposed project will also link up with the Government's budgetary measure in 2017[78] to promote development of alternative livelihood opportunities for coastal communities through coral farming by fishermen and SMEs. A budget of USD 242,000 has been earmarked for this purpose. This project will enable the setting up of ocean-based coral farms for developing ornamental corals for the tourism sector, aquarium market and high-end jewellery manufacturing. This will therefore generate considerate considerable employment benefits along the coastal zone. In addition, the restored reefs will benefit the tourism industry, through greater aesthetic value and consequently higher visits by snorkelers and divers. This will create more opportunities for employment in the tourism industry and thus an increased source of livelihoods and greater food security.

Disaster risk reduction:

[77] Frias-Torres S, Goehlich H, Reveret C, Montoya-Maya PH. 2015. Mid-water coral nurseries recruit reef fish assemblages in Seychelles, Indian Ocean. *African Journal of Marine Science* 2338:1–6. doi: 10.2989/1814232X.2015.1078259.
[78] Government of Mauritius, Budget Speech 2017-2018

The coastline of mainland Mauritius extends over 322 km and that of Seychelles extends over 491km. These coastal areas support a number of activities including tourism, recreation, fishery, trade and industry.

The coastal areas are under constant threat. In Mauritius, based on the coastal erosion study[79], carried out by the JICA in collaboration with the Government of Mauritius, it has been found that 17% of the beaches of Mauritius are suffering from long term erosion (representing about 13 km of beaches). As a result of climate change, different parts of Mauritius are likely to be affected by a sea level rise of 1 m[80], the beach erosion is expected to accelerate due to sea-level rise between 52 and 98 cm by 2100 if no mitigating action is taken[81]. Furthermore, it is estimated[82] that 12.2 km^2 of built-up land, 11.8 km^2 of expansion areas, 60km of primary and 80 secondary roads are at risk from coastal inundation, due to sea level rise as a result of climate change.

In Mauritius, the targeted coastlines to be protected include:

- the Mahebourg region (Mauritius) – It is located next to the Blue Bay Marine Park which was earmarked as a rehabilitation site. It has been designated as a vulnerable coast, with 1442 persons likely to be affected by coastal inundation by 2065.

- the SEMPA Region (Rodrigues) – The population of the region is 4,661.

The above target areas host small businesses comprising tourism enterprises and hotels, which are at risk from flooding from increased storm surges due to climate change, and in a long-term, from the sea level rise. According to a DRR study carried out in 2012 in Mauritius, some 12.2 km^2 of built-up land and c. 11.8km^2 of expansion area in the Mauritius Island are exposed to high or very high hazard of inundation. The exposure is relatively lower in Rodrigues Island, with 0.56 km^2 of build-up areas being exposed to higher hazard levels. Considering the sea level rise increase scenarios (from 2.5 to 6m a.s.l), the population exposed to inundation ranges from 22,800 to 63,400 people in Mauritius and 800 to 1,800 in Rodrigues. It was estimated the annual damage cost due to extreme case of inundation in Mauritius arise to USD 25 million and USD 0.7 million in Rodrigues. The study didn't include the potential expected medium-term impacts (by floods due to storm surges, before the permanent inundation), but most of the areas that are expected to be inundated permanently (due to sea level rise) will be subject to the flood damages by storm surges.

Research has indicated that mass mortality over the past decade at some sites in Seychelles has resulted in a reduction in the level of the fringing reef surface, a consequent rise in wave energy over the reef and thus an increased coastal erosion. As in Mauritius, coastal inundation and coastal erosion in Seychelles will have significant impact on coastal infrastructures, especially tourism and the road network[83]. In Seychelles, it is seen that a number of low lying islands such as south and north Cousin and Marianne are likely to experience highest extent of coastal e inundation. Among the main granitic Islands, Praslin Island is most likely to be affected.

In Seychelles, the entire coastline of the nation is vulnerable to climate change and its vulnerability increasing due to the loss of coral reefs. According to the Centre for Research on the

[79] The Project for Capacity Development on Coastal Protection and Rehabilitation in the Republic of Mauritius by JICA (Japan International Cooperation Agency), 2015
[80] DRR Strategic Framework and Action plan, MOESDDBM, 2013
[81] *IPCC 2013*, *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change,* Geneva: IPCC.
[82] DRR Strategic Framework and Action plan, MOESDDBM, 2013
[83] Government of Seychelles, National Climate Change Strategy, 2009

Epidemiology of Disasters database, the economic damages caused by tsunami[84]. that hit Seychelles in December 2004 was estimated at approximately USD 30,000,000 . With its terrain and population distribution, most of its c. 95,000 population is vulnerable to coastal erosion, coastal floods and storm surges, but the hardest hit would be its urban dwellers (+/- 40,000 in Seychelles). Further, the World Bank estimates about 200 small businesses enterprises, especially tourism enterprises which tend to be located near the beach or waterfront establishments, is subject to the highest risk from floods resulting from increased storm surges. They are as vulnerable as coastal population; thus, would benefit equally from the adaptation interventions.

Further, the two most important economic sectors, tourism and fisheries, both depend largely on the healthy corals. There is a high dependency on tourism as a means of generating employment, foreign exchange and economic activity in Seychelles. This reliance on tourism has also spread across sectors, with resources in agriculture and forestry largely being seen as a means to generate activity in tourism, while further growth in ports and coastal transport now directly hinges on increased activity from cruise and leisure vessels. For the most part, there does not appear to be any sign that this reliance on tourism will subside. Thus, the entire nation is, but most significantly, coastal communities are, clearly vulnerable to fluctuations in tourist activity, which could most certainly decline with the lost of corals and eroded coastlines in the future. Thus, the coral restoration activities will – in a long-run – address the vulnerability of the most important economic sector of the country.

The healthy corals are also important for the country's fisheries sector, especially, for the small-scale fisheries, in which second most concentration of economic activities, just after tourism, is observed.

The target coast lines to be protected by the project are located on Anse Forbans, Ste. Anne Island, Curieuse Island, and Cousin Island, of which only at Anse Forbans (and nearby Takamaka) there reside local communities (2,825 people) directly affected by (and involved in) coral restoration activities. At Anse Forbans, climate change vulnerability of communities is increasing as they lose coral reefs. Therefore, they are committed to engaging in coral restoration activities themselves to increase natural capital's ability to reduce the impacts of climate change.

For all other locations chosen to pilot active coral restoration efforts, the locations are chosen by their high probability of coral survival, thanks to the strong level of protection measures established for the conservation and management of coastal and marine ecosystems in these areas. In order to expect the most successful and fastest coral restoration results to be achieved from the pilot activities during the limited project implementation period, it was important to select these sites. Also, the corals at these sites support the high-end tourism, which is very important for the Seychelles overall economy.

As a response, various adaptation programmes have already start implementation. For example, in Mauritius, the minimum setback from high water mark has been increased from 15m to 30m for hotels and residential coastal development; an Integrated Coastal Zone Management Framework has been developed and many coastal activities are controlled through the EIA mechanism; and coastal rehabilitation works around the island, with the financial assistance of external donors. A study carried out by Japanese International Cooperation Agency[85] and the

[84] Disaster Risk Profile of Republic of Seychelles – UNDP, 2008

[85] The Project for Capacity Development on Coastal Protection and Rehabilitation in the Republic of Mauritius by JICA (Japan International Cooperation Agency), 2015

Third National Communication Report 2016[86] also recommend coral farming and growth of coral reefs as long-term adaptation measures to ensure coastal protection[87].

Coral reefs reduce wave energy impacting shorelines by an average of 97%, with reef crests dissipating most (86%) of this energy and reef flats dissipating approximately half of the remaining wave energy. This means that even narrow reef flats effectively contribute to wave attenuation. The restoration of degraded reefs will stabilise the reef substrate and increase coral cover and thus restore the protective barrier function provided by coral reefs. This has been demonstrated in Grenada[88], where innovative restoration of coral reefs has helped to stabilise the shoreline. In the long-term this project will contribute to demonstrating where, when and how healthy or restored coastal ecosystems can contribute to cost-effective solutions that address current and growing risk from natural hazards and climate change.

The full protection of all coastlines in Mauritius and Seychelles against flooding, sea-level rise and coastal erosion is beyond the scope of this project. Coral reef restoration activities will be focused on sites located at Marine Protected Areas (MPAs) in Mauritius and Seychelles. When properly restored, these sites will demonstrate how the coral reefs protect against wave energy and coastal erosion compared to sites that have not been restored. Such comparison is incorporated into the different monitoring strategies to scientifically quantify the results of the restoration effort.

Under the project, approximately 3.2 Ha of coral reefs will be restored in Mauritius and 2.5 Ha in Seychelles, as such protecting some 1 km and 1.5km of coastline in Mauritius and Seychelles, respectively. The restoration sites are Blue Bay Marine Park in Mauritius, SEMPA in Rodrigues, and the three MPAs of Seychelles found at Cousin Island, Curieuse Island, Ste Anne. Additionally, a site outside MPA (Anse Forbans) will be restored on a pilot scale.

The project will also enhance regional coordination, scientific exchange and learning across the WIO, that has been identified as one of the regions that will be most negatively impacted by climate change. This regional scaling-up and learning would not occur if two separate national projects were to be funded. In particular the Seychelles will benefit from the established scientific capacity and facilities in Mauritius; and Mauritius will benefit from the recent experience gathered in Seychelles in undertaking large scale reef restoration.

Currently Disaster Risk Reduction (DRR) monitoring in Mauritius is effected by the National Disaster Risk Reduction and Management Centre (NDRRMC), supported by a number of national institutions. One such institution is the Mauritius Meteorological Services which has an ocean monitoring station in the east of the island. While Seychelles does not possess the same technology, much efforts and resources are committed to the identification and assessment of disaster risks through the Division of Risk and Disaster Management (DRDM), the Climate Adaptation and Information Division, the National Emergency Committee and National Relief Fund body. One of the regional studies to be carried out during the proposed project, is the temporal studies on wave profiles in the lagoon of Mauritius (including Rodrigues) and in Seychelles that will be carried out by the Mauritius Oceanography Institute, to find the effect of coral restoration on wave pattern and hence on coastal protection.

The project will also contribute to the cross-cutting fourth theme of regional projects supported by the Adaptation Fund in that it will support activities that can be considered as an “innovation in

[86] MOESDDBM 2016, Third National Communication Report 2016
[87] UNDP, 2008 Disaster Risk Profile of Republic of Seychelles
[88] Reguero, B.G., Beck, M.W., Agostini, V.N., Kramer, P., & Hancock, B.T. (2018). Coral reefs for coastal protection: A new methodological approach and engineering case study in Grenada. Journal of environmental management, 210, 146-161.

adaptation finance[89] towards transformational impact", through the work that will be done to identify mechanisms for ensuring sustainable financing of coral restoration.

C. Project / Programme Components and Financing:

The table below describes indicative outputs and outcomes, and these are explained in more detail in Part II, Section A.

Table 1 Indicative outputs and outcomes of the project.

Project Components	Expected Outcomes	Expected Outputs	Responsible Authorities / Countries	Amount (USD)
Component 1: Enhancement of food security and reduction of risks from natural disasters through the restoration of degraded reefs in Mauritius.	**Outcome 1.1:** Improved livelihood for a sustainable partnership and community-based approach to reef restoration.	**Output 1.1.1** Coastal communities benefit from improved livelihoods through employment establishing and maintaining coral nurseries and transplantation sites.	MOEMRFS UNDP Mauritius	158,161
		Output 1.1.2 Coastal communities benefit from improved livelihoods through increased revenue from alternative work including tourism (glass bottom boat tours, snorkelling and diving trips).	MOEMRFS and NGOs Mauritius	
	Outcome 1.2: Coral farming and nursery facilities established at a sufficient scale for more climate change resilient corals.	**Output 1.2.1** Donor coral colonies of appropriate species (resilience, maintaining genetic diversity) available at sufficient scale (quantity, time, intervals etc.) for propagation in nurseries.	MOEMRFS Mauritius	1,660,150
		Output 1.2.2 Reports on coral reef status, water quality, and other key environmental and social parameters for potential nursery sites.	MOEMRFS MDR, RRA Mauritius	
		Output 1.2.3 A land-based nursery and 2 or more ocean nurseries established and maintained on a regular basis.	MOEMRFS Mauritius	
		Output 1.2.4 Stock of farmed corals available for transplantation	MOEMRFS MDR, RRA Mauritius	
	Outcome 1.3 The health of degraded reefs restored, through active restoration work, maintenance and	**Output 1.3.1** Rugosity and structure of reefs restored, leading ultimately to greater protection of shore from erosion.	MOEMRFS MDR, RRA, NGO Mauritius	681,689

[89] "Adaptation finance" is taken here to mean "the finance for activities that address current and expected effects of climate change" http://www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/Common_Principles_for_Climate_Change_Adaptation_Finance_Tracking_-_Version_1__02_July__2015.pdf

Project Components	Expected Outcomes	Expected Outputs	Responsible Authorities / Countries	Amount (USD)
	monitoring efforts, leading ultimately to greater protection of shore from flooding and storm damage	**Output 1.3.2** Recovery of fish population and other reef associated fauna and flora, leading ultimately to improved food security in Mauritius and Rodrigues.		
Component 2: Enhancement of food security and reduction of risks from natural disasters through the restoration of degraded reefs in Seychelles.	**Outcome 2.1:** Improved livelihood for a sustainable partnership to coral reef restoration	**Output 2.1.1** Coastal communities benefit from improved livelihoods through employment establishing and maintaining coral nurseries and transplantation sites.	MEECC, Nsey, SNPA, MCSS Seychelles	93,340
		Output 2.1.2 Coastal communities benefit from improved livelihoods through increased revenue from alternative work including tourism (glass bottom boat tours, snorkelling and diving trips)		
	Outcome 2.2 Coral farming and nursery facilities established at a sufficient scale for more climate change resilient corals**.**	**Output 2.2.1** Donor coral colonies of appropriate species (resilience, maintaining genetic diversity) available at sufficient scale (quantity, time, intervals etc.) for propagation in nurseries	MEECC, Nsey, SNPA, MCSS Seychelles	1,811,985
		Output 2.2.2 Reports on coral reef status, water quality, and other key environmental and social parameters for potential nursery sites		
		Output 2.2.3 A land-based nursery established, and 2 or more ocean nurseries are established and maintained on a regular basis	MEECC, Nsey, SNPA, MCSS Seychelles	
		Output 2.2.4 Stock of farmed corals available for transplantation		
	Outcome 2.3: The health of degraded reefs restored, through active restoration work, maintenance and monitoring efforts, leading ultimately to greater protection of shore from flooding and storm damage	**Output 2.3.1** Rugosity and structure of reefs restored, leading ultimately to greater protection of shore from erosion	MEECC, Nsey, SNPA, MCSS Seychelles	594,675
		Output 2.3.2 Recovery of fish population and other reef associated fauna and flora, leading ultimately to improved food security in Seychelles		
Component 3: Knowledge management and sharing,	**Outcome 3.1:** Improved understanding and knowledge	**Output 3.1.1** Comparative review and analysis of coral restoration initiatives in the region and globally, with gaps in knowledge identified	MOEMRFS MDR, RRA, MEECC,	412,005

Project Components	Expected Outcomes	Expected Outputs	Responsible Authorities / Countries	Amount (USD)
training and sensitization to build regional capacity for sustainable reef restoration.	management of use of reef restoration as an adaptation measure	**Output 3.1.2** Based on past and ongoing coral restorations efforts undertaken by the project and others, science-based best practice and methodologies (e.g. factors determining success in coral restoration are known; cost-effective approaches, etc.) developed, constraints and challenges identified, and lessons learned documented.	Nsey, SNPA, MCSS Mauritius and Seychelles	
		Output 3.1.3 Research undertaken to provide information to guide restoration and enhance reef resilience where required (e.g. genetic connectivity of coral species, spawning seasons and coral recruitment patterns, resistant/ resilient species and clades)		
	Outcome 3.2: Improved understanding within the WIO and globally of successful approaches to reef restoration, the constraints and challenges, with lessons learned incorporated into new initiatives	**Output 3.2.1** Lessons learned in reef restoration documented and shared	MOEMRFS MDR, RRA, MEECC, Nsey, SNPA, MCSS Mauritius and Seychelles	1,037,823
		Output 3.2.2 Reef Restoration tool kit and manual for use in the WIO published and disseminated		
	Outcome 3.3: Regional capacity developed for sustainable and climate resilient coral restoration.	**Output 3.3.1** Regional training workshops undertaken on monitoring, DNA-based approach for the identification of resilient corals, and other topics as appropriate.	MOEMRFS MDR, RRA, MEECC, Nsey, SNPA, MCSS Mauritius and Seychelles	1,387,495
		Output 3.3.2. Sustainable long-term monitoring programme developed and underway for restored reefs, based on international/regional protocols and best practice.		
	Outcome 3.4: Monitoring and Evaluation		UNDP/PMT	427,310
Project Execution Cost				867,787
Total Project Cost				9,132,420
Project Cycle Management Fee charged by the Implementing Entity				867,580
Amount of Financing Requested				10,000,000

D. Projected Calendar:

Table 2 Projected milestone

Milestones	Expected Dates
Start of Project/Programme Implementation	January 2019
Mid-term Review (if planned)	June 2022
Project/Programme Closing	December 2024
Terminal Evaluation	December 2024

PART II: PROJECT / PROGRAMME JUSTIFICATION

A. Project Components

The project will use the approach of ecosystem-based adaptation, which involves the management and restoration of ecosystems in such a way that the services provided by these ecosystems reduce the vulnerability of communities and also increase the resilience of ecosystems to human induced climate change. The project will use the "coral gardening" concept for active restoration of coral reefs in a two-step process: First, coral fragments or nubbins are raised in nurseries. Second, after reaching a target size, the nursery corals are harvested and transplanted onto degraded reef areas[90]. Specifically, the project will support the "up-scaling" of coral reef restoration, using best available science and knowledge gained in both countries from pilot initiatives and from research undertaken globally. The focus will be on coral colonies that have survived coral bleaching and that are therefore either resistant (i.e. do not bleach as a result of elevated temperatures), or resilient (i.e. despite bleaching, the colony recovers).

Nurseries and restoration sites have been targeted to be within Marine Protected Areas (MPAs) in both countries, so as to ensure the sustainability of coral reefs restoration works. The MPAs:

1) provide a protected environment so the effects of the coral reef restoration activity can be scientifically quantified without interference from confounding factors (i.e. fishing, anchor damage from boats, runoff pollution, etc), and the coral reefs restored there will also be protected as per MPA regulations;

2) have an existing ecotourism infrastructure so any increase in job opportunities and benefits to locals can be incorporated quickly within the MPA system; and

3) are ideal locations to showcase the coral reef restoration work for educational, capacity building and ecotourism purposes because there's already a communication infrastructure in place for them.

Although country-specific responses are needed to facilitate adaption to climate change, capacities to address these challenges in the SIDS are limited. Mauritius and Seychelles, two of four SIDS in the WIO region (the others are Comoros and Maldives), both share the geographically common challenges and climate-induced threats of rising seawater temperatures, sea level rise, and ocean acidification. The focus of the project will thus be on consolidating and sharing best practices and expertise in coral reef restoration and the most cost-effective measures for this approach, between the two countries and more widely across the WIO region.

[90] Rinkevich B. 2006. The coral gardening concept and the use of underwater nurseries; lessons learned from silvics and silviculture. In: Precht WF, ed. Coral reef restoration handbook. Boca Raton: CRC Press, 291–302.

Existing international and regional platforms will be used, including those established specifically for ensuring the future survival of coral reefs (e.g. WIO Coral Reef Monitoring Network, International Coral Reef Initiative) and those established to ensure that information and knowledge related to climate change adaptation is widely available and shared. An important aspect of the project is that it will demonstrate south-south co-operation. Coral reef restoration has been trialled in a number of other countries in the WIO, notably in the Maldives. Presentations at the 13th International Coral Reef Symposium (ICRS) in June 2016 indicated that great strides have been taken around the world in the development of the science of coral reef restoration, techniques tailored to the specific needs of each region, and in understanding the obstacles, constraints and factors in success, particularly in developing countries which now have greater experience. Although a few developed countries are advanced in coral reef restoration (e.g. USA) this is not usually undertaken with the primary purpose of restoring reefs as an adaptation measure, and so this project will be innovative at the global, as well as the regional level by implementing coral reef restoration as adaptation to climate change.

The three project components will run in parallel and are closely interlinked. Components 1 and 2 address Mauritius and Seychelles respectively and concern the establishment of new, or expansion of existing, coral farming facilities and nurseries, and the restoration of selected degraded reefs. This measure (restoration of degraded coral reefs with thermal tolerant species), if successfully implemented, will ultimately lead to both an increase in food security and in disaster risk reduction. The project has therefore been designed with a coral reef restoration component for each country. The activities will be broadly similar in each country but adapted to the different national environmental and socio-economic characteristics, and to the previous experiences in coral reef restoration and development of adaptation measures of each country. However, throughout implementation, there will be extensive regional networking and exchange through Component 3, in order to use the knowledge generated in both countries. Component 3 is entirely regional in nature and will ensure sharing of knowledge, resources and the joint development of capacity. It will be important to allow for flexibility in planning and implementation through the adaptive management so that the project can make full use of the rapidly accumulating new research on the most appropriate way to undertake coral reef restoration.

Component 1: Enhancement of food security and reduction of risks from natural disasters through the restoration of degraded reefs in Mauritius

Outcome 1.1. Improved livelihood for a sustainable partnership and community-based approach to reef restoration

Output 1.1.1. Coastal communities benefit from improved livelihoods through employment establishing and maintaining coral nurseries and transplantation sites.

The involvement of coastal communities in establishing and maintaining coral nurseries and transplantation sites can become a new source of revenue for these communities. Such involvement will rely on stakeholders willing to participate in the training required to perform such activities. In Mauritius and Rodrigues, the approach will be to work with small coastal communities and local NGOs, with the involvement of tourism enterprises (hotels, dive centres, boat operators etc.) where appropriate. The technical work will be led by AFRC and MOI (under the aegis of MOEMRFS). The community/NGO will be selected through a call for proposals, with the selection of organizations and communities to take part based on a careful assessment. The interest of coastal communities in coral farming in Mauritius was assessed in 2014[91], and many would be

[91] Nazurally, N. and Rinkevich, B. 2014. A Questionnaire-based Consideration of Coral Farming for Coastal Socio-economic Development in Mauritius. *Western Indian Ocean J. Mar. Sci.* 12 (1): 47-56.

willing to participate. During the preparation phase, as stakeholder analysis and Gender assessment was carried out (see Annex 7 and 8). There are also a number of NGOs with relevant experience including Reef Conservation, the Mauritius Marine Conservation Society (MMCS), Eco-Mode, Eco-Sud and, on Rodrigues, possibly TerMer Rodrigues and the Shoals Rodrigues Association. Each of the NGO recruited will also include a project site coordinator and a project site assistant, who will oversee the implementation of the project at restoration site.

Activities include:

1.1.1.1 Stakeholder analysis
1.1.1.2 Training of communitry members in establishing and maintaining coral nurseries in Mauritius and Rodrigues
1.1.1.3 Awareness campaint on coral restoration in Republic of Mauritius
1.1.1.4 Training of direct beneficiaries in snorkelling and advance PADI or other relevant diving qualitifation.

Output 1.1.2. Coastal communities benefit from improved livelihoods through increased revenue from alternative work including tourism (glass bottom boat tours, snorkelling and diving trips)

Restored sites will be located in MPAs and nursery sites can generate new income opportunities for coastal communities by increasing tourist activities. To support the development of a coral reef restoration economic and financial strategy, a report on sustainable financing mechanisms for the maintenance and monitoring of coral restoration work will be completed. This Output requires the development of coral restoration economic and financial strategy for the sustainable financing and maintenance of both the nurseries and the transplantation sites. These strategies will consider the potential sources of funding and what remuneration is needed for labour, as well as the costs of maintenance and monitoring programmes and equipment purchase. The project will provide an opportunity to develop partnerships with the diving and hotel industries and to take advantage of Corporate Social Responsibility (CSR) opportunities to leverage funding. In several countries (such as Maldives and Malaysia) hotels have “adopt-a-reef” programs through which they involve their clients in coral reef conservation activities and also generate new funding opportunities; these activities might provide new funding models for the project. The environmental impact of the revenue generation activities identified will be carefully assessed; for example, it will be important not to promote or encourage collection and sale of wild grown corals. This is also in line with the Mauritian Governmental budgetary measure in 2017[92] to promote development of alternative livelihood opportunities for coastal communities through coral farming by fishermen and Small and Medium Enterprises (SMEs). In the long run, this budgetary measure is expected to provide a viable source of income for inhabitants along the coastal zone.

Activities include:

1.1.2.1 Development of a coral restoration economic and financial strategy.
1.1.2.2 Establising partership agreement with community groups
1.1.2.3 Livelihood survey to evaluate impact of project on beneficiaries.

Outcome 1.2. Coral farming and nursery facilities established at a sufficient scale for more climate change resilient corals

Output 1.2.1. Donor coral colonies of appropriate species (resilience, maintaining genetic diversity) available at sufficient scale (quantity, time, intervals etc.) for propagation in nurseries

[92] Government of Mauritius – Budget Speech 2017-2018.

This Output includes a technical assessment and selection of coral species for transplantation based on thermal tolerance (survivors of previous coral bleaching events) and genetic analysis of thermal-tolerant *Symbiodinium* clades.

Coral reef restoration will be implemented within Marine Protected Areas (MPAs). In Mauritius, the MPAs selected are: Blue Bay Marine Park and in Rodrigues-SEMPA (South East Marine Protected Area). Within the MPAs, nursery sites will be selected based on the reports on coral reef status, water quality, current pattern and key environmental and social parameters. The preliminary locations of the restoration sites are indicated in figures 10 and 11. Surveys will also be completed to identify coral donor sites for locally threatened species in both Mauritius and Rodrigues.

Activities include:

1.2.1.1 Technical assessment and selection of resilient coral species.
1.2.1.2 Identification of donor sites
1.2.1.3 Survey for identification of ocean-based nurseries

Figure 10: *Restoration site at Blue Bay Marine Park, Mauritius*

Figure 11 *Restoration site at SEMPA, Rodrigues*

Output 1.2.2. Reports on coral reef status, water quality, and other key environmental and social parameters for potential nursery sites

Sea based nurseries will be set up within the MPAs, i.e. BBMP in Mauritius and SEMPA in Rodrigues. These sites will be selected based on the reports on coral reef status, water quality and key environmental and social parameters.

Activities include:

1.2.2.1 Monitoring of sea water quality and other key environmental parameters at donor and nursery sites.
1.2.2.2 Carrying out the Environmental and Social Impact Monitoring.

Output 1.2.3. A land-based nursery and 2 or more ocean nurseries established and maintained on a regular basis

Mauritius will be using both land-based and ocean nurseries. In Mauritius, building on previous experience, one land-based coral nursery will be built in the premises of MOI. This nursery will be used to propagate locally threatened species and selected massive corals. The land-based nursery will also be used to propagate mother coral colonies so as to minimise collection from donor sites. Additionally, colonies in land-based nurseries are a safeguard to the project, in case of an unexpected severe bleaching event occurs. An experimental land-based set-up will also be used to obtain new coral recruits from collecting coral spawn, that can settle on pre-conditioned plates for a future relocation to the ocean nurseries. The objective of this experimental nursery is to identify the optimal conditions for obtaining recruits on a large scale, for future restoration works nationally.

Small-scale ocean-based nurseries including table nursery bottom attached model (for culture of up to 100 corals per nursery) (see Annex 1) and multi-layered rope nursery (for culture of up to 1000 corals per nursery) will be built for community-based coral farming at each MPA site and additional sites as per interest of adjacent hotels. It is aimed that at least 30% of the communities involved will be women. These ocean nurseries will be filled with nubbins from asexual propagation and eventually will also include nubbins obtained from sexual propagation in the land-based nursery.

Activities include:

1.2.3.1 Setting up of a large-scale land-based nursery at MOI

1.2.3.2 Setting up, populating and maintenance of 100 table nurseries and 100 multi-layered rope nurseries in BBMP

1.2.3.3 Setting up, populating and maintenance of 50 table nurseries and 40 multi-layered rope nurseries in SEMPA

Output 1.2.4. Stock of farmed corals available for transplantation

Different species of corals will be farmed (see Annex 1) and total numbers will depend on sites and nursery method. In Mauritius, the project target is producing 15,000 coral fragments from land-based nursery, 20,000 from the table nurseries, and 100,000 from the multi-layered rope nursery units. In Rodrigues, the target is producing 10,000 nursery-reared corals in table nurseries and 40,000 from the multi-layered rope nursery units. The target is 140,000 farmed coral (75% survival rate) by the end of the project.

The nurseries will be set up during the first year and will have a 6 months acclimatization period. The farmed corals will reach the appropriate size for transplantation by the end of the third year.

Activities include:

1.2.4.1 Collection of coral fragments cultures in land-based nurseries and ocean-based nurseries in Mauritius and Rodrigues

Outcome 1.3. The health of degraded reefs restored, through active restoration work, maintenance and monitoring efforts, leading ultimately to greater protection of shore from flooding and storm damage

Output 1.3.1. Rugosity and structure of reefs restored, leading ultimately to greater protection of shore from erosion.

Farmed corals will be cemented at sites targeted for restoration within the Blue Bay Marine Park (Mauritius) and SEMPA (Rodrigues) by the NGOs and the communities. The density of restoration (number of corals per square meters) will depend on the size of corals at transplant time and the status of the degraded reef (See Annex 1). It is however estimated that approximately 4 nursery grown corals will be transplanted per square meter. As such it is estimated that approximately 2.5 Ha of coral reef will be restored in Mauritius and approximately 0.7 Ha in Rodrigues. The approximate beach area that is potentially protected is 1.5 Ha and 1 Ha respectively (see figures 10 and 11). Monitoring of the current pattern and coast at the restoration works in Mauritius and Rodrigues will be partly implemented in output 1.3.1 and partly in Component 3.

Activities include:

1.3.1.1 Transplantation of farmed corals at restoration sites in Mauritius and Rodrigues

1.3.1.2 Part of the spatio-temporal study of the coast and restoration site in Mauritius and Rodrigues.

Output 1.3.2. Recovery of fish population and other reef associated fauna and flora, leading ultimately to improved food security in Mauritius and Rodrigues.

Under this output, standardized long-term monitoring programs will record the effects of the coral reef restoration effort, mainly coral survival, growth rates and abundance and diversity of reef-associated species. It is expected that the restored sites located in MPAs will have an increase in fish biomass and fish species as a result of the coral reef restoration actions. It is foreseen that these reef fish increases will eventually spill over from the MPAs and become available to fishers. Nearby control sites will also be selected to scientifically quantify the results of the coral reef restoration efforts

Activities include:
1.3.2.1 Monitoring and maintenance of the restoration sites
1.3.2.2 Monitoring of the restoration site for water quality, live coral cover, fish and other fauna and flora density.
1.3.2.3 Updating the inventory of the corals in Mauritius and updating the booklet describing the corals of Mauritius and Rodrigues.

Component 2: Enhancement of food security and reduction of risks from natural disasters through the restoration of degraded reefs in Seychelles

Outcome 2.1. Improved livelihood for a sustainable partnership to coral reef restoration

Output 2.1.1. Coastal communities benefit from improved livelihoods through employment establishing and maintaining coral nurseries and transplantation sites.

In Seychelles, during the preparation phase, as stakeholder analysis and Gender assessment was carried out (see Annex 9 and 10). there are few local coastal communities and the focus here will be more on NGOs, and the tourism industry. The project will be implemented by SNPA (under the aegis of MEECC), and the two NGOs, Nature Seychelles and Marine Conservation Society of Seychelles (MCSS). Other NGOs with little or no experience in coral reef restoration will participate as part of the capacity building effort. Consideration will be given to involving students from the University of Seychelles as part of their work-study activities, notably the Blue Economy Research Institute (BERI) which was established in 2015 to provide the knowledge and technical input for the development of the Seychelles Blue Economy. The National Institute of Science, Technology and Innovation (NISTI) might also play a role by contributing to the innovative approaches that will be needed to develop coral restoration as a sustainable enterprise.

Activities include:
2.1.1.1 Training of community members in establishing and maintaining coral nurseries
2.1.1.2 Awareness campaign in Seychelles on coral restoration.
2.1.1.3 Scuba training of volunteer students.

Output 2.1.2. Coastal communities benefit from improved livelihoods through increased revenue from alternative work including tourism (glass bottom boat tours, snorkelling and diving trips)

In Seychelles, the focus will be on large-scale coral reef restoration. This will be achieved in two steps: updating the strategic plan for the management of MPAs and the development of a business plan. The strategic plan will be upgraded so as to involve the local communities and local businesses that will benefit from the coral restoration works. The plan will consider the potential sources of funding and what remuneration is needed for labour, as well as the costs of maintenance and monitoring programmes and equipment purchase.

Seychelles will also develop a business plan focusing on making long-term, large-scale coral reef restoration financially viable, with several strategies that generate income to be invested again in the coral reef restoration effort:

- Mass-Production and sell of farmed fast-growing corals for reef restoration and for the aquarium trade (CITES compliant)
- Leverage other opportunities in mariculture, notably low trophic level species, with facilities and capacity available
- Attract other marine research & development projects, partners, researchers and students (with facilities and capacity available) to establish platform and knowledge hubs.
- Provide training and boot camp learning programs for national and international trainees in coral mariculture and coral reef restoration.
- Explore science and technology opportunities for uses of farmed corals
- Partner with hotel resorts and other private sector businesses for coral reef restoration using CSR funds

The USAID-funded Reef Rescuers project (2011) initiated by Nature Seychelles included research, development, implementation and teaching. Results from this project can be used to reach the next level through the AF project and expand coral propagation and restoration to foster a sustainable coral aquaculture enterprise, which in turn reverts into more resources for coral reef restoration.

The mariculture activity will focus on corals and live rock[93] during the AF project, and sponges will

Figure 12 *The relationship between the complexity of an aquaculture operation and not it fits into a blue economy framework (adapted from Hughes et al.2016)*

be investigated for future implementation. Such activity is tailored to the needs and capabilities of Seychelles as a SIDS[94] (Figure 12). The trade in live corals for aquariums has grown at approximately 9 % per annum since 1990, and on average coral retails at $56 a piece in the US. Traditionally, the Fiji Islands have been the main source of live rock for import to the US. The value of this trade is $50 million globally. In the case of sponges, large specimens attract a premium for the bath sponge market and take approximately two years to grow to market size.

