

**PRE-CONCEPT FOR A REGIONAL PROJECT/PROGRAMME**

**PART I: PROJECT/PROGRAMME INFORMATION**

Title of Project/Programme: **Restoring marine ecosystem services by rehabilitating coral reefs to meet a changing climate future**

Countries: Republic of Seychelles and Republic of Mauritius

Thematic Focal Area[[1]](#footnote-1): Food security

Type of Implementing Entity: MIE

Implementing Entity: UNDP

Executing Entities: Ministry of Environment, Climate Change and Energy, Nature Seychelles and Seychelles National Parks Authority; Ministry of Ocean Economy & MRSOI, Mauritius Oceanography Institute (MOI), Albion Fisheries Research Centre, UNDP GEF Small Grants Programme

Amount of Financing Requested: $4,900,000 (U.S Dollars), excluding PFGs

**Project / Programme Background and Context:**

Coral reefs provide a wealth of ecosystem services (food provisioning, recreational, biodiversity benefits, and regulating services, such as coastal protection) that are vital to vulnerable Small Island Developing States (SIDS). The degradation of coral reefs due to anthropogenic and climate change related impacts can have direct and indirect negative repercussions on the economies and local human populations on SIDS[[2]](#footnote-2),[[3]](#footnote-3),[[4]](#footnote-4). In 1997/1998, an El-Nino coupled with an Indian Ocean Dipole event resulted in the highest seawater temperature anomalies recorded in 50 years (Saji *et al.*1999) and a world-wide mass coral bleaching event (Wilkinson *et al.* 1999). The reefs in the western Indian Ocean (WIO) region were the most severely impacted during this event. Coral mortality was 30% at the regional level (Obura 2005) ranging from 10% in Mauritius (Turner *et al.* 2000; Moothien Pillay *et al.* 2002) to 80-95% on the most heavily impacted reefs in the Seychelles (Wilkinson *et al.* 1999). This event resulted in the loss of functional groups of corals, a reduction in fisheries productivity, sustainability of tourism revenues and ecosystem resilience. While some reefs recovered naturally within 5-10 years of this event others remained as rubble strewn wastelands even within well established Marine Protected Areas (MPAs) (Graham *et al.* 2007, 2015). High coral mortality has been recorded during subsequent bleaching events in Mauritius (e.g. 50% bleaching recorded in 2009, Moothien Pillay, unpublished data) which in combination with localised impacts has left the reefs in a heavily degraded state (AFRC, unpublished; MOI, unpublished).

Coral bleaching caused by warmer than normal seawater temperatures has emerged as one of the major threats to coral reefs and their associated communities (IPCC, 2013). Within the WIO region this menace has undermined existing conservation efforts (Obura 2005) and many countries have been unable to respond using conventional practices (McClananhan *et al.* 2009). The frequency of coral bleaching events is predicted to increase in coming decades as seawater temperatures continue to rise (Sheppard, 2003, IPCC, 2013). SIDS need to develop new capacities to be able to restore the ecosystem services lost after bleaching and to build resilience to climate change.

Natural recovery processes may fail after a large scale disturbances such as coral bleaching due to a limited supply of coral larvae and/or the substrate being unsuitable for the settlement and/or survival of coral spat. When natural recovery processes fail, it may become necessary to intervene in order rehabilitate degraded reefs and restore ecosystem services. Various reef restoration[[5]](#footnote-5) methods have been developed which include 'passive' or indirect management measures to remove the impediments to recovery, and 'active' or direct interventions such as coral gardening (Edwards and Gomez 2007, Edwards 2010). The selection of which method, or combination of methods, is the most appropriate requires careful consideration as the answers are often site-specific. Both Seychelles and Mauritius have successfully employed the 'coral gardening concept' method (Rinkevich 2006, 2014) to rehabilitate reefs. The proposed project will upscale and mainstream these reef rehabilitation experiences, capture and disseminate lessons learnt so as to ensure long term and sustainable adaptation. The farming of corals will be done as a community activity and as an mariculture venture to supply a cost effective and continuous stock of corals for transplantation into areas degraded by climate change and to restore the ecosystem services that healthy coral reefs normally deliver.

