Concept note

Reducing the risk of degradation of the Kayankerni and Paskudah coral reef ecosystems in Sri Lanka by addressing nutrient, wastewater and other land-based sources of marine pollution within the Maduru Oya watershed

Summary

Goal: Contribution to strengthened local and regional enabling environments to foster the uptake and adoption of innovative approaches in reducing threats to coral reefs from nutrient and wastewater and other land-based pollution in Sri Lanka.

Objectives:

- To enhance capacities of local stakeholders in the assessment of environmental challenges and implementation of appropriate approaches to address nutrient, wastewater and other forms of land-based pollution that impacts coral reef ecosystems;
- To strengthen the community of practice in pollution and coral reef protection at the regional level through knowledge exchange and transfer;
- To contribute to leveraging of additional financing for on-ground investments in best practices to reduce the influx of land-based pollution in the target area;
- To define methodologies for assessment and monitoring of Sustainable Development Goal targets 6.3 and 14.1 associated with freshwater and marine pollution respectively, within the source-to-sea/ridge-to-reef framework;
- To contribute to obligations under relevant United Nations Environment Assembly (UNEA) resolutions associated with coral reef management, freshwater and marine pollution, in addition to obligations under the South Asian Seas Programme (SASP), notably the South Asian Seas Agreement aiming at protecting the marine environment from land and sea-based activities;
- To contribute to activities in commemoration of the 2018 International Year of the Coral Reef through UN Environment's coral reef campaign and the wider 'Call for Action' from the UN SDG14 Ocean Conference.

Expected results and sustainability: Through this initiative, capacities of local agencies will be strengthened to implement ongoing nutrient, wastewater and other land-based pollution reduction activities. Increased awareness of the benefits of effective wastewater and nutrient management and methods will promote knowledge sharing and partnerships among national, regional and global communities, in addition to partner agencies on best practices. The initiative will be embedded within the programme of work of UN Environment under the aegis of the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities, in close cooperation with UN Environment's Coral Reef Unit, Freshwaters Unit and the GEMS Waters Unit, and the South Asia Cooperative Environment Programme (SACEP). This work will be part of the wider technical support provided to countries in the South Asia region through the GPA global partnerships, specifically the Global Programme on Nutrient Management (GPNM), the Global Wastewater Initiative (GW^2I) and the Global Partnership on Marine Litter (GPML). The International Coral Reef Initiative is expected to be associated with the project through the Coral Reef Unit. The initiative will contribute to achievements in commemoration of 2018 as the International Year of the Coral Reef, and resources developed will be incorporated within the new global Coral Reef campaign being rolled out by UN Environment.

Duration: February to December 2018 (11 months)

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Background

The issue of nutrient pollution in the form of excess nitrogen and phosphorus flows to the marine environment has gradually gained prominence given the growing ecological and socio-economic impacts in coastal and marine ecosystems. An estimated 80% of marine pollution originates from land-based sources of pollution that includes wastewater and nutrients loadings. Deoxygenation and hypoxia in coastal waters due to land-based pollution has increased exponentially since the 1960s and is estimated to cover an area of about 245,000 km^2 worldwide (UN DOALOS, 2016)[1] with over 700 eutrophic and hypoxic coastal systems worldwide (Diaz et al., 2010). Of these, at least 169 coastal areas are considered hypoxic, with dead zones especially prevalent in the seas around South East Asia, Europe and eastern North America. According to the Transboundary Assessment Programme (TWAP)[2] of the 63 large marine ecosystems (LMEs) assessed under the Programme, some 16% are in the 'high' or 'highest' risk categories for coastal eutrophication. They are mainly in Western Europe and southern and eastern Asia, and the Gulf of Mexico (IOC-UNESCO and UNEP, 2016).

Global trends point to continued deterioration in terms of nutrient pollution, with regions of greatest concern being south East Asia, Europe and eastern North America (UNEP 2012)[3]. Global river nutrient export has increased by approximately 15% since 1970, with South Asia accounting for at least half of the increase (Seitzinger et al. 2010; UNEP 2012). Based on current trends, it is estimated that the risk of coastal eutrophication will increase in just under one-quarter of large marine ecosystems by 2050. Most of the projected increase will be in LMEs in southern and eastern Asia, with some increase also in LMEs in South America and Africa. Only two large marine ecosystems (the Iberian Coastal and Northeast US Continental Shelf) are projected to lower their coastal eutrophication risk by 2050 (IOC-UNESCO and UNEP (2016).

There are noted adverse global environmental outcomes associated with poor management of nutrient and wastewater discharges. Fluvial phosphorus transport from agricultural land, and release of phosphorus-rich animal and human wastewater into the environment, have degraded lakes, rivers, reservoirs and coastal waters with excess phosphorus, causing costly damages. In the case of nitrogen, a substantial amount of nitrogen entering agricultural soils, both by fertilization and biological fixation, is lost through surface run-off, leaching into groundwater and emissions the atmosphere, according to the Our Nutrient World (2013) report[4]. Nitrogen-based fertilizers are also the source of gaseous reactive nitrogen emissions. Globally, synthetic fertilizer and agricultural crops account for 12% of total ammonia emission and FAO predictions indicate that global nitrous oxide (N_2O) emissions from fertilizers will increase to between 35 and 60% by 2030.