[93] Live rock is fragmented pieces of old coral reefs that broke off during storms or by wave action. These pieces then washed into shallower water where they were naturally colonized by marine life such as invertebrates, corals, sponges, and bacteria

[94] Hughes A, Day JG, Greenhill L, Stanley MS (2016). Aquaculture. Commonwealth Blue Economy Series No. 2. Commonwealth Secretariat, London

The live coral trade will open a potential market for Seychelles maricultured corals. When corals die in the nursery, they can be re-purposed to be sold as live rock, and as part of the development part of the project, sponge species can be tested for mariculture activities

Additional income generating opportunities in the Seychelles business plan include:

- Use of farmed coral carbonate extractions for the medical/pharmaceutical industry
- New projects with the private sector: Thai Union; COI,
- Upcoming project with a 5-star resort as pilot to test feasibility of using CSR funds for long term restoration
- Potential new call for proposals for AF project in Seychelles, using the Sey Debt-for Adaptation Swop funding mechanism (SeyCCAT), linked to Blue Bonds mechanism

Activities include:
2.1.2.1 Development of a Buisiness Plan and update of MPA strategic plan.

Outcome 2.2 Coral farming and nursery facilities established at a sufficient scale for more climate change resilient corals

Output 2.2.1. Donor coral colonies of appropriate species (resilience, maintaining genetic diversity) available at sufficient scale (quantity, time, intervals etc.) for propagation in nurseries

This output includes a technical assessment and selection of coral species for transplantation based on thermal tolerance (survivors of previous coral bleaching events) and genetic analysis of thermal-tolerant *Symbiodinium* clades. In Seychelles, coral reef restoration and nurseries will be implemented within the MPAs, except for one site (Anse Forbans). The other sites are the Curieuse Marine National Park. Cousin Special Reserve, and Ste Anne Marine National Park. The nursery sites will be selected based on the reports on coral reef status, water quality and key environmental and social parameters. Surveys will also be completed to identify coral donor sites. The preliminary locations of the restoration sites are indicated in figures 13, and 14. Surveys will also be completed to identify coral donor sites for locally threatened species.

Activities include:
2.2.1.1 Technical assessment and selection of resilient coral species.
2.2.1.2 Identification of donor sites
2.2.1.3 Survey for identification of sea based nurseries

Output 2.2.2. Reports on coral reef status, water quality, and other key environmental and social parameters for potential nursery sites

Sea based nurseries will be set up within the MPAs, i.e. Curieuse Marine National Parks, Ste Anne Marine National Parks and Curieuse Special Reserve. The nursery sites will be selected based on the reports on coral reef status, water quality and key environmental and social parameters.

Activities include:
2.2.2.1 Monitoring of sea water quality and other key environmental parameters at donor and nursery sites.
2.2.2.2 Carrying out the Environmental and Social Impact Monitoring.

***Figure 13** Location of Nurseries at Ste Anne Marine National Park and Anse Forbans reef restoration site*

Output 2.2.3. A land-based nursery established, and 2 or more ocean nurseries are established and maintained on a regular basis

A land-based nursery will be set up on Praslin. The land-based nursery will be used to propagate massive corals (micro-fragmentation and fusion) and to obtain new coral recruits from collecting coral spawn that can settle on pre-conditioned plates for a future relocation to the ocean nurseries. The ocean nurseries will be filled with nubbins from asexual propagation and eventually will also include nubbins obtained from sexual propagation in the land-based nursery.

Activities include:
2.2.3.1 Setting up of a land-based nursery on Praslin

Figure 14: *Location of restoration sites at Cousin Nature Reserve and Curieuse Marine National Park (Curieuse and St Pierre islands)*

2.2.3.2 Setting up, populating and maintenance of ocean nurseries (midwater rope type); 10 in Cousin Island; 20 in Curieuse Island and 8 in Ste Anne Island.

Output 2.2.4. Stock of farmed corals available for transplantation

Different species of corals will be farmed (see previous outputs) and total numbers will depend on sites and nursery method. In Seychelles, the project target is to produce at least 20500 coral fragments per year targeting a total of 102,500 corals growing in midwater ocean-based rope nurseries and 1,000 corals growing in the land nursery derived from massive coral micro-fragmentation and asexual reproduction (See Annex 1) by the end of the project.

Activities include:
2.2.4.1 Collection of coral fragments cultures in land-based nursery in Praslin and ocean-based nurseries in Ste Anne, Cousin and Curieuse Islands.

Outcome 2.3 The health of degraded reefs restored, through active restoration work, maintenance and monitoring efforts, leading ultimately to greater protection of shore from flooding and storm damage

Output 2.3.1. Rugosity and structure of reefs restored, leading ultimately to greater protection of shore from erosion.

Farmed corals will be cemented at sites targeted for restoration within the Cousin Island Special Reserve, Curieuse Island Marine National Park, Ste Anne Marine National Park and Anse Forbans. The density of restoration (number of corals per square meters) will depend on the size of corals at transplant time and the status of the degraded reef (see Annex 1). It is however estimated that approximately 4 nursery grown corals will be transplanted per square meter. As such it is estimated that approximately 1 Ha will be restored at Cousin Island, 1 Ha in Curieuse Island (including St Pierre), 0.25 Ha at Ste Anne and 0.25 Ha at Anse Forbans, which totals to 2.5 Ha for Seychelles. It is estimated that around 200m of beach at Curieuse Island, 500m of Cousin Island, 200m at Ste Anne Island and 600m at Anse Forbans will be potentially protected due to the restoration works, in the long term. Monitoring of the coast and the current pattern will be effected in Component 3.

Activities include:

2.3.1.1 Transplantation of farmed corals at restoration sites in Curieuse Island, Cousin Island, Ste Anne Island and Anse Forbans

Output 2.3.2. Recovery of fish population and other reef associated fauna and flora, leading ultimately to improved food security in Seychelles

Under this output, standardized long-term monitoring programs will record the effects of the coral reef restoration effort, mainly coral survival, growth rates and abundance and diversity of reef-associated species. It is expected that the restored sites located in MPAs will have an increase in fish biomass and fish species as a result of the coral reef restoration actions. It is foreseen that these reef fish increases will eventually spill over from the MPAs and become available to fishers. Nearby control sites will also be selected to scientifically quantify the results of the coral reef restoration efforts.

Activities include:

2.3.2.1 Monitoring and maintenance of the restoration sites

2.3.2.2 Monitoring of the restoration site for water quality, live coral cover, fish and other fauna and flora density.

Component 3: Knowledge management and sharing, training and sensitization to build regional capacity for sustainable reef restoration

This component focuses around the need to ensure that experiences built up through Components 1 (Mauritius) and 2 (Seychelles) contribute to the development of a solid base of knowledge on best practices in the use of coral reef restoration as an adaptation measure at both international and regional levels, with particular emphasis on the SIDS. Discussions with stakeholders indicated a need for a better understanding of work undertaken to date in each country, particularly relative strengths and weaknesses of different approaches and their application in different marine environments. The proposed Regional Scientific Advisory Committee (see implementation arrangements) would play an important role in the planning of any research under this component.

The Coastal Oceans Research and Development in Indian Ocean (CORDIO[95]) already has an existing and active Coral Specialist Group. This Group consists of international specialists in coral protection and restoration and is also affiliated to the International Union for Conservation of Nature (IUCN). The project will look into the possibility for the Coral Specialist Group to act as the Regional Scientific Advisory Committee. Further, the project will collaborate with CORDIO on knowledge management and sharing at the Indian Ocean level regarding coral restoration efforts as an adaptation mechanism. The project will share its knowledge products widely with other Indian Ocean states, in particular, with SIDS, while the project expects to learn experience of others through the coral specialist group network established by CORDIO.

In addition, the project will collaborate closely with the Nairobi Convention and the two regional projects that the Nairobi Convention Secretariat is executing, funded by the Global Environment Facility; namely, UNEP-GEF WIOSAP and UNDP-GEF SAPPHIRE. Both projects are supporting the WIO coastal and island states on their coastal habitat restoration efforts, including coral reefs, though effective management on the ground. Their interventions may form part of the baseline activities for this adaptation project at least indirectly when the knowledge on climate change adaptation through coral restoration generated by this project is shared widely across WIO countries.

Outcome 3.1 Improved understanding and knowledge management of use of reef restoration as an adaptation measure

Output 3.1.1. Comparative review and analysis of coral reef restoration initiatives in the region and globally, with gaps in knowledge identified.

A review of coral reef restoration initiatives in the region and globally will be undertaken at the start of the project to identify factors determining success, constraints and obstacles, lessons learned, and cost/benefits of different approaches. Emphasis will be given on assessing applicable methods and experiences in scaling up successful approaches as adaptation measures. Understanding of restoration as a coral reef conservation intervention, and increasingly as an adaptation measure, is evolving rapidly. During the inception phase of the project it will be important to take stock of progress made in order to learn the most recent lessons and adapt the planning for project activities accordingly.

Activities include:

3.1.1.1 Comprehensive review of coral reef restoration in the region and globally.

Output 3.1.2. Based on past and ongoing coral reef restorations efforts undertaken by the project and others, science-based best practice and methodologies (e.g. factors determining success in coral restoration are known; cost-effective approaches, etc.) developed, constraints and challenges identified, and lessons learned documented.

In this output, a comprehensive review of past and ongoing coral reef restoration efforts will be developed and disseminated, including constraints, challenges and lessons learned.

Activities include:

3.1.2.1 Development and publishing of methodology/guidelines for coral restoration in Mauritius and Seychelles, based on past restoration efforts, best available science and practices.

[95] CORDIO was initiated in 1999 as a response to the El Nino related mass bleaching and mortality of corals in the Indian Ocean in 1998. This non-profit research organisation has supported and collaborated in various coral related project in the eastern Africa, Western Indian Ocean islands (including Mauritius and Seychelles), South Asia, Red Sea and Andaman Sea

Output 3.1.3. Research undertaken to provide information to guide restoration and enhance reef resilience where required (e.g. spawning seasons and coral recruitment patterns, resistant/ resilient species and clades)

Knowledge gaps in the taxonomy and ecology of corals will be identified and research will be undertaken to fill these, where this is necessary, for successful coral reef restoration (e.g. identification of coral species that are resistant or resilient to bleaching; genetic connectivity of species; spatial and temporal variations in coral spawning and recruitment). It will be useful to develop a better understanding of why adjacent sites may have widely different coral cover and be affected in very different ways by bleaching events.

Previous studies[96] on ocean currents and seasonal currents in the Indian Ocean suggest that there is connection between the different islands in the SWIO region. If some coral species are found to be genetically identical, the propagation and maintenance of common coral stocks in both countries could spread the risk during future disturbance events. On the other hand, in case the coral stocks from the different islands are unique, then these stocks should be preserved.

In addition to using species already shown to be resilient, further studies will be undertaken (e.g. identification of bleaching-resistant clades of zooxanthellae) to identify other suitable species and strains. This will also enable information on the coral fauna of both countries to be updated and coral distributions mapped. A regional WIO field guide would be a useful output and could contribute to the development of coral reef restoration in other parts of the region. In both countries, the maintenance of coral nurseries will be critical to success and this component will also address the need for rigorous maintenance programmes at each nursery site. Coral nurseries attract biofouling which is a major impediment to the growth of the corals, but research undertaken through the Nature Seychelles project has shown that increased presence of fish, attracted by the nursery, helps to control biofouling and thus can reduce the person-hours needed for nursery cleaning. Higher abundance of large fish (total number of individuals) resulted in 2.75 times less person-hours spent in nursery cleaning[97].

Activities include:
3.1.3.1 Study in genetic connectivity among Mauritius, Rodrigues and Seychelles
3.1.3.2 Study in the coral spawning and recruits in Mauritius, Rodrigues and Seychelles
3.1.3.3 Study in the identification of bleaching resistant clades of zooxanthellae.

Outcome 3.2. Improved understanding within the WIO and globally of successful approaches to reef restoration, the constraints and challenges, with lessons learned incorporated into new initiatives

Output 3.2.1. Lessons learned in coral reef restoration documented and shared

The lessons learned in each country will be compiled, documented and shared and made available widely, both in the region and globally, and will contribute to the existing documentation

[96] Smith WH and Sandwell DT (1997) Global seafloor topography from satellite altimetry and ship depth soundings. Science 277: 1957-1962

[97] Frias-Torres S, Goehlich H, Reveret C, Montoya-Maya PH. 2015. Mid-water coral nurseries recruit reef fish assemblages in Seychelles, Indian Ocean. *African Journal of Marine Science* 2338:1–6. doi: 10.2989/1814232X.2015.1078259.

on coral reef restoration (e.g. Caribbean restoration manual[98], World Bank guidance[99]; papers presented at 13th International Coral Reef Symposium, ICRS, in 2016).

Activities include:
3.2.1.1 Creation and maintenance of project website
3.2.1.2 Short clips and documentary film on the project implementation in Mauritius and Seychelles. Same will be used for showcasing the project nationally, regionally and globally.
3.2.1.3 Participation in relevant international symposium.

Output 3.2.2. Coral Reef Restoration Tool Kit and manual for use in the WIO, published and disseminated

During the USAID-funded Reef Rescuers Project, Nature Seychelles produced a Coral Reef Restoration Toolkit[100] for the methodology that it is currently using at Cousin Island. The Toolkit will be updated with guidance for wider applicability in the WIO, including a broader discussion of approaches and methodologies. The updated Coral Reef Restoration Toolkit will be published online, and available to the public.

Activities include:
3.2.2.1 Updating and online publishing of the Coral Reef Restoration Toolkit

Outcome 3.3. Regional capacity developed for sustainable and climate resilient coral restoration

Output 3.3.1. Regional training workshops undertaken on monitoring, DNA-based approach for the identification of resilient corals, and other topics as appropriate

Regional technical training workshops, involving individuals from other countries in the Indian Ocean (particularly the SIDS) will be held on a range of relevant topics as determined during the project. Priority will be given to training on methods of coral farming and transplantation, using the experiences and lessons learned gathered in Mauritius and Seychelles. If appropriate, the training programme could be developed in such a way that a Certificate of Competence could be awarded to participants.

Mauritius has the institutional capacity to undertake genetic research of coral *Symbiodinium* clades, while currently Seychelles does not – hence the advantage of a regional approach. Seychelles will be involved in this component, providing assistance and building research capacity through knowledge exchange with Mauritius. Moreover, Mauritius will carry out a feasibility study for setting up of genetic laboratories in Seychelles, namely at the Seychelles Fisheries Authority and the University of Seychelles. Until Seychelles sets up its own genetic laboratory, an MOU will be signed between Mauritius and Seychelles so as genetic analysis could be effected by Mauritius for Seychelles at a preferential cost.

[98] Bowden-Kerby, A. 2014. Best Practices Manual for Caribbean Acropora Restoration. Punta Cana Ecological Foundation, 40pp.
[99] Edwards AJ (2010) Reef rehabilitation manual. Coral Reef Targeted Research and 530 Capacity Building for Management Program. St Lucia, Australia. ii + 166 pp.
[100] Frias-Torres S, Montoya-Maya PH, Shah N.J (Eds.) 2015. Coral Reef Restoration Toolkit: A Field-Oriented Guide Developed in the Seychelles Islands. Nature Seychelles, Mahe, Republic of Seychelles.

Seychelles will provide for a regional training on micro fragmentation and fusion of massive corals to the Mauritian counterpart.

Activities include:

3.3.1.1 Regional training on genetic/clade analysis

The scope is to build capacity of stakeholders from Mauritius and Seychelles in carrying out genetic/clade analysis to identify resilient coral species and also the feasibility of sexual propagation of corals in land-based nurseries. A genetic expert will be recruited to assist in the study and build capacity of the Mauritian and Seychelles Stakeholders. The lead government institute will be Mauritius Oceanography Institute (MOI). Beneficiaries will include staff of the Ministry of Ocean Economy, Marine Resources, Fisheries and Shipping (MOEMRFS) of Mauritius, the Seychelles National Park Authority (under the Ministry of Environment and Climate Change of Seychelles), Nature Seychelles, MCSS and some participants from the WIO region who are active in coral restoration work in the region.

3.3.1.2 Regional training on coral farming and transplantation

A regional training on coral reef restoration using standardized methodology and lessons learned and best techniques used, to representative of the WIO region countries involved in coral reef restoration. The lead institution will be MOEMRFS in Mauritius

3.3.1.3 Regional training on micro-fragmentation

Building capacity of Mauritian counterparts on proper method of micro-fragmentation. The lead institution is Nature Seychelles.

3.3.1.4 Feasibility study of setting up of genetic laboratory in Seychelles.

MOI will carry out a feasibility study for setting up of genetic laboratories in Seychelles, namely at the Seychelles Fisheries Authority and the University of Seychelles, for capacity transfer.

Output 3.3.2. Sustainable long-term monitoring programme developed and underway for restored reefs, based on international/regional protocols and best practice

Comparative monitoring across both countries will increase knowledge about the effectiveness of the propagation and restoration methods. This will assist in the evaluation of the project. Appropriate indicators must be selected, building on global experience and ensuring that socio-cultural, economic, and governance considerations are included so that the efficacy of coral restoration as a tool to promote coral reef resilience and ensure the sustainable delivery of coral reef ecosystem services is assessed.[101]

Mauritius and Seychelles will develop a Regional Coral Reef Restoration Plan, which will include national components. This Plan will enable both countries (i) to have a long-term National plans for coral reef restoration works for the whole country; (ii) to improve policy, institutional framework and enforcement of coral reef protection in each country and in the region; (iii) set up long-term monitoring of restoration and coral reef ecosystem; (iv) to devise a sustainable financial mechanism to future restoration works; and (v) establish a domestic and regional network and collaboration for regional research, knowledge and expertise exchange, and transfer of knowledge, expertise and equipment (e.g. GIS, drone, ADCP, WTR etc.).

[101] Hein, M. Y., Willis, B. L., Birtles, R. A., Beeden, R., 2016. Characterising coral restoration effectiveness: a review of current limitations and challenges at a socio-ecological scale. Paper presented at Int Coral Reef Symp, Hawaii.

The study in current pattern and spatio-temporal study of the coasts in Mauritius and Seychelles will be used as planning tool for the regional coral reef restoration plan. These will enable to identify strategic location for future restoration works, without having negative impacts on the coast. Furthermore, it will also enable to identify location where hybrid reef structures could be used for future coastal protection works and thus enhancing coastal protection.

Activities include:

3.3.2.1 Carrying out a spatio-temporal study of the coast at the restoration sites to monitor the long-term impact of the restoration works on the coast.

3.3.2.2 Carrying out the current pattern for Mauritius, Rodrigues and Seychelles, which will be a planning tool to be included in the Regional Coral Reef Restoration Plan.

3.3.2.3 Review the legislative and legal framework of each country

3.3.2.4 Preparation of a Regional Coral Reef Restoration Plan.

Outcome 3.4. Monitoring and Evaluation

Project Monitoring and Evaluation has been detailed in Section III: D.

B. Promotion of new and innovative solutions to Climate Change Adaptation

As Small Island Developing States (SIDS), Mauritius and Seychelles are very vulnerable to climate change. For several decades, it was observed that accentuated beach erosion has shrunk the width of beaches around certain coastal areas, coral reefs are in a state of deterioration and there has been a steady decrease in fish catches, especially in artisanal fisheries partly due to climate change. As such, there is an urgent need to develop new capacities to restore the ecosystem services lost after coral bleaching and build resilience.

When reefs have been damaged by human use or misuse, removing or mitigating the anthropogenic stressors responsible for decline may enhance natural recovery. Both Mauritius and Seychelles have a number of measures underway that will indirectly or passively improve coral reef health, including the establishment of networks of MPAs, pollution mitigation projects, fisheries management, introduction of ICZM and coastal development regulation activities. Mauritius has established 3 Marine Protected Areas (MPAs) protecting 51.5 km^2 of the lagoon and 82.7 km^2 of Fishing Reserves; and Seychelles has established 6 Marine National Parks covering 61.77 km^2 and 3 Special Reserves covering 350.98 km^2.

It has been however observed that the recovery of the coral reefs ecosystem, even in MPAs, do not occur fast enough before an unpredicted damaging event occurs, such as coral bleaching. This results in increasingly poor health of the reef and reduced resilience to both further climate-induced events and to local anthropogenic impacts. In such situations, “active” restoration becomes the only option to initiate the rehabilitation of degraded reefs and protection of their ecosystem services. It has become clear that if reefs are to be able to continue providing the key ecosystem services of fisheries, tourism and coastal protection, a more active form of reef restoration should be attempted. In this project, the restoration of the reef ecosystem will be through implementation of both passive as well as active restoration measures.

The project will provide for active restoration of coral reefs, through coral nurseries / gardening. This will help prevent further degradation and advance the natural recovery process in injured or damaged habitats. The coral gardening concept consists of *in situ* and *ex situ* mariculture of coal fragments, followed by transplantation into degraded reef sites, using a two-step restoration strategy. In the first step, large *in situ* pool of farmed corals will be established in both Mauritius

and Seychelles. These nurseries will be installed in sheltered zones, and the different types of coral recruits will be maricultured. In the second step, nursery-grown coral colonies will be transplanted to degraded reef sites.

To further increase the success rate of transplantation, corals will also be harvested *ex situ* in land-based nurseries through sexual and asexual reproduction. Farming corals on land reduces risks that ocean-based nurseries are exposed to, such as storms, or warming events. Moreover, many coral species that serve as critical building blocks for reefs (such as Brain or Great Star corals) grow too slowly to be feasible for restoration projects using only ocean-based nurseries. To accelerate this growth, Seychelles will be using microfragmenting process so as to grow these corals in months rather than decades. Both countries will be "seeding" reefs with sexually reproduced coral offspring, with the aim to help maintain corals' genetic diversity which in turn maximizes their ability to adapt to future conditions. Furthermore, working with sexual coral restoration has the great potential to produce huge numbers of coral offspring from one coral spawning event.

Coral reef restoration activities will be focused on sites located at Marine Protected Areas (MPAs) in Mauritius and Seychelles since:

i) they provide a protected environment, so the effects of the coral reef restoration activity can be scientifically quantified without interference from confounding factors (i.e. fishing, anchor damage from boats, runoff pollution, etc), and the coral reefs restored there will also be protected as per MPA regulations;

ii) they have an existing ecotourism infrastructure so any increase in job opportunities and benefits to locals can be incorporated quickly within the MPA system, and

iii) they are ideal locations to showcase the coral reef restoration work for educational, capacity building and ecotourism purposes because there’s already a communication infrastructure in place for them

The work in Mauritius will be innovative in that it will demonstrate how this relatively new adaptation measure could be rolled out in a larger number of communities on a sustainable basis. Involving communities fully in reef restoration programmes is a key component of the project. Local communities will be actively involved in the process, providing local partners with outreach tools to facilitate community engagement. Integrating the communities that are impacted by this work is critical to making any restoration and conservation efforts successful in the long-term. In Seychelles, coral transplantation will be based from its previous large-scale coral reef restoration experience to target larger scale, sustainable, business approach to coral restoration.

Since coral reef ecosystems are complex and the processes affecting recovery potential are varied (e.g. water quality, local disturbances, habitat structure), the project will be undertaking a multifaceted, research-based approach to developing successful restoration tools and methodologies. The regional and international community will be engaged for the evaluation of the restoration efforts through convening session on coral reef restoration at major international symposia; and publishing peer-reviewed articles and technical documents and hosting websites on damage assessment, mitigation, and restoration approaches and the efficacy of carious restoration projects.

Some restoration projects have been previously implemented in Mauritius and Seychelles. However, these efforts have been sporadic, disparate, lacked coordination and there has been an absence of a harmonized monitoring methodology. This project aims to study and apply coral restoration techniques and practices on a larger scale, integrating coordinated conservation,

education and outreach efforts. The project will establish a Regional Coral Reef Restoration Plan, which will include national components. This Plan will enable both countries (i) to have a long-term National plans for coral reef restoration works for the whole country; (ii) to improve policy, institutional framework and enforcement of coral reef protection in each country and in the region; (iii) set up long-term monitoring of restoration and coral reef ecosystem; (iv) to devise a sustainable financial mechanism to future restoration works; and (v) establish a domestic and regional network and collaboration for regional research and knowledge and expertise exchange.

C. Economic social and environmental benefits

Table 3 Specific expected benefits of the proposed project outlined for Component 1–3.

Component	Economic benefits	Social benefits	Environmental benefits
1. Enhancement of food security and reduction of risks from natural disasters through the restoration of degraded reefs in Mauritius	Coral nursery set up and maintenance provides tourism value-addition and income Restoration of ecosystem services provided by reefs increase availability of commercial reef fish in the long term Ecosystem services provided by healthier and more resilient reefs continue to provide coastal protection services of a substantial value plus reduce the infrastructural costs of adaptation (i.e. sea walls, beach replenishment) in the long term	Reduction of coastal inundation risk for vulnerable communities on the coast Increase in skills and expertise as well as employment opportunities and alternative livelihood options for local fishers, women and youth in coral reef restoration Increase in fish catches lead to improvements in (1) food security and livelihoods (2) health and quality of life indicators (3) help maintain social cohesion and the traditional artisanal fisheries sector.	Increase resilience of coral reefs Protection of reef biodiversity Maintenance and restoration of essential ecosystem provisioning and regulating services
2. Enhancement of food security and reduction of risks from natural disasters through the restoration of degraded reefs in Seychelles	Coral nursery set up and maintenance provides tourism value-addition and income Restoration of ecosystem services provided by reefs increase availability of commercial reef fish in the long term Ecosystem services provided by healthier and more resilient reefs continue to provide coastal protection services of a substantial value plus reduce the infrastructural costs of adaptation (i.e. sea walls, beach replenishment) in the long term	Reduction of coastal inundation risk for vulnerable communities on the coast Increase in skills and expertise as well as employment opportunities and alternative livelihood options for local fishers, women and youth in coral reef restoration Increase in fish catches lead to improvements in (1) food security and livelihoods (2) health and quality of life indicators (3) help maintain social cohesion and the traditional artisanal fisheries sector	Increase resilience of coral reefs Protection of reef biodiversity Maintenance and restoration of essential ecosystem provisioning and regulating services

Component	Economic benefits	Social benefits	Environmental benefits
3. Knowledge management and sharing, training and sensitization to build regional capacity for sustainable reef restoration	Increase in availability of regional expertise decreases the costs for external know-how Regional expertise increases and becomes a valuable resource within the WIO and on the global stage.	Adaptive capacity of coastal communities to climate change increased General raising of awareness of importance of ecosystems services to the community and the need for an enhanced role by the community in their maintenance.	Increased regional scientific knowledge on coral reef restoration in the face of climate change leading to a better understanding and delivery of an effective ecosystem-based management approach for the marine environment.

Economic benefits

The introduction of an ecosystem-based adaptation measure in the form of coral restoration will have a range of long-term economic benefits. Coral reef restoration will ensure that the majority of the population in Mauritius and Seychelles who depend on reef fishes for protein, will still have such critical source of food and income. It will ensure that the aesthetic value of coral reefs, which are an important component of the tourist industry in both countries is retained, while maintaining ecosystem function for the provision of beaches and marine-based leisure activities. In both countries, direct beneficiaries will include not only those employed directly in the tourism industry, but also their dependents (as a result of job security and the maintenance of current quality of life).

Tourism value-addition and commercialisation of grown corals

In Mauritius, the project lays great emphasis on a partnership approach, which the hotels will be able to benefit from through Outcome 1.1 “Improved livelihoods for a sustainable partnership and community-based approach to reef restoration”. Over the past few years, hotels have expressed a very keen interest in engaging in coral reef restoration efforts. By building the capacity of local stakeholders – scientists in the concerned government agencies, NGO researchers and university graduates as well as community members – the project will provide hotels with the opportunity to tap into a larger and stronger pool of expertise and skilled workers in coral reef restoration. At the same time, supporting coral reef restoration efforts provides value addition to the hotels, which can market this as part of their social responsibility efforts.

The proposed project will link up with the Mauritian Governmental budgetary measure in 2017[102] to promote development of alternative livelihood opportunities for coastal communities through coral farming by fishermen and Small and Medium Enterprises (SMEs). A budget (Government budget) of USD 242,000 has been earmarked for this purpose. In the long run, this budgetary measure is expected to provide a viable source of income for inhabitants along the coastal zone.

Through the Seychelles business plan, large-scale coral reef restoration will generate income through:

- Mass-Production and sell of farmed fast-growing corals for reef restoration and for the aquarium trade (CITES compliant)
- Leverage other opportunities in mariculture, notably low trophic level species, with facilities and capacity available
- Provide training and boot camp learning programs for national and international trainees in coral mariculture and coral reef restoration.

[102] Government of Mauritius – Budget Speech 2017-2018.

- Partner with hotel resorts and other private sector businesses for coral reef restoration using CSR funds
- Use of farmed coral carbonate extractions for the medical/pharmaceutical industry

Restoration of ecosystem services provided by reefs increases availability of commercial reef fish in the long term

In Mauritius, fisheries related to coral reefs has been estimated to contribute USD 12.16 million annually to GDP and in Seychelles artisanal fisheries represent an average of 1-2% of the annual GDP. With the presence of other management measures, the anticipated long-term improvement in reef-based fisheries as a result of coral restoration will also have economic benefits with the artisanal fishery sector most directly concerned.

Ecosystem services provided by healthier and more resilient reefs reduce the infrastructural costs of adaptation (i.e. sea walls, beach replenishment) in the long term

The project will also provide economic benefits in terms of savings on coastal infrastructural solutions for climate change adaptation. Reef building corals form solid calcium carbonate skeletons, which act as an effective method of dissipating destructive wave energy. Currently, 12.2 km^2 of built-up land, 11.8 km^2 of expansion areas, 60 km of primary and 80 secondary roads are at risk of coastal inundation[103]. It is estimated that up to 36 hotels are considered potential elements at inundation risk, 6 at landslide risk and 8 at flood risk, while 17 percent of beaches representing 13% of the coastline are suffering from long-term erosion[104]. Pointe d'Esny, a locality located close to Blue Bay Marine Park earmarked as a rehabilitation site, has been designated as vulnerable for coastal erosion at a rate of over 0.2 meters per year[105].

Rates of sea level rise around Mahe in Seychelles have been measured at 1.46 mm a year[106]. Flooding in the coastal areas of Seychelles is already increasing, affecting many of the most populated locations because these are concentrated on the low-elevation coastal areas, and there are predicted to be large relative increases in flooding in the small island region of the Indian Ocean[107]. Of the 86% of the Seychelles population living on Mahe, around 60% of people live in coastal areas; the remaining 14% of the population live mostly on Praslin and La Digue and almost all people live in the narrow coastal plains. Thus around 75% of the population may be considered vulnerable to climate change risks and in need of adaptation measures.

Not only does coral reef act as a regenerating protective barrier in regions prone to strong currents and harsh weather, but it also creates vast quantities of beach material to counteract the erosion of land. The protected land and waters benefit economically via tourism and cultivation of habitats for fisheries.

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[103] Japan International Cooperation Agency Kokusai Kogyo Co. Ltd., "Guideline for Climate Change Adaptation Strategy - Coastal Setback" (2016) The Republic of Mauritius Ministry of Environment, Sustainable Development, And Disaster and Beach Management

[104] Republic of Mauritius "Third National Communication", 2016

[105] The Project for Capacity Development on Coastal Protection and Rehabilitation in the Republic of Mauritius by JICA (Japan International Cooperation Agency), 2015

[106] 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.

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

Social benefits

The project will respond to the needs of vulnerable groups in each country. In Mauritius 8.5% of the population is below the national poverty line[108]. In Seychelles, the poorer groups within the community comprise 39.3% of the population who live under the Basic Needs Poverty Line[109].

Many of these groups are the most vulnerable to coastal flooding either because they live on the shoreline or in reclaimed areas of wetlands at risk of flooding or because the structures they live in are not robust enough to withstand flooding. Infrastructure that is immediately adjacent to the beach is at risk, and there is clear evidence of this in some areas, with seawalls collapsing and erosion of roadbeds, especially after storms. Beaches are critically important as a first line of defence for coastal infrastructure, and the restoration of coral reefs will help to maintain these through the provision of coral sand.

The project will also provide some alternative livelihood options for those communities and individual in the vicinity of the MPAs or even from neighbouring areas who can work at the nurseries and on the restoration process (see below).

Disaster risk reduction for vulnerable communities on the coast

Mahébourg region – located next to Blue Bay Marine Park which was earmarked as a rehabilitation site - has been designated as a vulnerable coast, with 1442 persons likely to be affected by coastal inundation by 2065[110]. The project thus reduces the possibility of displacement and associated challenges.

In Seychelles, small businesses (+/-200 businesses total) especially tourism enterprises which tend to be near the beach/waterfront investment will be at risk from flooding resulting from sea level rise and increased storm surges and will similarly benefit, as will urban dwellers (+/- 40,000 people in the Seychelles) that are at risk of losses of life and property from increased flooding.

Increase in skills and expertise as well as employment opportunities and alternative livelihood options for local fishers, women and youth in coral reef restoration

Under Outcomes 1.1 and 2.1, fishers, women and youth from local communities will be trained in the establishment and maintenance of coral nurseries and the importance of maintaining corals and coral reef. The vast majority of registered fisher folks are men, although there are some fishing villages that include registered fisherwomen. Although most are not at sea on fisher pirogues, women have traditionally been active users of coastal resources through gleaning, including crabs and bivalves which provide complimentary source of food for the household. Moreover, octopus fishing is an important economic activity among women in Rodrigues. These activities have been gradually decreasing as resources have been degrading and economic and social structures as well as cultural habits have changed. However, these types of activities remain alive in some areas of the country, particularly in more remote coastal communities with direct access to the sea.

The interventions under this project in both countries will increase the skill set and expand employment opportunities available to these coastal communities who may be able to provide their services to private sector stakeholders beyond the duration of the project. It will also reduce their dependency on fishing while protecting the very resources they depend on.

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[108] https://www.undp-aap.org/countries/mauritius

[109] www.nsb.gov.sc National Bureau of Statistics, Seychelles. Poverty Report for the Household Budget Survey 2013

[110] JICA "Guideline for Climate Change Adaptation Strategy - Coastal Setback" (2016) The Republic of Mauritius

Increase in fish catches lead to improvements in (1) food security and livelihoods (2) health and quality of life indicators (3) help maintain social cohesion and the traditional artisanal fisheries sector

Women and men in coastal villages have historically relied on fishing as their main source of income before the advent of tourism. Coastal fisheries include lagoon and outer reef areas are the main source of fresh fish supply. The project will lay special emphasis on local fishers and boat operators who reside in socio-economically deprived neighbourhoods adjacent to the sites. Fishers and tourist boat operators are particularly at risk for the consequences of climate change and coral bleaching as these impacts threaten the very basis of their revenue.

Increased shoreline protection as a result of the proposed interventions, as well as improved biodiversity indicators will help preserve traditional artisanal fishing and coastal gleaning and secure coastal food security. The inclusion of women in local decision-making forums will help support progress towards gender equality goals and gender considerations in climate change.

Local targeted communities in Mauritius, Rodrigues and Seychelles will also benefit from awareness raising activities. The resulting mobilization around coral reef restoration can act as a focal point for reef and lagoon resource management and empowerment and expand the coral restoration effort nationwide.

In Mauritius and Seychelles, the extensive progress in improving human development conditions risk being rolled back by climate change. With the proposed project, reef restoration will in the long-term build the adaptive capacity of coastal communities to climate change (reducing the need for investment in costly structural solutions, such as coastal sea walls). As a result of this approach, finance can be diverted to increase social welfare e.g. education and health. In the absence of this project, the country would have been forced to make continuous reactive and ad-hoc expenditures to address the loss and damage to infrastructure.

