South Asia Co-operative Environment Programme
(SACEP)
and
United Nation Environment Programme (UNEP)

Report on the:

Regional Stakeholder Meeting addressing on Sustainable Nutrient Management to reduce soil, water and coastal pollution in (SAS) region

1 - 2 April 2019
Colombo
Sri Lanka

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1. Introduction

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 km2 worldwide (UN DOALOS, 2016) 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) 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) . 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 . 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 (N2O) 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 living environment. Increasing sediment and nutrient loads have been linked to declines in coral cover in reef ecosystems around the world . 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) .

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 km2 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. Furthermore, chronic wastewater stress prevents recovery of reef communities after a bleaching event. The interaction between ocean acidification and locally high nutrient loading accelerates coral reef loss (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. Corals have also been observed to ingest pieces of micro-plastic, confusing them for planktonic prey, with potential health impacts for the corals.

2. Objectives and Activity

I. 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;
II. To strengthen the community of practice in pollution and coral reef protection at the regional level through knowledge exchange and transfer;
III. 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;
IV. 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;

V. 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;
VI. 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.

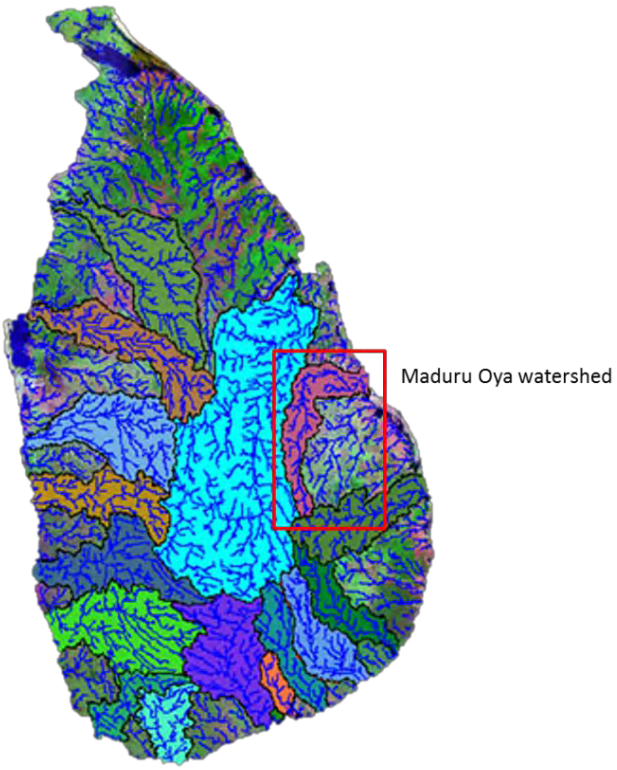
3. Toward action in a local context: Addressing land-based pollution of the Kayankerni and Paskudah reefs from the Maduru Oya watershed in Sri Lanka

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.

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) .

According to an FAO proceedings report on Pre- and Post-Tsunami Coastal Planning (2007) 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 was 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 was 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 . (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)



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 . 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 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.

4. Agenda of the Workshop

The agenda for the workshop was composed of informative and technical presentations. It also included discussions related to the project's work programme and schedule. In addition, opportunity was provided for updates on progress made in relation to national marine pollution preparedness and response from each country delegation, recognizing that national response systems underpin regional cooperation planning. The details agenda is reported in Annex-I

04. Venue, Dates and Participants

4.1 Meeting Venue

The meeting was held in Colombo, Sri Lanka at the Galadari Hotel from 1 to 2 April 2019. Each of the five beneficiary countries involved in the project were represented by a delegation comprising a minimum of two persons. These country delegations included key personnel from those Ministries or Governmental Agencies involved.

In addition to the SACEP Secretariat, number of international organizations and media were represented at the meeting. This enabled the sharing of experiences from other regions, particularly on day 2 during the technical preparatory workshop. The list of the participants is provided at Annex-II.