**Project / Programme Objectives:**

The main **objective** of the proposed regional project is to upscale and mainstream the rehabilitation of degraded coral reefs in order to restore essential ecosystem services in the face of climate change threats and to compile and disseminate lessons learnt. The project responds to two of the three thematic focal areas namely 'Food Security' and 'Disaster Risk Reduction' as: (i) the rehabilitation of degraded reefs will restore fish habitats thereby encouraging the recovery of reef associated fish communities important as food to the local communities and (ii) the rehabilitation of degraded reefs will restore the protective barrier function provided by coral reefs through stabilising the reef substrate and planting corals. The proposed project will demonstrate innovations in adaptation finance for transformational impact both by using new technologies and different financial models to create cost effective solutions to sustain these adaptation measures beyond the project lifespan.

**Project / Programme Components and Financing:**

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| **Project/Programme Components** | **Expected Outcomes** | **Expected Outputs** | **Countries** | **Amount (US$)** |
| **1: Scoping and technical assessments to identify nursery and rehabilitation sites and priority species** | | | | |
| (1a) Stakeholder engagement & analysis. | Identification of interested groups and private sector partners | Partnership agreements with private sector and /or community groups. | Republics of Mauritius & Seychelles | 30,000 |
| (1b) Scoping studies and technical assessments to identify potential nursery sites and coral priority reef sites for rehabilitation. | Potential coral nursery sites and priority reef sites for rehabilitation identified and justified in Mauritius and Seychelles; ESIAs completed for proposed sites as required and in accordance with national and AF social and environmental safeguards. | Report identifying potential mariculture sites and degraded reefs where ecosystem services will be restored; ESIA report(s) for proposed mariculture sites; Coral reef status and water quality assessed and mapped; GIS maps identifying nursery and reef rehabilitation sites. | Republics of Mauritius & Seychelles | 375,000 |
| (1c) Identification of resistant/resilient / threatened coral species for propagation | Update on coral faunal diversity in Mauritius and identification of resistant / resilient / threatened species for propagation. | Field survey report documenting threatened / resistant /resilient coral species to be targeted for culture; Revised "Field Guide on Corals of Mauritius" | Republic of Mauritius | 244,000 |
| **2. Improved understanding of genetic connectivity and coral recruitment patterns** | | | | |
| (2a) Study into the genetic connectivity of coral species between Republics of Mauritius & Seychelles | Improved understanding about the regional genetic connectivity in coral species diversity and resilience between Republics of Mauritius & Seychelles. | Data available on the genetic connectivity of coral species between Republics of Mauritius & Seychelles. | Republics of Mauritius & Seychelles | 122,000 |
| (2b) Monitoring of coral spawning and recruitment patterns in Republics of Mauritius & Seychelles | Improved understanding about regional seasonal variability in coral reproductive behaviour and recruitment patterns | Data available on spawning seasons and coral recruitment patterns for | Republics of Mauritius & Seychelles | 122,000 |
| **3. Mainstreaming coral farming and mariculture into the Blue / Ocean Economy** | | | | |
| (3a) Setting up of ocean based coral mariculture operation for the large scale propagation of resistant/resilient /threatened species | New ocean-based mariculture facility established for the cost effective mass propagation of selected coral species; Maintenance of coral brood stock to retain local species and genetic diversity; Replacement of wild caught coral from the tourist market thus further protecting reefs. | Stock of mass propagated corals available for transplantation on eroded coasts, MPAs, marinas, island resorts through commercial ventures; Stock of threatened coral species and long term maintenance of brood stock by achieving economies of scale; Stock of certified corals to replace marine souvenir corals. | Republic of Seychelles | 700,000 |
| (3b) Setting up of land-based 'Coral Sanctuary' for the mass propagation of threatened / resilient / coral species | Land-based 'Coral Sanctuary' established for the propagation of threatened/resistant/resilient coral species, to maintain brood stock to retain local coral species and genetic diversity; 'Coral Sanctuary' used for public sensitization programmes. | Stock of corals available for transplantation; Stock of threatened coral species and long term maintenance of brood stock; General public and tourists sensitized on coral reef conservation issues. | Republic of Mauritius | 500,000 |