Coral reefs are particularly vulnerable to land-based pollution, which not only threatens the health of the ecosystems and the biodiversity contained therein, but also the health and wellbeing of hundreds of millions of people who depend on coral reef ecosystem services for nutrition, livelihoods and a safe

[1] First Global Integrated Marine Assessment - First World Ocean Assessment (UN DOALOS, 2016) http://www.un.org/Depts/los/global_reporting/WOA_RegProcess.htm
[2] IOC-UNESCO and UNEP (2016) GEF- Transboundary Waters Assessment Programme http://www.geftwap.org/
[3] Global Environment Outlook: Environment for the future we want (GEO-5) (UNEP, 2012) http://web.unep.org/geo/sites/unep.org.geo/files/documents/geo5_report_full_en_0.pdf
[4] Our Nutrient World (Sutton el al., 2013) on behalf of Global Partnership on Nutrient Management and the International Nitrogen Initiative http://nutrientchallenge.org/document/our-nutrient-world

living environment. Increasing sediment and nutrient loads have been linked to declines in coral cover in reef ecosystems around the world[5]. Release of excess nutrients into coastal waters causes eutrophication, resulting in macroalgae proliferation, algal blooms and the creation of hypoxic 'dead zones', which can kill large numbers of organisms, such as fish. Sediment input stresses coral reefs by reducing light penetration in water and smothering reef organisms (UNEP, 2017)[6].

Actions to combat degradation of coral reefs must be considered against the fact that approximately 500 million people depend on coral reefs for food, coastal protection, building materials and income from tourism and fisheries. This includes 30 million who are almost totally dependent on coral reefs for their livelihoods or for the land that they live on (i.e. atolls; Wilkinson, 2008). For example, at least 94 nations benefit from reef-related tourism, and reef tourism contributes more than 15% of gross domestic product in 23 of these nations (World Resources Institute, 2012). Coral reefs therefore support the socioeconomic well-being of many coastal communities, and their ecosystem goods and services are estimated at between US$100,000 and US$600,000 per km^2 per year (UNEP, 2006). A global semi-quantitative assessment of social and economic vulnerability to coral reef decline found that more than 33% of very highly vulnerable countries and territories are in the Caribbean, 20% are in east Africa and the western Indian Ocean, and smaller numbers are found in the Pacific, southeast Asia, and south Asia. Among the 27 countries and territories rated as very highly vulnerable, the majority (19) are small island states (World Resources Institute, 2012). Reducing local pressures on reefs, such as pollution, particularly in small island states is the most effective way to build reef resilience and support reefs in the face of warming seas and ocean acidification (UNEP, 2017).

Compounding the effects of land-based pollution are the influences of climate change particularly in terms of ocean acidification, along with the cumulative impacts of extreme events caused by climate change, such as coral bleaching, floods and tropical storms, and the chronic impacts of poor water quality; these are all additional drivers of reef degradation (UNEP, 2017). The science is suggesting that corals exposed to excess nutrients, turbidity, sedimentation, pathogens or chemical pollutants are more susceptible to thermal stress or less able to survive a coral bleaching episode[7]. Furthermore, chronic wastewater stress prevents recovery of reef communities after a bleaching event[8]. The interaction between ocean acidification and locally high nutrient loading accelerates coral reef loss[9] (UNEP, 2017). Table 1 summarizes the documented effects of nutrient enrichment on coral reefs as noted in regional and global studies. Furthermore, studies have shown that billions of pieces of plastic on coral reefs have increased the rate of coral diseases 20-fold and that plastic stresses corals through light deprivation, toxin release, and anoxia, giving pathogens a foothold for invasion[10]. Corals have also been observed to

[5] Restrepo, J.D., Park, E., Aquino, S., Latrubesse, E.M. 2016. Coral reefs chronically exposed to river sediment plumes in the southwestern Caribbean: Rosario Islands, Colombia. Science of the Total Environment, 553, 316-329

[6] United Nations Environment Program (2017) Managing Wastewater to support Coral Reef Health and Resilience – White Paper. Johnson, J.E., Brodie, J. and Waterhouse, J. (Authors) [in review]

[7] Wiedenmann, J., D'Angelo, C., Smith, E.G., Hunt, A.N., Legiret, F-E., Postle, A.D., Achterberg, E.P. 2013. Nutrient enrichment can increase the susceptibility of reef corals to bleaching. Nature Climate Change, 3, 160-164

[8] Hoegh-Guldberg, O., Anthony, K. Berkelmans, R. et al. 2007a. The vulnerability of reef building corals on the Great Barrier Reef to climate change. In: Climate Change and the Great Barrier Reef: A Vulnerability Assessment, 1st Edition (Johnson, J. E., and P. A. Marshall, Eds.), Townsville, Australia: Great Barrier Reef Marine Park Authority

[9] DeCarlo, T.M., Cohen, A.L., Barkley, H.C., Cobban, Q., Young, C., Shamberger, K.E., Brainard, R.E., Golbuu, Y. 2015. Coral macrobioerosion is accelerated by ocean acidification and nutrients. Geology 43, 7–10.

[10] Lamb, J.B. et al. 2018. Plastic waste associated with disease on coral reefs. Science 359, 460-462.

ingest pieces of micro-plastic, confusing them for planktonic prey, with potential health impacts for the corals[11].

Table 1. Summary of the documented effects of nutrient enrichment on coral reefs (Managing Wastewater to support Coral Reef Health and Resilience – White Paper' (UNEP, 2017).