Environmental benefits

Increase resilience of coral reefs

Environmental benefits are inherent in the ecosystem-based adaptation approach proposed in the project, as it will result in increased resilience of coral reefs, protection of reef biodiversity and maintenance and restoration of essential ecosystem provisioning and regulating services.

Protection of reef biodiversity

Marine Protected Areas have been established in Mauritius and Seychelles to maintain the marine ecosystem, including the reef ecosystem and conservation of marine biodiversity, amongst other. Carrying out coral reef restoration activities in MPAs will boost the conservation factor since these areas are already legislated. This will provide opportunity for capacity building of reef restoration in the region.

Maintenance and restoration of essential ecosystem provisioning and regulating services

Mauritius will benefit from Seychelles experiences in the professional training in reef restoration techniques. Seychelles will benefit from Mauritius experiences in setting up a land-based nursery and community ventures, and laboratory facilities (e.g. coral genetics, identification of resistant clades and larval propagation). The advantage of the regional approach will thus reside principally in the development of real cooperation within a sector where long term success and capacity building requirement need to be ensured.

The project is compliant with the Environmental and Social Policy of the Adaptation Fund. As described in Section II: L, it will avoid negative impacts relating to the environmental and social principles identified by the Fund. For details on how the project will adhere to the Environmental and Social Policy of the Adaptation Fund, please see Section II: L.

Regional and Global Benefits

The project will have some regional and global benefits in terms of training opportunities, enhance expertise, replicability in the region and transfer of skills, amongst others.

The development and implementation of regional capacity building and training programme will be aiming at strengthening the local expertise, institutional capacities and training for scientific and managerial skill, etc. Best lessons learned and practices from this project could be transferred and replicated throughout the region as well as globally to benefit of many countries needing to address climate change adaptation.

This project will under-pin the broad geographic approach put in place by other regional projects (e.g. WIOSAP IMP, ASCLME and UK SOLSTICE-WIO[111]) but more specifically focused on the protection, restoration and management of critical coral reefs, and the engagement of communities in the process. The AF coral reef restoration project will provide a tried, tested and proven demonstrations and technology and would provide valuable knowledge and lessons for upscaling and coordinating various restoration efforts, which are required to realize the expected adaptation benefits at scale in the region.

The project will also look into the genetic connectivity of coral species between Mauritius, Rodrigues and Seychelles. It is suspected that this connectivity goes beyond just the Mascarene Islands and is almost certainly driven by the South Equatorial Current which may bring larval renewal from Chagos and, as it 'hits' Mauritius first, means, that Mauritian corals may be of vital significance to seeding other parts of the WIO.

To ensure the sustainability as well as the cost effectiveness to realize potential regional benefits beyond Mauritius and Seychelles, the dissemination of knowledge, best practices and lessons learned in the region will be done in partnership with existing relevant regional organizations and institutions such as the Nairobi Convention, CORDIO, WIOMSA and the Indian Ocean Commission. The AF investments through this project will provide useful information on climate change adaptation benefits through coral restoration activities, on socioeconomic benefits to coastal communities and on scalability of various coral restoration efforts, which are all critical to successfully upscale ongoing coral restoration activities in the region. While there are a number of more location specific, often once-off, coral restoration efforts in the region, few had focused on its climate change adaptation impacts or their scalability with community and stakeholder engagement.

D. Cost-effectiveness analysis

The project is designed to up-scale coral reef restoration using best practices and to build national and regional capacity for using this adaptation measure more widely to reverse the trend of rapid decline in reef health and thus ultimately improve shore protection and food security ecosystem

[111] Implementation of the Strategic Action Programme for the protection of the Western Indian Ocean from land-based sources and activities started in 2017); Agulhas and Somali Current Large Marine Ecosystems Project (ASCLME, 2008-2014); WIO LME SAP Policy Harmonization and Institutional Reform (SAPPHIRE, 2017-2023); and other initiatives such as Sustainable Oceans, Livelihoods and food Security Through Increased Capacity in Ecosystem research in the Western Indian Ocean (SOLSTICE-WIO) started in 2017.

services that coral reefs provide. Ecosystem restoration is increasingly recognised as being a more cost-effective approach to building long-term adaptation to climate change impacts, than developing hard engineering and expensive technological solutions. Therefore, the proposed project is considered as a key catalytic investment in climate change adaptation.

The cost of coral reef restoration varies significantly according to method, objective and location, as does the cost effectiveness of the methods used, but as the number of initiatives increase and further research is undertaken, costs are reducing as greater experience is gathered. Preliminary costs of restoration have been assessed in Mauritius (USD100/m^2 rehabilitated reef; USD565/nursery unit)[112] and Seychelles (approx. USD153/ m^2)[113] based on work to date, but these figures are not directly comparable as they have been estimated in different ways. Nevertheless, they are broadly comparable with estimates obtained from meta-analyses of studies which have resulted in costs of about USD115/m^2 according to one study of 52 coastal restoration efforts[114]. A more detailed study of 71 coral reef restoration efforts[115] is also available which provides a range of estimates for different situations.

The cost of global coral reef restoration is only a fraction of the annual revenue generated by coral reefs. The value of coral reefs globally ranges from US $ 30 Billion/year to $ 375 Billion/year. The costs of restoring coral reefs globally range from US $ 1.2 Billion/year to US $ 22.5 Billion/year. Variations in value and costs depend on how the calculations are done. Therefore, at the lowest estimate, the value vs. cost ratio between value of coral reefs and cost of restoration is 4% and the highest 6 %. Meaning, only 4 -6 % of the value globally generated by coral reefs every year is needed to restore these valuable ecosystems[116].

The cost of restoring one square meter of coral reef has been steadily decreasing since 1990 (Fig. 15).

Artificial approaches are more costly in the long term, requiring the installation of shoreline defences, and the development of more costly alternative food sources for coastal communities, such as offshore fisheries or mariculture. A meta-analysis[117] of the costs of coral reef restoration versus construction of artificial defences found that the former was significantly less than the costs of building breakwaters. Cost-effectiveness of coral reefs for coastal defence was higher than artificial systems when maintenance costs for breakwaters was compared to the benefits of coral reefs in terms of fisheries, recreation and economic values of ecosystem goods and services. In addressing coastal erosion and flooding, structural 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 – for a 500 m stretch of coast the cost of seawall construction can be USD40,000 – 80,000, plus annual maintenance costs. Further, tourism is dependent on

[112] MOI 2016. Pers.com. Presentation
[113] Montoya-Mya, P. 2016. Pers.com (webinar)
[114] Narayan S, Beck MW, Reguero BG, Losada IJ, van Wesenbeeck B, Pontee N, et al. (2016) The Effectiveness, Costs and Coastal Protection Benefits of Natural and Nature-Based Defences. PLoS ONE 11(5): e0154735. doi:10.1371/ journal.pone.0154735
[115] Bayraktarov E, Saunders MI, Abdullah S, Mills M, Beher J, Possingham HP, Mumby PJ & Lovelock CE 2016 The cost and feasibility of marine coastal restoration. *Ecological Applications*, 26(4): 1055–1074
[116] Montoya-Maya PH, Frias-Torres S. 2016. Reef restoration meets reef conservation: proposing coral gardening as a MPA management tool. 4th International Marine Conservation Congress, 30 July–3 August 2016, St. John's, Newfoundland and Labrador, Canada.

[117] Ferrario F, Beck MW, Storlazzi CD, Micheli F, Shepard CC, Airoldi L. 2014. The effectiveness of coral reefs for coastal hazard risk reduction and adaptation. Nature Communications 5.

natural beauty and aesthetic values, which such artificial barriers will affect adversely, whereas careful science-based coral reef restoration adds attraction for divers and snorkelers.

Figure 15 *Costs of restoring one square meter of reef from 1990 to 2015. The cost of coral reef restoration has been decreasing steadily since 1990. The USAID-funded Reef Rescuers project implemented in Seychelles included research, development, implementation and training, not just restoration, hence the price per square meter was higher than other restoration only projects. The Y-axis is in year 2012 Unit costs. Cost estimates from Ferse et al (2008), Ferrario et al (2014), Mbije et al (2013), Guest et al (2014), Horoszowski-Fridman et al (2015). Modified from Montoya-Maya & Frias-Torres (2016) Reef restoration meets reef conservation: proposing coral gardening as an MPA management tool, IMCC 2016.*

Coastal protection using artificial hardening structures is perceived as an immediate solution to coastal erosion problems. However, in the long term, living shorelines (restoring wetlands, mangroves, coral reefs, etc) outperform grey infrastructure (artificial hardening). The most comprehensive literature review contrasting living shoreline restoration with artificial hardening concluded that natural alternatives, such as living or nature based shore protection or biogenic habitat restoration, can reduce erosion while also enhancing other ecosystem services[118] (Gittman et al. 2016); the superiority of nature-based shore protection over artificial hardening has been shown restoring oyster reefs on intertidal marshes (Meyer et al 1997[119]; Scyphers et al. 2011[120],), natural marshes in estuarine shorelines (Gittman et al 2014[121]), and in 89 restoration assessments in a wide range of ecosystem types across the globe where ecological restoration increased provision of biodiversity and ecosystem services by 25% to 44 % (Benayas et al. 2009[122]).

For the specific case of Mauritius and Seychelles, the availability of hard substrate (carbonate rock, granite) is not a limiting factor for new coral recruitment. However, coral reefs have reached such a state of degradation that human intervention is needed in the form of coral reef restoration, so coral reefs continue to provide shoreline protection and other ecosystem services to people.

[118] Gittman RK, Scyphers SB, Smith CS, Neylan IP, Grabowski JH (2016) Ecological Consequences of Shoreline Hardening: A MetaAnalysis. BioScience 66: 763773

[119] Meyer DL, Townsend EC, Thayer GW. 1997. Stabilization and erosion control value of oyster cultch for intertidal marsh. Restoration Ecology 5: 93–99.

[120] Scyphers SB, Powers SP, Heck KL Jr., Byron D. 2011. Oyster reefs as natural breakwaters mitigate shoreline loss and facilitate fisheries. PLOS ONE 6 (art. e22396).

[121] Gittman RK, Popowich AM, Bruno JF, Peterson CH. 2014. Marshes with and without sills protect estuarine shorelines from erosion better than bulkheads during a category 1 hurricane. Ocean and Coastal Management 102: 94–102

[122] Benayas JMR, Newton AC, Diaz A, Bullock JM. 2009. Enhancement of biodiversity and ecosystem services by ecological restoration: A meta- analysis. Science 325: 1121–1124

Several coast protection initiatives have been carried out in Mauritius (parapet wall, rock revetment) and Seychelles (retaining walls, rock armouring, groyne and timber pilling). It is estimated that the cost of rehabilitating 1km of coastal line in Mauritius using hard structures (rock revetment, parapet walls, etc) will be approximately USD 2 million. In Seychelles the cost for rehabilitating 1.5 km of coast using hard structure will range from USD 2.5 million to USD 5.7 million. Mauritius is presently testing the use of reef balls to protect a northern coast in Mauritius using 900,000 concrete reef balls (hybrid measure) over approximately 0.4 Ha, which cost some USD 2.5 million. Therefore, if hybrid measures were to be used to cover the targeted 3.2 Ha in Mauritius and 2.5 Ha in Seychelles, will cost approximately USD 20 million and USD 15.6 million, respectively.

The activities under the project will not be solely coral restoration, it will also be adopting a community-based strategy for coral restoration. Communities (will be sensitised on the importance of coral reefs as a habitat for fish and understanding that the destruction of corals can contribute in the longer-term loss of fisheries productivity. This will develop a community stewardship for the protection of the coral reefs. Communities will also be trained in the coral reef restoration techniques. With the assistance of the Government initiative alternative, livelihood to coastal communities will be promoted.

The project will invest in long term planning and monitoring of coral reef in both countries. Through the project, a baseline data on spatio-temporal study of the coast dynamics and the current wave pattern would be effected. This will be used as a planning tool for the strategic positioning and planning of future restoration works in both countries, thus reducing the cost of potential negative impact on coast erosion, due to lack of planning. Mauritius and Seychelles will review the existing legislation and institutional framework for the development of a Regional Coral Reef Restoration Plan that will also include Coral Management Plan, improve enforcement in both countries, and promote coral farming at the community levels, and promote regional studies on coral reef restoration. Through the study on genetic connectivity between Mauritius and Seychelles, the biodiversity of the corals will be enhanced, and could be applied in decision making regarding the managing and enhancing of coral reef resources.

The project is also cost effective in that through the component on knowledge sharing and dissemination, and capacity building there will be multiple add-on impacts for the WIO region as a whole. A coral reef restoration Toolkit has already been produced by Nature Seychelles[123]. As part of the scaling up of activities the Toolkit will be revised throughout the project to provide a resource for the region. The regional approach is a major approach for ensuring the cost-effectiveness of the project, through the sharing of experience, knowledge, research facilities, and other resources.

E. Consistency with other strategies

The proposed project is fully consistent with the national development policies and associated strategies, programmes of action and other instruments of each country, and well as to relevant regional strategies and agreements.

Mauritius

Table 4: *Consistency with Mauritian strategies*

[123] Frias-Torres S, Montoya-Maya PH, Shah N.J (Eds.) 2015. Coral Reef Restoration Toolkit: A Field-Oriented Guide Developed in the Seychelles Islands. Nature Seychelles, Mahe, Republic of Seychelles.

Policy	Consistency with strategy
Republic of Mauritius Three Year Strategic Plan 2017/18-2019/20	The strategic plan provides an overview of key development areas for the country for the next three years. One of the key sectors in the development of the Ocean Economy, in which coral farming was identified as a main sector for growth in the near future.
Climate Change Information, Education and Communication Strategy and Action Plan 2014, and National Climate Change Adaptation Policy Framework 2013:	Components 1 and 3 and related outcomes are in alignment with the key principles laid out in the National Climate Change Adaptation Policy Framework, namely, to • "do all possible to enhance and maintain environmental quality, recognizing that the resilience of the natural environment (i.e. ecosystem service flows, including coral reef restoration) is key to coping with climate change" and • "Create an enabling environment for the adoption of appropriate technologies and practices that will assist in meeting national and international commitments with respect to the causes and effects of climate change". The Framework Policy Sectoral Policy Directives, more specifically concerning fisheries and marine ecosystems "Promote and facilitate the undertaking of ongoing multi-disciplinary assessment of coastal and marine ecosystems, to ensure that needs of marine life are understood and taken into account for fisheries and coastal zone management" support outcomes 1.2 and 1.3 Activities under Outcome 1 of the project, involve the development of partnerships and business plans calls for the inclusion of the hotel industry and relates to the policy's Sectoral Strategy and Action Plan, namely • T1 "Provide national guidance for protecting existing critical ecosystems, existing coastal development and future investment" • T2 "Engage the tourism sector in adaptation and sustainable development". In the same Strategy and Action Plan, Outputs 1.1.2 and 1.1.3 relate to the F1 "sustainable utilization of fisheries resources", F2 "protect critical habitats and plan for future hazards" and F3 "support essential data collection and information sharing".
National Environmental Policy (NEP) 2007, which defines the overarching environmental objectives and strategies for the country	Component 1 of the project aligns with Objective (i) of the NEP, "Conservation of Environmental Resources" relating to protecting and conserving critical ecological systems and resources essential for life-support, livelihoods, economic growth and human well-being. It also aligns with Objectives (ii), (iii) namely intra and inter-generational equity, (iv) integration of environmental concerns in economic and social development, (vii), enhancement of partnerships across society and (viii) development of environmental ethics in the citizen. Component 1 also closely aligns with the thematic areas of the NEP strategies in priority areas, namely conservation and sustainable use of biodiversity, marine and coastal zone management, energy and environment, natural and man-made disasters management, and capacity building, research and innovation.

Policy	Consistency with strategy
National Tourism Policy (2005/6) and Strategy Paper (2016)	Component 1 of the project aligns with the latest Tourism Strategic Paper namely to enhance the local tourism product and to uplift the attractiveness of iconic places around the island including beaches and lagoons.
Integrated Coastal Zone Management (ICZM) Framework (2010)	The ICZM Framework places emphasis on "living within environmental limits" and more importantly, the maintenance of basic ecological integrity of coastal habitats such as coral reefs, seagrass beds, mangroves and wetlands" which links to Component 1 of the project and more specifically outcomes 2 and 3. ICZM priorities identified include focus on information provision, more specifically "survey and monitoring" (3.3.2) which relates to outcome 1.3 output 1.3.3 "Long-term maintenance and monitoring programmes in place, recording survival and growth rates of transplanted corals, and abundance and diversity of other reef-associated species" and "Monitoring of survival and bleaching of natural, donor and transplanted colonies before, during and after restoration actions".
Reef Environment Conservation Plan (2015)	The policy calls for active reef restoration given the declining health of coral reefs and recommends that further work builds on the experiences gained to date, that local communities and other stakeholders are involved, and that collaboration and co-operation between the various organisations are essential if measures are to be effective. The Japan International Cooperation Agency (JICA) project *Capacity Development on Coastal Protection and Rehabilitation in the Republic of Mauritius*[124] this project undertook an analysis of coastal erosion in the RM and developed coastal management plans for 14 sites in Mauritius, with guidelines for reef conservation and coral farming as one option for erosion control. Component 1 is consistent with the coastal management plan development therein.
Intended Nationally Determined Contribution [125] (INDC)	Consistent with component 1, the proposed INDC for Mauritius mitigation contributions aims for a smart use of marine resources. Adaptation measures proposed, namely the Disaster Risk Resilience Strategy and its focus on investing and resilience and Marine and Terrestrial Biodiversity Resilience calls for the improvement of the management of marine and terrestrial protected areas, the expansion of the protected area network and the restoration of coral reefs.

[124] JICA 2015. Reef Environment Conservation Plan. Chap. 6. Final Report. The Project for Capacity Development on Coastal Protection and Rehabilitation in the Republic of Mauritius

[125] Government of Mauritius 2015. Intended Nationally Determined Contribution for the Republic of Mauritius

Policy	Consistency with strategy
Country Strategy Paper	The country strategy paper provides a roadmap for achieving economic growth. Within the strategy objectives of the paper, objective 1 which is to enhance competitiveness for increased investment and sustainable development, increasing resilience to weather/climate and natural hazards is identified as a strategy. This aligns with component 1 outcomes 1.1, 1.2 and 1.3.
Third National Communication for Republic of Mauritius to UNFCCC 2016	In order to address sea level rise, coral reef decline and temperature increases and the resulting impacts on coastal erosion, lagoon quality, tourism and local leisure activities, the third National Communication Report has proposed some adaptation policies and strategies. Activities under Components 1 and 3 will address strategies to ensure coastal protection by encouraging coral nursery and growth of coral reefs, restoration and expansion of coral reefs and Incentivise eco-tourism, with the valorisation of natural capital, in Mauritius and Rodrigues.
National Programme on Sustainable Consumption and Production (SCP)	Community participation and empowerment under Component 1 is in line with the National Programme on SCP which consist of 'greening' the tourism sectors and capturing for resource efficient green goods and services and supporting local green entrepreneurs in starting up and developing green business ventures.
National Biodiversity Strategy and Action Plan (NBSAP) 2017 – 2025	Component 1 aligns with the National Conservation Strategy, namely: (i) to maintain essential ecological processes and life support systems; (ii) to preserve genetic diversity, on which depend the breeding programmes necessary for the protection and improvement of cultivated plants and domesticated animals, as well as for scientific advancement; (iii) to ensure the sustainable utilisation of species and ecosystems One of the National Target is that by 2025, at least 20% of degraded coral reef areas are sustainably managed and /or rehabilitated.
Protected Area Network Expansion Strategy (2016-2026)	Component 1 covers partly 3 of the four major areas of competency the need to be developed, namely: • Conservation planning • Biodiversity stewardship; and • Nature-based tourism development
Other relevant laws and policies	• Fisheries and Marine Resources Act 2007 • Environment Protection Act 2002 • Beach Authority Act 2002 • Removal of Sand Act 1982 and Removal of Sand (amendment) Act 1997 • Merchant Shipping (civil Liability for Oil Pollution Damage and International Fund for Compensation for Oil Pollution Damage) Regulations 1996

Policy	Consistency with strategy
	• Prohibition of Removal of Coral and Sea-shell Regulations 2006 (GN No 95 of 2006) • Marine Protected Areas Regulations 2001 (GN No 172 of 2001)

Seychelles:

Table 5: *Consistencies with strategies of Seychelles*

Policy	Consistency with strategy
National Biodiversity Strategy and Action Plan (NBSAP) 2015-2020	Components 2 and 3 aligns with some of the strategies developed in the NBSAP for Seychelles: • Economic valuation of Seychelles' biodiversity (including marine ecosystem) e.g. ecotourism • Capacity Building on biodiversity conservation and sustainable use of natural resources • To protect through a network of viable ecological representative and effectively manage protected coastal and marine areas • To maintain the genetic diversity • To enhance ecosystem resilience and the contribution of biodiversity to carbon stocks through ecosystem conservation and restoration, including coral reef restoration. • To improve, share, transfer and apply the knowledge, science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss
Seychelles National Climate Change Strategy 2009	Component 2 is consistent with the following objectives: • *Objective 1* - to advance understanding of climate change, its impacts and appropriate responses; • *Objective 2* - to put in place measures to adapt, build resilience and minimize vulnerability to the impacts of climate change, including: developing and implementing pilot scale effective adaptation measures and tools at community level, including coastal ecosystem restoration approaches; demonstrating of adaptation technology implementation, with focus on nature-based methods; enhancing the management of coral refugia and resilient areas; and exploring and developing micro-insurance, risk reduction and financing mechanism and private sector financing options for adaptation; • *Objective 5* - to build capacity and social empowerment at all levels to adequately respond to climate change; promote

Policy	Consistency with strategy
	ongoing stakeholder/community involvement in decision making regarding climate change education, awareness and training at national and district level; and develop communication and awareness strategies to engage the community in responding and adapting to climate change.
Seychelles Mariculture Master Plan	Although focusing primarily on fish and sea cucumbers, the principles and approaches identified through the Seychelles Mariculture Master Plan are likely to be applicable to coral farming as well.
Seychelles Strategic Land Use and Development Plan	The country's strategic plan promotes Blue economy, eco-tourism, marine tourism, protection of the environment and protected areas, responding to climate change and improving resilience,
Intended Nationally Determined Contribution (INDC) Under the United Nations Framework Convention on Climate Change (UNFCCC) 2015	Consistent with component 2, the proposed INDC for Seychelles mitigation contributions aims for a smart use of marine resources. Adaptation measures proposed include ecosystem-based approach to agriculture, mariculture for food security and water security, protection of the biodiversity and set up a Blue Economy Research Institution for proper marine resource management.
Seychelles Sustainable Development Strategy (SSDS) 2012-2020	The SSDS comprises of thirteen thermic areas, which covers the main areas of sustainable development intervention in Seychelles. Component 2 of the project covers the following thematic areas: • Biodiversity Conservation, • Agriculture and Food Security • Fisheries and Marine Resources. • Tourism and Aesthetics • The economics of Sustainability (the green economy) • Climate Change • Education for sustainability,
The Seychelles Sustainable Tourism Master Plan 2012-2020	The project is in line with one of the priority are identified, namely: to respond adequately tot the challenges generated by the rapid development of coastal and marine – based tourism activities.
National Report for Republic of Seychelles for UNCSD Rio 2012	Component 2 and 3 align with the recommendations of the Seychelles National Report, namely: • Establishment of necessary mechanism for increased involvement/participation and action of stakeholders and civil society organisation in the participatory decision-making and implementation of sustainable development. • Strengthen coordination and integration of education for sustainable development at all levels and in all forms, encompassing both formal and non-formal approaches. • Expedite efforts to further mainstream climate change adaptation and disaster risk reduction in all relevant sectors. • Strengthen regional cooperative mechanisms, which address national priorities and needs as well as regional

Policy	Consistency with strategy
	targets and commitments. • Encourage the development and adoption of innovative schemes to build resilience in the fisheries and agricultural sector for long-term food security on islands.
Second National Communication for Republic of Seychelles to UNFCCC 2016	Component 2 aligns with some of the recommendations of the Second National Communication: • Encourage residents to gradually participate by raising awareness and education on the Climate Change and anthropological impacts on coral reef habitat • Continue the coral reef monitoring network that was set up in 1998 • Encourage research, build capacity, developing local expertise and strengthening institutional capacity to better understand the coral reef ecosystem amongst others.
Other relevant laws and policies	• Environment Protection Act 2016 (Act 18 of 2016) • Environment Impact Assessment Regulations

Regional Strategies

Table 6: *Consistency with regional strategies*

Regional policy or strategy	Consistency with Strategy
Barbados Programme of Action (1994), Mauritius Strategy for Implementation of Small Island Developing States (2004) and the Samoa Pathway (2014)	As Small Island Developing States (SIDS), the Mauritius and Seychelles are committed to meeting the sustainable development goals and priorities of the Barbados Programme of Action and the Mauritius Strategy for Implementation (MSI)[126] and the Samoa Pathway; the project will contribute to meeting the goals of these programmes. The consistencies and linkages between the proposed project and the Samoa Pathway include but are not limited to: • The Samoa Pathway encourages "Designing and implementing participatory measures to enhance employment opportunities, in particular of women, youth and persons with disabilities, including through partnerships and capacity development, while conserving their natural, built and cultural heritage, especially ecosystems and biodiversity". The gender and youth assessment developed during project preparation phase is in line with this measure. • The Samoa pathway also calls for building resilience to the impacts of climate change and improving adaptive capacity. All project components and outcomes are consistent with this approach.

[126] National Report of the Republic of Mauritius; Third International Congress on Small Island Developing States, September 2014, Western Samoa. UNDP/UNDESA

Regional policy or strategy	Consistency with Strategy
	• Component 3 outcome 3.3, output 3.3.3 calls for sustainable long-term monitoring which is consistent with "improving the baseline monitoring of island system", while components 1 and 2 are also linked with raising awareness and communicating climate change risks, "including through public dialogue with local communities, to increase resilience to the longer-term impacts of climate change". • The project is also consistent with all resolutions concerning oceans and seas as well as disaster risk reduction. • Last, components 1 and 2 contribute to achieving food security and nutrition as identified in the Samoa Pathway.
Nairobi Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Western Indian Ocean Region (1985) - Draft Climate Change Strategy for the Nairobi Convention Area (June 2015)	The project will contribute to meeting the commitments of both countries under the Nairobi Convention, particularly the recommendations relating to marine and coastal biodiversity developed at the 8th Conference of the Parties held in June 2015[127]. Part of the mission identified in the Draft Climate Change Strategy for the Nairobi Convention Area is to support governments, civil society, the private sector and coastal communities in the Western Indian Ocean in the process of adaptation to climate change. The project emphasis a partnership approach to coral reef restoration as an ecosystem-based adaptation approach and is exemplified in Component 1 outcome 1.1, outputs 1.1.1 and 1.1.4 and Component 2, outcome 2.1, outputs 2.1.1 and 2.1.2. Strategic outcome 1 'Improved Adaptation Policymaking" and associated key result 1.3 (mainstreaming adaptation) relates to outcomes 1 in components 1 and 2 and component 3 in terms of involvement of private sector stakeholders, local communities and regional knowledge dissemination and management. Key results 2.1 and 2.3 of the Draft Strategy are to improve the ecological understanding of the impact of climate change and to effectively communicate knowledge about climate change. Component 3 of the project and all of its outcomes and outputs relate to these key results directly in terms of knowledge management and sharing, training and sensitization to build regional capacity for sustainable reef restoration.
Strategic Action Programme for the protection of the Western Indian Ocean from land-based	Both countries endorsed WIO SAP and WIO LME SAP. Coastal and marine ecosystem restoration as well as livelihood improvement of coastal communities are among the transboundary priorities identified for WIO states. Coral

[127] http://www.unep.org/NairobiConvention/Meetings/COP8/index.asp

Regional policy or strategy	Consistency with Strategy
sources and activities (WIO-SAP); and Strategic Action Programme for the sustainable development of the Western Indian Ocean Large Marine Ecosystems (WIO LME SAP)	restoration will bring positive impacts on both ecosystem restoration and coral livelihood improvement.
Western Indian Coastal Challenge	The project will support the Western Indian Ocean Coastal Challenge (WIOCC)[128], which is a Global Island Partnership (GLISPA) initiative led by Seychelles and launched in 2012 that promotes actions for climate resilient development that achieves effective conservation of biodiversity, enhanced livelihood and economies for greater social security among coastal communities.
Agenda 2030	The project is consistent with: • SDG 3 – Good health and wellbeing: Ensure healthy lives and promote well-being for all at all ages relating to components 1 and 2 outcome 1. • SDG 13 – Climate action: Take urgent action to combat climate change and its impacts o 13.1 Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries o 13.3. Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning o 13.B Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities • SDG 14 – Life below water: Conserve and sustainably use the oceans, seas and marine resources for sustainable development o 14.7 - By 2030, increase the economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism

[128] http://glispa.org/11-commitments/32-western-indian-ocean-coastal-challenge-wio-cc
https://sustainabledevelopment.un.org/partnership/?p=8020

Regional policy or strategy	Consistency with Strategy
	○ 14. B. Provide access for small-scale artisanal fishers to marine resources and markets
Other relevant laws and policies	• Nagoya Protocol on Access to Genetic Resources • UN Convention on the Law of the Sea • Ramsar Convention

The project will also complement and assist in meeting the goals of a number of regional projects and programmes as described in Section II: G.

F. Project alignment with technical standards

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. The project will comply with the Environmental and Social Policy of the Adaptation Fund as described in Section L.

In addition, all UNDP 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 Local Project Appraisal Committee (LPAC) established by the UNDP Resident Representative. During the LPAC meeting, as per the UNDP's Social and Environmental Screening Procedure, social and environmental risks identified are presented together with the proposed management measure(s) for each risk identified to ensure the social and environmental safeguard system is in place during the project implementation. A signed copy of the Social and Environmental Screening Report is at Annex 2.

In addition, regional technical standards will be developed for the establishment of coral propagation nurseries and transplantation activities, and the selection of the locations of these activities will be guided by criteria developed through the project which will take account of zoning, MSP and MPA regulations and other relevant requirements in each country. Where required, EIAs will be conducted prior to implementation of activities.

Coral restoration techniques and methodologies are evolving and advancing rapidly in the past few years with the growing scientific interests and body of evidence; thus, there are not yet fixed technical standards that govern coral restoration activities even internationally. The project will support the two countries to stay updated with discussions among the international communities for coral restoration and any guidelines or standards emerging from such bodies, based on the best available science. In the meantime, the project activities in the two countries are regulated and guided by a set of existing relevant standards, regulations, policies, and acts listed below. It is to note that all the relevant legislations, standards and guidelines will be triggered when project intervention takes place:

Mauritius

- The Environment Protection Act (EPA) 2002 (as consequently amended) covers pollution prevention measures, development of environmental standards and guidelines. For some listed undertaking, an Environment Impact Assessment (EIA) studies or Preliminary Environmental Reports (PER) are warranted and environmental clearances are required prior to commencement of work of these undertakings.

- The Fisheries and Marine Resources Act 2007 (amended 2008) provides for: the management, conservation, protection of fisheries and marine resources and protection of marine ecosystems and covers the establishment of aquaculture enterprises and MPAs. The Fisheries Division of the MOEMRFS is the responsible authority for placement of structures at sea and would ensure compliance with its regulations.

- The 2009 draft proposed bill on Environmentally Sensitive Areas (ESAs) Conservation and Management and the associated ESA study, the recommendations of which address the conservation and sustainable use of biodiversity and ecosystem services in the coastal zone, with particular reference to coral reefs and other threatened habitats, will be reviewed as part of the forthcoming UNDP/GEF project Mainstreaming biodiversity into the management of the coastal zone in the Republic of Mauritius. The review and assessment may result in relevant amendments to legislative approaches, which will make legislative and institutional environment more favourable to activities such as coral restoration for DRR and food security benefits.

- Fisheries and Marine Resources (Prohibition of Removal of Coral and Sea-shell) Act 2006 prohibits the removal of corals from any maritime zone of Mauritius unless the person holds a permit. MOEMRFS is the only government body that can issue such permits.

- Guidelines for coastal water quality, which defined the coastal water quality requirement for various activities around the Republic of Mauritius. The MOEMRFS is also the responsible authority, with laboratory facility that would ensure compliance with standards prescribed. The monitoring of the water quality at nurseries and transplanted site form an integrated part of the proposed project interventions.

- Environment Protection (standards for Effluent discharge into the ocean) Regulations 2003. This legislation provides the permissible standards for parameters in effluents discharged into the ocean. The coral reef restoration activity will not produce effluent. However, monitoring of the water quality will be ensured and budget has been earmarked.

- Relevant guidelines and policies in the Aquaculture Master Plan would be adhered to. The Fisheries and Marine Resources Act of 2006 authorizes MOEMRFS to issue a written permit with a set of conditions to a promoter or an institution to carry out a coral farming/rehabilitation project after the review of the application for such permit. The permit is normally given on a pilot basis for 1 year maximum and is renewable upon satisfactory reporting. The set of conditions have slight variations depending on the project target and objectives. The normal set of conditions (template) is at Annex 14 for reference. The permit holders are required to send monitoring report biannually, and AFRC, on behalf of MOEMRFS, conducts annual monitoring on site before the permit renewal. Coral fragmentation activities, if approved in the permit, can be only performed in the presence of an officer from MOEMRFS.

Seychelles

- The Environmental Protection Act (EPA) 2016 provides for the protection, preservation and improvement of the environment and for the control of hazards to human beings, other living creatures, plants and property.

- Environmental Impact Assessment (EIA) is dealt with under the EPA 2016 as well as Environmental Protection (Impact Assessment) Regulations [EP (EIA) 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. This legislation is being strengthened under the Adaptation Fund, *Ecosystem Based Adaptation to Climate Change* project with a view to improving climate change risk management and strengthening the public consultation process.

- Fisheries Act 1987, prohibit the blasting of coral unless permit is obtained from Seychelles Fisheries Authority (SFA). SFA will be a stakeholder and member of the project steering committee.

- The National Parks and Nature Conservancy Act (1969), designate National Parks or Reserves and regulates the type of activities permissible within these boundaries. This legislation is enforced by Seychelles National Environment Commission.

- Environment Protection (Seychelles National Parks Authority) Order provide for the establishment of the Marine Parks Authority as a body corporate. This Authority is vested with the posers and duties of the Seychelles Environment Commission for purposes of carrying out the functions of the commission under National Parks and Nature Conservancy Act. The Authority is responsible for the management and protection of marine parks and other specified areas. The Seychelles National Parks Authority is one of the Responsible Party of the project and will thus ensure that all activities are being carried out according to the law.

- Relevant guidelines and policies in the Mariculture Master Plan would be adhered to.