| (3c) Setting up of community coral farms in proximity to degraded reef sites | Community coral farms established providing a sustainable alternate livelihoods for coastal fisher communities and womens groups. | Community coral farms established and operational; Stock of locally farmed corals available for transplantation onto degraded reef sites. | Republic of Mauritius | 200,000 |
| **4. Rehabilitation of degraded reef sites, maintenance and monitoring** | | | | |
| (4a) Active rehabilitation of degraded reefs | xxx m2 of reef rehabilitated and reef ecosystem services restored in Republics of Mauritius & Seychelles. | Priority sites prepared and rehabilitated using farmed corals | Republics of Mauritius & Seychelles | 700,000 |
| (4b) Maintenance and monitoring survival and growth rates of cultured and planted corals. | Improved survivorship of propagated coral larvae through regular maintenance; Effectiveness of different methods understood through comparative monitoring at rehabilitation and control sites. | Survival and growth rate of farmed corals recorded and data available; Lessons learnt about the effectiveness of different methods and modes of implementation documented and shared online. | Republics of Mauritius & Seychelles | 431,671 |
| **5. Knowledge management, capacity building and sensitization programmes** | | | | |
| (5a) Regional comparison of the effectiveness of 'active' and 'passive' coral reef rehabilitation methods | Increased understanding of the relative costs and effectiveness of active and passive coral reef rehabilitation methods from the western Indian Ocean region. | Cost benefit analysis of the different reef rehabilitation methods; Report documenting lessons learnt from coral reef rehabilitation programmes within western Indian Ocean; Workshop to present findings / case studies. | Regional | 100,000 |
| (5b) Business planning for coral reef rehabilitation for adaptation | Financially sustainable ocean-based coral mariculture for transplantation, or to supply aquaculture or tourist trade;  Financially sustainable community level coral farming. | Business model(s) and plan(s) for ocean-based coral mariculture and community farming to ensure financial sustainability. | Republics of Mauritius & Seychelles | 125,000 |
| (5c) Certification scheme for farmed corals. | Certification scheme for farmed corals to replace wild-caught corals for use in tourist trade (Seychelles only). | Certification scheme for farmed propagated corals. | Republic of Seychelles | 50,000 |
| (5d) Community level sensitisation and training. | Fisher communities aware of the need for reef rehabilitation, sensitised to the potential of coral farming as an alternative livelihood and provided with training in how to establish and operate coral farms. | Fisher / women's community groups aware of the need for coral rehabilitation and trained in how to establish and manage coral farms as an alternative livelihood. | Republic of Mauritius | 50,000 |
| (5e) Regional technical training workshops. | Increased regional capacity in coral reef rehabilitation methods and specialist techniques. | Regional technical training workshop/s on: (a) Habitat mapping and site assessments methods; (b) Coral reproductive ecology, recruitment monitoring and coral larvae propagation techniques; (c) Coral taxonomy; (d) DNA-based approach for the identification of resilient corals | Regional | 200,000 |
| (5f) Establishment of an internationally recognised training programme in coral reef rehabilitation. | *In situ* training programme in reef restoration leading to a Certificate of Competence; Pool of trainees qualified in coral reef rehabilitation techniques from within the region and elsewhere. | Internationally recognised training programme in Coral Reef Rehabilitation Techniques. | Republic of Seychelles | 100,000 |
| **6. Project/Programme Execution cost** | | | | **425,215** |
| **7. Total Project/Programme Cost** | | | | **4,474,886** |
| **8. Project/Programme Cycle Management Fee charged by the Implementing Entity (if applicable)** | | | | **425,114** |
| **Amount of Financing Requested** | | | | **4,900,000** |

**Project / Programme Duration:** 5 years

**pART ii: Project / programme JUSTIFICATION**

The Republic of Mauritius and the Seychelles are two of four SIDS in the WIO region that share geographically common challenges. The people and economies of these SIDS are facing climate-induced threats such as coral bleaching, due to rising seawater temperatures, as well as sea level rise, and ocean acidification. Despite the common challenges, the environmental and socio-economic status of the SIDS in this region, are such that country-specific responses are needed to facilitate adaption to climate change (McClananhan *et al.*, 2009). In acknowledgment of the vulnerability and diversity of the SIDS in the WIO region, the proposed project will support different methods for propagating and for farming of corals to rehabilitate sites degraded by bleaching as a means to assist the countries to address the adverse affects of climate change and build resilience.