Issue	Process	Effect	Region	References
Macroalgal overgrowth	Nutrient enrichment leads to fast-growing macroalgae expansion	Macroalgae proliferates at the expense of coral	Global. However in absence of grazing fish and invertebrates problem may be more severe, e.g. the Caribbean.	D'Angelo and Wiedenmann (2014); De'ath and Fabricius (2010); Gavio and Mancera Pineda (2015); Hixon (2015); Jouffray et al. (2015); Lapointe et al. (2004, 2015); Rasher et al. (2012)
Increased turbidity	Increased sediment and nutrient inputs from rivers	Reduced light for coral growth	Global	Fabricius et al. (2014, 2016); Lapointe et al. (2004, 2015); Risk (2014)
Coral disease	Nutrient excess promotes certain coral diseases	Higher levels of coral disease in areas of poor water quality	Global	Bruno et al. (2003); Furby et al. (2014); Haapkylä et al. (2011); Lamb et al. (2016); Redding et al. (2013); Voss and Richardson (2006)
Crown-of-thorns starfish outbreaks	Enhanced survivorship of COTS larvae	Outbreak populations of COTS and large scale coral predation	Indo-Pacific	Brodie et al. (2005, 2017); Fabricius et al. (2010); Wolfe et al. (2015)
Increased bleaching susceptibility	Nutrient enrichment leads to lower bleaching thresholds in corals	Higher levels of bleaching when water quality is poor.	Global	Carilli et al. (2010); Fabricius et al. (2013); Vega-Thurber et al. (2014); Wiedenmann et al. (2013); Wooldridge (2009); Wooldridge and Done (2009)
Bioerosion	Nutrient enrichment leads to increased populations of bioeroding organisms	Loss of coral framework	Global	DeCarlo et al. (2015); Glynn and Manzello (2015); Smith et al. (1981); Ward-Paige et al. (2005)
Nutrient enrichment exacerbating Ocean Acidification	Multiple stressors acting in additive or synergistic way	Reduced coral growth	Global	D'Angelo and Wiedenmann (2014); Vogel et al. (2015)

Toward action - policy and management recommendations

The 'Managing Wastewater to support Coral Reef Health and Resilience – White Paper' (UNEP, 2017) noted that wastewater, nutrient and other pollution on coral must be addressed through an ecosystem-based, 'ridge-to-reef' or 'source-to-sea' approach, covering catchments and urban areas as well as marine areas. It requires a range of regulatory and voluntary efforts, and work across public and private sectors as well as with communities. Key relevant recommendations advanced in the report include:

[11] Allen, A.S. et al. 2017. Chemoreception drives plastic consumption in a hard coral. Marine Pollution Bulletin 124, 198 – 205.

- Raise awareness on the negative environmental, social and economic impacts of wastewater pollution on coral reefs, the opportunities associated with using treated wastewater as a resource, and other approaches for reducing wastewater pollution among key stakeholder groups including all levels of government, companies in sectors that generate wastewater or are vulnerable to its impacts on coral reefs, and the general public;
- Adopt discharge and ambient water quality standards and management guidelines taking into consideration the sensitivity of coral reefs, e.g. drawing on standards specific to coral reefs such as the ASEAN Marine Water Quality Criteria 2002 and the Great Barrier Reef Water Quality Guidelines;
- Support the creation and voluntary adoption of sectoral codes of practice such as zero-discharge policies, or standards for wastewater reduction, treatment and monitoring that also take into account coral reef vulnerability to wastewater pollution;
- Establish nutrient use efficiency targets for the agricultural sector (e.g. as described by the Global Partnership on Nutrient Management), taking into consideration downstream impacts on coral reefs, and incentivize efforts to achieve these;
- Plan and implement coral reef management using resilience principles. Prioritize wastewater reduction and management in the catchments of reefs that are relative climate change refugia[12], and use resilience assessments to strategically define reef management interventions through marine spatial planning as well as land-use planning processes;
- Establish monitoring of wastewater loading and impacts on coral reefs to inform policy and management decisions, and to support evaluation of policy and management responses. Since coral reefs are under pressure from many different stresses, it is important to monitor the pollutant source as the first priority, along with coral reef ecosystem condition. Where possible combining monitoring with modeling of the delivery of pollutants as well as specific bioindicators is strongly encouraged;
- Ensure monitoring and reporting on nationally and internationally established targets, including reporting on wastewater pollution on coral reefs and efforts to address this under SDG 6.3 and 11.6 as well as SDG 14.1.

Toward action in a local context: Addressing land-based pollution of the Kayankerni and Paskudah reefs from the Maduru Oya watershed in Sri Lanka

To best demonstrate the tangible cause-effect linkages between land-based activities, pollution and the impacts on coastal ecosystems, a watershed area that is undergoing land degradation with an offshore coral reef ecosystem that is being affected from nutrient and wastewater pollution was identified. In consultation with technical experts within UN Environment, SACEP and collaborators working on coral reefs, Sri Lanka was selected as a candidate country for a demonstration initiative given the diversity of its coral reef ecosystems, the livelihoods they support and the multiple threats that climate change and bleaching events, in combination with pollution have been exerting on reef ecosystems in the country. Reef communities at particular locations in the country have demonstrated resilience to recent bleaching events, signaling possibly a higher chance of being less impacted by climate change in the coming decades. This makes a good case for their protection from anthropogenic stressors where these reefs may be used in the future for restorative work in other locations. This further strengthens the case of integrated source-to-sea management.

[12] http://www.uneplive.org/theme/index/19#about

Sri Lanka, is surrounded by the tropical waters of the Indian Ocean and is fringed by coral reefs along many segments of its coastline. The reef ecosystems, categorized as fringing reefs, patchy reefs, sandstone reefs and rocky reefs, which can occur in combination, are relatively diverse with more than 200 hard coral species recorded. Pseudo barrier reefs, parallel to the shoreline and lying some distance away and forming a broad 'reef lagoon' are found between Vankalai and Silavaturai, south of Mannar, and also the offshore reefs at Great Basses and Little Basses. The Bar Reef in Kalpitiya is the largest patchy reef (quoted from Martenstyn , 2016)[13].