G. Project duplication

There is no duplication of the proposed project with other initiatives or funding sources. However, the project will complement a number of on-going and planned initiatives, which will result in added value and complementarity. Note that there is no overlap with projects underway or planned for the Seychelles Outer Islands, as the focus of the coral restoration is the granitic inner islands, where reef restoration is most feasible and cost effective.

Relevant on-going and upcoming initiatives are described in the following table:

Table 7 Relevant on-going and upcoming initiatives

Project & Funding Institution	Objective	Potential Synergies
Mauritius – on-going		
ROM/UNDP/AFB *Climate Change Adaptation Programme in the*	To increase climate resilience of communities and livelihoods in coastal areas of Mauritius.	This project is aimed at combating beach erosion and flood risk at selected sites with different forms of hard infrastructure and natural protection mechanisms, and helping to ensure that all policies,

Project & Funding Institution	Objective	Potential Synergies
Coastal Zone of Mauritius: 2012-2018. Implemented by MoSSNSESD.		strategies, plans, and regulations recognize climate change impacts in the coastal zone over the next 50 years. It will directly complement the coral restoration project in that it will provide an enabling environment for the work to be undertaken in terms of policy and will sensitize the public to the urgency of climate change. The project has a component on reef and seagrass restoration at Mont Choisy, the results of which will provide useful experience to feed into the new project.
UNDP/GEF FSP *Mainstreaming biodiversity into the management of the coastal zone in the Republic of Mauritius*. Started in 2017 Implemented by MOI	To mainstream the conservation and sustainable use of biodiversity and ecosystem services into coastal zone management and into the operations and policies of the tourism and physical development sectors in the Republic of Mauritius through a 'land- and seascape wide' integrated management approach based on the Environmental Sensitive Areas' (ESAs) inventory and assessment.	This project directly complements the new project in that it will include activities that will contribute directly to the passive conservation of coral reefs (e.g. improved management of marine protected areas; a "reef-to-ridge" approach to coastal planning; sustainable management of tourism activities) and will also help to create the environmental conditions (good water quality, reduced sediment run-off, reduced damage from boats and tourism) that will facilitate the survivorship of transplanted corals.
GEF SGP UNDP - Eco-Sud (NGO) "Community Based Coral and Voluntary Marine Conservation Area" Started in 2017	The main goal of the project is to locally enhance communities' capacity to contribute to management, conservation and rehabilitation of coral reefs 'ecosystems in order to improve their resilience for sustainable livelihoods and economic development. This will be achieved through the set-up of a coral nursery and a voluntary no-take zone.	This project also directly complements the new project. The coral nurseries on mainland Mauritius will be adjacent to the coral nurseries developed through this SGP-funded project, and will benefit from lessons learned, both in terms of coral farming and involvement of local communities of the region.
Mauritius – upcoming		
Smart Agriculture Project. Mauritius Chamber of Commerce funded by Agence	To reduce the use of pesticides at national level.	The project aims at controlling the use of pesticide, sensitise agriculturalists about the impact of the use of pesticide; this will reduce land-based pollution and ultimately improve lagoon water quality.

Project & Funding Institution	Objective	Potential Synergies
Francaise de Developpement		
EU/Global Climate Change Alliance (GCCA) + Initiative supporting climate smart agriculture for small holders in Mauritius	To increase the resilience of non-sugar small holders to climate change by building their capacity to develop and sustain climate smart agriculture practices and techniques in Mauritius.	The project will build institutional capacity to promote the adoption of climate smart agricultural practices that make minimal use of agrochemicals (fertilisers and pesticides) in crop production and will thus complement this project as it will help address one of the key causes of coral reef degradation. In reducing the amount of agrochemicals being washed into the sea this project will create the required enabling lagoonal environment for coral restoration and will thus increase likelihood of success of the restoration project.
Seychelles - Ongoing Projects		
GOS/UNDP/GEF Seychelles *Protected Areas Finance Project* 2016-2020	To improve the financial sustainability and strategic cohesion of Seychelles protected area system, while addressing emerging threats to biodiversity	This will have close synergy with the proposed project, in relation to find ways to make interventions financially sustainable. In Seychelles, many of the restoration sites are likely to be within protected areas and will benefit from work undertaken through this finance projects. Both projects will be working with the tourism industry and will be able to build on shared lessons learned and activities.
GOS/Adaptation Fund, *Ecosystem Based Adaptation to Climate Change* 2012-2018	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.	This project takes a broader approach than the restoration project to restoring ecosystem functionality and enhancing ecosystem resilience, addressing watershed and coastal processes in order to secure critical water provisioning and flood attenuation ecosystem services from watersheds and coastal areas. One of the activities has direct relevance to the new project: a reef restoration activity involving a soft-engineering approach at North-East Point, Mahe; this will provide experience relevant to the design of the new project.
UNEP-EU *Building capacity for coastal ecosystem-based adaptation in SIDS*	To strengthen the climate change resilience and adaptive capacity of SIDS, which have high dependence on coastal ecosystems	Includes site projects in Seychelles and Grenada; the Seychelles component involves the SNPA and coral farming activities in the Curieuse Marine Park, Praslin

Project & Funding Institution	Objective	Potential Synergies
GEF SGP – Anba Lao (NGO); Testing methods of human induced resilience of socio-economically important coral reef sites within the Seychelles Marine National Parks 2016 -18	To promote recovery of coral reefs that is presently classed as non-resilient.	This project is looking at differential survival of coral recruits at different locations which is directly relevant to proposed project activities in Seychelles and will provide important knowledge that can be used when considering survival of transplanted corals.
UNDP-EU GCCA+ project	To ensure that the people, economy and environment of Seychelles are able to adapt to and develop resilience to climate change and its effects, thereby safeguarding the sustainable development of Seychelles	Project activities focus on La Digue Island. Integrated shoreline management will result in enhanced shoreline protection and potentially contribute to stabilization of offshore reefs. There are no coral restoration activities under the project.
TNC *SeyCCAT Seychelles Conservation and Climate Adaptation Trus*t 2016 onwards	To provide a sustainable flow of funds - which supplements existing and future funds from any sources - to support the long-term management and expansion of the Seychelles system of protected areas and other activities which contribute substantially to the conservation, protection and maintenance of biodiversity and the adaptation to climate change	SeyCCAT will be used for activities to work towards the expansion of the MPA network (planned addition of 400,000 km2 new MPAs). Coral restoration is one of 8 identified priorities for SeyCCAT funding but the SeyCCAT Board expects that any funded projects will add incremental value, be synergistic and not duplicate any existing initiatives.
GOS/GEF/TNC Seychelles Marine Spatial Planning (MSP) initiative 2014-2020	To develop and implement an integrated marine plan to optimise the sustainable use and effective management of the Seychelles marine environment while ensuring and improving the social, cultural and economic wellbeing of its people.	The MSP Initiative is an integrated, multi-sector approach to address climate change adaptation, marine protection and support the Blue Economy and other national strategies. It will demarcate areas designated for fishing, tourism and recreation, biodiversity conservation and cultural heritage, and a range of industries, taking into account the need for MPAs; it will be particularly relevant to the coral restoration project in relation to the selection of sites for nurseries and transplantation

Project & Funding Institution	Objective	Potential Synergies
EU/UN Environment and UNEP-WCMC - *Building Capacity for Coastal Ecosystem-based Adaptation in Small Island Developing states* 2014-2016	The overall goal of the project is to strengthen the Climate Change resilience and adaptive capacity of communities and societies in SIDS with high dependence on ecosystem services provided by healthy tropical coastal ecosystems.	A coastal EbA options guide and online decision support tool were developed and training workshops were held in Grenada and the Seychelles. Decision makers were helped to understand future threats to coastal communities and ecosystems, and how governments and civil society can together act to maintain the future health of ecosystems and buffer coastal communities from climate change impacts. These will be useful for the incorporation of EbA approaches during the preparation of the Regional Coral Reef Restoration Plan.
Seychelles - Upcoming projects		
UNDP/GEF PIF – to be prepared for a Reef to Ridge project	To address the 'whole island' priorities of improved management and conservation of upland forest and agricultural ecosystems as well as coastal and marine ecosystems in the Seychelles to produce global benefits in terms of conservation of globally significant biodiversity and the effective management of the large marine ecosystems (including coastal and near-shore marine ecosystems), and to arrest and reverse ecosystem degradation	The project has a focus on addressing land-based threats to coastal and near-shore marine ecosystems, including particularly reducing land-based threats to offshore coral reefs. The project will aim to enhance protection of selected resilient reef areas from further threats, subsequent to assessment of target reef areas that remain viable following the 2016 coral bleaching event.
USAID/Nature Seychelles	Potential development of a coral reef research centre	Potential 3rd phase of Reef Rescuers Project – this would be directly relevant to the proposed project in that it would provide a much needed research base in the Seychelles
Regional – ongoing		
COI – EU The *coastal, marine and island specific biodiversity management in East African and Indian Ocean states*. 2014-2018	Strengthening national and regional capacities, at all levels, in managing coastal, marine and island-specific biodiversity resources and ecosystems.	This project has components on (1) improving and harmonising policies and institutional framework; (2) education, awareness-raising and communications particularly aimed at decision makers; (3) improving mechanisms for sharing data relating to biodiversity; (4) establishment of regional biodiversity thematic centres; and

Project & Funding Institution	Objective	Potential Synergies
		(5) a small grants programme for projects relating to biodiversity and sustainable livelihoods. Many aspects of the work undertaken through this will be of value to and support the coral restoration project. In particular the WIO Coral Reef Monitoring Network which is being established through this project, will provide a regional framework and long-term monitoring of the restored reef
COI/FFEM - *Project de Gestion Durable des Zones Côtières des pays de la COI – Indian Ocean Commission* (GDZCOI). 2014-2017	Gathering and disseminating experiences and progress in ICZM and protection of marine and coastal biodiversity in Mauritius (Rodrigues), Madagascar and Comoros	Lesson learned and knowledge gathered through the GDZCOI project, with respect to coral reefs, will potentially be of value to the new project
UNDP/GEF *Western Indian Ocean Large Marine Ecosystems Strategic Action Programme Policy Harmonisation and Institutional Reform* (WIO LME SAPPHIRE): 2015-2020	To support and assist government institutions and intergovernmental bodies in the region to implement the activities required to deliver the Strategic Action Programme and to ensure sustainability of efforts and actions toward long-term management of activities within the LMEs and the sustainability of associated institutional arrangements and partnerships.	This large regional project includes components on policy harmonisation and management reforms, capacity building, integrating the ecosystem-based management approach into Local Economic Development Plans at selected pilot sites; ecosystem-based practices among artisanal fisheries. It will contribute to providing an appropriate policy and governance context for coral restoration in the region. SAPPHIRE also has expectations of habitat restoration built into its Results Framework with some modest targets. This current AFB Coral Restoration project could provide a vital and complementary demonstration role.
WIOMSA/MASMA– *Emerging Knowledge for Local Adaptation - Modifying the Symbiosis of Knowledge and Governance for the Adaptation of Western Indian Ocean Coastal Communities at Risk from Global Change.* 2014-2017.	Assess emerging knowledge on coastal vulnerability to inform and guide climate change adaptation at local government level; Evaluate the capacity of local government to build resilience; Devise strategies and make recommendations to strengthen knowledge management systems relating to vulnerability to climate	This project involves Kenya, Mauritius, Mozambique, and South Africa, and will contribute to work underway in the region to build capacity for adaptation with a focus on local government; the involvement of MOI in this project will mean that knowledge and lessons learned from this project can be fed into the coral restoration project at the design stage

Project & Funding Institution	Objective	Potential Synergies
	change; Build capability of local government to implement this emerging knowledge; Test the applicability of improved knowledge systems to improve local government ability to use emerging knowledge and monitor their uptake	
Regional- upcoming		
WIO-SAP *Partnerships for the Implementation of the Strategic Action Programme for the Protection of the Western Indian Ocean from Land Based Sources and Activities*. 2nd Phase of WIO-LAB programme	To reduce impacts from land-based sources and activities and sustainably manage critical coastal-riverine ecosystems through the implementation of the WIO-SAP priorities.	This project will address water pollution and degradation of critical habitats from land-based impacts and will therefore be critically important to the new coral restoration project, given that water quality will be a key issue to address. The WIOSAP project will have excellent synergies with the coral restoration project as it aims to calculate environmental flows and address compliance with effluent standards which ultimately will result in better lagoon water quality.

H. Learning and knowledge management component of the project.

Learning and knowledge management dimensions are integrated in all project components and includes the creation of knowledge products (lessons learned, data and information of the processes) that will be publicly accessible and widely disseminated, as well as increased capacity/knowledge among all stakeholders. Progress of the project will also be communicated through social media. An overview table (table 8) is given below for each component and relevant knowledge management product.

A website will be created to share information on the project regarding progress, lessons, plans and milestones of the project, amongst others. These will be leveraged for disseminating information on the process of both countries as well as lessons learned throughout the project. This website will also be accessible through a link from the existing websites of the Ministry of Ocean Economy, Marine Resources, Fisheries and Shipping Mauritius (fisheries.govmu.org) and the Ministry of Environment, Energy and Climate Change Seychelles (meecc.seydevplus.com/) including the Seychelles National Parks Authority (www.snpa.gov.sc).

A media outreach strategy will include the invitation of both local and national media (press, radio and TV) at key project stages for contributing to awareness-raising and promoting best practices at local and national level.

The project will include systematic bottom-up dissemination of lessons learned from local to national level, whereby lessons learned from the local level will be presented at the national level

and translated into useful training guidelines and recommendations for evidenced based policy making. Component 3 also includes the further refinement of the coral reef restoration Toolkit, previously developed by one of the implementing organizations in Seychelles. The project aims to disseminate the Toolkit widely and make it accessible at no cost to the public and other countries of the Indian Ocean region which are interested in coral reef restoration. The knowledge management strategy foresees to produce informative and easily accessible venues (e.g. videos tutorials etc.) that guide communities/stakeholders to use the tool without outside intervention.

The project has a dedicated component related to knowledge management (Component 3: Knowledge management and sharing, training and sensitization to build regional capacity for sustainable reef restoration). The component will focus on systematically keeping track of experiences gained from the project both to enrich the local, national, regional and global knowledge of coral reef restoration and its potential climate change adaptation. The project will also carry out regional studies, such as genetic resilience (thermal-resistant symbionts clades) of corals of the Indian Ocean, temporal studies of wave patterns at coral reef restoration sites and their effect on food security and coastal erosion. These could then be used as best practices for potential replication nation-wide and in the region. Knowledge exchange among countries affected by similar climate-related threats is at the core of the project. Regional workshops and training will be organised with a view to share lessons learned for the locally implemented coral reef restoration activities. Project key findings will be published in scientific peer-reviewed journals and presented at international conferences to enrich the field of coral reef restoration globally.

The table below gives an overview on learning and knowledge management products foreseen under this project.

Table 8: *Knowledge management objectives and indicators*

Expected project outputs	Learning objectives(LO) and Indicators(I)	Knowledge products
Output 1.1.1 Coastal communities benefit from improved livelihoods through employment establishing and maintaining coral nurseries and transplantation sites.	(LO): improved understanding of the importance of coral reefs, impacts of climate change on the coral reefs and importance of coral reef restoration; capacity building of coastal communities on establishment and maintenance of coral nurseries and innovative approaches to derive alternative financing. (I): Number of local communities and stakeholders trained (data disaggregated by community groups, gender and age groups).	Training materials (e.g. pamphlet, flyers, posters manuals, guidelines)
Output 2.1.1 Coastal communities benefit from improved livelihoods through employment establishing and maintaining coral nurseries and transplantation sites.		
Output 1.2.3 A land-based nursery and 2 or more ocean nurseries established and maintained on a regular basis in Mauritius	(LO): improved knowledge of coral reef restoration as a coastal climate change adaptation project implemented locally	• Project reports and detailed data collected in each restoration site

Expected project outputs	Learning objectives(LO) and Indicators(I)	Knowledge products
Output 2.2.3 A land-based nursery and 2 or more ocean nurseries established and maintained on a regular basis in Seychelles	(I): Number of sensitisation materials shared among the coastal beneficiaries.	• Where applicable, physical demonstration sites, and sensitization material related to climate change adaptive effort and coral restoration.
Output 3.1.1 Comparative review and analysis of coral reef restoration initiative in the region and globally, with gaps in knowledge identified.	(LO): Improved knowledge and experience exchanged in coral reef restoration efforts undertaken by the project, science based best practices and methodologies (I): Number of publicly shared knowledge products	Studies, reports and research papers on coral reef restoration methodology and reports on past and current coral reef restoration projects locally and in the region for dissemination.
Output 3.1.2 Based on past and on-going coral restorations efforts undertaken by the project and others, science-based best practice and methodologies (e.g. factors determining success in coral restoration are known; cost-effective approaches, etc.) developed, constraints and challenges identified, and lessons learned documented.		• Coral Restoration Methodologies/guidelines document • Good practices guide on coral reef restoration • Reports of country to country learning exchanges. • Articles published on project website. • Documentary film and short video clips on project progress.
Output 3.1.3 Research undertaken to provide information to guide restoration and enhance reef resilience where required (e.g. genetic connectivity of coral species, spawning seasons and coral recruitment patterns, resistant/ resilient species and clades)	(LO): Improved knowledge and experience exchange in genetic connectivity of corals of the Indian Ocean, their resilience to climate change and their impact on food security and Disaster Risk Reduction. (I): Number of regional studies implemented.	Scientific articles published in a peer reviewed journal capturing the lessons learned from the project implementation for the global academic community.
Output 3.2.1 Lessons learned in reef restoration documented and shared.	(LO): Improved knowledge and experience exchange around coral reef restoration and adaptation to climate change (I): Number of publicly shared knowledge products.	• At least one scientific article published in a peer reviewed journal capturing the lessons learned from the project implementation for the global academic audience. • One detailed report per country on project implementation, capturing lessons learned and best practices.
Output 3.2.2 Coral Reef Restoration tool kit and manual for use in the WIO published and disseminated		• Coral Reef Restoration Toolkit, upgraded and available to the public.

Expected project outputs	Learning objectives(LO) and Indicators(I)	Knowledge products
Output3.3.1 Regional training workshops undertaken on monitoring, DNA-based approach for the identification of resilient corals, and other topics as appropriate	(LO): Improved capacity in monitoring, genetic identification of resilient corals and adaptation to climate change through coral reef restoration (I): Number of national officers and other beneficiaries trained.	• Report of regional training and workshops for project stakeholders and representative of countries of the region involved in coral reef restoration, including genetic analysis of coral zooxanthellae *Symbiodinium* clades, and techniques of microfragmentation and fusion of massive corals • Training video for coral reef restoration, capturing lessons learned and best practices.
Output 3.3.2 Sustainable long-term monitoring programme developed and underway for restored reefs, based on international/regional protocols and best practice	(LO): Improved nation institutional and legislative framework for enabling upscaling of coral reef restoration efforts. (I): Number of policies, legislation developed	• Regional Coral Reef Restoration Plan, which will include National components and Coral Reef Monitoring protocol. • Baseline data on current pattern and spatio-temporal study to measure impact of coral reef restoration efforts.

I. Consultative process

A wide range of stakeholders have been consulted during the preparation of the Concept Note and full Project Proposal for this project. The proposed project's Executing Entities were consulted through the iterative process of refining the project design. As a regional organisation, the Project Steering Committee is comprised of national representatives from Mauritius and Seychelles. Therefore, it is well-positioned to ensure that the proposed project design is tailored to local requirements, benefits vulnerable groups and includes gender considerations.

In the course of preparing the Concept Note, discussions and meetings were held with the project's Executing Entities, including a meeting of the Regional Steering Committee in Seychelles, July 2016, to review the draft concept. Discussions were also held with the regional organisations COI and CORDIO, and the consultant for the Concept Note participated in the reef restoration sessions at the 13th International Coral Reef Symposium and was thus able to benefit from meetings with scientific experts on this topic to gain an understanding of the current global scientific perspective on coral restoration.

In addition to the Project Steering Committee, representatives from national ministries in each country were consulted on numerous occasions and at various stages of project preparation to ensure that the proposed project design meets the specific national circumstances of each country. These consultations included the National Designated Authority (NDA) and the National Executing Entity (NEE) in Mauritius and Seychelles. The details of these consultations are further described below.

National consultations were held in each Partner State. For these national consultations, workshops were convened with representatives from relevant national ministries and NGOs.

Representatives from the steering committee and UNDP were also in attendance. These workshops were held on: 8 May 2017 (Stakeholder workshop in Mauritius) and 12 May 2017 (Stakeholder workshop in Seychelles). Moreover, several bilateral meetings were held between September and December 2017, with the implementing partners in each partner state to agree on the activities and result framework.

Two Regional Steering Committees were held, one in Mauritius (08 May 2017) and one in Seychelles (20-21 June 2017), where the results of these consultations were used to further revise and update the logical framework for the proposed project. In addition, national arrangements for the implementation of the project were agreed.

A full participant list and summary of the discussion of the three Regional Steering Committee meetings and stakeholder meetings are included in Annexes 3, 4, 5 and 6.

A full stakeholder analysis has been completed during preparation of the full Project Proposal to inform the project design and to ensure that the vulnerable groups are identified, and their needs addressed. The stakeholder analysis is included in the Community Development Plan for Mauritius and Seychelles (Annex 7 and 9 respectively). In Mauritius, the stakeholder analysis will be updated as per output 1.1.1. The full range of stakeholders will ultimately be involved, including in particular coastal communities, who in Mauritius have already expressed an interest in taking part in coral restoration activities[129], and the tourism sector. In Mauritius, the involvement of hotels is likely to be co-ordinated by the hotel association, AHRIM.

Stakeholders have been identified through desk review of past projects, giving consideration to women led projects and local private sector stakeholders. Several consultancy meetings and interviews were conducted with members of the communities in the villages along the target sites, including some hotel association, key governmental and non-governmental Organisation intervening in in coral reef conservation and rehabilitation.

Canvassing was carried out to ensure that vulnerable and underserved groups would not be left out of the equation. Through key informants, informal interviews were held with village inhabitants and information was gathered in order to include the maximum number of stakeholders as well as underserved and underrepresented groups and stakeholders.

Focus groups were carried out among community members in the coastal areas of targeted areas, where they have identified processes that already work well and common visions of success for the project and their communities in relation to climate change. They have carried out SWOT analysis, defined goals, objectives and action plan and defined roles and responsibilities that they wished to have during the project implementation.

The civil society and private sector stakeholders consulted were: coastal community groups, local non-governmental organizations operating in the vicinity of the proposed rehabilitation sites and more particularly conservation organizations, fishers - both registered and non-registered, boat operators and hotel associations. The consultations carried out revealed overall a favourable attitude towards the perspective of a coral rehabilitation project. In Mahébourg, the fishers and boat operators were wary of the diversity of corals to be rehabilitated, as there had been a recent resurgence of branching *Acropora* in boat passage areas. Fishers consulted on this site were also part of an ongoing project to rehabilitate a local *barachois* and mangrove swamp for which they were receiving daily allowances. They revealed that this supplemental income was very much appreciated due to their economic vulnerability and fishers in Mauritius and Rodrigues expressed

[129] Nazurally, N. and Rinkevich, B. 2014. A Questionnaire-based Consideration of Coral Farming for Coastal Socio-economic Development in Mauritius. *Western Indian Ocean J. Mar. Sci.* 12 (1): 47-56.

that any income associated with rehabilitation work would be similarly appreciated as an alternative to complement to their fishing income. Hotel groups were also very favourable to the project and some hotels had already started small-scale coral rehabilitation projects, mainly with the aim to raise awareness among their clients. The hotel stakeholders consulted welcomed the future technical expertise brought about by the project. NGOs consulted were already either actively engaged in coral rehabilitation projects or in the development phase of such projects, using a community-based approach, with scientists and technical experts working with local fisher groups and boat operators to identify adequate sites and engage them in rehabilitation work through both paid and non-paid basis.

A full gender analysis has been completed during preparation of the full Project Proposal to inform the project design and to ensure that the gender specific needs are addressed to realize women empowerment and gender mainstreaming. the youth and gender analysis reports for Mauritius and Seychelles are at Annexes 8, and 10, respectively

Both in Mauritius and Seychelles, women have the largest share of responsibility for child caring, house cleaning and cooking. This means that when epidemics and natural disasters strike, women tend to bear a larger burden of the share of the adaptation to the consequences of these phenomena. As such, it is important to identify gender sensitive strategies to respond to the environmental and humanitarian crises caused by climate change. It is also important to note the role that women have as agents of change and the strong body of knowledge and expertise they possess that can be used in climate change mitigation, disaster reduction and adaptation strategies.

In mainland Mauritius the project may only affect women in as much as the project may affect the household; since very few women were directly involved in fishing or sea-based activities but are indirectly involved as most had fishermen or boatmen in their family. This is not the case in Rodrigues, as there are many more registered fishermen who are women. On the other hand, there is no record of female fishers registered in Seychelles.

Both countries are taking significant steps to improve gender equality; for example, in Mauritius the Local Government Act of 2011 stipulates that at least one third of candidates for the municipal council and village council elections must be of either gender. As a result, the share of women on municipal councils rose from 13.5% in 2001 to 36.7% in 2012, and on Village Council elections, from 2.8% in 1998 to 25.4% in 2012.

J. Funding justification

Component 1. Enhancement of food security and reduction of risks from natural disasters through the restoration of degraded reefs in Mauritius.

Baseline (without AF Resources)

In Mauritius, as in all SIDS, the main climate change threats, confirmed in many cases by meteorological observations, are changes in rainfall patterns leading to flooding and landslides, extended periods of drought, increases in sea surface temperature, changes in ocean acidity which weakens the carbonate structure of reefs, and increases in storms, storm surges and sea level rise. Escalating coastal erosion and flooding events are already being felt in Mauritius.

Between 1998 and 2007, mean sea level rose by 2.1mm per year in Mauritius and since then has been rising by around 3.8 mm/year; average temperature has risen by 0.74^{o}C when compared to

the 1961-90 average; flash floods in 2008 and 2013 resulted in loss of lives; and there has been an increase in the frequency of extreme weather events, heavy rains and storms[130]. It is predicted that half of the beaches on Mauritius could disappear by the middle of the century, which would be disastrous for the tourism industry[131].

Flooding in the coastal areas of Mauritius is already increasing, affecting many of the most populated locations given that these locations are concentrated on the low-elevation coastal areas; large relative increases in flooding are projected in the small island region of the Indian Ocean[132]. In Mauritius, the impacts of cyclones and tropical storms have intensified[133] and this trend is projected to continue as Mauritius lies in the South Western Indian Ocean cyclone basin. There is also evidence that wave action in coastal areas has increased as a result of climate change, with sea level rise exacerbating coastal erosion as the waves reach further inland at high tide.

Mauritius is particularly vulnerable. It is ranked 13th in terms of overall disaster risk (measured according to the extent that natural hazards - *floods, droughts, storms, earthquakes and sea level rise* - coincide with a vulnerable society) on the World Risk Index[134] (on this set of parameters it is at highest risk of all the African nations) and 7th on the list of countries most exposed to natural hazards.

In 2011, insured losses from natural disasters, especially coastal (and riverine) hazards, reached globally USD105 billion, an all-time high. The Indian Ocean, one of the most disaster-prone regions, is particularly vulnerable to storms and wave surge, coastal flooding and sea-level rise.

Mauritius has developed comprehensive action plans and strategies to adapt to the negative environment and socio-economic impacts of climate change, and also to protect and sustainably manage ecosystems, such as coral reefs, that provide services that will provide concrete adaptation measures for climate change.

Mauritius has a Climate Change Action Plan in place and has invested significant resources in starting to develop appropriate adaptation and mitigation measures, and planning is in place for the introduction of a Climate Change Bill. A National Climate Change Adaptation Policy Framework and a Technology Needs Assessment (TNA) identifying and prioritizing relevant technologies for adaptation to and mitigation of climate change impacts has been prepared that highlights the importance of adaptation to Mauritius. A Climate Change Information Centre has been set up, with the support of UNDP, the Inter-Regional Technical Support Component of the Africa Adaptation Programme and Japan International Cooperation Agency (**JICA**) funded by the Government of Japan[135].

In Mauritius, work is underway to strengthen the management of and expand the network of MPAs, with the support of the forthcoming GEF project, and this will help protect coral reefs *in situ*.

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[130] http://environment.govmu.org/English/Climate_Change/Pages/Climate-Change.aspx
[131] Mauritius TNA
[132] Nicholls, R.J. & Hoozemans, F.M.J. 2002. *Global Vulnerability Analysis*. In Schwartz, M. (Ed). Encyclopedia of Coastal Science, Kluwer Academic Publishers.
[133] 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.
[134] 2015 World Risk Index, UNU-EHS and the Alliance Development Works/Bündnis Entwicklung Hilft (BEH) http://www.worldriskreport.org/
[135] http://environment.govmu.org/English/Climate_Change/Pages/CCIC.aspx

However, the costs of implementing all the adaptation measures are extremely high and for Mauritius, further active measures and financial and technical support are required to ensure that life and property are protected from disaster and that food security and livelihoods are assured.

Coastal erosion is being addressed in Mauritius through the continual upgrading of infrastructure (e.g. rock armouring, sea-walls, break-water/piers, groynes) and through reclamation. This strategy results in a fragmented approach, with the tourist industry covering costs to protect beaches, government financing the protection of public infrastructure, and private owners safeguarding their own investments. In extreme cases, infrastructure such as roads has to be moved away from the shoreline. Under the business as usual scenario, coastal erosion is thus likely to continue, affecting public and private/hotel beaches and impacting on the recreational enjoyment of the public and the willingness of tourists to both countries. The potential impact of coastal erosion on tourism in Mauritius is already of concern to the government and efforts are underway to reduce this but these are costly and not necessarily effective.

As coral reefs decline, fewer tourists will come for the purpose of diving and snorkelling, and already the government is promoting a strategy of greater diversification of tourist attractions.

Flooding of coastal communities will continue to increase; artisanal fish catches will continue to decline, and food security will be jeopardized. Coral reefs will be protected within the MPAs for their biodiversity values and for tourism and fisheries purposes, but MPAs are not always in locations where the coral reefs can provide buffering services to protect coastal infrastructure and communities, and the management of the MPAs rarely takes adaptation to climate change and food security into account.

Mauritius has undertaken pilot activities in coral reef restoration, but these have been uncoordinated and have often lacked sustainability and adequate resources for maintenance and monitoring. Existing adaptation efforts have not adequately incorporated Ecosystem based Approaches (EbA) to adaptation.

Additionality (with AF Resources)

Up to now coral reef restoration efforts have not been up to scale in Mauritius, despite the fact that Climate Change and El Nino regularly affect the existing coral reefs. Hence there is need to upscale coral reef restoration efforts significantly. Also, there is need to learn from other coral reef restoration efforts in the Indian Ocean so as to obtain the most climate resilient methods available and improve on them.

With AF financing, activities under the proposed project will result in the restoration of degraded coral reefs in key locations in Mauritius that ultimately will have the outcomes of:

- More effective shore protection and a buffering service against erosion and floods on the long term
- Enhanced economic activities, leading to improved livelihoods and greater food security as a result of increased fish catches for coastal communities, and increased enjoyment of reefs for tourists, leading to greater employment for local people through the tourism industry
- Have trained workforce available for future partnership in coral restoration activities, nationally.

The additional resourcing will provide an opportunity to upscale initiatives significantly to restore degraded coral reefs, and to ensure that they provide improved livelihoods for local communities

and in the long-term benefit the national economy. The sites where coral reefs would be restored may well become visitor destinations in their own right, attracting scientists, tourists and the general public.

Component 2. Enhancement of food security and reduction of risks from natural disasters through the restoration of degraded reefs in Seychelles

Baseline (without AF Resources)

In Seychelles, as in all SIDS, the main climate change threats, confirmed in many cases by meteorological observations, are changes in rainfall patterns leading to flooding and landslides, extended periods of drought, increases in sea temperature, changes in ocean acidity which weakens the carbonate structure of coral reefs, and increases in storms, storm surges and sea level rise. Escalating coastal erosion and flooding events are already being felt in Seychelles.

Rates of sea level rise around Mahe in Seychelles have been measured at 1.46 mm a year[136]. It has been estimated[137] that globally, without adaptation, a 1 m rise in sea level will produce a 14-fold increase in flooding compared to the situation without sea-level rise. Even under a lower sea-level rise scenario of 38 cm by the 2080s, the global increase in flooding will be seven-fold compared with the situation without sea-level rise. Shore wave heights are limited by water depths, so with the increase in sea level, the height of waves will also increase.

Flooding in the coastal areas of Seychelles is already increasing, affecting many of the most populated locations because these are concentrated on the low-elevation coastal areas, and there are predicted to be large relative increases in flooding in the small island region of the Indian Ocean[138]. In Seychelles, the impacts of cyclones and tropical storms have intensified[139] and this trend is projected to continue. Although Seychelles is situated just north of the South Western Indian Ocean cyclone basin, the granitic islands are affected by the associated extreme rainfall and wave swells[140]. There is also evidence that wave action in coastal areas has increased as a result of climate change, with sea level rise exacerbating coastal erosion as the waves reach further inland at high tide.

Seychelles is considered less at risk than Mauritius due to its favourable socio-economic status (it ranks 153rd) but lacks the ability to reduce overall risk: 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. Furthermore, of the 86% of the Seychelles population living on Mahe, around 60% of people live in coastal areas; the remaining 14% of the population live mostly on Praslin and La Digue and almost all people live in the narrow coastal plains. Thus around 75% of the population may be considered vulnerable to climate change risks and in need of adaptation measures.

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[136] 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.

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

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

[139] 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.

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

In 2011, insured losses from natural disasters, especially coastal (and riverine) hazards, reached globally USD105 billion, an all-time high. The Indian Ocean, one of the most disaster-prone regions, is particularly vulnerable to storms and wave surge, coastal flooding and sea-level rise.

Seychelles has developed comprehensive action plans and strategies to adapt to the negative environment and socio-economic impacts of climate change, and also to protect and sustainably manage ecosystems, such as coral reefs, that provide services that will provide concrete adaptation measures for climate change.

In both countries, work is underway to strengthen the management of and expand the network of MPAs, with the support of the forthcoming GEF project, and this will help protect coral reefs *in situ*. The recently completed GOS-UNDP-GEF project 'Strengthening Seychelles' Protected Area System through NGO management modalities'.

In Seychelles, progress will be made toward adaption as a result of the Seychelles MSP Initiative which will produce a national multi-use marine spatial plan that guide the strategies and interventions to be undertaken through the Seychelles Conservation & Climate Adaptation Trust (SeyCCAT). SeyCCAT will ultimately lead to designation for some 30% of the EEZ as protected areas, half of which is planned to be strict no take zones.

However, the costs of implementing all the adaptation measures are extremely high and for both countries, further active measures and financial and technical support are required to ensure that life and property are protected from disaster and that food security and livelihoods are assured.