The proposed project will capitalise upon the knowledge gained from the successful USAID and GEF-funded Nature Seychelles’ Reef Rescuers Project and experiences of Albion Fisheries Research Centre (AFRC) and Mauritius Oceanography Institute (MOI). Reef Rescuers completed the first large-scale coral reef restoration in the world using the coral gardening concept method between 2011 and 2014, which built 12 mid-water nurseries and cultivated ~40,000 fragments (from donor corals and corals of opportunity) from 82 coral species. Corals were grown in the nurseries for 1-1.5 years and 27,000 corals were transplanted over a 5,500 m2 area within Cousin Island Special Reserve in 2014 (Shah *et al.,* 2015, unpublished). The project was highly successful (USAID project evaluation, 2014) and 1 year after transplantation, the corals appeared more resistant to bleaching (Friar-Torres *et al.,*, in prep). Since 2008, AFRC and MOI have been adapting the coral gardening technique for use in with community-groups in the shallow lagoons around Mauritius and Rodrigues. Corals were cultured in both land-based (Moothien Pillay *et al*., 2012) and ocean-based nurseries. NGOs such as Eli Africa (Moothien Pillay *et al.,* unpublished report, 2014), Reef Conservation, and Shoals Rodrigues, then established small-scale community based coral farms, transplanted 6,200 coral colonies to rehabilitate degraded sites (between 150 m2 to 350 m2) with funding from the GEF-Small Grants Programme implemented by UNDP. The proposed project will upscale and mainstream these experiences through the following five components, which will be completed in accordance with national legislation and Adaptation Fund Environmental and Social safeguards:

Component 1 will identify nursery and rehabilitation sites through field- and desk-based studies and forge partnerships with the private sector and community groups for implementation. Selection criteria will include the likely effectiveness of efforts to restore ecosystem services and the feasibility of maintenance and monitoring. Seychelles has already completed a national study to identify potential mariculture sites[[6]](#footnote-6), and the suitability of these sites for coral mariculture will be reassessed alongside the identification of high priority reef sites for rehabilitation. In Mauritius, the current status of coral reef habitats will be mapped using high resolution satellite imagery (WorldView-2 or 3) validated in-situ by ground-truthing, accompanied by water quality monitoring to identify sites with the environmental conditions conducive for the healthy growth of corals. Coral faunal diversity will also be reassessed to identify resilient / resistant / threatened species to be propagated for rehabilitation.

Component 2 will improve understanding about the genetic connectivity and the spatio-temporal variations in coral spawning and recruitment processes between the countries. The results will provide the information needed for implementing an alternative low-tech coral reef rehabilitation method using the culture of wild caught coral larvae, which has yet to be trialed in either country. While this technique is still experimental the advantage is that it does not remove corals from healthy donor reefs and has the potential to produce huge numbers of small corals for use in transplantation. Monitoring of coral recruitment will also complement existing reef monitoring programmes and provide an early warning system to help predict future problems with reef health after major disturbances (e.g. cyclones, coral bleaching).

Component 3 will establish new coral farming facilities in both countries, which will include: (a) a large ocean-based coral mariculture facility in Seychelles to increase sustainability by reducing rehabilitation costs through economies of scale; (b) a land-based "Coral Sanctuary" in Mauritius to culture the resilient / resistant / threatened coral species to preserve faunal diversity, for reintroduction into the wild or for use as coral broodstock and for public sensitisation and; (c) small-scale ocean-based community coral farms around Mauritius and in Rodrigues. Fisher's and women's community groups will be trained to manage these small-scale farms as an alternative sustainable livelihood, which could help alleviate fishing pressure in the lagoons and improve local stewardship, thereby further improving the sustainability of the project.