According to an FAO proceedings report on Pre- and Post-Tsunami Coastal Planning (2007)[14] only the Kandakullya and Talawila reefs, out of some eight coral reef areas studied under a USAID-funded Coastal Resources Management Project (CRMP) from 2000 to 2005, showed live coral coverage greater than 50 percent. Two nearshore reefs, Weligama and Polhena, showed a significant proportion of dead corals, while dead corals at Hikkaduwa and Akurala are reported to amount to 25 percent. Degradation of coral reef habitats is also influenced by illegal and destructive fishing, overexploitation commercially harvested species, unregulated tourism, and over visitation of coral reefs in popular tourist areas. The FAO report further noted that increased pollution associated with the siting of poorly designed coastal infrastructure, along with encroachment of unplanned and unauthorized development, has caused direct habitat loss with increased public health risks. Extractive activities such as logging and mining in the upland areas have been detrimental to fisheries, aquaculture and coastal tourism-dependent industries.

The target area for the project will be the watershed and adjacent coastal area along the Kalkudah Bay in the Batticaloa District along the central eastern segment of the Sri Lankan coast. The project will focus on the Kayankerni and Paskudah reef systems which are ecologically diverse and host to a diverse array of corals and other vibrant plant and animal life that includes just over 200 species of fish[15]. (Dilmah Conservation, 2017). Nearshore reefs in the area, particularly within Pasikudah Bay have been observed to be undergoing significant degradation due to sedimentation, decreased salinity due to changes in flow patterns, and agricultural runoff (WRCT 2015). The influx of land-based pollution comes from the adjacent Maduru Oya river basin discharged via the Valachchenai estuary. The Maduru Oya is a major river system in the North Central Province of Sri Lanka, with the main channel traversing approximately 135 km, in a general south to north orientation with its headwaters in the vicinity of Bibile and Rideemaliyadda. The river intersects the Maduru Oya National Park and drains into a large estuarine environment around Valaichchenai Harbour at the coast. The basin area is some 1,541 square kilometres and receives an estimated 3,060 million cubic metres of rain per year, where approximately 26 percent of the water reaches the sea (FAO, accessed 2017)[16] (see Figure 1).

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[13] Corals & Coral Reefs (Martenstyn, 2016) http://www.slam.lk/corals; http://www.slam.lk/protected-waters
[14] Proceedings of the workshop on coastal area planning and management in Asian tsunami-affected countries (FAO, 2007) http://www.fao.org/docrep/010/ag124e/AG124E10.htm
[15] Conservation of Sri Lanka's Marine Heritage https://www.dilmahconservation.org/initiatives/biodiversity/marine-heritage-conservation.html
[16] Reservoirs of Sri Lanka and their fisheries (1988) http://www.fao.org/docrep/003/T0028E/T0028E02.htm
WRCT 2015. Progress report of the Coral Restoration Program. Progress report submitted to Tokyo Cement Group. (Unpublished).

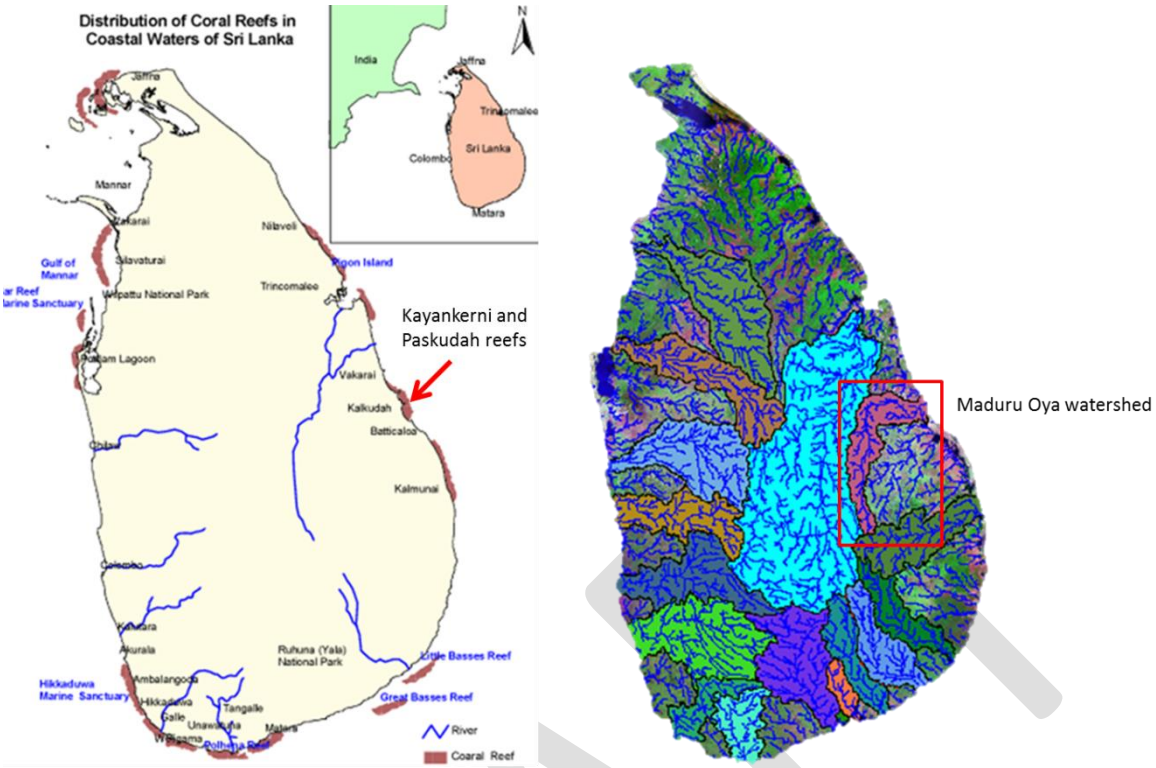

Figure 1. Left: Distribution of coral reefs; Right: River drainage basins of Sri Lanka (Sources: FAO, accessed 2017[17]; River Basins in Sri Lanka, accessed 2017[18])