Coastal erosion is being addressed in Seychelles through the continual upgrading of infrastructure (e.g. rock armouring, sea-walls, break-water/piers, groynes) and through a strong focus on land reclamation. This strategy results in a fragmented approach, with the tourist industry covering costs to protect beaches, government financing the protection of public infrastructure, and private owners safeguarding their own investments. In extreme cases, infrastructure such as roads has to be moved away from the shoreline. Under the business as usual scenario, coastal erosion is thus likely to continue, affecting public and private/hotel beaches and impacting on the recreational enjoyment of the public and the willingness of tourists visit Seychelles.

As coral reefs decline, fewer tourists will come for the purpose of diving and snorkelling, and already the government is promoting a strategy of greater diversification of attractions.

Flooding of coastal communities will continue to increase; artisanal fish catches will continue to decline, and food security will be jeopardized. Reefs will be protected within the MPAs for their biodiversity values and for tourism and fisheries purposes, but MPAs are not always in locations where the reefs can provide buffering services to protect coastal infrastructure and communities, and the management of the MPAs rarely takes adaptation to climate change and food security into account.

Seychelles has undertaken pilot and large-scale activities in coral reef restoration, but these have been uncoordinated and have often lacked sustainability and adequate resources for maintenance and monitoring. In Seychelles, the Government has recognized as a shortcoming that existing adaptation efforts have not adequately incorporated EbA. Therefore, it has identified EbA as its priority for adaptation fund financing—seeking to put in place the requisite management systems.

Additionality *(with AF Resources)*

With AF financing, activities under the proposed project will result in the restoration of degraded coral reefs in key locations in Seychelles that ultimately will have the outcomes of: (1) More

effective shore protection and a buffering service against erosion and floods, and (2) Enhanced economic activities, leading to improved livelihoods and greater food security as a result of increased fish catches for coastal communities, and increased enjoyment of reefs for tourists, leading to greater employment for local people through the tourism industry

The additional resourcing will provide an opportunity to upscale initiatives significantly to restore degraded reefs, and to ensure that they provide improved livelihoods for local communities and in the long-term benefit the national economies of both countries.

The sites where coral reefs have been restored may well become visitor destinations in their own right, attracting scientists, tourists and the general public. These efforts are expected to increase public awareness of the coastal adaptation issues in Seychelles and an understanding of cost-effective solutions to climate change impacts.

Component 3. Knowledge management, training and sensitization to build regional capacity for sustainable reef restoration

Baseline (without AF Resources)

Institutional capacity for coral reef restoration will remain insufficient, with limited technical knowledge. Coral reef restoration efforts will remain small scale, wasting financial and human resources on initiatives that are not sustainable in the long term and efforts will remain fragmented and uncoordinated. No systematic knowledge management system with adequate ecosystem-based adaptation elements will be developed and instituted. Up-scaling of best practices will therefore be unlikely to happen.

Currently, there is no regional exchange of knowledge in coral reef restoration techniques and efforts. Neither is there a standardized approach in coral restoration efforts.

Additionality (with AF Resources)

With the financing rendered through the Adaptation Fund, decision makers, local communities and the general public will have a good understanding of coral reef restoration and how it will contribute to comprehensive adaptation measures. This approach will increase the likelihood that both countries will succeed in their adaptation efforts. Institutions will be strengthened in skills and capacity for active reef restoration, and knowledge generated and shared.

Moreover, the project will enable the implementation of regional capacity in coral reef restoration, with the promotion of a more standardized science-based approach and cumulative knowledge through sharing experiences. All people engaged in the coral reef restoration project will benefit from the latest scientific knowledge and techniques.

Currently results in coral reef restoration have been publicized for some projects in Seychelles but not all projects in Mauritius and Seychelles. As such AF support will provide regional and international visibility on actions initiated and results obtained in both countries. The AF financing will also enable for improved livelihood opportunities, e.g. creation business opportunities as a result of coral reef restoration activities at the community level.

With AF financing, Mauritius and Seychelles will enable the compilation of spatio-temporal data on current wave pattern, which will be used as a planning tool for future restoration to maximize coastal protection and minimize potential negative impacts on the coasts. Additionally, the AF

financing will enable the review of the legislative and institutional framework of both countries to develop a regional coral reef restoration plan.

K. Project Sustainability

Marine Protected Areas (MPAs) with effective enforcement have been targeted for restoration (at selected sites within MPAs) in both Mauritius and Seychelles because: 1) they provide a protected environment so the effects of the coral reef restoration activity can be scientifically quantified without interference from confounding factors (i.e. fishing, anchor damage from boats, runoff pollution, etc), and the coral reefs restored there will also be protected as per MPA regulations, 2) they have an existing ecotourism infrastructure so any increase in job opportunities and benefits to locals can be incorporated quickly within the MPA system, 3) they are an ideal location to showcase the coral reef restoration work for educational, capacity building and ecotourism purposes because there's already a communication infrastructure in place for them.

The development of a business plan or a coral reef economic and financial strategies or business plan for each coral reef restoration initiative is a key element in ensuring sustainability. A summary business plan is shown in Part II "Project Justification". In particular, the project will evaluate the use of Corporate Social Responsibility (CSR) funding. In Mauritius, under the Finance Act 2015, all companies must put 2% of their chargeable income of the preceding year towards a CSR Programme, which must have objectives of benefiting Mauritian communities. Similarly, in Seychelles, there is a CSR contribution of 0.5% of the monthly turnover, of which half can go to approved NGOs. Such regulatory set-up in both countries provides opportunities for private sector finance (especially the tourism industry) to actively and directly support small scale coral reef restoration activities through the CSR funding. The involvement of other industry partnerships in active coral reef restoration activities will be streamlined once the active coral reef restoration activities are more standardized, their effectiveness and results monitored regularly and disseminated widely. Moreover, coral reef restoration is in line with the Mauritian Government's budgetary measure in 2017[141] to promote development of alternative livelihood opportunities for coastal communities through coral farming by fishermen

Although some reluctance was observed in the past from hotels to contribute to conservation initiatives, recently, the number of hotels involved in marine and coastal conservation work is growing. Disappointments expressed by tourists in their diving and snorkelling experiences in these countries in recent years might be helping the hotels to recognize the importance of marine and coastal ecosystem conservation and restoration work.

Development of linkages with related projects will help to further develop and ensure sustainability. For example, the COI Islands project, currently in its second phase but due to complete in 2017, contains a number of activities related to coral reef monitoring including the establishment of a regional coral reef facility and development of the Coral Reef Information System (CRIS).

The long-term sustainability of active coral reef restoration efforts can only be ensured if coral recruitment is enhanced, either by the coral transplants becoming an additional source of recruits or by the attraction of recruits from elsewhere due to the settlement cues associated with the presence of corals[142]. This indicates the importance of establishing a permanent monitoring

[141] Government of Mauritius, Budget Speech 2017-2018

[142] Montoya-Maya1 PH, Smit KP, Burt AJ, Frias-Torres S. (2016). Large-scale coral reef restoration could assist natural recovery: a case study in Seychelles, Indian Ocean. *Nature Conservation*

programme at each coral reef restoration site to develop a full understanding of the evolution of the restored coral reefs.

To ensure long-term sustainability of active coral reef restoration effort and scale up of restoration activities a regional coral reef restoration plan will be developed. This will consider the management of coral reefs, enforcement plan, DRR aspect, the strategic restoration plan, knowledge sharing, capacity building, regional studies and long tern collaboration of the countries in the region.

Feasibility and experience built on the project will appeal to other funding donors for future coral restoration projects. A collaboration with private sector on coral reef restoration activities is also viable. During consultative process, it was noted that the private sector was also interested in the coral restoration works, however, they were not aware of the coral reef restoration in a changing climate context. As such, securing funds from potential funding donors and collaboration with private sector will further ensure the sustainability of the coral reef restoration efforts.

L. Environmental and social impacts and risks

To avoid or reduce potentially negative impacts of the project activities, the potential risks have been identified and analysed in line with the AF's Environmental and Social Policy, as well as the UNDP Social and Environmental Screening Principles (SESP), see Annex 2. The project proposal is categorised within **Category B**, considering that some risks are being observed but are considered low.

Social principles to identify potential negative impacts: Despite the positive impacts that can enhance the project results, some environmental and social principles of the AF could be triggered by the project in terms of environmental and social impact and risks. An evaluation of the project against each of the AF Environmental and social principles is described below and summarised in Table 9.

Table 9 *Checklist for environmental and social principles*

Checklist of environmental and social principles	No further assessment required for compliance	Potential impacts and risks – further assessment and management required for compliance
Compliance with the Law		X
Access and Equity		X
Marginalized and Vulnerable Groups		X
Human Rights	X	
Gender Equity and Women's Empowerment	X	
Core Labour Rights		X
Indigenous Peoples	X	
Involuntary Resettlement		X
Protection of Natural Habitats		X
Conservation of Biological Diversity		X
Climate Change	X	
Pollution Prevention and Resource Efficiency	X	
Public Health	X	
Physical and Cultural Heritage	X	
Lands and Soil Conservation	X	

Principle 1: Compliance with the Law.

The project will be undertaken in compliance with domestic law of Mauritius and Seychelles and with all relevant international laws. The consultative process during the concept note and full project proposal allowed all stakeholders to review the relevant legal requirements for both countries and ensure that the proposed project is aligned with regional and national laws as well as policies and plans for coral reef restoration and climate change adaptation. Further specifications are expected to arise as a result of the new budget measure proposed by the Government of Mauritius, namely measure 104[143] which aims to promote coral farming by fishermen and small and medium enterprises (SMEs) for developing ornamental corals for the tourism sector, aquarium market and high-end jewellery manufacturing.

According to the laws of Mauritius and Seychelles, it is prohibited to remove corals from the sea and trade of corals are illegal. The project will be implemented within MPAs, Fisheries Reserves and Special Reserves. These areas already have enforcement procedures put in place.

At present, the regulatory framework for coral reef restoration in Mauritius falls under the Marine Resources and Fisheries Act of 2007. It also provides for the management, conservation, protection of fisheries and marine resources and protection of marine ecosystems, and covers the establishment of aquaculture enterprises and MPAs. In Seychelles, the Environmental Protection Act 2016 provides for the protection, preservation and improvement of the environment and for the control of hazards to human beings, other living creatures, plants and property. List of legislations, guidelines and policies that regulate coral farming and the means to meet the requirements have been described in Part II Section E of the proposal.

Both Mauritius and Seychelles require Environment Impact Assessment (EIA) studies for some listed undertaking under the Environment Protection Act 2002 (Mauritius) and the Environmental Protection (Impact Assessment) Regulations 1999 (Seychelles). It is to be noted that works related to coral reef restoration are not one of the listed undertakings for both countries requiring an EIA.

There is a slight risk that the restoration activities through coral nurseries, might result in poaching or illegal/uncontrolled traffic of corals.

The regulatory framework provides for the control of the coral nurseries in both countries. The relevant authorities will provide enhanced enforcement measures so as to ensure that private sector involvement in coral reef restoration follows required standards and chain of custody for corals grown in nurseries It is to be noted that MOEMRFS and MECC are the Ministries responsible to enforce the protection of MPAs and marine ecosystems in Mauritius and Seychelles, respectively. They are the Executing Entities for this project. In the event poaching has been observed, the responsible Ministry will take all necessary legal actions against the offenders.

Presently in Mauritius, the Fisheries Protection Service of the MOEMRFS and the National Coast Guard are working together for patrolling the MPAs and enforcing the laws at sea. Several patrols are being carried out. The management of the nurseries and restoration sites will be through increased enforcement, in both countries. Measures would be taken to enhance community policing around the coastal areas and with the boat operators to sensitize the latter on the importance or corals.

Measures to enhance enforcement have already been initiated. In Mauritius, under a GEF project on Mainstreaming Biodiversity, staff from SEMPA have already received a boat, vehicle and

[143] Government of Mauritius (2017), Budget Speech 2017-2018, pg. 16

equipment to strengthen the enforcement in the SEMPA. Same will be done for the enforcement of the Blue Bay Marine Park this year.

Workers and communities will be informed that they will be responsible for any offences that they may commit and as such will be accountable. In this way AF, UNDP and the project cannot be accused for any illegal action that may occur. Moreover, under the project there will be a lot of public sensitization on the importance of corals, their protection and offences for illegal action towards corals.

Additionally, in Mauritius, another means to control on any programmes, activities involving coral culture is through registration at the MOEMRFS. For instance, the on-going "Coral Culture Training Programme" currently being run by the MOI and AFRC, coastal communities participating in the project are being registered under a training programme under which they will be eligible to "work with corals" under the supervision of MOI/AFRC/FPS/NCG. NGOs who will be participating in this project will also need to register under the said training programme.

It is to be noted that in Mauritius there will be no trade of corals. Aquaculture corals from this project will serve for restoration purposes only. Rehabilitation of degraded reefs will allow for restoration of reef ecosystem services. Moreover, measure to control traffic of protected species are already put in place in Mauritius. The Competent Authority (Fisheries) of the MOEMRFS, is also responsible for all export and import of marine organisms. They make regular intervention at the airport to detect illegal import and export of any illegal marine organisms.

Principle 2: Access and Equity.

The project will provide fair and equitable access to benefits in a manner that is inclusive and does not impede access to basic health services, clean water and sanitation, energy, education, housing, safe and decent working conditions, and land rights.

During the implementation of the project under Component 1 for Mauritius, the two executing entities – the Albion Fisheries Research Centre (AFRC) and the Mauritius Oceanography Institute (MOI) in collaboration with non-governmental organizations selected through a Call for Proposals, at each of the selected sites, will work to ensure that members of vulnerable groups – particularly individuals who depend on the coastal zone for their livelihood – become direct beneficiaries of the project. The same approach will be taken in Seychelles by the three Responsible parties in all the 4 restoration sites.

Adequate safety measures will be taken for all those involved in the practical restoration work, particularly with regards to SCUBA diving. The lessons learned from the project will then allow private sector stakeholders such as hotels to continue supporting the inclusion of vulnerable groups in coral reef restoration efforts during and after the project. The development of coral reef economic and fiscal strategies and business plans for restoration work in each country will ensure a full understanding of the costs involved.

Although the labour requirements are intensive, the project will not involve a large number of local community participants at each site due to the specialized nature of the skills involved. As such, there is a risk that this limits access to a larger number of community members to participate directly in the project.

Project proponents will work with fishermen and other coastal stakeholders to ensure that the locations of the nursery and restoration sites do not limit access to traditional fishing grounds or impede boat passage for tourist operators. The project will not exacerbate existing inequities, particularly with respect to marginalized or vulnerable groups. All but one of the restoration sites

are selected in MPAs and fisheries reserves, where boat access are already regulated and any fishing activities prohibited (for both registered and unregistered fishers). Regular patrols from coast guards and other government officials are carried out regularly to ensure compliance to the laws (as described in section II-F). As such, coral restoration activities taking place inside MPAs and fisheries reserves will not affect anyone's fishing activities.

One coral restoration site in Seychelles (Anse Forbans) is deliberately selected outside of a protected area with an aim to pilot community-based coral restoration activities in Seychelles for potential future replication, to expand community-based ecosystem restoration activities to reduce their climate change vulnerabilities and to prove that coral restoration activities can be successful even outside of protected areas as long as strong community engagement is ensured. (refer to the Proposal on page 19)

This coastal region has a local community that is quite dependent on artisanal fisheries. Degradation of coral reefs in this locality has made the local community more vulnerable. The coastline at Anse Forbans has suffered severe erosion over the last few years, due mainly to the loss of the coral reef and its change from a coral dominated community to a macro-algae dominated community. This has led to a reduction in reef-crest rugosity and increased long-shore currents causing sand loss and erosion. This has also led to the reduction of their fish catch. In other words, the loss of coral reefs has left them with less natural protection from coastal storms and with less income and food security due to reduced catch. Given the situation and resulting from awareness activities by MCSS, the community has expressed strong willingness to engage in the coral restoration activities for the expected long-term DRR and food security benefits.

During the coral restoration activities under implementation, there will most likely be a change in their fishing practices (either on the areas they fish, or the route they get to their fishing ground, etc.) in order to ensure the effectiveness of the coral restoration activities; however, those changes in their fishing practices will NOT be involuntary. Rather, they will be willingly and voluntarily implemented by the communities to ensure the effectiveness of coral restoration activities, because they are the ones implementing coral restoration activities. There will be sufficient sensitization and training activities supported by the project to ensure that the communities appreciate the various linkages between their activities and their impacts on marine ecosystems, as well as the linkages between the healthy marine ecosystems (including restored corals and fisheries) and ecosystem goods and services that they provide to the communities in a long term.

As from the start of the implementation of the project, all the community members neighbouring the project site (including the vulnerable and marginalised groups) will be informed of the grievance mechanism put in place by the proposed project. They will be informed that they could voice out their comments and complaints. The grievance mechanism has been explained in Part III Section C of the proposal.

In the event the community-based approach is found successful in the coral reef restoration activities, the restoration plan could be expanded, and as such, involve a larger number of community members. In Mauritius, there is political commitment, since the Government promotes SMEs for coral restoration under the direction of MOEMRFS.

Other possible risks identified include limited access to published papers and data on regional studies that may impact on the regional studies. Also, if communication plan not well prepared there was a risk that some of the communities will not be aware of the works carried out and the results of the restoration works.

Principle 3: Marginalized and Vulnerable Groups.

In Mauritius 8.5% of the population live below the national poverty line, and 39.3% of the population of Seychelles live under the Basic Needs Poverty Line.

According to social register of Mauritius, there are some communities around the target site in Mauritius (e.g. Cite La Chaux,) that have been designed as pockets of poverty. These communities are the most vulnerable to coastal flooding either because they live on the shoreline or in reclaimed areas of wetlands at risk of flooding or because the structures they live in are not robust enough to withstand flooding. Income sources in these areas are not very varied, and the majority of its residents (54 % of men and 61% of women) earn between USD 115 and USD 233 per month, being at or below the national poverty line.

Also, these people normally heavily dependent on marine environment adjacent to Blue Bay Marine Park and Grand Port Fishing Reserves for their livelihood. There are approximately 194 registered Fishermen and much more that are not registered. And in Rodrigues, the coastal community are even more dependent on the ocean for their livelihood. Furthermore, there are many more registered fishermen who are women

As such their vulnerability to coastal flooding, storms, hurricanes, coastal erosions or any other potential negative impacts associated with climate change is worsened due to their limited livelihood means and high dependency on the healthy and abundant marine and coastal ecosystem.

However, it is to be noted that since the coral restoration activities will be implemented in MPAs and Fisheries Reserve, where fishing is already prohibited by laws and the laws strictly enforced; thus, we expect no changes in fishing activities by fishers (either registered or unregistered) by the project interventions. The project will, on the contrarily, positively benefit these vulnerable and marginalised groups in both short-term and long-term. On the short term, some of these communities would have employment opportunities due to community-based approach of coral reef restoration activity in Mauritius and Rodrigues. These new types of employment associated with coral restoration activities are expected to be promoted beyond the project implementation period in Mauritius with the Government's policy to promote coral restoration efforts involving SMEs. On the long term, fishers who are fishing in the areas adjacent to MPAs and fisheries reserves will benefit from the spill off effect (increase of fish population in region neighbouring the project sites) as a result of coral reef restoration in the region.

In Seychelles some 40,000 people live in coastal areas and are vulnerable to coastal flooding, storms and coastal erosion. Moreover, around 10% of the households are to some extent dependent on small-scale artisanal fisheries. Tourism in Seychelles contributed 46.1% of the country's GDP, providing 56.4% of national employment and generating 33.2 % of the country's foreign exchange earnings. As such coral reef protection is of national interest and we consider all the coastal population is considered vulnerable.

It is to be noted that much of the coastline at Anse Forbans has suffered severe erosion over the last few years, due mainly to the loss of the coral reef and its change from a coral dominated community to a macro-algae dominated community. This has led to a reduction in reef-crest rugosity and increased long-shore currents causing sand loss and erosion. The projected restoration should also help to reduce such events and as such provide direct benefits to those currently affected.

The project will avoid imposing any disproportionate adverse impacts on marginalized and vulnerable groups including children, women and girls, the elderly, displaced people, refugees, people living with disabilities, and people living with HIV/AIDS. Vulnerable groups including community members and particularly women and youth living in proximity to the proposed sites

of interventions, living in deprived socio-economic conditions and who are heavily dependent on the marine environment for their livelihoods were consulted during the project development phase to identify needs and define roles and responsibilities. The inclusion of these targeted communities is a core part of the implementation of the project and its financial, environmental and social sustainability. Although the number of direct beneficiaries remains small, the project is expected to build capacity within the larger community for alternative livelihoods. Sensitization and awareness campaigns undertaken locally will further avoid the exclusion of marginalized groups and ensure their participation in the decision-making processes at a local level.

At Anse Forbans the project will be implemented by the community for the community. Any restriction will not be involuntary and only temporary. Rather they will be voluntary to ensure that their hard work (coral reef restoration) is not impacted. There will be no economic deprivation, rather the proposed restorative activities will improve the local reef and thereby increase marine life generally on these reefs to the benefice of both visitors (tourists) and fishers.

Principle 4: Human Rights.

The project will respect international human rights. The project integrates overarching human rights principles in order to strengthen social and environmental sustainability by including measures to assist the republics of Mauritius and Seychelles to implement human rights. UNDP consistently applies the Human Rights Based Approach (HRBA) in all programming, taking into account the responsibilities of the duty-bearers and the obligations of the right-holders. The project design includes the identification of the government authorities as the primary enforcer in ensuring effective management of the nursery grown corals and the transplanted corals in the lagoons as they provide essential ecosystem services to an island nation.

The Mauritius and Seychelles governments recognize the importance of partnerships across various sectors, and the integral engagement and involvement of the rights-holders themselves in this agenda. These rights-holders include fishermen, NGOs and other community members participating in the project efforts, integrating community views, limiting negative impacts and improving livelihoods for coastal stakeholders. As an adaptation project with an ecosystem approach, the project promotes the right to food, the right to life and health, and the right to an adequate standard of living. The project will also take special care in respecting the right to non-discrimination, particularly in connection with the integration of vulnerable groups.

Moreover, Mauritius and Seychelles are not among countries cited in any Human Rights Council Special Procedures. Therefore, there is no relevant human rights issue to consider.

Principle 5: Gender Equality and Women's Empowerment.

In Mauritius, men and women enjoy the same legal status and rights under the constitution and law. The courts uphold these rights. Nonetheless, cultural and societal barriers prevented women from fully exercising their legal rights. The Ministry of Gender Equality, Child Development, and Family Welfare has a mandate to promote the rights of women. The National Women Entrepreneur Council, operating under the ministry, is a semiautonomous government body established to promote the economic empowerment of women. Women have equal access to credit and can own or manage businesses[144].

In Seychelles, the law provides for the same legal status and rights for women as for men, and the society is largely matriarchal.[145] There was no officially sanctioned discrimination in

[144] Mauritius (2016) Human Right Report
[145] Seychelles (2016) Human Right Report

employment, and women were well represented in both the public and private sectors. There is no economic discrimination against women in employment, access to credit, equal pay for equal work, or owning or managing a business. Inheritance laws do not discriminate against women.

The proposed project is designed and will be implemented so that women and men: (a) are able to participate fully and equitably; (b) receive comparable social and economic benefits; and (c) do not suffer disproportionate adverse effects. The project will ensure gender equity and women's empowerment through gender sensitive indicators in all levels of project monitoring and evaluation.

Gender equity and women's empowerment has been considered from the early project development phases, with the elaboration of two gender and youth assessments for each country, where roles and responsibilities of women in selected communities for the project were defined (Annexes 8 and 10). The roles played by women in these coastal communities as well as all levels of the project development and decision-making process have been considered, and more information is available in the dedicated socio-economic reports.

Both in Mauritius and Seychelles, women have the largest share of responsibility for child caring, house cleaning and cooking. This means that when epidemics and natural disasters strike, women tend to bear a larger burden of the share of the adaptation to the consequences of these phenomena. As such, it is important to identify gender sensitive strategies to respond to the environmental and humanitarian crises caused by climate change. It is also important to note the role that women have as agents of change and the strong body of knowledge and expertise they possess that can be used in climate change mitigation, disaster reduction and adaptation strategies.

In mainland Mauritius the project may only affect women in as much as the project may affect the household; since very few women were directly involved in fishing or sea-based activities but are indirectly involved as most had fishermen or boatmen in their family. This is not the case in Rodrigues, as there are many more registered fishermen who are women. On the other hand, there is no record of female fishers registered in Seychelles. The project may contribute to exacerbating the existing division of labour in mainland Mauritius.

Equal participation of men and women in decision-making forums as well as capacity building activities will be sought. In Mauritius, women from coastal communities have expressed an interest in supporting awareness raising activities and want to be a part of local decision-making forums. In addition, fisherwomen as well as women who have strong swimming and underwater skills in Rodrigues and the South of Mauritius will have an opportunity to participate in coral reef restoration training and implementation.

The project will ensure that

- At least 30% of young people and women will be direct beneficiaries of the project
- at least 30% of all trainings/workshops and learning events will be female
- at least 35% of representatives in higher level authorities participating in the project will be female

Two Project Gender Officers will be recruited to monitor progress in implementation of the project Gender Action Plans and oversee the gender related works.

Principle 6: Core Labour Rights.

Mauritius and Seychelles have both ratified to the eight fundamental labour rights conventions. The project will meet the core labour standards as identified by the International Labour

Organization. Components 1 and 2 will involve intensive labour for a limited number of individuals for the installation of coral reef nurseries, maintenance and transplantation to restoration sites. In Mauritius, community members will be recruited to provide assistance to scientific SCUBA divers. The budget developed has earmarked daily wages for community members based on the prevailing practices for minimum wages, and a clear record of works carried out. Safety measures for all underwater activities will follow internationally recognized standards.

The direct beneficiaries may be exposed to the risk of accidents, through the mishandling of materials and equipment, while implementing the proposed coral reef restoration work. As such, during the project's implementation, the PMT and National Project Teams will ensure compliance with national and international labour laws and will provide adequate protection equipment for workers, training (advanced training for SCUBA diving activities), insurance and access to medical decompression chambers.

Principle 7: Indigenous Peoples.

Not applicable: there are no indigenous peoples in both the Republic of Mauritius and the Republic of Seychelles.

Principle 8: Involuntary Resettlement.

In Mauritius, all the project sites are selected within MPAs and Fishing Reserve. Since fishing is already prohibited (for both registered and non-registered fishers) in these protected areas, coral reef restoration works will not cause any loss of access to fishing grounds and thus there will not be any economic displacement.

Anse Forbans (in Seychelles) is the only restoration site that is not within a MPA or a Reserve. This site is a fishing ground for the neighbouring activities. One coral restoration site was deliberately selected outside of a protected area with an aim to pilot community-based coral restoration activities in Seychelles for potential future replication, to expand community-based ecosystem restoration activities to reduce their climate change vulnerabilities and to prove that coral restoration activities can be successful even outside of protected areas as long as strong community engagement is ensured. (refer to the Proposal on page 19). Anse Forbans was selected due to the high interests by the communities. Restoration at Anse Forbans will be implemented by the community for the community. Any restriction will be voluntarily set by the community themselves to ensure that their hard work (coral reef restoration) is not impacted. The possibility of involuntary resettlement is considered to be remote owing to the fact that 1) the high level of commitment and interests by the community themselves are confirmed during the proposal development stage and 2) there are other fishing areas in the neighbouring region.

The risk of economic deprivation is very low, rather the proposed restorative activities will improve the local reef and thereby increase marine life generally on these reefs to the benefice of both visitors (tourists) and fishers. Strong communication efforts will be sustained through the project implementation to ensure the buy-ins and cooperation of the fishers.

Nonetheless, there is a remote possibility that any community members may feel they have to involuntarily alter their fishing activities, leading to involuntary resettlement, due to voluntary measures set by the community. As from the start of the implementation of the project, all the community members neighbouring the project site (including the vulnerable and marginalised groups) will be informed of the grievance mechanism put in place by the proposed project. They will be informed that they could voice out any restriction that they may be victim. The grievance mechanism has been explained in Part III Section C of the proposal. In an extreme case that a grievance received cannot be resolved without a change in the project location, then the project

would consider selecting another coral restoration site within a protected area, where no fishing activities are allowed, to ensure that the project will cause no impacts on the existing fishing activities of any fishers.

Further, the Environment Unit of UNDP will collaboration with the Socio-Economic Development Unit to monitor the Marshall Plan on poverty to ensure that these vulnerable community are not negatively impacted and are benefiting from the project through participation.

Principle 9: Protection of Natural Habitats.

The project proposal aims to restore 2 reef sites in the Marine Protected Areas in Mauritius (Blue Bay Marine Park and South East Marine Protected Area) and 3 sites in the MPAs of Seychelles (Cousin Island, Curieuse Island and Ste Anne) and one non MPA site in Seychelles (Anse Forbans-pilot site). The project will impact positively these marine habitats, since it aims to restore the damaged coral reefs and increase the biodiversity of the ecosystem.

The main legislations for Marine Protected Areas in Mauritius are: The Fisheries and Marine Resources Act (2007), The Environment Protection Act (2002); and the Marine Protected Areas Regulations (2001). In Seychelles, the MPAs are regulated through: the National Parks and Nature Conservancy Act (1969); the Protected Areas Act (1967); the Environment Protection Act (2016); the Wild Animals and Birds Protection Act (and associated regulations) (1966); and the Fisheries Act (1987).

The project will not involve unjustified conversion or degradation of critical natural habitats, including those that are: (a) legally protected; (b) officially proposed for protection; (c) recognized by authoritative sources for their high conservation value, including as critical habitat. The ecosystem-based approach to adaptation will support the protection of natural habitats and help critical habitats within Marine Protected Areas recover from climate-change related bleaching and other impacts. By engaging with local stakeholders and involving them directly in project implementation, it is expected that management of these protected areas will improve.

Although it is not possible to completely eliminate risks that some small areas of natural habitat may be disturbed in the construction of nursery sites, due to mishandling of material or equipment, science-based coral reef restoration work, proposed by this project, will avoid the risk of impacting natural habitats when installing ocean nurseries and intervention in restoration sites as much as possible. A detailed science-based evaluation of nursery and restoration sites, which is included in the proposed activities, will help minimize such risks. The similar approach has already been tested in previous work done in Seychelles, which successfully minimized the impacts on the existing habitats from the installation of the nurseries and the restoration sites.

Being MPAs and Fishing Reserves, all access and activities are regulated and controlled, and fishing is strictly prohibited. All precautions will be taken to ensure that the natural habitat remains undisturbed, as far as possible. Training will be provided to Responsible Parties, workers and community members that will be directly involved in the project to ensure the protection of natural habitat. Moreover, in the event that there is need to displace some living species, same will be done in the presence of the authority (e.g. Fisheries officers of the MOEMRFS in Mauritius). Additionally, a complete survey (e.g. current pattern, coastal water quality, biodiversity survey) will be undertaken during the first year of the project implementation to establish the baseline information of the natural habitats for future monitoring purposes. In the long run, the project activity will restore the damaged coral reefs.

Principle 10: Conservation of Biological Diversity

The project will be implemented in MPAs as described in Principle 9. Being MPAs, the project sites have high level of biodiversity. However, with the past coral bleaching events that occurred in both countries due to increase in sea surface temperature amplified by Climate Change, the biodiversity of these MPAs has been greatly affected. The project therefore aims to restore the damaged coral reefs in the MPAs and ultimately, will improve the biodiversity of these ecosystems.

The project is designed and will be implemented in a way that avoids any significant or unjustified reduction or loss of biological diversity. There will be no introduction of known invasive species into the MPAs.

The science-based coral reef restoration will not harm the donor colonies where the coral nubbins are extracted. This was tested already in the previous efforts in Seychelles. As long as the maximum amount to be extracted from a donor coral is limited to 10 % per colony volume, damage to donor colonies can be avoided.

Both Mauritius and Seychelles are dominated by patch reefs harbouring significant coral biodiversity. Over 6 years, the target is to farm 140,000 corals in Mauritius and 103,500 in Seychelles. Coral nubbins will be collected from donor colonies.

Coral reef restoration work will be carried out mainly with identified based on a set of criteria which include climate change resilient species, resilient strains, colony state and health, colony size, amongst others .

Depending on species, colony size, colony type, colony state and health, coral nubbins will be taken from the wild for culture in nurseries. Based on studies undertaken by the MOI, 10% nubbins taken from a *Pocillopora verrucosa* colony of approximate size diameter 25cm may amount to a total of 10-12 fragments. However, 10% nubbins taken from a *P.eydouxi* colony of approximate size diameter 35cm may amount to a total of 5-8 fragments. For *Acropora selago*, 10% nubbins taken from a colony of approximate size diameter 40cm may amount to a total of 18-20 fragments. On the other hand, for *A.muricata,* which usually covers whole patches of reefs (but with patches comprising several colonies, which are usually hard to demarcate among each other), 10% nubbins taken from a patch of approximate size diameter 2000cm may amount to a total of 200-220 fragments. Based on these findings, it is estimated that 140,000 fragments will be acquired from a total area of 7.7ha of healthy reef.

It is possible that the focus on climate-resilient species will lead to a loss of genetic diversity in the marine ecosystems. Asexual reproduction (fragmenting) of climate resilient species in coral reef restoration aims to stabilize and stop the degradation of the restoration sites. Previous work shows that once a site has been restored with nursery grown corals using asexual reproduction, the newly transplanted corals perform normal sexual reproduction and the restored sites recruit new juveniles of the coral species used in the restoration action but also coral species coming from elsewhere though larval drift in ocean currents. Therefore, the larval attraction effect generated by the restored site ensures the increase of biodiversity over time.

Principle 11: Climate Change.

The proposed project will not result in any significant or unjustified increase in greenhouse gas emissions or other drivers of climate change.

Principle 12: Pollution Prevention and Resource Efficiency

The project will be implemented in a way that meets applicable international standards for maximizing energy efficiency and minimizing material resource use, the production of waste, and the release of pollutants. The project will not require significant amounts of water, energy, materials or other natural resources. The project is not likely to result in the production of significant quantities of wastes, especially of hazardous or toxic wastes. Efforts will be made to use materials that are not hazardous (i.e. using marine cement instead of epoxy). Wherever possible, recycled materials will be used for the establishment of nurseries. The project will not produce significant volumes of effluents or air pollutants, including greenhouse gases. The project will not affect important water bodies or significantly affect water regimes, as it will use seawater. The project will not generate significant nuisances such as air pollution, noise, vibration and odours.

Principle 13: Public Health

The project is designed and will be implemented in a way that avoids potentially significant negative impacts on public health. Healthier, more resilient coral reef ecosystems in each country will have positive impacts on health, supporting livelihoods and local economies. Two of the five project sites are characterised by having low-income population with low education levels. The impacts of climate change on the marine resources have reduced the availability and access to food. The proposed project is expected to have a positive impact in food security in the long term.

Principle 14: Physical and Cultural Heritage

The project does not entail any risk for physical and cultural heritage. The land nurseries will be constructed in sites where no physical and cultural heritage has been identified. The other nurseries will be ocean based. The project is designed and will be implemented in a way that avoids the alteration, damage, or removal of any physical structures.