Component 4 will support the preparation and planting out of farmed corals onto the priority reef sites to be rehabilitated, as well as the maintenance and monitoring of corals within the nurseries and at both control and rehabilitated reef sites. The comparative monitoring will increase knowledge about the effectiveness of the propagation and rehabilitation methods and modes of implementation to assist in the evaluation of the project and to help inform the wider region and globally.

Component 5 will support knowledge management and sharing. The effectiveness of active (transplantation, larval propagation) and passive (ridge-to-reef, no-take zones, MPAs) reef rehabilitation approaches will be compared using a cost benefit analysis approach and lessons learnt from within the region will be compiled to further existing knowledge in these adaptation techniques[[7]](#footnote-7). Business plans will be prepared for (a) the new mariculture facility in Seychelles to assist in the mainstreaming of coral farming into productive sectors, attract private sector investment and ensure cost efficiency, launching of new activities, and long term viability beyond project lifespan and; (b) for community farms to improve the sustainability of livelihood outcomes, building upon sucessful examples from other small-scale community based coral cultivation projects[[8]](#footnote-8). An eco-labelling scheme will be developed for the corals farmed to increase market differential and value. Training courses will be provided on habitat mapping and assessment techniques, coral taxonomy and genetic techniques and coral recruitment. Seychelles has developed a practical training course in coral rehabilitation and this training will be upgraded to a certificated course accredited at University level (national Qualification Authority criteria) which will be provided to trainees from both countries.

The activities included in the proposed project support the recently adopted ocean-based economic visions of both countries namely, the Ocean Economy in Mauritius and the Blue Economy in Seychelles wherein coral reef restoration can be embedded. In fact, a new report by the Commonwealth Secretariat for the Government of Seychelles entitled “*Developing a Blue Economy Roadmap in The Republic of Seychelles: Contribution of New and Emerging Marine Sectors”* has identified coral mariculture as a growth area for the Blue Economy. The report says: “*In Seychelles there is already a coral reef restoration programme being run by Nature Seychelles, which is propagating corals and this offers the opportunity for simple knowledge and technology exchange to foster a coral aquaculture enterprise*”.

**pART iiI: Implementation arrangements**

**SEYCHELLES Coordinator: Ministry of Environment, Climate Change and Energy (MECCE)** has the mandate for environmental, climate change and energy policy and management. As the GEF Operational Focal Point, it hosts the Project Coordinating Unit (PCU) with the assistance of UNDP, which coordinates the execution of GEF and other donor funded projects. The PCU will assume coordination of this project. **Nature Seychelles (NS)** is an NGO that has pioneered terrestrial restoration of islands and been the recipient of GEF-funds and other large donor funded projects. In the last 4 years it has: implemented the world’s largest *in-situ* coral reef restoration project using the coral gardening method; trained scientific divers in reef restoration techniques and; set-up a marine conservation facility on Praslin island. It is a registered Private Educational and Training Institute (under the Education Act). It manages the Cousin Island Special Reserve which is the site of a 5,500 m2 restored reef. NS will be the key NIE. **Seychelles National Parks Authority (SNPA)** is responsible for the management of all state owned terrestrial and marine protected areas. SNPA wishes to restore reefs within MPAs and will partner with NS and receive training for its staff.

**MAURITIUS Coordinator: Ministry of Ocean Economy, Marine Resources, Fisheries, Shipping and Outer Island (MOE) Mauritius Oceanography Institute (MOI)** established in January 2000, operating under the MOE, the MOI’s mission is to develop and strengthen oceanographic research, using an integrated approach, to enhance understanding of ocean and coastal processes, for rational development of marine resources, within the maritime zone of the Republic of Mauritius. The MOI has a team of dedicated scientists and technicians with wide-ranging expertise including coral culture and reef rehabilitation. **Albion Fisheries Research Centre (AFRC)** established in 1982 under the MOE, carries out applied research, development and management activities and is responsible for stock assessment of marine resources of the Republic of Mauritius and has been involved in coral farming. **Rodrigues Regional Assembly (RRA)** established in 2001 under the RRA Act (Act 39 of 2001), and operational since January 2002, the RRA's main function is the making of Regulations for matters falling within its purview and legislations. In 2009, the RRA, under section 31 of the RRA Act 2001 put forward regulations for delimitation of the South East Marine Protected Area (SEMPA). The **UNDP GEF Small Grants Programme** in Mauritius has experience in projects which have developed alternative livelihood opportunities for communities to reduce pressure on biodiversity and increase coastal resilience. Small–scale projects with communities have seen the setting up of sea based coral nurseries for propagation afterwards in the lagoon as well as monitoring of survival and growth rates of cultured corals. SGP provides access to a ready mechanism for selection, delivery, oversight and monitoring of the community grants. The SGP Mauritius will be tasked with working with community groups to implement coral restoration techniques and programmes.