The main coastal towns of Oddamavadi and Valaichchenai are situated along the coastal estuary of the Maduru Oya River, north of Pasikudah Bay and south of Kayankerni. According to the Sri Lanka Department of Census and Statistics (2007) the Batticaloa District had a population of 515,857[19]. The main economic activities of these coastal communities are fishing, agriculture and trade. There is an extensive coastal fishery using gill nets, drift nets, traps and lines for reef-associated species and small pelagics. Collection of lobsters, sea cucumber, chanks, and ornamental species by scuba diving is also carried out. The Valachchenai estuary and fisheries harbor provides anchorage for around 250 multi-day fishing boats engaged in offshore fisheries. The use of illegal and destructive fishing methods such as bottom set nets and dynamite fishing are prevalent in the area and constitute significant threats to coral reefs.

Agriculture consists of rice farming, fruit and vegetable cultivation and cashew cultivation, as well as extensive livestock. There have also been efforts to expand aquaculture, with a large prawn farm established near Kayankerni by the National Aquaculture Development Authority. The interior upland areas of the Maduru Oya watershed is dominated by a mix of agricultural and pastoral land, homesteads, and dry zone forest. The main agricultural crops include rice, corn, and vegetables. Recreational tourism has been generating modest revenue to coastal communities and can be expected

[17] Proceedings of the workshop on coastal area planning and management in Asian tsunami-affected countries, FAO (2007) http://www.fao.org/docrep/010/ag124e/AG124E10.htm
[18] http://sri-lanka.wikidot.com/basins
[19] Basic Population Information on Batticaloa District, Department of Census and Statistics http://www.statistics.gov.lk/PopHouSat/Preliminary%20Reports%20Special%20Enumeration%202007/Basic%20Population%20Information%20of%20Batticaloa%20District%202007.pdf

to grow significantly in terms of total revenue and relative importance over the next decade. Pasikudah has been identified as a major tourism development zone by the government and more than ten new resorts have been established in the last five years, along with a growth in locally owned budget accommodation and auxiliary services such as tours, excursions, eateries and shops. Tourism activities that are directly dependent on the coral reef such as scuba diving and snorkeling have also seen a growth in recent years.

With the development and population growth, plastic and solid waste pollution has become a major problem in Sri Lanka including Valachchenai. The estuary is a dumping ground for both urban and fisheries waste and contributes significant input of plastic into coastal waters.

Project activities and outputs

The project will be conceptually underpinned by recommendations outlined in the draft Marine and Coastal Biodiversity Strategy for the South Asian Seas Region and in a review study Controlling Nutrient Loading and Eutrophication of Coastal Waters of the South Asian Seas[20].

The *Marine and Coastal Biodiversity Strategy for the South Asian Seas Region: Living in Harmony with our Oceans and Coasts* aims to address the issues threatening marine biodiversity, by supporting the achievement of the Aichi Biodiversity Targets in marine and coastal habitats through strengthening implementation of and coherence of actions under National Biodiversity Strategies and Action Plans (NBSAP) for 2011-2020 period. The strategy provides initial identification of Regional Targets and Action Plans for the SAS region. A key goal is to ensure the provision of ecosystem services of the coastal and marine habitats for the wellbeing of coastal communities that speaks to no net loss of coral reef or seagrass by 2020, through a reduction of the anthropogenic pressures that erode the resilience of coral reefs, seagrass and mangroves. Marine pollution reduction, particularly nutrient loading, is highlighted as a goal in the strategy.

The study *Controlling Nutrient Loading and Eutrophication of Coastal Waters of the South Asian Seas* was undertaken within the scope of the Bay of Bengal Large Marine Ecosystem (BOBLME) Project. The study identified major gaps in data availability needed for assessment work on the state of the coastal environment such as production and use of fertilizers, estimates of detergent phosphate uses and quantities and sewage reaching the coast. The study noted that sewage treatment before discharge to receiving waters is limited in the region and hence is an important source of nutrient pollution. Additionally, the large livestock population in the South Asian countries is a major contributing factor.

On the ground, the project will be substantially oriented around capacity building and awareness-raising targeting the most important 'upstream and downstream stakeholders' that may either be contributing to the land and water degradation issues in the watershed and coastal areas, or are being affected by degradation, or a combination of both. The project will seek to strengthen the knowledge exchange process for joint learning among technical and policy-level stakeholders and practitioners, with emphasis on exchanges between geographic areas with similar 'assemblages' of concerns. The project will draw on key resources such as *Catchment Management and Coral Reef Conservation - A practical*

[20] Nutrient Loading and Eutrophication of Coastal Waters of the South Asian Seas – A Scoping Study (SACEP, 2013) http://www.sacep.org/pdf/Scoping_study_on_Nutrient_loading_in_SAS_Region.pdf

guide for coastal resource managers to reduce damage from catchment areas based on best practice case studies in the design of the various interventions[21].