Principle 15: Lands and Soil Conservation

The project does not involve productive lands or land that provides valuable ecosystem services. As the sites are located within MPAs, all efforts will be made for an integrated approach to coastal zone management in the context of climate change adaptation, and linkages with sustainable land and coastal management efforts will be made. In Mauritius, the integrated coastal zone management (ICZM) committee on coral reefs will have an important role to play to support in the follow-up of the project. Moreover, the project is expected to have a positive impact on coastal preservation. The restoration of coral reefs will potentially protect some 2.5 Km of coast line in Mauritius and some 600m in Seychelles.

Table 10 *Environmental and social impacts and risks*

Check List of environmental and social principles	Potential impacts and risks
Compliance with the Law	There is a slight risk that the restoration activities using coral nurseries, might result in poaching or illegal/uncontrolled traffic of corals. Probability (P)=1 Impact (I)=2
Access and Equity	Although the labour requirements are intensive, the project will not involve a large number of local community participants at each site due to the specialized nature of the skills involved. There is a risk that this limits direct participation to a larger number of community members. In Seychelles,

Check List of environmental and social principles	Potential impacts and risks
	access to fishing ground at one coral restoration site (Anse Forbans) will be temporarily limited. Although such restriction will be imposed by the community themselves voluntarily, in case there is any grievance emerging from any individual fisher(s) who feel their access to their fishing ground is involuntarily removed from them, it will be dealt with properly through the grievance mechanism set for the project and through a social response mechanism by UNDP Mauritius/Seychelles. P=2 I=2
Marginalized and Vulnerable Groups	At the coral restoration site in Anse Forbans, community members will have to alter their fishing activities temporarily to protect the coral restoration site. A communication plan will be in place to sensitize each member of the community how such temporary fishing restriction will contribute to the restoration of corals and its ecosystems, leading to the better fishing experiences in a long run. As all other coral restoration sites are within MPAs or Fisheries Reserves, the project implementation will not affect anyone's fishing activities, including those by marginalized and vulnerable groups (e.g. unregulated fishers). A communication plan will sensitize community members, fishers (both registered and unregistered) and others whose livelihood depend on the healthy coral ecosystems, that the coral restoration activities within MPAs and Fisheries Reserves will bring spill-over positive impacts to those who fish areas adjacent to those MPAs and Fisheries Reserves in a long run. P=1 I=1
Human Rights	Not applicable
Gender Equity and Women's Empowerment	Not applicable
Core Labour Rights	There is a risk of accidents due to mishandling of equipment or material P=2 I=2
Indigenous Peoples	Not applicable
Involuntary Resettlement	Only one coral restoration site, which is selected outside of MPA or Fisheries Reserves, might potentially cause an involuntary alternation of fishing activities of local community member(s) due to the project intervention. Communities at Anse Forbans are planning to set voluntary measures to restrict fishing activities at their coral restoration site to protect the site. Although the measures are proposed, set, and enforced by the community themselves, there is a remote risk that this may lead to a situation where a community fisher(s) feel that their fishing activities are involuntarily altered, resulting in involuntary economic resettlement. P=1 I=4
Protection of Natural Habitats	Small areas of natural habitat may be disturbed in the construction of nursery sites – however the nurseries also act as habitats providing shelter and food to marine species in the lagoon. P=4 I=1
Conservation of Biological Diversity	As a climate change adaptation project, coral reef restoration work will be carried out mainly with identified climate resilient species. While land-based nurseries will also include rare species of coral, it is possible that the focus on

Check List of environmental and social principles	Potential impacts and risks
	climate-resilient species will lead to a loss of genetic diversity in the restored sites P=4 I=1
Climate Change	Not applicable
Pollution Prevention and Resource Efficiency	Not applicable
Public Health	Not applicable
Physical and Cultural Heritage	Not applicable
Lands and Soil Conservation	Not applicable

PART III: IMPLEMENTATION ARRANGEMENTS

A. Project arrangements

Implementing Entity

The project will be implemented over a period of six years (72 months). Since there are no accredited National Implementing Entities (NIEs) to the Adaptation Fund (AF) in the target countries, the project will be implemented by the **United Nations Development Programme (UNDP)**, which is accredited as AF Multilateral Implementing Entity (MIE). UNDP will assure the administrative and financial management of the project. The following implementation services under the Direct Implementation Modality (DIM) will be provided by UNDP for the proposed project:

- coordinating and managing the overall implementation of project outcomes and activities;
- facilitating of interactions with the AF Board and related stakeholders;
- accountability of the project implementation and reporting on budget performance;
- quality assurance and accountability for outputs and deliverables at the project development phase, during implementation and on completion;
- information and communication management, including maintaining Information Management Systems and specific project databases to track and monitor progress – financial and substantive – of project implementation;
- regional knowledge management, communications and awareness raising;
- disbursing funds to the Responsible Parties for the implementation of on-the-ground activities within those countries;
- providing technical oversight to all activities carried out by the Responsible Parties; and
- managing centralised procurement of goods and services for the project.

The UNDP will be collaborating with the Executing Entities in Mauritius and Seychelles, who will act as Responsible Parties to carry out activities within the DIM Project. They will have to report progress to the Project Manager and the Project Steering Committee.

In terms of project management, there will be three levels of implementation, i.e. Regional, National and local. The project organogram is shown in fig 16.

Executing Entities

The Executing Partner for the Republic of Mauritius will be the **Ministry of Ocean Economy, Marine Resources, Fisheries, and Shipping (MOEMRFS),** which has the mandate to provide an enabling environment for the promotion of sustainable development of the fisheries sector and is responsible for the management of coastal waters and any related activities being carried out within these, and specifically the following bodies under this Ministry:

- **Albion Fisheries Research Centre (AFRC)** was established in 1982 under the MOEMRFS, and responsible for stock assessment of marine resources, MPA management, ocean-based coral farming/restoration and long-term coral reef monitoring, will lead on the development of ocean-based coral nurseries, with support from Mauritius Oceanography Institute.

- **Mauritius Oceanography Institute (MOI)** was established in 2000 to develop and strengthen oceanographic research, within the maritime zone of the Republic of Mauritius,

with technical expertise and institutional capacity for both coral farming, species identification and coral genetics. MOI will lead on research activities in the project, and the development of a land-based coral nursery.

To assist the Executing Partner in the implementation of the project at the community/local level, UNDP will recruit one NGO in Mauritius and one in Rodrigues.

The Executing Partner for the Republic of Seychelles will be the **Ministry of Environment, Climate Change and Energy (MEECC)**, which has the mandate for environmental, climate change and energy policy and management.

In Republic of Seychelles, the following organisation will act as the Responsible Parties:

- **Seychelles National Parks Authority (SNPA)**, which is a government organisation under the aegis of MEECC, is responsible for the management of all state owned terrestrial and marine protected areas. SNPA will build on its existing coral reef restoration work and benefit from opportunities for further training for its staff and permit staff retention (from EBA project) as well as integration in the organisation at the end of the FB project.

- **Nature Seychelles (NSey)**, an NGO that has pioneered terrestrial restoration of islands, and has been the recipient of GEF-funds and other large donor funded projects. NSey manages the Cousin Island Special Reserve, the site of a 5,500 m^2 restored reef, and will build on its previous large-scale coral reef restoration experience (up to 25,000 nursery-grown corals transplanted). NSey is registered as a Private Educational and Training Institute (under the Education Act);

- **Marine Conservation Society of Seychelles (MCSS)** is an NGO, which promotes the conservation of the marine environment through education, research and the implementation of a number of programmes. MCSS has participated in several marine ecosystem management programmes and supported projects on coral predators.

Project Management Team (PMT)

UNDP, as MIE for this project, will recruit and establish a Project Management Team (PMT) to be led by a Regional Project Manager (RPM). He will be supported by a Project Assistant (PA) and a Financial Assistant (FA) and technically supported by a Chief Technical Advisor (CTA). The PMT will be accountable to UNDP and the PSC for the quality, timeliness and effectiveness of the activities carried out, as well as for the use of funds. Moreover, the PMT will have the following responsibilities:

i. Facilitate the coordination of the overall project implementation at the different (regional, national and local/city) levels, including supervision, oversight and backstopping of the various Executing Entities;
ii. Act as Secretariat of the Project Steering Committee (PSC), to which it will submit annual work plans for review and approval, as well as annual narrative reports (see also Section D, Part III, on reporting requirements);
iii. Produce progress reports and financial reports every 3 months
iv. Produce Annual Project Progress Reports every 12 months to be submitted to the donor (Adaptation Fund);
v. Ensure budgeting and financial management, with the support of UNDP administration;
vi. Prepare and manage all contractual agreements with the national/international consultants, including terms of reference, work plans, budgets and payment schedules, and perform payments upon progress, as per UNDP procedures;

vii. Carry out regular project monitoring at all levels (regional, national and local/project site level), ensuring compliance and quality control in accordance with UNDP and AF standards and requirements;
viii. Organise the mid-term review and the independent terminal project evaluation;
ix. Organise duty travel, seminars, public outreach activities and other project events
x. Carry out Environmental and Social Impact Monitoring as per Environmental and Social Management Plan (Section C, Part III)
xi. Coordinate overall knowledge management and project communication.
xii. Handle any grievance received and respond accordingly, as per the stakeholder Response Mechanism of UNDP described Section C, Part III.

The terms of reference of the RPM, PA, FA and CTA have been described in Annex 11.

Project Steering Committee (PSC)

A **Project Steering Committee** (PSC) is the overall and highest decision-making body for the project and provides strategic guidance on project implementation issues. It will meet at least once a year at the regional level and will have the following responsibilities:

i. Review, discuss and provide substantive comments and main recommendations to the annual progress reports prepared and presented by the PMT during the annual PSC meetings;

ii. Review, discuss and approve the annual work plans, procurement plans and budget submitted by the PMT;

iii. Define the main strategies and provide overall policy guidance, recommendations and orientations for project implementation and coordination thought the implementation period.

iv. Ensure policy conformity of the project activities in each country and policy mainstreaming, as required, of project activities to ensure the sustainability of the project results beyond the project implementation period.

v. Ensure that co-financing will be realized through effective consultation and partnership;

vi. Ensure that the project will make positive impacts on gender mainstreaming as much as possible.

The PSC will be composed of senior representatives of the Project National Coordination Committee of each country and UNDP. A representative of the Regional Scientific Advisory Committee (RSAC) will be co-opted. The Chairperson will be elected at each seating. The RPM will act as Secretariat to the PSC.

Project National Coordination Committee (PNCC)

In each target country, a Project National Coordination Committee (PNCC) will be set up, which will meet at least quarterly to discuss the status of the project implementation at the national level and provide guidance and recommendations for the next 3 months. It will also act as an immediate grievance mechanism and provide response and direction accordingly. The RPM will act as the Secretariat of the PNCC. The PNCC will report to the PSC. The PNCC may be able to make decisions on matters delegated by the PSC as and when appropriate.

The highest authority of the Executing Partners (i.e. MOEMRFS for Mauritius and MEECC for Seychelles) will chair their respective PNCCs. The PNCC will be gender-balanced and will be composed of the principal stakeholders for each country, and will include representatives from Executing Partner, the Responsible Parties, other relevant Ministries, UNDP, NGOs, Private Sector, Civil Societies, Accademia and other relevant stakeholders. The PNCC representation and terms of reference will be finalized in the Project Inception Workshop (IW). The TOR of the PNCC is at Annex 11.

Regional Scientific Advisory Committee (RSAC)

A Regional Scientific Advisory Committee will be established composed of relevant scientists from each target country and including recognised international and regional coral reef restoration experts (i.e. Australia, Madagascar, Maldives, South Africa, Sri Lanka and Thailand). As mentioned in Section II-A “Project Component- Component 3”, the project will look into the possibility for the Coral Specialist Group, hosted by the Coastal Oceans Research and Development in Indian Ocean (CORDIO), to act as the Regional Scientific Advisory Committee. As such a member of the Coral Specialist Group will be co-opted as member of the Project Steering Committee.

Existing regional bodies and platforms will be used where appropriate to ensure that activities undertaken through the project are appropriately co-ordinated and communicated at the regional level. These will include the Indian Ocean Commission, WIOMSA, the proposed WIO coral reef network, CORDIO and the various committees and co-ordinating bodies under the Nairobi Convention. The RSAC will meet virtually every year. However, the RSAC will meet at least once during the course of the project, as back to back meeting with the PSC. The terms of reference of the RSAC is at Annex 11.

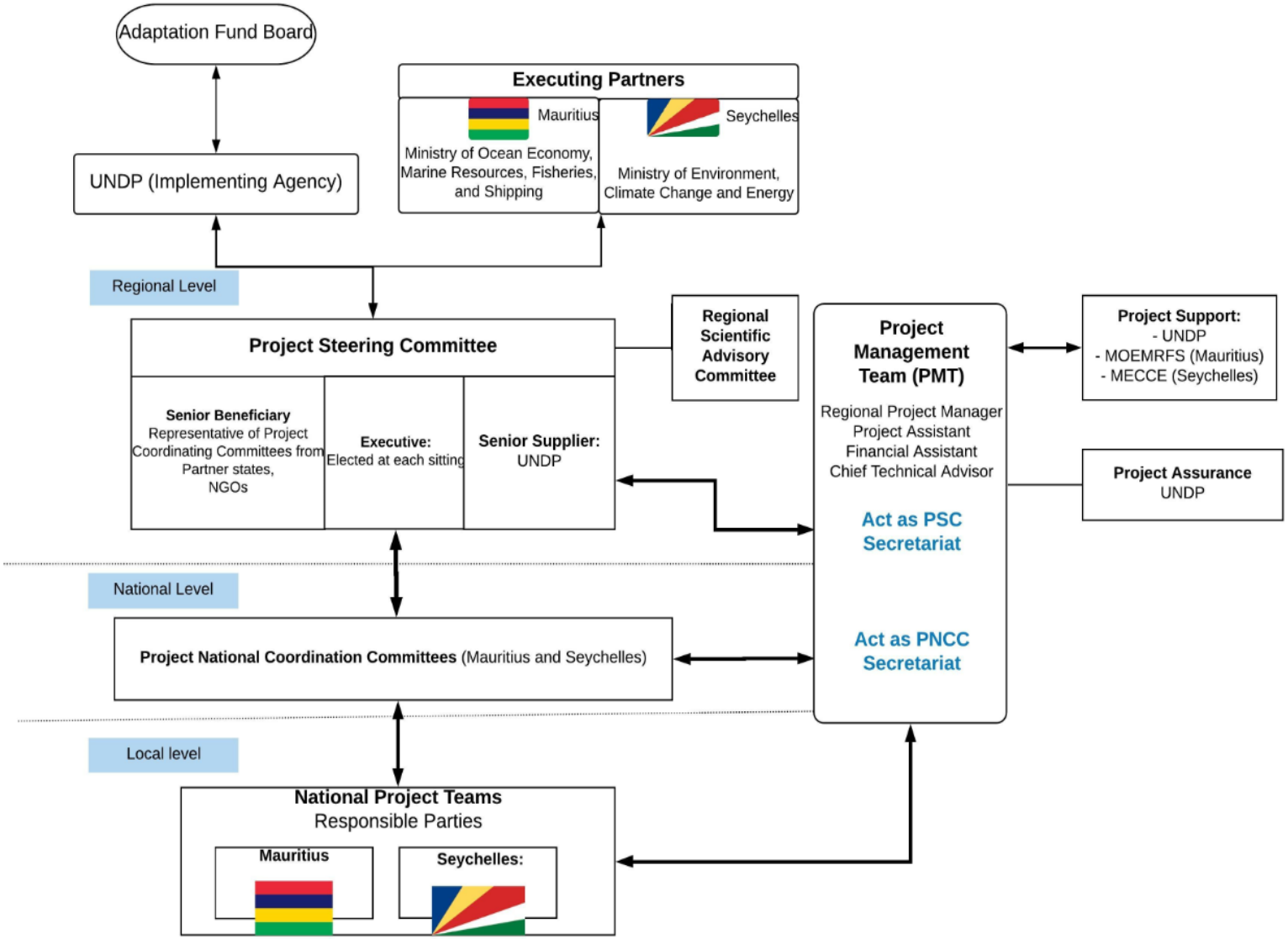

Figure 16: *Project Organogram*

B. Financial and project risk management

Financial and project risk management measures will be assessed throughout project design and implementation. Potential risks related to project implementation and response measures are described in Table 11.

Table 11 *Potential risks related to project implementation and response measures*

#	Description	Type	Risk rating	Countermeasures/ Management Response
1.	**Loss of government support may result in lack of prioritization of proposed project activities.** It may become more difficult to get the full engagement of higher level Government staff and politicians, if coral reef restoration activities appear to constrain development, or has an apparent high cost that is not understood to bring benefits	Political	*Low* P=1 I=3	Regular stakeholder consultation and involvement will be undertaken to ensure that government maintains its commitment and considers the proposed project as a support to its costal protection and coral restoration programmes.
2.	**Disagreement amongst stakeholders with regards to demonstration of site selection in Mauritius and Seychelles** Discussion about demonstration site among the stakeholders may become a distraction from the coral reef restoration activities and may cause delay in the implementation.	Operational	*Low* P=1 I=2	• Intervention sites have been selected at the preparation stage. • There will be a participatory approach to the proposed project, particularly with regard to intervention site selection. • The Selected sites need to be reconfirmed at the LPAC[146] stage.
3.	**Capacity constraints of local institutions may limit the ability to undertake the research and interventions in Seychelles.** It may be difficult to obtain full engagement of local institution if they feel they do not have the capacity to undertake in research in the domain of coral reef restoration.	Institutional	*Low to medium* P=2 I=2	• Collaboration and exchange between local institutions and Regional research institutes will be initiated and capacity building will be provided by Mauritius to the Seychellois counterparts.
4.	**Lack of commitment/buy-in from local communities may result in failure of intervention sites** It may be difficult to obtain the full engagement of the community if they do not find the change in livelihood beneficial in the long term	Operational	*Medium* P=3 I=1	• Community stakeholders were consulted though a bottom-up approach integrating the community into the proposed project's implementation phases will be followed.
5.	**Disagreement among stakeholders in respect of roles in the proposed project.**	Institutional	*Low* P=2	• Stakeholder roles are detailed clearly in the stakeholder involvement plan, which was developed at project

[146] Local Project Appraisal Committee

#	Description	Type	Risk rating	Countermeasures/ Management Response
	Discussion on the roles and responsibilities about the areas of action of each stakeholder may become a distraction for the implementation of the coral reef restoration activities.		I=1	development stage during the consultative processes (2 Regional Steering Committees) in Mauritius and Seychelles (Project Formulation Grant II). • This plan will be presented and confirmed during the Inception Workshop.
6.	**Current climate and seasonal variability and/or hazard events result in poor results for the coral restoration.** Severe bleaching may occur for long periods thus decreasing the success rate of coral survival in the restoration sites.	Environmental	*Medium* P=2 I=4	• Thermal-resistant corals (more resilient to bleaching) will be used as much as possible. • Nursery-grown corals of appropriate size will be transplanted at the restoration sites to reduce risks of hazard impact from predators. • Diversity in transplanted coral species will reduce this risk. • In Seychelles, where it is not frequently affected by cyclones and storms (compared to Mauritius), rope nurseries will be used in nurseries • In Mauritius adapted multi-layered rope nurseries and table nurseries will be used.
7.	**Delays in fund transfers and procurement of technical services and equipment.** Late funding (slow transfer of funds) or limited absorptive capacity for the Programme (UNDP/ MOEMRFS/ MEECC) may delay some activities, and have a knock-on effect, as outputs from one component are required for the initiation of other component.	Financial	*Medium* P=3 I=1	• Project activities have been designed and paced to ensure a reasonable chance of completion over six years (a timeframe less than this would be too ambitious); the PMT will provide required oversight for management of project inputs. • Bridging arrangement could be considered between the project and National Institutions in case there are delays.

C. Environmental and social risk management measures

Environmental and social impacts and risks have been identified for the proposed project (see Part II Section L). According to Mauritian and Seychelles legislation, works pertaining to coral reef restoration does not require submission of an Environment Impact assessment (EIA) study. However, since the project is a Category B as per AF requirement, an Environment and Social Risk Management Plan (ESMP) has been prepared. The Matrix below (Table 12) shows the identified risks/negative impacts and the measures for environmental and social risk management. It is to be noted that management measures have been provided only to principles where potential impacts and/or risks have been identified. Annex 15 presents the detailed ESMP, linking Project Activities with identified risks; the role of stakeholders in the implementation of the ESMP; the institutional arrangement; and the frequency of monitoring and reporting of the identified environmental and social impacts and risks.

Table 12 *Environmental and social risk management plan*

Principles	Identified Risks and impacts	Mitigating measures	Indicator	Responsible for Monitoring[147]
Compliance with the Law	If monitoring and control not maintained, there is risk that the restoration activities using coral nurseries, might result in an illegal or uncontrolled traffic of corals	– The relevant authorities would implement enhanced enforcement measures so as to ensure that private sector involvement in coral reef restoration follows the required standards and chain of custody for corals grown in nurseries. – Regular and enhanced monitoring at nursery grounds and restoration sites – Enhanced monitoring in ports/airport areas for illegal transport of corals	– Number of monitoring patrols to enforce existing National Laws. – Number of interventions – Number of intervention of unauthorised transport/trafficking of corals at ports and airports	National Project Team (NPT) With assistance from: – MOEMRFS – MEECC – SFA[148] – NCG[149] – Customs
Access and Equity	Due to the specialized nature of the skills	– Clear and transparent criteria for eligibility of the project beneficiaries will be applied,	– Number of complaints received	National Project Team (NPT)

[147] NOTE: at project inception stage, all stakeholders mentioned in ESMP will have to sign an ESMP implementation agreement with UNDP.
[148] Seychelles Fisheries Authority
[149] National Coast Guard (in Mauritius and Seychelles)

Principles	Identified Risks and impacts	Mitigating measures	Indicator	Responsible for Monitoring[147]
	needed, the project will not involve a large number of local community participants. As such, there is a risk that this limits direct participation in on-site restoration activities (i.e. activities requiring SCUBA diving certificates) to a larger number of community members. Fishers at Anse Forbans may temporarily have limited boat access in this pilot site. There is a slight risk that not all the communities will be aware of the works carried out and results of studies Limited access to published papers and data may impact on the regional studies	including the selection of participants in the training sessions to be organised. – Creation of other, not so specialised jobs associated with coral nursing and restoration efforts. – Communication on grievance mechanism. – Public communication and sensitization campaign will be developed to (i) raise public awareness and engagement; (ii) facilitate communication and collaboration among stakeholders and project partners; and (iii) enable dissemination of information and lessons through tailor-made communication products, such as: ○ Creation and maintenance of project website ○ Use of social media ○ Short clips and documentary films – Ensure access to publish papers to all project team and have agreement with Accademia to have access to published data generated with support of the project fund.	– Level of application of clear and transparent criteria for eligibility of the projects beneficiaries. – Level of application of the fair criteria for selection of participants in the training sessions organised. – Number and quality of the project communication system. – Project website updated regularly – Communication plan approved by PSC	UNDP MOI MOEMRFS PMT

Principles	Identified Risks and impacts	Mitigating measures	Indicator	Responsible for Monitoring[147]
Marginalized and Vulnerable Groups	At some community-based coral nurseries, some of the marginalized and vulnerable group (including fishers and women) might: i) Not be able to participate in the project implementation directly due to specialised nature of the skills required or not well represented in the business plan ii) Temporarily be unable to carry out their normal economic activities due to the coral reef restoration activities (Anse Forbans).	Ensure the participation of women and other marginalised and vulnerable groups participate in the implementation of the project and in sensitization campaign. (Some indicators in the Project Results Framework are made sensitive to the marginalized and the vulnerable.) The project includes activities to promote alternative income generating activities. Selection of the restoration sites and nurseries will occur through a participatory process where fishers can provide input on their fishing areas so that these can be avoided if possible. During the period that the fishing activities are curtailed, fishers will be encouraged and provided with authorization to fish in different areas.	– At least 30% of young people and women will be direct beneficiaries of the project – Number of alternate livelihoods (instead of fishing) undertaken by the local community (disaggregated data) – at least 30% of all trainings/workshops and learning events will be female – at least 35% of representatives in higher level authorities participating in the project will be female. – Number of marginalised/vulnerable groups benefiting from the project	NPT Project Gender Officers With assistance from: MOEMRFS MEECC and Economic Development Division of UNDP
Core Labour Rights	There is a risk of accidents due to mishandling of equipment or material	During implementation, the PMT and National Project Teams will ensure compliance with national and international labour laws and occupational and health safety laws.	– Proportion of workers who wear protective equipment – Level of compliance of the project with the labour laws in each country.	Responsible parties.

Principles	Identified Risks and impacts	Mitigating measures	Indicator	Responsible for Monitoring[147]
	– Trained SCUBA Divers may be exposed to the risk of accidents while planting corals – Other risks to workers, associated with mishandling of equipment at coral nurseries or at coral restoration sites.	Adequate protection equipment for workers, training (advanced training for diving activities), insurance and access to medical decompression chamber will be provided.	– Number of incidence caused due to mishandling of equipment	With the assistance from: – MOEMRFS – MEECC – MLIRET[150] – MEIC[151]
Involuntary Resettlement	Some fishers actively fishing in Anse Forbans may feel the voluntary measures set by the Anse Forbans community to restrict fishing activities at their coral restoration site is set unfairly or set without their full consent.	There will be full community engagement in the restoration activities, with a strong sustained communication effort throughout the project implementation to ensure the buy-ins and cooperation of the fishers. Fishers will also be encouraged to use the neighbouring fishing area during the project implementation. In case the project activity at Anse Forbans cause an economic issue to the local community, another restoration site (with legal protection) will be sought, since Anse Forbans is a pilot restoration site outside MPA or Reserve	– Level of satisfaction of the community with the coral restoration works – No of persons redirected to neighbouring fishing ground – No. of complaints received for restriction of boat access.	Responsible Parties

[150] Ministry of Labour, Industrial Relations, Employment and Training
[151] Ministry of Employment, Immigration and Civil Status

Principles	Identified Risks and impacts	Mitigating measures	Indicator	Responsible for Monitoring[147]
Protection of Natural Habitats	There is a low risk that some small areas of natural habitat in the project sites may be disturbed in the collection of the donor corals and construction of ocean-based nursery sites.	Since the restoration works will be carried in MPAs and Fishing Reserves, all access and activities are regulated and controlled. In the long term, the project activity will restore the Natural Habitats. Science-based coral reef restoration work, proposed by this project, will avoid the risk of impacting natural habitats when installing ocean nurseries and intervention in restoration sites as much as possible. All precautions will be taken to ensure that the natural habitat remains undisturbed, as far as possible. Training will be provided to Responsible parties, workers and community members that will be directly involved in the project to ensure the protection of natural habitat. Moreover, in the event that there is need to displace some living species, same will be done in the presence of the authority (e.g. Fisheries officers of the MOEMRFS in Mauritius) Continuous monitoring of the water quality, biodiversity and other key environmental parameters of the donor and nursery sites.	– Area of coral reef restored increased – Report on condition of the coral reef ecosystem – Coastal seawater quality, meeting the standards – Improved level of biodiversity of the restored coral reef compared to natural sites – Number of community members trained in handling living organisms – Number of translocated living organism	NPT MOEMRFS (AFRC and MOI) MEECC With the assistance of SFA
Conservation of Biological Diversity	Coral reef restoration work will be carried out mainly with identified climate resilient species. It is possible that the focus on climate-resilient	In the short term, asexual reproduction (fragmenting) of climate resilient species will be implemented to stabilize and stop the degradation of the restoration sites. Thereafter, the genetic	– Number of asexually farmed corals successfully transplanted. – Number of sexually farmed corals successfully transplanted – Fish diversity (abundance and number of species)	MOEMRFS MEECC NPT

Principles	Identified Risks and impacts	Mitigating measures	Indicator	Responsible for Monitoring[147]
	species will lead to a reduction of genetic diversity in the restored sites	diversity would be increased through sexual reproduction of the transplanted corals.		

Grievance mechanism

The proposed project will utilize the existing UNDP grievance mechanism (known as Stakeholder Response Mechanism) to allow the affected to raise concerns that the proposed project is not complying with its social or environmental policies or commitments. It will be the responsibility of the PMT and National Project Teams to ensure that all relevant stakeholders are adequately informed of the grievance mechanism. The Grievance mechanism will be housed in UNDP. The focal point of the grievance mechanism would be Mr. Satyajeet Ramchurn, Head of Environment Unit in Mauritius and Mr Roland Alcindor, Program Manager in Seychelles.

The Regional Project Manager, Project Assistant and Financial Assistant or the executing partners (in Mauritius and Seychelles) are usually the first point of contact for any project-related complaints from stakeholders. The PMT and project team should respond promptly and appropriately to a complaint. The different steps involved in the Stakeholders Response Mechanism (RSM) is described in the flow chart in figure 17

Anyone could raise concern on the project. This mechanism considers the special needs of different groups as well as gender consideration and potential environmental and social risks. A combination of mailboxes (at project site), confidential persons in the community and telephoning options offer an immediate way for employee, community and public affected by the project to safely express their concerns. It will also be possible to raise their concerns through Facebook, twitter, or email.

The address and e-mail address of the Adaptation Fund will also be made public (i.e. on project website, Facebook and mailbox) for anyone to raise concerns regarding the project:

Adaptation Fund Board secretariat
Mail stop: MSN P-4-400
1818 H Street NW Washington DC
20433 USA
Tel: 001-202-478-7347
Email: afbsec@adaptation-fund.org

The Adaptation Fund Board Secretariat will receive a copy of any complaint received and a report describing how the grievance has been addressed.

Project staff will be trained in procedures for receiving messages and on the reporting of any grievances. In addition, monitoring activities allow project participants to voice their opinion or complaints as they may see fit.

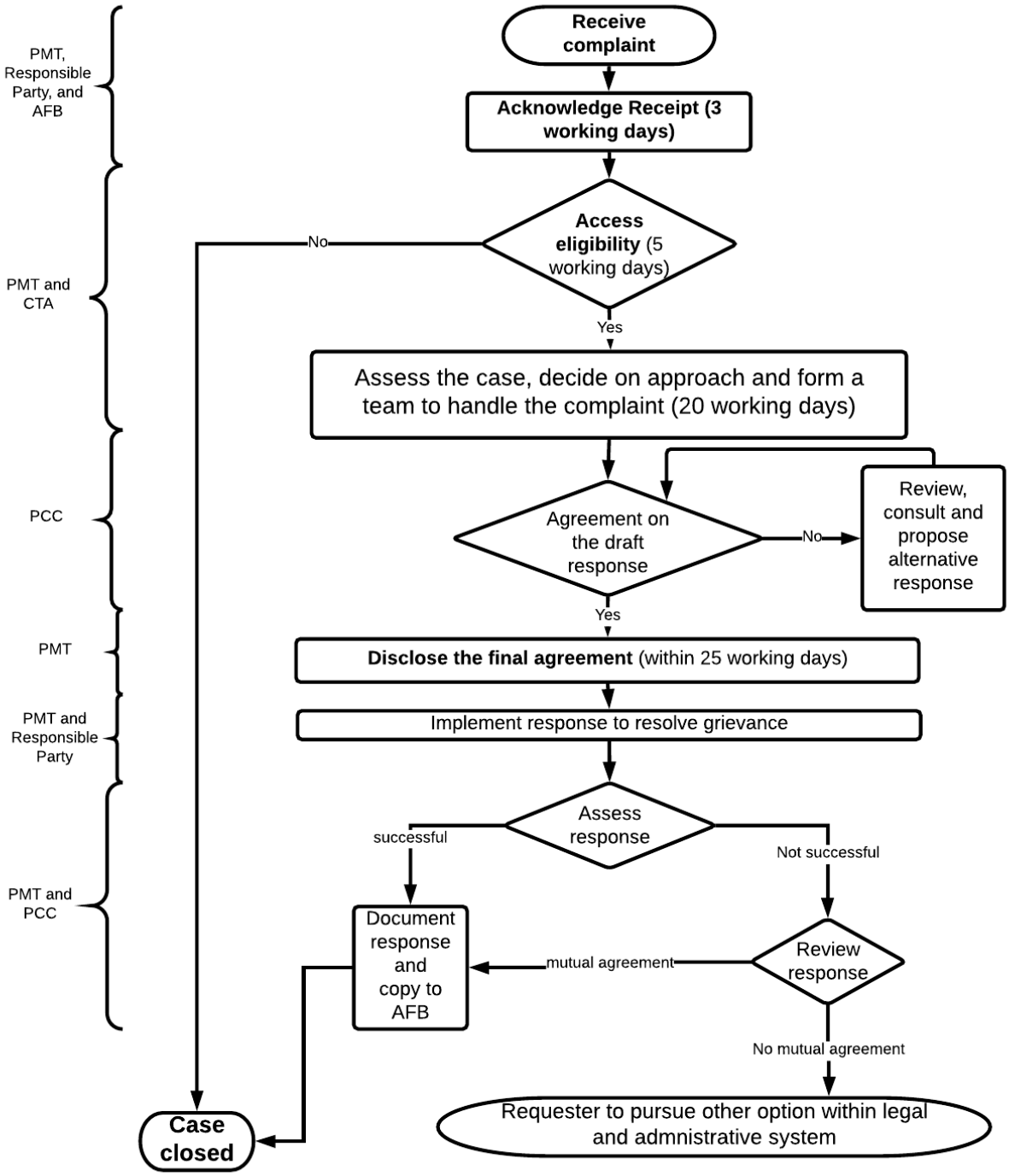

Figure 17: *Work flow for the RSM mechanism following a complaint*

D. Monitoring and evaluation

The monitoring and evaluation (M&E) scheme will be applied in accordance with the established UNDP procedures throughout the project lifetime. The executing partners, 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 the table below. Technical guidance and oversight will be also provided from the UNDP's Regional Service Centre in Addis Ababa as well as the PSC.

The audits on the project will follow UNDP finance regulations and rules and applicable audit policies on UNDP projects.

The Results Framework noted in Section E below (Table 14) provides performance and impact indicators for project implementation along with their corresponding means of verification. These will form the basis on which the project's Monitoring and Evaluation system will be built throughout the 6-year implementation period.

The principle components of the Monitoring and Evaluation Plan will include: (1) establishing monitoring responsibilities and events, (2) project reporting and (3) independent evaluations. The project's Monitoring and Evaluation Plan will be presented and finalized at the Project's Inception Phase following a collective fine-tuning of indicators, means of verification, and the full definition of project staff M&E responsibilities

Milestones

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, 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.