**part iV: endorsement by governments and certification by the Implementing Entity**

1. **Record of endorsement on behalf of the government[[9]](#footnote-9)** *The endorsement letters should be attached as annexes to the project/programme proposal.*

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| *Mr R Chellapermal, Deputy Financial Secretary, Alternate Designated Authority, Ministry of Finance and Economic Development* | Date*:* *08/03/2015* |
| *Mr Wills Agricole, Principal Secretary, Designated Authority, Ministry of Environment, Energy and Climate Change* | Date*: 07/31/2015* |

**B. Implementing Entity certification**

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| 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 (National Climate Change Adaptation Framework)) 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. | |
| **Adriana Dinu**  Executive Coordinator,  UNDP-GEF | |
| Date: *08/04/2015* | Tel. and email: +1 (212) 906-5143 [adriana.dinu@undp.org](mailto:adriana.dinu@undp.org) |
| Project Contact Person: Roland Alcindor (Sey) and Satyajeet Ramchurn (Mru) | |
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**ANNEX 1 References:**

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1. Thematic areas are: Food security; Disaster risk reduction and early warning systems; Transboundary water management; Innovation in adaptation finance. [↑](#footnote-ref-1)
2. Seychelles is the 3rd largest consumer of fish per capita (59.3 kg) and the percentage of fish as a contribution to animal protein is 47.6% (2011). SOURCE: http://www.globefish.org/total-fish-consumption-per-capita-kg-and-fish-contribution-to-total-proteins-percent.html [↑](#footnote-ref-2)
3. In Seychelles and Mauritius the tourism sector contributes 50% and 30% to GDP; 60% and 28% to total employment; and approximately 35% and 34% to export receipts respectively (Makochekanwa 2013). [↑](#footnote-ref-3)
4. Coral reefs protect the beaches of Mauritius and Seychelles, which are classified among the most attractive in the world. The loss of live coral and associated reef structure that follows bleaching-induced mortality reduces the reefs ability to dampen oncoming hydrodynamic forces, leading to increased wave exposure, changes in sediment formation and transport pathways and coastal erosion (Sheppard et al., 2005). [↑](#footnote-ref-4)
5. Ecological restoration is defined as *the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed*. [↑](#footnote-ref-5)
6. Seychelles Mariculture Master Plan 2011 [↑](#footnote-ref-6)
7. A global review of coral reef restoration methods was completed between 2007-2010 as part of The Coral Reef Targeted Research & Capacity Building for Management (CRTR) Program, which was a partnership between the GEF, the World Bank, The University of Queensland (Australia), the United States National Oceanic and Atmospheric Administration (NOAA), and various research institutes and other third parties around the world. The CRTR program produced (i) a review of coral reef rehabilitation techniques (Edwards and Gomez 2007), and (ii) a manual which explained how to implement the different rehabilitation methods (Edwards 2010). The guides provide an excellent source of information but given the timing did not include specific examples or case studies from within the WIO region. [↑](#footnote-ref-7)
8. The trade in live corals for the aquarium trade has grown at approximately 9% per annum between 1990 and on average corals retail at $56 a piece in the US. The current trade in live coral is thought to amount to between 11-12 million pieces, only 20% of which comes from cultured sources. Small scale coral farms have been established in Pacific islands to supply aquaculture trade. [↑](#footnote-ref-8)
9. 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. [↑](#footnote-ref-9)