The project will seek out indigenous innovation in combatting land-based pollution where it may already exist in Sri Lanka, or in nearby countries where it may have a good possibility for replication. In this regard the project will serve as leverage to access larger financing to invest in such scalable innovative pollution control measures within the project location in the future, with possibility to include other locations in the country or perhaps at the regional level. In a broad view, the project will endeavor to forge closer linkages between private sector operators and the traditional state/local government actors toward the development of longer-term sustainable investments to reduce land-based sources of marine pollution.

Finally, the project will aim to contribute to current efforts to develop, test and adopt assessment methodologies fresh and coastal waters pollution within the framework of the Sustainable Development Goals under Goals 6 and 14.

The project will be implemented over the course of 11 months through an agreement between UN Environment with oversight from the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (GPA) and the South Asia Co-operative Environment Programme (SACEP) which will serve as the executing agency for the project. The frontline national counterpart government agency will be the Marine Environmental Prevention Authority.

The following are the anticipated activities under the project and outputs:

1. **Best management practice guidelines** based on lessons learned from the project implementation will be compiled. At least two guidelines will be developed. One guideline shall focus on effective and innovative practices that can be implemented to reduce main sources of nutrient discharges in the watershed based with a focus on point and non-point source agricultural runoff (crop and livestock) and wastewater discharges (domestic and commercial). The other guideline will focus on effective practices to reduce the influx of plastics into waterways and the coastal environment. The guidelines should incorporate in as much as possible, local examples of suitable approaches to enhance the possibility of replication in the country and perhaps at the regional level under similar geographic, economic and demographic conditions. The guidelines will be designed for use by technical personnel such as agricultural extensionists, school educators and other stakeholders in outreach efforts. The guidelines, to be no longer than 6 printed pages, will incorporate information graphics in main presentation format and be done in English, Sinhalese and/or Tamil as deemed appropriate. The guidelines will be designed for online publication also. The final design and production will be done by UN Environment's Communications Division.

   Outputs:

   a. Field best management practice guideline on nutrient pollution mitigation
   b. Best management practice guideline on successful approaches for plastic waste disposal

2. **Training activities on implementing best practices** for pollution mitigation will be designed and executed for primary stakeholders. This will build on existing national efforts of relevant agencies

[21] Catchment Management and Coral Reef Conservation (Wilkinson, C. and Brodie, J. 2011): https://www.icriforum.org/sites/default/files/%20CATCHMENT%20MANAGEMENT%20AND%20CORAL%20REEF%20CONSERVATION.pdf

and support organizations and incorporate emerging innovation around new tools and techniques to reduce pollution, to include topics *inter-alia* fertilizer use efficiency in agriculture, green eco-solutions for wastewater diversion and reuse and minimizing plastics in the waste stream through upstream recycling efforts. The training will target stakeholders including farmer groups/associations, wastewater managers, private sector (various commercial interests and the hospitality sector) and relevant non-governmental and community-based organizations. Resource personnel for the training will be drawn from local agencies and academia, including external experts as needed from the global pollution partnerships under the GPA; the Global Partnership on Nutrient Management, the Global Wastewater Initiative and the Global Partnership on Marine Litter. Local and external experts involved with coral reef conservation will complement the training team. These experts could be drawn from the International Coral Reef Initiative.

Outputs:

a. At least 3 national and 1 regional training event on implementing best practices for pollution mitigation
b. Suite of training resources in electronic format
c. Training reports

3. To **strengthen communities of practice** with another country in the region, at least one inter-regional technical exchange for relevant industry practitioners/users and professionals will be supported under the project. This country visit will facilitate direct expertise and experience sharing supported through the regional platforms, coordinated by the GPA and SACEP Secretariats. Countries for consideration are India and the Maldives given active programmes in coral reef conservation in Gulf of Mannar and Lakshadweep (Laccadive Sea, off the coast of Kerala, India), followed by Bangladesh and Pakistan. It is anticipated that the exchange to run over at least 3 days, will involve at least 10 persons from the Sri Lanka project where they will be hosted by the counterpart agency in the receiving country, with costs supported under the project. The hosting country agency will be expected to organize as relevant, field visits and classroom sessions to promote interactive dialogue to showcase local best practices on pollution in relation to coastal ecosystems and coral reefs.

Outputs:

a. One inter-regional technical exchange for at least 10 relevant industry practitioners/users and professionals from Sri Lanka
b. Report on main lessons and experiences

4. This project seeks to **build the basis for continued focus and investment in innovative solutions** to address pollution, however does not make provision for actual investment in on-ground solutions. In this regard, based on the lessons derived over the course of the project and stakeholder inputs, a detailed project proposal will be prepared that identifies high priority interventions to reduce significant sources of pollution in the target area that has been negatively affecting coral reefs. This proposal will be fielded to potential donors in a collaborative effort between UN Environment and SACEP for funding, through continued joint cooperation.

Output:

a. One project proposal on pollution mitigation solutions

5. The project will explore opportunities to develop **national and regional capacities for assessment of SDG targets 6.3 and 14.1 on freshwater and marine pollution** respectively, in the context of source to sea connections. The Madura Oya watershed is instrumented with stream flow gauging stations and these stations will be used to assess freshwater quality physico-chemical parameters, including

those used to assess the Index of Coastal Eutrophication Potential (ICEP). The project will contribute to formulation/strengthening of monitoring protocols linked with a validation and field training activities of technical professionals in relevant data collection. The protocol will be modified as needed based on the outcomes of the field training and validation of the methodology. This will be an extension of ongoing collaborative efforts between UN Environment, UN Water and IOC-UNESCO in supporting countries in reporting on the SDG targets and be based on the International Water Quality Guidelines for Ecosystems (IWQGES)[22], among other key references. This work will be done in conjunction with the Marine Environmental Prevention Authority, Eastern University with others as deemed appropriate.