The **Inception Workshop** should address a number of key issues including:

- Assist all partners to fully understand and take ownership of the project. Detail the roles, support services and complementary responsibilities of UNDP CO and Regional Coordinating Unit (RCU) staff (i.e. UNDP Mauritius/Seychelles and CTA) vis-à-vis the project team. Discuss the roles, functions, and responsibilities within the project's decision-making structures, including reporting and communication lines, and conflict resolution mechanisms. The Terms of Reference for project staff will be discussed again as needed.
- Based on the project results framework, to finalize the first annual work plan. Review and agree on the indicators, targets and their means of verification, and recheck assumptions and risks.
- Provide a detailed overview of reporting, monitoring and evaluation requirements. The Monitoring and Evaluation work plan and budget should be agreed and scheduled.
- Discuss financial reporting procedures and obligations, and arrangements for annual audit. Audits on the project will follow UNDP finance regulations and rules and applicable audit policies.
- Plan and schedule Project Steering Committee and Project National Coordination Committee meetings. Roles and responsibilities of all project organization structures should be clarified, and meetings planned. The first Project Steering Committee meeting should be held within the 12 months following the inception workshop.

An Inception Workshop Report is a key reference document and must be prepared and shared with participants to formalize various agreements and plans decided during the meeting.

Quarterly

- Progress made shall be monitored in the UNDP Enhanced Results Based Management Platform.
- Based on the initial risk analysis submitted, the risk log shall be regularly updated in ATLAS.
- Based on the information recorded in ATLAS, an Annual Project Progress Report (PPR) can be generated in the Executive Snapshot;
- Other ATLAS logs will be used to monitor issues, lessons learned etc. The use of these functions is a key indicator in the UNDP Executive Balanced Scorecard.
- Evaluation of the Environment and Social Impact Assessment monitoring.

Annually

An **Annual Project Progress Report (PPR)** will be prepared by the Regional Project Manager, shared with the PSC. The PPR will evaluate yearly project progress, using identified M&E indicators. The PPR will identify yearly objectives and targets, lessons learned and risk mitigation measures, as well as relevant financial information. The data for monitoring will consist of financial, procurement and physical progress reports as well as compliance with the requirements of the environmental and social assessment and management frameworks, along with financial audit reports. It will also include measures considered in the risk management plans proposed in Section B of Part III.

Project Reporting

Periodic monitoring through site visits: UNDP Mauritius/Seychelles and PMT and Chief Technical Advisor will conduct visits to project sites based on the agreed schedule in the project's Inception Report/Annual Work Plan to assess first hand project progress. Other members of the PSC and PNCC may also join these visits. A Field Visit Report/BTOR will be prepared by the PMT and will be circulated no less than one month after the visit of the project team to and PSC and PNCC members.

Mid-term of the project cycle: The project will undergo an independent Mid-Term Evaluation (MTE) at the mid-point of project implementation (beginning-year 4). The MTE will determine progress being made toward the achievement of outcomes, assess financial, social and environmental risks and pinpoint corrective actions as required. 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 evaluation will be incorporated as recommendations for enhanced implementation during the final half of the project’s term.

Project Closure: An independent Final Evaluation will be undertaken 3 months prior to the final RSC meeting (prior to project closure) and will be undertaken in accordance with UNDP guidance. 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 took 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. The Terms of Reference for this evaluation will be prepared by the UNDP CO. The Final Evaluation should also provide

recommendations for follow-up activities and will require a management response, which will be uploaded to PIMS and to the UNDP Evaluation Office Evaluation Resource Centre (ERC).

Learning and knowledge sharing

Results from the project will be disseminated within and beyond the project intervention zone through existing information sharing networks and forums.

The project will identify and participate, as relevant and appropriate, in scientific, policy-based and/or any other networks, which may be of benefit to project implementation though lessons learned. The project will identify, analyse, and share lessons learned that might be beneficial in the design and implementation of similar future projects.

There will be a two-way flow of information between this project and other projects of a similar focus.

Monitoring and Evaluation Budget

Table 13 Indicative Project Monitoring and Evaluation Workplan and budget

Type of M&E activity	Responsible Parties	Budget USD	Time frame
Inception Workshop and Report	▪ PMT ▪ UNDP CO	10,000	Within first three months of project start up
Measurement of Means of Verification of project results	UNDP RTA/Programme Manager will oversee the hiring (specific studies and institutions), and delegate responsibilities to relevant team members.	N.A	Start, mid- and end of programme (during evaluation cycle) and annually when required.
Measurement of Means of Verification for Project Progress on output and implementation	Oversight by Regional Project Manager PMT National Project team	N. A	Annually prior to PPR and to the definition of annual work plans
ARR/PIR	▪ PMT ▪ UNDP CO ▪ UNDP RTA	None	Annually
Periodic status/ progress reports	▪ PMT	None	Quarterly/ Annually
Mid-term Evaluation	▪ PMT ▪ UNDP CO ▪ UNDP RTA ▪ External Consultants (i.e. evaluation team)	45,000	Year 4, A the mid-point of the project implementation.
Final Evaluation	▪ PMT, ▪ UNDP CO ▪ External Consultants (i.e. evaluation team)	45,000	Year 6, at least three months before the end of project implementation

Type of M&E activity	Responsible Parties	Budget USD	Time frame
NEX Audit	▪ UNDP CO ▪ PMT	30,000	As per UNDP regulations
Visits to field sites	▪ UNDP CO ▪ Government representatives ▪ PMT ▪ PSC ▪ CTA	20,000	Yearly
TOTAL indicative COST		**150,000**	

Note:

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

2. The budget for M&E activities are included in the project budget component found in Section G of Part III.

E. Results framework

Table 14: Project Result Framework

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
Objective 1: To improve food security and livelihoods and mitigate disaster risk through active restoration of coral reefs degraded by coral bleaching as a result of climate change in Mauritius and Seychelles, in order to restore their essential ecosystem services.	Degraded sites restored to scale using farmed corals, with good survivorship and growth rates of the colonies	Mauritius : 0.075ha (750 m^2) in Mauritius (non-projet sites) 0 Ha at BBMP and SEMPA (project sites) Seychelles: 0.5 ha (5.225 m^2)	At least 3.2 Ha in Mauritius and 2.5 Ha in Seychelles	Survey, evaluation report, Annual Progress Report	No major events (climate, tsunami) occur during the project period, allowing the timely transplantation of nursery grown coral colonies.
	Number of stakeholders with improved livelihoods due to new and sustained employment & business opportunities	0	At least 800 persons	Livelihood Survey	Coastal communities and stakeholders have successfully completed the training provided and are interested in undertaking new business approach for coral based business.
	Number of people involved in the building, maintenance and monitoring of ocean nurseries		In Mauritius, at least 20 community members involved In Seychelles: Cousin: 6 staffs, volunteers and 10 community members. Ste Anne/Anse Forbans: 4 staff, Communities and 10	Monitoring and evaluation reports for land-based and ocean-based nurseries; staff contracts; volunteer contracts	Low turnover for community members and staff involved until the end of the project Scientific diver volunteers change every 3 months Community member, staff and volunteers learn to work together through the project lifetime

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
			Community members Curieuse: 4 staff and 12 rotating volunteers		
Objective 2: To generate knowledge about effective restoration techniques for dissemination to other SIDS and countries within the wider region.	Number research papers on coral reef restoration submitted for presentation at various scientific forums in the WIO and globally		At least 3 papers published	Report published in journal & Project Progress Report	Studies, Reports and Research papers on coral reef restoration initiatives in the region and globally available and accessible Capacity of key stakeholders on coral reef restoration techniques and coral genetics analysis including clade analysis built
Component 1: Enhancement of food security and reduction of risks from natural disasters through the restoration of degraded reefs in Mauritius					
Outcome 1.1: Improved livelihood for a sustainable partnership and community-based approach to reef restoration	Number of members from coastal communities that are deriving an income from new coral restoration and related economic activities	0	At least 200 persons (disaggregated by sex and age) by end of project	Survey, Evaluation reports, annual reports from NGOs	Coastal communities have successfully completed the training provided and are participating fully throughout the duration of the project
Output 1.1.1 Coastal communities benefit from improved livelihoods through employment establishing and maintaining coral nurseries and	Number of community members (as identified in Community Action Plan and any other complementary analysis) trained in establishing and maintaining proposed coral nurseries (Data disaggregated by community groups, gender and age group)	0	At least 20 for Mauritius 11 for Rodrigues	Training report	Community members have successfully completed the training provided

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
transplantation sites.					
Output 1.1.2 Coastal communities benefit from improved livelihoods through increased revenue from alternative work including tourism (glass bottom boat tours, snorkelling and diving trips)	Number of coral restoration economic and financial strategies developed for sustainable financing mechanism	0	1 coral restoration economic and financial strategy developed for Mauritius and Rodrigues	coral restoration economic and financial strategy document	Mauritius economy remains stable, tourism remains at same level or higher, so that the business plan is implemented as written.
	Number of partnership agreement signed for job opportunities	0	at least 2 agreements signed, and new employment opportunities created	Signed Agreement document	Mauritius economy remains stable, tourism remains at same level or higher, so that the business plan is implemented as written.
	Number of people benefiting from improved income as result of the project	0	At least 100 persons (disaggregated by sex and age) by end of project	Livelihood surveys, annual reports from NGOs	Coastal communities have successfully completed the training provided and are participating fully throughout the duration of the project
Outcome 1.2: Coral farming and nursery facilities established at a sufficient scale for more climate change resilient corals	Land and ocean-based nurseries operational and producing sufficient coral stock for transplantation	0	• Mid-term: 1 Nursery established and operational • End of project: 3 nurseries (land & sea based) operational and	Technical reports, survey reports, established nurseries, coral stock available for transplantation	Favourable weather conditions (incl. no extreme El Nino events experience) Timely delivery and availability of necessary equipment for set up of nurseries

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
			producing coral stock at sufficient scale		
Output 1.2.1 Donor coral colonies of appropriate species (resilience, maintaining genetic diversity) available at sufficient scale (quantity, time, intervals etc.) for propagation in nurseries	Number of coral species for propagation based on resilience and genetic diversity identified.	none	Coral species identified and validated by the Project Steering Committee	Technical Assessment Report on coral species identified, Minutes of Steering Committees	Preliminary findings on list of coral species that are suitable for culture in Mauritius readily available. Personnel of the MOI has been effectively trained for clade analysis and genetic connectivity.
	Number of donor sites with locally threatened species (Mauritius & Rodrigues) identified	None	at least 2 donor sites identified	Survey Reports	Preliminary findings on list of locally threatened coral species readily available. Favourable weather conditions allow the timely completion of surveys
	percentage of high=thermal tolerance corals collected from donor sites for propagation in nurseries.	0%	not more than 10 % of each donor coral colony will be collected to avoid death of donor corals at donor site	Technical assessment report, Report on genetic analysis, survey report of donor site	Favourable weather conditions, including no extreme El Mino events causing bleaching of aqua-cultured resilient coral species

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
Output 1.2.2 Reports on coral reef status, water quality, and other key environmental and social parameters for potential nursery sites	Survey for identification of nursery sites (Mauritius and Rodrigues)	Not yet undertaken	Reports on coral reef status, water quality, current patterns/flushing and other key environmental and social parameters for potential nursery sites produced	Survey reports	List of Nursery site locations based in MPAs/Marine Parks available, Favourable weather conditions allow the timely completion of surveys
	Number of Environmental and Social Monitoring surveys carried out	0	one survey per year, as per ES Risk Assessment (Part II-L)	Environment and Social Monitoring Reports	implementation of the project does not lead to social issues.
Output 1.2.3 A land-based nursery and 2 or more ocean nurseries established and maintained on a regular basis	Number of Land based nursery established and operational	0	One land-based nursery established and operational	Monitoring and evaluation report for nursery site, Physical verification (site visits), Operational reports, List of assets	Timely delivery and availability of necessary equipment for set up of nurseries
	Number of infrastructure for nursery seeding from sexual reproduction (Mauritius) established	Infrastructure non-existing	1 Infrastructure established	Monitoring and evaluation report for nursery site, Physical verification (site visits), Operational reports, List of assets	Favourable weather conditions allow the timely collection of spawns/larvae from the wild during spawning seasons

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
	Number of ocean-based nurseries established and operational in Mauritius	1 ocean-based nursery is currently operational	1 new ocean-based nursery established and operational with 100 basal tables, 100 multi-layered ropes nursery units	Monitoring and evaluation report for nursery site, Physical verification (site visits), Operational reports, List of assets	Timely delivery and availability of necessary equipment
	Number of community members involved in the maintenance and monitoring of new ocean-based nurseries in Mauritius	0	At least 20 community members involved	Monitoring and evaluation report for nursery site	Community members involved till the end of the project - low turnover
	Number of ocean-based nurseries established and operational in Rodrigues	No ocean-based nursery is currently operational	1 ocean-based nursery established and operational with 40 multi-layered ropes nursery unit	Monitoring and evaluation report for nursery site, Physical verification (site visits), Operational reports, List of assets	Timely delivery and availability of necessary equipment
	Number of community members involved in the maintenance and monitoring of ocean-based nurseries in Rodrigues	0	At least 11 community members fully involved	Trained work force in field of coral farm management Monitoring and evaluation report (from monitoring)	Community members involved till the end of the project

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
Output 1.2.4 Stock of farmed corals available for transplantation	Number of coral fragments under culture in land-based nursery (Mauritius)	0	15,000 coral fragments (including resilient species and locally threatened coral species)	Monitoring and evaluation report for nursery site	The actual survival rate of coral fragments is as per estimated survival rates based on past studies and research undertaken by MOI (75%)
	Percentage of coral polyps successfully settled in situ	0%	1.5% of polyps settled from each spawning. (approximately 1500 recruits per year)	Technical and monitoring reports	Surveys of dates of spawning have been identified correctly and that all conditions are favourable for settling of coral polyps.
	Number of coral fragments under culture in new ocean-based nurseries in Mauritius	0	120,000 fragments	Monitoring and evaluation report for nursery site	The actual survival rate of coral fragments is as per estimated survival rates based on past studies and research undertaken by MOI (75%)
	Number of coral fragments under culture in ocean-based nurseries in Rodrigues	0	40,000 fragments for multi-layered rope nursery unit	Monitoring and evaluation report	Timely delivery and availability of necessary equipment Favourable weather conditions allow the timely completion of surveys
Outcome 1.3: The health of degraded reefs restored, through active restoration work, maintenance and monitoring efforts, leading ultimately to greater protection of shore from flooding and storm damage	Number of sites restored with nursery grown corals in Mauritius and Rodrigues	0	2 Sites restored with nursery-grown coral colonies contributing to coral and fish recovery.	Monitoring reports	Favourable weather conditions allow the timely completion of surveys, transplantation of corals, maintenance and monitoring of restored sites

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
Output 1.3.1: Rugosity and structure of reefs restored, leading ultimately to greater protection of shore from erosion.	Areas of site successfully restored using farmed corals of resilient species in Mauritius and Rodrigues	Total of 750 m2 restored at Trou aux Biches (150m^2), Flic en Flac (250m^2), Albion (350 m^2) No restored site in BBMP	2.5 Ha in Mauritius and 0.7 Ha in Rodrigues	Monitoring reports GIS Mapping	Favourable weather conditions allow the timely completion of surveys, transplantation of corals, maintenance and monitoring of restored sites
Output 1.3.2 Recovery of fish population and other reef associated fauna and flora, leading ultimately to improved food security in Mauritius and Rodrigues.	percentage of live coral cover and quality of restoration sites (including, restored coral health status, coral recruitment, fish biomass, fish diversity and fish catch amongst others)	% live coral: NA Fish population and fish catch: NA	at least 10 % increase in live coral cover, fish density and diversity.	Annual monitoring report to assess the temporal progress of the project.	Favourable weather conditions (incl. no El Nino events experience). There is high survival rate of transplanted corals.
Component 2: Enhancement of food security and reduction of risks from natural disasters through the restoration of degraded reefs in Seychelles					
Outcome 2.1 Improved livelihood for a sustainable partnership to coral reef restoration	Number of members from coastal communities that are deriving an income from new coral restoration and related economic activities	0	At least 60 persons (disaggregated by sex and age) by end of project	Survey, Evaluation reports, annual reports from NGOs	Stakeholders are interested in undertaking new business approach & enabling national environment for coral based and mariculture based businesses

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
Output 2.1.1 Coastal communities benefit from improved livelihoods through employment establishing and maintaining coral nurseries and transplantation sites.	Number of people trained in establishment and maintenance of coral nurseries (Data disaggregated by community groups, gender and age group)	0	At least 60 people by end of project (Data disaggregated by community groups, gender and age group)	Surveys, Training certificates, annual reports from NGOs	Participants are willing to be trained in coral reef restoration and have successfully completed the training provided
Output 2.1.2 Coastal communities benefit from improved livelihoods through increased revenue from alternative work including tourism (glass bottom boat tours, snorkelling and diving trips)	Number of sustainable financing mechanisms for the maintenance and monitoring of coral restoration activities with recommendations	Draft business plan	1 Business plan produced including marketing & development of 2 products, at least 2 MOUs and new employment opportunities created	Statistics from Government of Seychelles Signed MOUs Business plan document Products marketed & sold	Seychelles economy remains stable, tourism remains at same level or higher, so the business plan is implemented as written
	Number of stakeholders with improved livelihoods due to new employment & business opportunities	0	At least 60 people by end of project (Data disaggregated by community groups, gender and age group)	Surveys, annual reports from NGOs	Participants are willing to be trained in coral reef restoration and have successfully completed the training provided Sufficient entrepreneurs motivated to develop associated business opportunities

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
Outcome 2.2 Coral farming and nursery facilities established at a sufficient scale for more climate change resilient corals	Land and ocean-based nurseries operational and producing sufficient coral stock for transplantation	Editing ocean-based nurseries: >Curieuse (~2000 fragments) >Ste Anne/Ile aux Cerfs (450 fragments) Beau Vallon (400 fragments) >Cousin (32500 fragments) Existing Land Based Nurseries: >Beau Vallon (200 fragments) >Anse Forbans (100 fragments)	Mid-term: Existing and Nursery established and operational End of Project: At least 10 ocean nurseries of different capacity, 1 land-based nursery operational and producing coral stock at sufficient scale	Technical reports, coral survey reports, established nurseries, coral stock available for transplantation	Timely delivery and availability of necessary equipment for set up of nurseries Nursery corals will have a similar survival as previous Reef Rescuers project (75 %) No major mass bleaching events, or crown-of-thorns & Drupella snail invasions during project period

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
Output 2.2.1 Donor coral colonies of appropriate species (resilience, maintaining genetic diversity) available at sufficient scale (quantity, time, intervals etc.) for propagation in nurseries	Number of coral species for propagation based on resilience and genetic diversity identified	Coral species selected during previous Reef Rescuers Project (Nature Seychelles) based on survival from 1998 El Nino	Coral species identified and validated by the Project Steering Committee	Technical Report on coral species identified, Minutes of Steering Committee	New coral species selected will perform equally or better than coral species of the Reef Rescuers project
	Number of donor sites with resilient and resistant coral species identified	2 Donor sites identified and used for previous Reef Rescuers project (Nature Seychelles)	At least an additional donor site identified in Cousin island, Ste Anne, Cerf Islands and Curieuse/Praslin area.	Donor site survey reports	List of local thermal tolerant coral species available Favourable weather conditions allow the timely completion of surveys
	percentage of climate resilient coral collected from donor sites for propagation in nurseries	0%	not more than 10 % of each donor coral colony will be collected to avoid death of donor corals at donor sites	Technical assessment report, report on genetic analysis, survey report of donor site	Favourable weather conditions, including no extreme El Nino events causing bleaching of aqua-cultured resilient coral species.

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
Output 2.2.2 Reports on coral reef status, water quality, and other key environmental and social parameters for potential nursery sites	Surveys for identification of nursery sites including parameters suitable for maximized coral growth	1 nursery site at Cousin Island; 1 nursery site at Curieuse Island; 1 nursery site at-Ste Anne/Ile aux Cerf	3 Nursery sites of different size operational	Reports on nursery sites	Species selection is science-based and performs as in previous projects. Adequate environmental conditions remain for ideal coral growth in nurseries
	Number of Environmental and Social Risk Assessment Reports	0	6	Annual Environment and Social Risk Assessment Reports	Implementation of the project does not lead to environmental and social issues
Output 2.2.3 A land-based nursery established, and 2 or more ocean nurseries are established and	Number of land-based nursery established and operational	2 small scale land nurseries at Beau Vallon and Anse Forbans	One additional land-based nursery established and operational at Cousin Island	Monitoring and evaluation report for land-based nursery	Land based nursery will work for production of coral sexual recruits; availability of necessary workers, equipment and materials to build land-based nursery

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
maintained on a regular basis	Number of ocean-based nurseries established and operational	Previous experience installing & maintaining ocean nurseries; midwater rope nurseries still operational from Reef Rescuers project	Cousin: At least 10 ocean nurseries; Curieuse: 20 Nurseries; St Anne: 8 Nurseries.	Monitoring and evaluation report for ocean nursery sites, physical verification (site visits), operational reports, list of assets	Timely delivery and availability of necessary equipment and materials to build ocean nurseries
	Number of people involved in the maintenance and monitoring of new land and ocean-based nurseries	Reef Rescuers project: Prior team of 3 permanent staff and 35 rotating volunteer scientific divers. Current team of 2 MCSS: 3 project staff and volunteers	Cousin: 6 staffs, volunteers and 10 community members. Ste Anne/Anse Forbans: 4 staff, Communities and 10 Community members Curieuse: 4 staff and 12 rotating volunteers	Monitoring and evaluation reports for land-based and ocean-based nurseries; staff contracts; volunteer contracts	Low turnover for community members and staff involved until the end of the project Scientific diver volunteers change every 3 months Community member, staff and volunteers learn to work together through the project lifetime

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
Output 2.2.4 Stock of farmed corals available for transplantation	Number of coral fragments under culture in land-based nursery	0	At least 1,000 corals growing in the land-based nursery derived from sexual and/or sexual reproduction	Monitoring and evaluation reports for land nursery site	The survival rate of coral fragments in the land nursery is similar or better than the survival rate in past ocean nurseries (75 %) implemented by Nature Seychelles
	Number of coral fragments under culture in new ocean nurseries	Past Reef Rescuers Project by Nature Seychelles grew 40,000 corals in ocean-based nurseries; Present bleaching resistant corals (super corals) at Cousin Island nursery site	Cousin: At least 50,000 corals Curieuse: at least 40000 Ste Anne at least 12500 Total: 102,500.	Monitoring and evaluation reports for ocean nursery site	The survival rate of coral fragments in ocean nurseries is similar (75%) or better than in previous Reef Rescuers project; No major mass bleaching events, or crown-of-thorns & Drupella snail invasions during project period

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
Outcome 2.3 The health of degraded reefs restored, through active restoration work, maintenance and monitoring efforts, leading ultimately to greater protection of shore from flooding and storm damage	Number of sites restored with nursery grown corals	1 site (0.5 hectare) of degraded reef were restored in Cousin Island by Nature Seychelles, Reef Rescuers project	At least 3 degraded reef sites of different sizes restored with nursery-grown corals, sea bed stabilisation and control of macro algae, thus contributing to coral and fish recovery	Underwater surveys & monitoring reports	Favourable weather conditions allow the timely completion of surveys, transplantation of corals, maintenance and monitoring of restored sites No major events (climate, tsunami) occur during project period
Output 2.3.1 Rugosity and structure of reefs restored, leading ultimately to greater protection of shore from erosion	Area of site successfully ~~restored~~ with nursery grown corals	Previous experience restoring a degraded reef with 25,000 nursery grown corals in the Reef Rescuers project covering 0.5 Ha	Cousin: At least 1 Ha of degraded reef Curieuse: 1 Ha over project life cycle Ste Anne: 0.25 Ha over project life cycle Anse Forbans: 0.25 Ha over project life cycle Total: 2.5 Ha	Monitoring reports, GIS Mapping	Favourable weather conditions allow the timely completion of surveys, transplantation of corals, maintenance and monitoring of restored sites The survival rate of transplanted corals is similar or better than in previous Reef Rescuers project; No major mass bleaching events, or crown-of-thorns & Drupella snail invasions during project period

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
	Number of people involved in cementing corals to the degraded reefs and monitoring restoration effects	Prior experience applying cementing techniques during the Reef Rescuers project: Cousin: 3 staff, 2 divers and 35 rotating volunteers SNPA: 4 staff and volunteers; MCSS: 3 staffs and volunteers	Cousin: 4 staff + volunteers rotating every 3 months or as needed SNPA: 4 staff and rotating volunteers MCSS: 4 staffs and volunteers	Monitoring reports for restored reefs; staff contracts; volunteer contracts	The survival rate of transplanted corals is similar or better than in previous Reef Rescuers project; No major mass bleaching events, or crown-of-thorns & Drupella snail invasions during project period
Output 2.3.2 Recovery of fish population and other reef associated fauna and flora, leading ultimately to improved food security in Seychelles	percentage of live coral cover and quality of restoration sites (including, restored coral health status, coral recruitment, fish biomass, fish diversity and fish catch amongst others)	Percentage cover of live coral: --Curieuse 19% cover --Anse Forbans < 5% -- Ste Anne/Cerf 49% Average fish population per m^2 at Ste Anne is 0.307. no data available for other sites	at least 10 % increase in live coral cover, fish density and diversity.	3 reports (coral reef ecosystem including, restored coral health status, coral recruitment, fish biomass, fish diversity and fish catch amongst others) to assess the temporal progress of the project - beginning, midterm and end of project	Favourable weather conditions allow the timely completion of surveys, transplantation of corals, maintenance and monitoring of restored sites

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
Component 3: Knowledge management and sharing, training and sensitization to build regional capacity for sustainable reef restoration					
Outcome 3.1 Improved understanding and knowledge management of use of reef restoration as an adaptation measure	Number of result dissemination reports produced for sharing of acquired experience/know-how, lessons learned etc.	0	At least 7	Reports and other tangible means of result dissemination	Sensitisation materials successfully disseminated to the right target audience/population
Output 3.1.1 Comparative review and analysis of coral restoration initiatives in the region and globally, with gaps in knowledge identified	Comprehensive review of coral reef restoration in the region and globally undertaken	None	Report/Paper on comprehensive review of coral reef restoration in the region and globally finalised and validated by the Project Steering Committee	Report on comprehensive review of coral reef restoration & Project Progress Report	Studies, Reports and Research papers on coral reef restoration initiatives in the region and globally available and accessible
Output 3.1.2 Based on past and ongoing coral restorations efforts undertaken by the project and others, science-based best practice and methodologies (e.g. factors determining success in coral restoration are known; cost-	Methodologies for coral restoration in Mauritius and Seychelles developed, based on best available science and practices	none	Coral restoration methodology and good practices guide developed and validated by the project steering committee	Methodologies developed and adopted for coral reef restoration activities. Project Progress Report Guideline document & survey Report (currents/wave pattern, GIS/habitat mapping,	Studies and Research papers on coral reef restoration methodology accessible Reports on past and current coral reef restoration projects locally and in the region readily available

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
effective approaches, etc.) developed, constraints and challenges identified, and lessons learned documented.				physico-chemical surveys of sites, inventory of coral species, genetic identification of resilient species, water quality amongst others)	
Output 3.1.3 Research undertaken to provide information to guide restoration and enhance reef resilience where required (e.g. genetic connectivity of coral species, spawning seasons and coral recruitment patterns, resistant/ resilient species and clades)	Research and surveys on key information for reef restoration undertaken	Preliminary surveys and analysis of past coral reef restoration projects undertaken	Regional research and analysis on key information coral reef resilience, and genetic diversity and connectivity undertaken	Report on research and analysis Published papers.	Capacity of key stakeholders on coral reef restoration techniques and coral genetics analysis including clade analysis built

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
Outcome 3.2 Improved understanding within the WIO and globally of successful approaches to reef restoration, the constraints and challenges, with lessons learned incorporated into new initiatives	Number of abstracts of research papers on coral reef restoration submitted for presentation at various scientific forums in the WIO and globally	0	Abstracts: Midterm: At least 2 End of project: At least 4	Project Progress Report Research papers published	Capacity of stakeholders built on preparation of research papers Commitment of stakeholders to produce research papers documenting the findings of the coral restoration initiative
Output 3.2.1 Lessons learned in reef restoration documented and shared	Knowledge sharing platform on reef restoration for sharing lessons learned developed	0	Knowledge sharing platform developed and operational	Project Progress report website	Active participation and collaboration of the key stakeholders of coral reef restoration Systematic monitoring and documentation of the coral reef restoration process at each stage
Output 3.2.2 Reef Restoration tool kit and manual for use in the WIO published and disseminated	Reef Restoration Manual developed	1	Reef Restoration Manual updated, revised and published online	Coral Reef Manual and website where it is made accessible	Active participation and collaboration of the key stakeholders of coral reef restoration for the timely drafting of the manual

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
Outcome 3.3 Regional capacity developed for sustainable and climate resilient coral restoration.	Number of members from Mauritius and Seychelles trained in coral reef restoration techniques and analysis (incl. identification of resilient corals, long-term monitoring programmes, sexual reproduction of corals, micro-fragmentation, GIS, genetic connectivity, etc.)	0	Mid-term: At least 20 End of year: At least 45 Beneficiaries: MOEMRFS, MOI, SNPA, Nature Seychelles, MCSS and some participants from the WIO region who are doing active in coral restoration work in the region.	Project Progress report Training report	Members have successfully completed the training provided
Output 3.3.1 Regional training programme on reef restoration in place, possibly with an associated Certificate of Competence	Number of members from Mauritius and Seychelles trained in coral reef restoration methods	0	Mid-term: At least 7 End of project: At least 20 Beneficiaries: representative of the WIO region countries involved in coral reef restoration	Project Progress report + Training report	Members have successfully completed the training provided
Output 3.3.2 Regional training workshops undertaken on monitoring, DNA-based approach for the identification of resilient corals, genetic connectivity and other topics as appropriate	Number of members from Mauritius and Seychelles trained in advanced coral genetics including clade analysis	0	End of project: At least 20 participants Beneficiaries: MOEMRFS, SNPA, Nature Seychelles, MCSS and some participants from the WIO region who are doing active in coral restoration work in the region.	Training report + Lab-book records	Recruitment of a consultant or sponsored training to an international genetic facility (with advanced knowledge in coral genetics) Timely delivery and availability of additional lab equipment

Expected Outcomes/Outputs	Outcome/Output Indicator	Baseline (2016-2017)	Target by end of project	Means of Verification	Assumptions
Output 3.3.3. Sustainable long-term monitoring programme developed and underway for restored reefs, based on international/regional protocols and best practice	Regional Coral Restoration Plan including national component and long-term monitoring programme	0	Regional Coral restoration plan developed and validated by the Project Steering Committee and adopted by both countries	Regional Coral Reef Restoration Plan Project Progress Report	Literature on coral reef restoration selection criteria accessible Reports on past and current coral reef restoration projects locally readily available
	Participation in regional and international forums	0	participation to at least 1 relevant regional/international forums	Feedback report minutes of Regional/international forum	Commitment of stakeholders to produce research papers documenting the findings of the coral restoration initiative
	Regional Studies on wave patter, beach erosion and mapping	0	At least 5 surveys (one in each site) by mid project and 10 by the end of the project.	Survey reports research paper	There is full cooperation between Mauritius and Seychelles. Commitment of stakeholders to produce research papers documenting the findings

F. Project Alignment with AF framework

Table 15 Project Alignment with AF framework

Project Objective(s)[152]	Project Objective Indicator(s)	Fund Outcome	Fund Outcome Indicator	Grant Amount (USD)
Objective 1: To improve food security and livelihoods and mitigate disaster risk through active restoration of coral reefs degraded by coral bleaching as a result of climate change in Mauritius and Seychelles, in order to restore their essential ecosystem services.	Degraded sites restored to scale using farmed corals, with good survivorship and growth rates of the colonies	**Outcome 5**: Increased ecosystem resilience in response to climate change and variability-induced stress	**5.** Ecosystem services and natural resource assets maintained or improved under climate change and variability-induced stress	5,423,007
	Number of stakeholders with improved livelihoods due to new employment & business opportunities	**Outcome 6:** Diversified and strengthened livelihoods and sources of income for vulnerable people in targeted areas	**6.1** Percentage of households and communities having more secure access to livelihood assets	1,557,706
	Number of people involved in the building, maintenance and monitoring of ocean nurseries			
Objective 2: To generate knowledge about effective restoration techniques for dissemination to other SIDS and countries within the wider region.	No of trained community members that have changed occupation to coral restoration activities	**Outcome 3:** Strengthened awareness and ownership of adaptation and climate risk reduction processes at local level	**3.2** Modification in behaviour of targeted population	1,283,921
	Number research papers on coral reef restoration submitted for presentation at various scientific forums in the WIO and globally			
Total at Objective level				**8,264,634**
Project Outcome(s)	**Project Outcome Indicator(s)**	**Fund Output**	**Fund Output Indicator**	**Grant Amount (USD)**
Improved understanding and knowledge management of use of reef restoration as an adaptation measure	No of training on effective restoration technique and sensitisation campaign on coral reef restoration as an adaptation measure to Climate Change.	***Output 3:*** Targeted population groups participating in adaptation and risk reduction awareness activities	**3.1.2** No of news outlets in the local press and media that have covered the topic.	1,283,921

[152] The AF utilized OECD/DAC terminology for its results framework. Project proponents may use different terminology, but the overall principle should still apply

Project Objective(s)[152]	Project Objective Indicator(s)	Fund Outcome	Fund Outcome Indicator	Grant Amount (USD)
Ecosystem services and assets provided by reefs in the form of shoreline protection, fisheries and tourism strengthened	Number of ocean nurseries established and operational with donor coral species that were survivors of previous bleaching events	***Output 5:*** Vulnerable ecosystem services and natural resource assets strengthened in response to climate change impacts, including variability	**5.1**. No. of natural resource assets created, maintained or improved to withstand conditions resulting from climate variability and change (by type and scale)	5,423,007
Stakeholders benefiting from improved livelihoods and greater food security as a result of employment in coral restoration initiatives, improved fish catches as reefs recover; potential sale and/or export of corals from nurseries for souvenir and the aquarium trade; greater revenue from tourism	Number of members from coastal communities that are deriving an income from new coral restoration and related economic activities	**Output 6:** Targeted individual and community livelihood strategies strengthened in relation to climate change impacts, including variability	**6.1.2.** Type of income sources for households generated under climate change scenario	1,557,706
Total at Outcome level				**8,264,634**

The following two of the Adaptation Fund core indicator are suggested to be monitored during the project implementation, namely: Number of Beneficiaries; and Natural Assets Protected or Rehabilitated. The targets for AF's Core Indicators of the project are indicated in Table 16. The reporting format of the AF core indicators are at Annex 12. The expected targets will be adjusted during the first year of implementation and the actual value will be reported at the completion of the project.