Outputs:

a. A protocol for joint assessment of the SDG Targets 6.3 and 14.1 on freshwater and marine pollution
b. Training resources for technical professionals
c. At least one training workshop for technical professionals
d. Training report and summary assessment

Relationships to the SDGs other relevant frameworks

The project will advance global commitments related on maintenance of the health of ecosystems. **Aichi Target 8 of the UN Convention on the Protection of Biological Diversity** states "*By 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity*." With respect to **Sustainable Development Goal 6**: "*Ensure availability and sustainable management of water and sanitation for all*" and its Target 6.3: "*By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally…*" is relevant in the context of minimizing excessive nutrient leakage to the environment from wastewater and agricultural runoff that can result in adverse environmental conditions and pollution.

Sustainable Development Goal 14: "*Conserve and sustainably use the oceans, seas and marine resources for sustainable development*" and its Target 14.1 "*By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution*" is directly related to addressing nutrient loading into the marine environment from land-based sources that include agricultural runoff (crop and livestock production), discharge of untreated domestic and industrial wastewater.

The second session of the **UN Environment Assembly** (UNEA2), adopted Resolution 2/12 in 2016 on sustainable coral reefs management, which encourages governments to formulate, adopt and implement integrated, ecosystem-based and comprehensive approaches for the sustainable management of coral reefs. The resolution calls on countries to undertake the priority actions to achieve Aichi Target 10 in CBD decision XII/23, which includes implementation of watershed management policies encompassing reforestation; erosion control; runoff reduction; sustainable agriculture and mining; reduction of pesticides, herbicides, fertilizer and other agrochemical use; and

[22] International Water Quality Guidelines for Ecosystems - How to develop guidelines for healthy freshwater ecosystems. A policy oriented approach.
http://web.unep.org/sites/default/files/Documents/20160315_iwqges_pd_final.pdf

wastewater management and treatment. The resolution also called on the Executive Director, UN Environment, within available resources and in cooperation with Governments and stakeholders in a position to do so, to strengthen capacity-building, knowledge transfer and the development of relevant planning tools to avoid, minimize and mitigate the adverse impacts of climate change and human-based threats on coral reefs and related ecosystems, as well as to support the improvement and maintaining of the resilience of coral reefs and related ecosystems. At the third session of the UN Environment Assembly (UNEA3) the adopted resolution on water pollution to protect and restore water-related ecosystems EA.3/L.27, invites Member States, in collaboration with relevant stakeholders, private sector, industry, academia, civil society, and the Global Programme of Action, including through encouraging platforms for wastewater and management of nutrients, to help prevent and mitigate water pollution and to protect and restore water-related ecosystems in order to minimize adverse impacts on human health and the environment.

SASEP Action Plans for SAS region and South Asia Coral Reef Task Force (SACRTF) in specifying the needs under the main components of (i) environmental assessment, (ii) environnemental management, (iii) environnemental legislation and institutional, identified the following priority areas:

- integrated coastal zone management,
- oil-spill contingency planning,
- human resource development and
- the environmental effects of land-based activities

The **Our Ocean, Our Future: Call for Action**[23] which emerged from the United Nations Conference to Support the Implementation of Sustainable Development Goal 14 of the 2030 Agenda, that was held in New York in June 2017, called on stakeholders to take urgent actions to develop and implement effective adaptation and mitigation measures that will enhance resilience of ecosystems including coral reefs to effects of climate change, and accelerate actions to prevent and significantly reduce marine pollution of all kinds, particularly from land-based activities.

Implementation partnership

The project will be led by the Coordination Office of the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (GPA) that is hosted by UN Environment. The Programme is a global intergovernmental mechanism directly addressing the connectivity between terrestrial, freshwater, coastal and marine ecosystems and since 2012, the programme has focused as priority on nutrient pollution, marine litter and wastewater management. As part of its strategy to tackle these issues, the Programme has established and continues to strengthen three global multi-stakeholder partnerships; the Global Partnership on Nutrient Management (GPNM), the Global Partnership on Marine Litter (GPML) and the Global Wastewater Initiative (GW^2I). These partnerships bring value to the work of the Programme and UN Environment in its engagement across multiple sectors. The GPA will work in close collaboration with the Coral Reef Unit, the Freshwaters Unit and the GEMS Water Unit of UN Environment.

The project will be carried out in partnership with the South Asia Cooperative Environment Programme, an inter-governmental organization, established in 1982 by the governments of South Asia to promote

[23] Our Ocean, Our Future: Call for Action https://oceanconference.un.org/callforaction

and support protection, management and enhancement of the environment in the region. SACEP also serves as the secretariat of South Asian Seas Programme (SASP), which is one of the significant regional Seas Agreement of UNEP. SACEP is mandated to promote cooperative activities for the management and conservation of the environment in countries bordering the northern Indian Ocean, Bay of Bengal and the Arabian Sea. SACEP member states are Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.

On-ground activities will be executed in cooperation with the Marine Environmental Prevention Authority, the Ministry of Mahaweli Development and Environment, and other relevant organizations already involved with training and capacity building in the agricultural sector, wastewater and waste (plastics) management, coastal zone and coral reef management, environmental assessment and monitoring, along with relevant organizations that support sustainable development initiatives in the local community and at the national level.

A project oversight committee comprising of select members of the Global Partnership on Nutrient Management, the Global Wastewater Initiative, the Global Partnership on Marine Litter, the International Coral Reef Management Initiative will be assembled, along with personnel from the Global Programme of Action, the Coral Reef Unit and the Freshwaters Unit of UN Environment, and the SACEP Secretariat. Representatives from lead local partner organizations will also be tasked to serve on the oversight committee. The total number of members on this committee should be no more than 10.