Table 16 *Expected target of AF Core Indicators*

Core Indicators	Expected target and information on the core indicators
Number of Beneficiaries	**Direct beneficiaries: 1001** • Mauritius: 660 (300 female, 150 youth) o 20 (taking part in training and restoration work) o 40 (NGO workers, University Students, researchers and conservationists) o 500 fishers o 100 boat operators • Seychelles: 223 (100 female and 70 youths) o 53 vulnerable group (35 female, 10 youth) o 45 boat operators o 85 (taking part in training and restoration works) (45 female, 40 youth) o 40 NGO workers, University Students, Researchers and conservationist (20 female,20 youth) **Indirect beneficiaries: 80,325** • Mauritius: 29500 (14,900 female and 4,500 youth) • Seychelles 59,725 (29,710 female and 9,820 youth) o 48,000 tourists (24000 female and 7400 youths) o 2825[153] population of Takamaka (1000 female, 400 youths) o 8900 Population of Praslin (4710 female, 2020 youths)
Restoration of coral reefs	3.2 Ha of coral reefs in Mauritius 2.5 Ha of coral reefs in Seychelles

[153] (2010) National Statistics Bureau, Seychelles

G. Budget

Award ID:	TBD	Project ID(s):	TBD
Award Title:	TBD		
Business Unit:	MUS 10		
Project Title:	Restoring marine ecosystem services by restoring coral reefs to meet a changing climate future		
PIMS no.	5736		
Implementing Partner /Executing Agency	UNDP		

Component 1: Enhancement of food security and reduction of risks from natural disasters through the restoration of degraded reefs in Mauritius

Table 17: Budget Component 1

Project Outcomes	Description	Account code	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Budget (USD)	Budget Note
Outcome 1.1: Improved livelihood for a sustainable partnership and community-based approach to reef restoration.	Contractual Services Companies	72100	10,555	-	2,920	-	-	2,920	16,395	*1*
	Equipment and furniture	72200	63,150	-	-	-	-	-	63,150	*2*
	Audio Visual & Print Prod Costs	74200	13,000	15,000	-	-	-	-	28,000	*3*
	Training Workshops and Conference	75700	49,300	-	-	-	-	-	49,300	*4*
	Travel	71600	1,316	-	-	-	-	-	1,316	*5*
Subtotal Outcome 1.1			**137,321**	**15,000**	**2,920**	**-**	**-**	**2,920**	**158,161**	
Outcome 1.2: Coral farming and nursery facilities established at a sufficient scale for	Contractual services Companies	72100	33,544	183,080	123,472	123,472	66,972	34,416	564,956	*6*
	Equipment and furniture	72200	100,000	-	-	-	-	-	100,000	*7*

Project Outcomes	Description	Account code	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Budget (USD)	Budget Note
more climate change resilient corals.	Materials and goods	72300	452,349	408,775	27,725	27,725	27,200	27,200	970,974	*8*
	Travel	71600	4,920	19,300	-	-	-	-	24,220	*9*
Subtotal Outcome 1.2			**590,813**	**611,155**	**151,197**	**151,197**	**94,172**	**61,616**	**1,660,150**	
Outcome 1.3: The health of degraded reefs restored, through active restoration work, maintenance and monitoring efforts, leading ultimately to greater protection of shore from flooding and storm damage.	Miscellaneous Expenses	74500	6,985	1,355	944	1,081	670	1,494	12,529	*10*
	Audio Visual & Print Prod Costs	74200	-	-	-	-	-	15,000	15,000	*11*
	Contractual Services Companies	72100	-	-	21,600	53,760	32,160	18,920	126,440	*12*
	Equipment and furniture	72200	230,000	-	-	-	-	-	230,000	*13*
	Materials & Goods	72300	202,000	-	-	6,000	6,000	38,000	252,000	*14*
	Transport, Shipping and handle	74700	-	-	-	1,500	1,500	1,500	4,500	*15*
	Travel	71600	13,260	-	3,800	5,700	-	18,460	41,220	*16*
Subtotal Outcome 1.3			**452,245**	**1,355**	**26,344**	**68,041**	**40,330**	**93,374**	**681,689**	
Total Component 1			**1,180,379**	**627,510**	**180,461**	**219,238**	**134,502**	**157,910**	**2,500,000**	

Component 2: Enhancement of food security and reduction of risks from natural disasters through the restoration of degraded reefs in Seychelles

Table 18: Budget Component 2

Project Outcomes	Description	Account code	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Budget (USD)	Budget Note
Outcome 2.1: Improved livelihood for	contractual services Companies	72100	4,380	15,000	-	4,380	-	4,380	28,140	*17*

Project Outcomes	Description	Account code	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Budget (USD)	Budget Note
a sustainable partnership to coral reef restoration.	Training Workshops and Conference	75700	-	10,400	28,400	10,400	10,400	5,600	65,200	*18*
Subtotal Outcome 2.1			**4,380**	**25,400**	**28,400**	**14,780**	**10,400**	**9,980**	**93,340**	
Outcome 2.2: Coral farming and nursery facilities established at a sufficient scale for more climate change resilient corals.	contractual services Companies	72100	138,389	251,399	255,583	259,867	264,253	123,139	1,292,630	*19*
	Equipment and furniture	72200	57,000	6,120	8,742	18,867	8,995	5,500	105,224	*20*
	Materials & Goods	72300	187,529	49,271	49,969	50,699	51,460	19,203	408,131	*21*
	Travel	71600	6,000	-	-	-	-	-	6,000	*22*
Subtotal Outcome 2.2			**388,918**	**306,790**	**314,294**	**329,433**	**324,708**	**147,842**	**1,811,985**	
Outcome 2.3: The health of degraded reefs restored, through active restoration work, maintenance and monitoring efforts, leading ultimately to greater protection of shore from flooding and storm damage.	Miscellaneous Expenses	74500	343	685	685	685	685	342	3,425	*23*
	contractual services Companies	72100	20,326	82,210	84,418	86,721	89,124	64,051	426,850	*24*
	Equipment and furniture	72200	20,000	8,000	8,000	8,000	8,000	8,000	60,000	*25*
	Materials & Goods	72300	2,400	7,400	7,400	7,400	7,400	7,400	39,400	*26*
	Travel	71600	7,000	13,000	13,000	13,000	13,000	6,000	65,000	*27*
Subtotal Outcome 2.3			**50,069**	**111,295**	**113,503**	**115,806**	**118,209**	**85,793**	**594,675**	
Total Component 2			**443,367**	**443,485**	**456,197**	**460,019**	**453,317**	**243,615**	**2,500,000**	

Component 3: Training to build capacity for sustainable coral reef restoration

Table 19: Budget Component 3

Project Outcomes	Description	Account code	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Budget (USD)	Budget Note
Outcome 3.1: Improved understanding and knowledge management of use of reef restoration as an adaptation measure	Audio Visual & Print Prod Costs	74200	2,000	2,000	2,000	2,000	5,000	8,000	21,000	*28*
	Contractual Services Companies	72100	-	5,000	-	-	-	-	5,000	*29*
	Equipment and furniture	72200	14,000	-	-	-	-	-	14,000	*30*
	International Consultant	71200	8,000	83,590	24,000	24,000	72,000	24,000	235,590	*31*
	Materials and goods	72300	-	27,600	27,600	12,600	3,000	-	70,800	*32*
	Training Workshops and Conference	75700	-	4,000	-	-	-	-	4,000	*33*
	Transport, Shipping and handle	74700	-	20,000	20,000	15,000	5,000	-	60,000	*34*
	Travel	71600	-	1,615	-	-	-	-	1,615	*35*
Subtotal Outcome 3.1			**24,000**	**143,805**	**73,600**	**53,600**	**85,000**	**32,000**	**412,005**	
Outcome 3.2: Improved understanding within the WIO and globally of successful approaches to reef restoration, the constraints and challenges, with lessons learned incorporated into new initiatives	Contractual Services Companies	72100	49,270	47,271	42,272	42,272	42,272	42,272	265,629	*36*
	Contractual Services Individual	71400	80,315	120,472	120,472	120,472	120,472	120,471	682,673	*37*
	International Consultant	71200	-	24,000	-	-	-	-	24,000	*38*
	Training Workshops and Conference	75700	-	1,000	-	-	1,000	-	2,000	*39*
	Travel	71600	-	3,580	-	-	59,940	-	63,520	*40*
Subtotal Outcome 3.2			**129,585**	**196,323**	**162,744**	**162,744**	**223,684**	**162,743**	**1,037,823**	
Outcome 3.3: Regional capacity developed for sustainable and climate resilient coral restoration	Contractual Services Companies	72100	24,000	20,000	20,000	20,000	20,000	24,000	128,000	*41*
	Information Technology Equipment	72800	720,000	-	-	-	-	-	720,000	*42*
	International Consultant	71200	-	4,000	66,860	44,000	44,000	50,000	208,860	*43*
	Local Consultants	71300	-	-	25,400	24,000	24,000	25,400	98,800	*44*
	Materials and goods	72300	22,000	16,000	19,000	14,000	14,000	22,000	107,000	*45*
	Training Workshops and Conference	75700	-	5,600	11,200	-	1,400	3,000	21,200	*46*
	Travel	71600	600	20,040	35,245	9,150	16,125	22,475	103,635	*47*

Project Outcomes	Description	Account code	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Budget (USD)	Budget Note
Subtotal Outcome 3.3			**766,600**	**65,640**	**177,705**	**111,150**	**119,525**	**146,875**	**1,387,495**	
Outcome 3.4: Project Monitoring and Auditing	Miscellaneous Expenses	74500	12,385	6,650	9,560	6,355	860	6,130	41,940	*48*
	International Consultant	71200	13,730	13,730	38,730	13,730	13,730	38,730	132,380	*49*
	Local Consultants	71300	6,666	6,666	26,667	6,667	6,667	26,667	80,000	*50*
	Professional Services	74100	5,000	5,000	5,000	5,000	5,000	5,000	30,000	*51*
	Training Workshops and Conference	75700	18,000	4,000	4,000	4,000	4,000	12,000	46,000	*52*
	Travel	71600	27,690	9,730	17,480	9,730	17,480	14,880	96,990	*53*
Subtotal Outcome 3.4			**83,471**	**45,776**	**101,437**	**45,482**	**47,737**	**103,407**	**427,310**	
Total Component 3			**1,003,656**	**451,544**	**515,486**	**372,976**	**475,946**	**445,025**	**3,264,633**	

Project Execution cost

Table 190: Budget Project Execution Cost

Project Outcomes	Description	Account code	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Budget (USD)	Budget Note
Project Execution cost	Miscellaneous Expenses	74500	6,410	2,530	2,530	2,530	2,530	3,170	19,700	54
	Contractual Services Individual	71400	64,962	83,765	85,361	87,037	88,796	90,644	500,565	55
	equipment and furniture	72200	6,000	290	290	290	290	290	7,450	56
	Information Technology Equipment	72800	5,400	292	275	275	275	275	6,792	57
	Travel	71600	114,880	43,680	43,680	43,680	43,680	43,680	333,280	58
Project Execution cost*			**197,652**	**130,557**	**132,136**	**133,812**	**135,571**	**138,059**	**867,787**	

**Project Execution Cost is the same or equivalent to Project Management Cost with UNDP's terminology*

Budget of implementing entity Management Fee

Table 201: Budget Implementing Entity Management Fee

UNDP Fees for Support to Adaptation Fund Project

"Restoring marine ecosystem services by restoring coral reefs to meet a changing climate future"

Category	Services Provided by UNDP	UNDP Fee (9.5%)
Identification, Sourcing and Screening of Ideas	Provide information on substantive issues in adaptation associated with the purpose of the Adaptation Fund (AF). Engage in upstream policy dialogue related to a potential application to the AF. Verify soundness & potential eligibility of identified idea for AF.	$43,379
Feasibility Assessment / Due Diligence Review	Provide up-front guidance on converting general idea into a feasible project/programme. Source technical expertise in line with the scope of the project/programme. Verify technical reports and project conceptualization. Provide detailed screening against technical, financial, social and risk criteria and provide statement of likely eligibility against AF requirements. Determination of execution modality and local capacity assessment of the national executing entity. Assist in identifying technical partners. Validate partner technical abilities. Obtain clearances from AF.	$130,137

Development & Preparation	Provide technical support, backstopping and troubleshooting to convert the idea into a technically feasible and operationally viable project/programme. Source technical expertise in line with the scope of the project/programme needs. Verify technical reports and project conceptualization. Verify technical soundness, quality of preparation, and match with AF expectations. Negotiate and obtain clearances by AF. Respond to information requests, arrange revisions etc.	$173,516
Implementation	Technical support in preparing TORs and verifying expertise for technical positions. Provide technical and operational guidance project teams. Verification of technical validity / match with AF expectations of inception report. Provide technical information as needed to facilitate implementation of the project activities. Provide advisory services as required. Provide technical support, participation as necessary during project activities.	$390,411

	Provide troubleshooting support if needed. Provide support and oversight missions as necessary. Provide technical monitoring, progress monitoring, validation and quality assurance throughout. Allocate and monitor Annual Spending Limits based on agreed work plans. Receipt, allocation and reporting to the AFB of financial resources. Oversight and monitoring of AF funds. Return unspent funds to AF.	
Evaluation and Reporting	Provide technical support in preparing TOR and verify expertise for technical positions involving evaluation and reporting. Participate in briefing / debriefing. Verify technical validity / match with AF expectations of all evaluation and other reports Undertake technical analysis, validate results, and compile lessons. Disseminate technical findings	$130,137
Total		$867,580

Budget Notes:

1. Contractual Service of NGOs (one in Mauritius and one in Rodrigues) for:
    - Carrying out stakeholder analysis in Mauritius and Rodrigues
    - Developing a strategic plan for self-sustaining of nurseries
    - Training of communities
    - Partnership agreement
    - Carrying out livelihood survey reports
2. Acquisition of information Technology equipment for responsible parties for training of communities (laptops, software licenses, external hard drive, project, etc); diving equipment (17 sets); and snorkelling equipment (13 sets)
3. Publication and printing costs for communication resources and media (newsletters, brochure, fact sheets, etc)
4. Costs associated with organisation of community/beneficiary training workshops and incentives to participants, training in advance PADI and snorkelling
5. Cost for trip to Rodrigues for resource persons from (1) AFRC and (1) MOI for community training in Rodrigues (3 days). (cost of trip= USD 250/person; DSA= USD 136/day):
6. Contractual Services of NGOs (Mauritius and Rodrigues) which include:
    - Boat rental (~ 20 days/year at a rate of USD 100/day)
    - Petrol for boat (~200 days trip/year at rate of USD 28/day trip) for Yrs. 2-4 in Mauritius and Rodrigues
    - Carrying out Environmental and Social Impact Assessment at each site on a yearly basis (USD 560/year).
    - Recruitment of 2 Site project coordinator (USD 970/month/person). (Marine Biologist or equivalent, minimum MSc Level, Rescue or Dive Master) for 60 months
    - Recruitment of 2 Site project assistant (USD 690/month/person) (Marine Biologist or equivalent, minimum BSc Level, Rescue or Dive Master) for 60 months
    - Incentive (USD24/person day) to Communities for
        - Manufacture (400-person days in Mauritius and 154-person days in Rodrigues) (year 2)
        - Deployment (600-person days in Mauritius and 84-person day sin in Rodrigues) (year 2)
        - Population of nurseries (800-person days in Mauritius and 154-person days in Rodrigues) (year 2)
        - Maintenance of nurseries (1500-person days/year in Mauritius and 600-person days/year in Rodrigues) from year 2 – 4.

    Recruitment of land-based nursery personnel:
    - 2 Nursery men (USD 648/months/person) for 5.5 years
    - 1 Plant operator (USD 648/months) for 5.5 years
    - Population of land-based nurseries and ocean-based nurseries with donor coral fragments.
7. Cost associated with acquisition of 2 transport vehicles (including running costs) (USD 50,000 each)
8. Cost associated with:
    - acquisition of material for genetic analysis of resilient donors (USD 150,000)
    - air tank refill for diving (USD 5 /dive; on an average of 43 dives/year)
    - tank air refill for collection of coral larvae for sexual propagation of corals (5 dives / year) for 3 years

- Materials and goods for collection of coral larvae (year 2-4) (USD 500 /year)
- Chemicals, consumable and reagents for monitoring of sea water quality and other environmental parameters in donor and ocean-based nurseries of Mauritius and Rodrigues (USD 26,000/year)
- Materials for survey and monitoring in Mauritius and Rodrigues (USD 10,000 for year 1 then USD 1,000/year)
- Materials for setting up of land-based nursery at MOI (USD 210,000)
- Material for setting up of land-based nursery (experimental) for sexual propagation of corals (USD 56,099).
- Materials for setting up multi rope nurseries (200 in Mauritius and 40 in Rodrigues) (USD 900/nursery)
- Materials for setting up of table nurseries (100 in Mauritius and 50 in Rodrigues) (USD 1100/ nursery)

9. Cost for trip in Rodrigues (cost of trip= USD 250/person; DSA= USD 140/day):
    - Year 1: 4 persons (2 MOI and 2 AFRC) for 7 days to carry out survey to identify donor sites in Rodrigues
    - Year 2: 4 persons (2 MOI and 2 AFRC) for 9 days for the collection of donor species from donor sites for asexual propagation in ocean-based nurseries and to carry out monitoring of donor and ocean-based nurseries (sea water quality and other key environmental parameters)
    - Year 2: 2 persons (1 MOI and 1 AFRC) for 14 days for identification of ocean-based nursery sites and restoration sites in Rodrigues.
    - Year 2: 4 persons (2 MOI and 2 AFRC) for 14 days to oversee the manufacture, deployment and population of nurseries in Rodrigues
    - Year 2: DSA for 2 persons (MOI and AFRC) for 4 days for training on monitoring in Rodrigues
10. Cost associated with services provided by UNDP CO Mauritius for activities such as procurement of goods, recruitment and organisation of travels and per diem for resource persons, any unforeseen expenses etc.
11. Cost associated with the updating and publication of the booklet on corals of Mauritius and Rodrigues

    Note: the inventory of corals will be done by Government of Mauritius as in-kind contribution.
12. Contractual Services of NGOs (Mauritius and Rodrigues) which include:
    - Petrol for boat (~58-day trip/year at rate of USD 28/day trip) for year 3-6 for Mauritius and Rodrigues
    - Incentive (USD24/person day) to Communities for
        - Transplantation of farmed corals (750-person days/year in Mauritius and 150-person days in Rodrigues) (year 3-4).
        - Maintenance of restoration sites (600-person days/year in Mauritius and Rodrigues for year 3-6.
13. Cost associated with:
    - acquisition of multi spectral drone to carry out spatio-temporal study of beach profiles at restoration sites in Mauritius and Rodrigues. (USD 140,000)
    - Acquisition of equipment and software for current pattern analysis. (USD 90,000)
14. Cost associated with:
    - acquisition of 2 pneumatic drills (USD 10,000 each);
    - consumables for water analysis (USD 1,000 for year 4-6)

- materials and logistics for monitoring survey in BBMP and SEMP (USD 5,000/ year for year 4-6)
- materials and goods to carry out current temporal study (USD 150,000).
- Logistics and consumables for current pattern survey and beach monitoring in Mauritius and Rodrigues (USD 32,000 / year in year 1 and year 6)

15. Cost associated with shipping of water samples from Rodrigues for analysis.
16. Cost for trip in Rodrigues (cost of trip= USD 250/person; DSA= USD 140/day):
    - Year 3: 4 persons (2 MOI and 2 AFRC) for 5 days to carry out survey to identify donor sites in Rodrigues
    - Year 4: 6 persons (3 MOI and 3 AFRC) for 5 days for monitoring of restored coral reef site in Rodrigues
    - Year 6: 4 persons (2 MOI and 2 AFRC) for 7 days for monitoring of restored coral reef site in Rodrigues
    - Year 1 and 6: 6 persons (5 MOI and 1 AFRC) for 14 days for spatio temporal study in Rodrigues

17. Cost associated with:
    - Development of Business Plan (Nsey) and Strategic/Financial Plan(SNPA)
    - Carrying out a livelihood survey.
18. Cost associated with:
    - Training of communities and NGO on establishing and maintaining coral nurseries
    - Awareness campaign on coral restoration in Seychelles
    - Scuba training of students (Nature Seychelles only)
19. 1) Cost associated with allowance of project staff for:
    a) technical assessment and selection of coral species for transplantation
    b) identification of donor sites
    c) collection of donor corals
    d) identification of ocean-based nursery sites
    e) monitoring of water quality of donor and sea nurseries
    f) maintenance of ocean-based nurseries

    Note: Allowance of project staff for each responsible party in Seychelles are as follows:
    - MCSS (USD 3000/month)
    - Nsey – Project site coordinator (USD 3355/months), Science/Technical Officer (USD2706/month) and Dive officer (USD 1082/month)
    - SNPA – Project site coordinator (USD 12000/months) and 3 project staff (USD 780/person/month) and interisland ferry fare allowance (USD 60/trip; 72 trip /year)

    2) Cost associated with operation of ocean-based nurseries (staff house, PC house)
    3) Cost for maintenance of land nurseries

20. 1) Transport Vehicle for MCSS
    2) Equipment for collection of donor corals for MCSS
    3) Cost associated for purchasing of equipment by Nsey as follows:
    - Dive equipment (USD 6000/year)
    - New Boat engine (USD 4,000)
    - Dissecting scope with lights (USD 2,500)

21. Costs associated with:
    - Material for monitoring of donor coral reef and nurseries (USD 1000/year for SNPA) for year 2-6
    - Data top up for SNPA (~USD 264/year)
    - Materials for land-based nursery (USD 130,000) for NSey
    - Materials for setting up and operation of ocean-based nurseries:
        - Ste Anne/le aux Cerfs – (USD 7000 /year)
        - Cousin Island (on average USD 3000 / year) and cost for petrol for 5 years (~USD 3600/year)
        - Curieuse Island (~USD 30,000/year)
        - Anse Forbans (~USD 7,000/year)
22. Return ticket for the 4 project staffs of Nature Seychelles (USD 1,500/ticket per project staff)
23. Cost associated with services provided by UNDP CO Mauritius for activities such as organisation of travels and per diem for resource persons, any unforeseen expenses etc.
24. Cost associated with:
    - allowance of project staff of MCSS for transplantation of ocean-based nursery corals (3 months/year for year 1-6)
    - incentives for 2 volunteers (Mauritius exchange) (USD 500/months) for 6 months and housing of the volunteers (USD 2,000/year) for year 1-5
    - monitoring of health and diversity of corals, fish and other fauna and flora of the restored sites:
        - Anse Forbans for 5 years
        - Curieuse Island: Project Site Coordinator and 3 project staffs for 5 years
        - Cousin Island:4 divers (2 from Mauritius and 2 international) x 4 cycles of 3 months each = 8 divers/year at an estimated rate of USD 1541/person/month
    - Monitoring and maintenance of restoration sites for 5 years:
        - Anse Forbans
        - Curieuse Island: Project Site Coordinator and 3 project staffs
        - Cousin Island: stipends for 4student volunteers (USD2346/year) and housing (USD 2,000/year) (year 2-5)
25. Cost associated with diving equipment, including maintenance (USD 8,000/year); and dive compressor (USD 12,000) for SNPA
26. Cost associated with material for transplantation of ocean-based corals:
    - Anse Forbans (USD 5,000/year for year 2-6)
    - Curieuse: petrol for boat (USD 1,440/year) and consumables (USD 960/year)
27. Cost associated with air ticket for:
    - 2 volunteers from Mauritius (USD 500/year/person) for Curieuse Island for 5 years
    - Air tickets for volunteer divers for Cousin Island (2 international divers x 4 cycles of 3 months each = 8 divers/year) (USD 1000/diver)
    - Air tickets for volunteer divers for Cousin Island (2 Mauritian divers x 4 cycles of 3 months each = 8 divers/year) (USD 500/diver)
28. Cost associated with access to publications (scientific journals) and for the publication in journals of the following:
    - Comprehensive review of coral reef restoration techniques in the region and globally (USD 3,000)
    - Genetic connectivity study (USD 2,000/year)

- Study on resistant/resilient species and clades analysis of thermos resistant species in Mauritius, Rodrigues and Seychelles. (USD 6,000)

29. Contract out services for design and printing of guideline to coral restoration document
30. Equipment for genetic connectivity study.
31. Cost of contractual appointment of international consultants (including air tickets and DSA):
    1) Chief Technical Advisor (USD 800/person days) for:
        - Comprehensive review of coral reef restoration in the region and globally (40-person days)
        - Reef restoration methodologies, concept and best practices guidelines (40-person days)
        - Oversee implementation of Component 1, 2 and 3 (60-person days)
        - Air ticket and DSA for Mauritius, Rodrigues and Seychelles (USD 6,730)
    2) Expert in coral sexual reproduction and genetics (USD 800/person days)
        - Assist in the genetic connectivity study, sexual reproduction of corals and study on clade analysis of resistant/resilient coral species in Mauritius, Rodrigues and Seychelles (140-person days)
        - Air ticket and DSA for Mauritius (13 days) (USD 4,860)
32. Cost associated with acquisition of materials and goods for:
    - Laboratory supplies for genetic connectivity analysis (USD 9600/year for yrs. 2-4)
    - Laboratory supplies for carrying out studies on identification of resilient coral species (USD 42,000)
33. Cost for the organisation of workshop/training in relation to reef restoration methodologies, concept and best practices guidelines
34. Cost associated with shipping of sample material for:
    - genetic connectivity analysis from Rodrigues and Seychelles (USD 5000/shipping, once per year during year 2-4)
    - clade analysis from Seychelles (USD 5000/shipping, once per year during yrs. 2-5)
    - clade analysis from Rodrigues (USD 5,000 /shipping, once per year during yrs. 2 and 3)
35. Cost for trip in Seychelles (cost of trip= USD 700/person; DSA= USD 305/day):
    - Year 2: 1 persons (MOI) for 3 days to take samples for genetic connectivity and build capacity of Seychelles to take sample and proper packaging for shipment to Mauritius.

36. Cost of contractual appointment of:
    - Website manager for hosting and monthly maintenance of the website (USD 25,000)
    - Company for documentary film development (USD 235,629)
    - Design, printing and publishing of coral restoration. toolkit/manual (NOTE: same contractual appointment for designing, printing and publishing works for Components 1,2 and 3) (USD 5,000)
37. Part of Cost of contractual appointment of regional project manager
38. Part of cost of contractual appointment of CTA for the review/updating of the coral restoration toolkit/manual (30-person days at rate of USD 800/person days)
39. Cost associated for the venue of RSAC meeting (USD 1000/meeting)
40. Cost associated with travel (air ticket and DSA) for:
    - Participation in relevant international forum for 2 participants from Mauritius, 1 from Rodrigues and 3 from Seychelles
    - Coral experts from the region to attend RSAC meeting and exchange programme: 2 Rodrigues (USD 250); Australia (USD 2000); Madagascar (USD 600); Maldives (USD 600); South Africa (USD 850); Sri Lanka (USD 900); and Thailand (USD 1200), 4Mauritius (to

Seychelles @USD700/person/trip). DSA for 2 days for meeting in Mauritius (USD 220) and in Seychelles (USD 305)

41. cost for contractual appointment to carry out biannual beach profiling (USD 120000) and GIS mapping (USD 8000) for Seychelles
42. Cost for the acquisition of:
    - Equipment (6 ADCP, 5WTR, 2 ECM) for collection of current pattern data (USD 600,000)
    - Equipment and Software for GIS (including workstation, GIS license (x3) map printing, MATLAB Licence (x3) (USD 90,000)
    - Software licences for spacio-temporal beach profiling (USD 30,000)
43. Part of cost of contractual appointment of:
    - CTA for training in micro-fragmentation (USD4000)
    - CTA for development of a Regional/National Coral Reef restoration plan (40-person days at rate USD 700/person days)
    - Expert in coral sexual reproduction and genetics for training in genetic analysis (15-person days at rate of USD 700/person days) including travel and DSA (USD 4860)
    - International expert in policy and legal, technical expert and financial expert for coral reef restoration plan (USD 700/person days for 72-person days/expert) and travel (USD 10,300)
44. Cost of contractual appointment of 2 local expert in policy/legal for development of a Regional/National coral reef restoration plan (USD 400/person days/expert for 120-person days/expert) including cost for air ticket to Mauritius and Seychelles (USD 700/trip/person) for 2 trips each.
45. Cost for acquisition of material for:
    - Genetic connectivity/clade analysis training (USD 5000)
    - Micro-fragmentation training (USD 2000)
    - Logistics for field surveys (GIS) in Mauritius and Rodrigues for yrs. 1 and 6 (USD 4000/year for Mauritius and Rodrigues each)
    - Consumables and logistics for biannual beach profiling in Mauritius and Rodrigues (USD 84,000)
46. Cost associated with catering of 20 participants for:
    - genetic connectivity, clade analysis regional training for 5 days (USD 6800)
    - micro-fragmentation for 4 days (USD 5,600)
    - Venue for training workshop, one for Mauritius and one for Seychelles (USD 3000/venue)
    - training of personnel of Seychelles (20) and Rodrigues (20) in current pattern study (USD 70/participant)
47. Cost associated with travel for regional training in:
    1) genetic connectivity, clade analysis (5 days training, DSA- USD 220/day):
        - 3 participants from Seychelles (USD 700/trip/person)
        - 2 participants from Rodrigues (USD 250)
        - Coral experts from the region: Australia (USD 2000); Madagascar (USD 600); Maldives (USD 600); South Africa (USD 850); Sri Lanka (USD 900); and Thailand (USD 1200).
    2) Regional training on micro-fragmentation (6 days, DSA= USD 305/day)
        - 4 participants from Mauritius (2 MOI and 2 AFRC) (USD 700/trip/person)
        - 1 participant from Rodrigues (USD 950 USD/trip/person)
    3) Regional/National Coral Reef Restoration Plan (2 workshops)
        - 1 participant from Rodrigues (USD 250/trip/person to Mauritius, USD 950/trip /person to Seychelles)

- 4 participants from Seychelles to Mauritius (USD 700/trip/person, DSA= USD 220/day/person for3 days)
- 4 participants from Mauritius to Seychelles (USD 700/trip /person, DSA= USD 305/day/person for 3 days)

4) Current pattern (installation and removal of equipment):
   - 3 technicians from Mauritius to Seychelles in year 5 and 6 (USD 700/trip/person, DSA=USD 305/person/day for 7 days/year
   - 3 technicals from Mauritius to Rodrigues in year 3 and 4 (USD 250/trip/person, DSA= USD 140/day/person for 3 days)
   - Boat rental in Mauritius and Rodrigues (USD3,600)
   - Ferry allowance of USD 60/person/trip for 8 persons in year 5 and 6
5) Beach profiling twice per year in Rodrigues
   - 3 technicians from Mauritius (2 MOI and 1 AFRC) (USD 250 / trip/person, DSA= USD 140/day/person for 6 days) for 5 years

48. Cost associated with services provided by UNDP CO Mauritius for activities such as procurement of goods, recruitment of experts/contractors/consultants and organisation of travels and per diem for resource persons, any unforeseen expenses etc.
49. Cost of contractual appointment of:
    - Independent International M& E consultant (USD 50,000)
    - Travel cost of CTA to Mauritius, Rodrigues and Seychelles (USD 82,300)
50. Cost of contractual appointment of:
    - 2 independent national M&E consultants (USD 40,000)
    - 2 National Gender Specialists (USD 40,000), one for Mauritius and one for Seychelles (3 weeks/year, including air ticket and DSA for Rodrigues and ferry fare for Praslin)
51. Cost for professional services for annual audit as per UNDP audit policies (USD 5,000/year)
52. Cost for the Organisation (venue and catering) of:
    - Project Steering Committees (USD 4,000/per meeting, 2 in yr1 and 6, 1 meeting/year for yrs. 2-5, alternating Mauritius and Seychelles)
    - Inception and completion workshops (USD 14,000)
53. Cost associated with travel of 6 participants from Seychelles 6 participants from Mauritius (1 from Rodrigues) to travel for PSC meeting, outside their country. Air ticket(MUR-SEZ): USD 700/trip/participant, USD 250 for participant from Rodrigues, DSA in Mauritius = USD 220/day/participant, DSA in Seychelles = USD 305/day/participants
54. Cost associated with services provided by UNDP CO Mauritius for activities such as procurement of goods, recruitment of project personnel and organisation of travels and per diem for resource persons, any unforeseen expenses etc.
55. Cost of contractual appointment of Regional Project Manager (part)P2, Project Assistant(USD1900/month) and Financial Assistant (USD 1900).
56. Acquisition of 2 diving sets and maintenance
57. Acquisition of IT equipment (laptops, external hard drive, digital camera etc.) for Regional Project Manager, Project Assistant and Financial Assistant.
58. Cost for the travel of Regional Project Manager and Project or Financial Assistant in Seychelles (USD 700/trip/person, DSA: USD 305/day/person) and Rodrigues (USD 250/trip/person, DSA = USD 140/day/person), 4 trips per year. 1st trip in Yr 1 for a duration of 21 days, other trips duration = 10 days.

H. Disbursement Schedule

Table 212: Disbursement schedule

	Upon Agreement signature		Year 2	Year 3	Year 4	Year 5	Year 6	Total
Scheduled Date	19-Jan	19-Jan	20-Jan	21-Jan	22-Jan	23-Jan	24-Jan	
Project Funds		2,627,401	1,522,539	1,152,146	1,052,233	1,063,765	846,549	**8,264,633**
Project Execution cost		197,652	130,557	132,136	133,812	135,571	138,059	**867,787**
Implementing Entity Fee	347,032	161,028	94,226	73,204	67,605	68,362	56,123	**867,580**
Total	**347,032**	**2,986,081**	**1,747,322**	**1,357,486**	**1,253,650**	**1,267,698**	**1,040,731**	**10,000,000**
		Tranche I	Tranche II	Tranche III	Tranche IV	Tranche V	Tranche VI	

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

A. Record of endorsement on behalf of the government[154]

Copies of the endorsement letters are at Annex 13:

Mr D D Manraj, Financial Secretary, Alternate Designated Authority, Ministry of Finance and Economic Development	Date: January 12, 2018
Mr Didier Dogley, Minister, Designated Authority, Ministry of Environment, Energy and Climate Change	Date: January 9, 2018

6. Each Party shall designate and communicate to the secretariat the authority that will endorse on behalf of the national government the projects and programmes proposed by the implementing entities.

B. Implementing Entity certification

Provide the name and signature of the Implementing Entity Coordinator and the date of signature. Provide also the project/programme contact person's name, telephone number and email address

<table>
<tr><td colspan="2">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 (Seychelles: National Climate Change Strategy, 2009 and Mauritius: Climate Change Information, Education and Communication Strategy and Action Plan 2014, National Climate Change Adaptation Framework 2013, INDC report 2015) and subject to the approval by the Adaptation Fund Board, commit to implementing the project/programme in compliance with the Environmental and Social Policy of the Adaptation Fund and on the understanding that the Implementing Entity will be fully (legally and financially) responsible for the implementation of this project/programme.</td></tr>
<tr><td colspan="2"> 
Adriana Dinu,
Director, Sustainable Development (Environment) a.i.
Executive Coordinator, UNDP-GEF</td></tr>
<tr><td>Date: August 6th, 2018</td><td>Tel. and email: +1 (212) 906-5143
adriana.dinu@undp.org</td></tr>
<tr><td colspan="2">Project Contact Person: Dr Akiko Yamamoto, Regional Technical Adviser</td></tr>
<tr><td colspan="2">Tel. And Email: +251 91 250 3316, akiko.yamamoto@undp.org</td></tr>
</table>

ANNEXES