The SACEP Secretariat will coordinate the day-to-day execution of the project under the guide of the Global Programme of Action Coordinating Office specified within a Terms of Reference and associated financing agreement. Table 2 summarizes the anticipated project agency partnership and roles.

Table 2. Project partnership stakeholders and expected roles.

Partners	Areas of interest and of benefit	Roles & responsibilities in project implementation
UN Environment GPA Coordinating Office**.** • Global Partnership on Nutrient Management • Global Wastewater Initiative • Global Partnership on Marine Litter	Lead responsibility for coordinating global efforts in minimizing land-based pollution to the marine environment. Lead for development of the SDG target 14.1 on marine pollution	Secretariat to the global pollution partnerships; the GPNM, GW2I, GPML; facilitate coordination and best practice knowledge exchange at the global and regional levels to foster action and change at the national level. Facilitate advancement of relevant UNEA resolutions and contribution to the joint SDG 6.3 and 14.1 target assessment methodologies on pollution (latter in association with IOC-UNESCO)
UN Environment Coral Reef Unit	Coordinate UN Environment's work on coral reefs, with further direction provided by Governing Council and UNEA decisions	Joint development of tools and methods that support development of ecosystem based approaches to coral reef management; capacity building and networking to promote exchange of best practice. The Unit also administers the Green Fins Programme for environmental standards for the dive sector. The Coral Reef Unit also represents UNEP in the International Coral Reef Initiative (ICRI).
UN Environment Freshwater Unit	Coordinate UN Environment's work on addressing ecosystem degradation from pollution of freshwaters. Lead for development of SDG target 6.3 on freshwater pollution	Support to the assessment methods of SDG target 6.3 on freshwater pollution and linkage to SDG target 14.1 on marine pollution

Partners	Areas of interest and of benefit	Roles & responsibilities in project implementation
South Asia Cooperative Environment Programme *with possible association with COBSEA and Nairobi Convention through technical exchanges. PEMSEA will be associated*	Coordinated inter-governmental cooperation in protection of shared marine resources from degradation.	Coordination and integration of work of the GPA within the regional seas frameworks for synergistic implementation of actions at national and regional levels
International Coral Reef Initiative	Partnership of countries and organizations which strives to preserve coral reefs and related ecosystems around the world.	Encourage the adoption of best practice in sustainable management of coral reefs and associated ecosystems.
UNEP Regional Offices *Regional Office for West Asia*	Facilitate implementation of UNEP's Programme of Work in a harmonized manner at the regional level	Support the extension of outreach and advocacy efforts of the GPA and its global partnership network to integrate within relevant UNEP programmes under implementation
UNDP *Country office; possibly linkage with GEF Small Grants Programme*	Strengthen capacity in sustainable development of livelihoods and economies	Technical and policy advisory support to the GPNM level and to the regional nutrient platforms
FAO Sri Lanka Office	Food security and sustainable food production and protection of the productive resource base in terms of forests, soils and water.	Technical and policy advisory support on agricultural best practices
NGOs **To be determined**	Sustainable human and environmental management and development	Promote broader-based advocacy and transfer of tools and methods for sustainable nutrient management at the level of farmers and the wider community. Consideration of traditional approaches especially by indigenous peoples.
Public sector; Government agencies • Marine Environmental Prevention Authority, Sri Lanka • Ministry of Mahaweli Development and Environment, Sri Lanka • Ministry of Earth Sciences, Sri Lanka Collaborators at the regional level: Ministry of Environment and Forests, India; Ministry of Environment and Forest, Bangladesh; Ministry of Climate Change, Pakistan; Ministry of Environment and Energy Maldives	Policy development and regulation	Translating the collective lessons and experiences to national context though the development of policy at global, regional and national level.
Applied research institutes • Eastern University; • University of Peridinya	Knowledge generation and knowledge dissemination and capacity building for investigation of the nutrient cycle	Scientific contributions to understanding nutrient cycling and development of metrics in support of advocacy efforts
Private sector • Farmer associations • Fertiliser & input suppliers • Fishers associations • Local hotels in target area • Dive operators	Maintenance of economic viability of business enterprise	Foster investment and advocacy for improved practices

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Implementation schedule

The project assumes that the work will be executed entirely within 2018 based on the funding availability.

Table 3. Project implementation schedule

Activity	Months											
	1	2	3	4	5	6	7	8	9	10	11	Lead
1. Best management practice guidelines												
(a) Draft field BMP guideline - nutrient pollution mitigation; plastic waste disposal/management												SACEP
(b) Publish BMP guidelines - print and electronic												UN Environment
2. Training activities on implementing best practices												
(a) Develop training resources (electronic format)												SACEP
(b) Convene training events												SACEP
(c) Draft training reports												SACEP
3. Strengthen communities of practice												
(a) Conduct Inter-regional technical exchange (*combined with Activity 2c*)												SACEP
(b) Draft report on main lessons and experiences												SACEP
4. Resource mobilization												
(a) Develop project proposal on pollution mitigation solutions												SACEP
5. Water quality assessment - SDG targets												
(a) Develop protocol for joint assessment of water quality SDG Targets 6.3 and 14.1												SACEP
(b) Develop training resources (*combined with Activity 5a*)												SACEP
(c) Convene training workshop for technical professionals												SACEP
(d) Draft training report and summary assessment												SACEP
6. Draft overall report												SACEP

Key:

Process

Deliverable

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