4.2.1 Day One (1st April 2019)

The workshop began with an opening ceremony and opening Remarks by Director General SACEP (Dr. Abash Basir) who gave a welcome address proceeded by the remarks from the UN Environment (Mr. Gabriel Grimsditch),followed by Inaugural address by the Host country

(Mr.M.P.D.U.K. Mapa Pathirana, State Secretary for the Ministry of Mahaweli Development and Environment, Sri Lanka). The speeches were emphasized the importance and role of the SACEP project activities with UN environment to address the risks of marine pollutions in the region and the need for collaboration and cooperation.

The speeches appreciated both project sponsors and coordinators in facilitating the gathering of the key players in response within the project's beneficiary countries so that they could work together in person and utilize this opportunity to discuss areas of further collaboration and knowledge sharing. The overall importance of protecting the marine environment was highlighted. The inaugural session was ended with vote of thanks made by Ms. Jacintha S.Tissera, Head of Chancery/Administrative Officer, SACEP with the token of appreciation to the H.E Mapa Pathirana to this occasion.

The opening ceremony was followed by a technical session, which began with a presentation of the UN Environment - SACEP Project by the Senior Programme Officer, South Asian Seas Programme. This was followed by remark presentations from the national of each of the beneficiary countries, who summarized the national report in their respective countries. The pilot project's lead consultants then made an introductory presentation to cover the current status and levels of preparedness in their respective subject wise, the activities undertaken so far to meet the future targets of the regional as well. Summaries of the presentations can be found in section 5 of the report.

4.2.2 Day Two (2nd April 2019)

Technical presentations on day 2 allowed to discuss the Predict the impacts of environmental variability and change on marine and coastal social-ecological systems focused on coral reef systems by the Dr.Joseph Maina Mbui, Macquarie University, Australia.The 1st draft of report by the regional project's lead consultant, to share their experiences with key preparedness, response and issues for the preparation of the final report. From the lesson learned of the presentation, the inputs for the regional project concept proposal was well received and has generated a lot of discussion, in particular to the following broad areas:

1.NUTRIENT POLLUTION
2.PLASTIC POLLUTION
3.CORALS
4.WATERSHED/RIVER BASIN/WETLANDS/SOURCE TO SEA(COUNTRY SPECIFIC)

DATA REQUIREMENTS:

1.PRIORITY AREA/LOCATIONS
2.PRORITY SOURCES OF POLLUTION
3.LAND USE
4.INSTITUTIONAL FRAME

SAS countries highlighted their views and comments on the above mentioned potentially areas to adopt well as the administrative burden involved with this process. This led to discussions on the establishment of funding mechanisms to address the shortfall of funds for the Marine

Pollution prevention from the land based activities for protection of marine biodiversity as well as sustaining the blue economy. The day ended with a summary of the current version of the regional plan for land-based sources to marine pollution response as agreed by the SAS-member state countries.

As a result of the through discussions during the workshop and the high level of interest in the topics covered, the workshop overran its allocated timeframe and therefore concluded with a short closing ceremony with addresses given by Host Country, Govt. of Sri Lanka, UN Environment and SACEP. All speakers expressed their gratitude to the participants of the workshop for their very active participation and to the project sponsors for facilitating the activity.

4.2.3

INAUGURAL ADDRESS

Dr Abas Basir
Director General, SACEP
Regional Stakeholder Meeting addressing on Sustainable Nutrient Management to reduce soil, water and coastal pollution in South Asian Seas region
1st April 2019, Colombo, Sri Lanka

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Honorable Mr. Mapa State Secretary, Ministry of Mahaweli Development and Environment, Government of Sri Lanka,
Mr. Gabriel Grimsditch representative from UN Environment,
H.E Dr. Shahid Ahmad Hashmat, High Commission of the Islamic Republic of Pakistan & Chairman of the Consultative Committee of SACEP,
SACEP Consultative Committee members;
Distinguished delegates;
ladies and gentlemen1

Very good morning and welcome

At the very outset let me welcome you all to the Regional Stakeholder Meeting addressing on Sustainable Nutrient Management to reduce soil, water and coastal pollution in South Asian Seas (SAS) region, jointly organized by SACEP and UN Environment under the patronage of Government of Sri Lanka.

It's my pleasure to be here with all of you at this important event.

As you are aware, SACEP is an inter-governmental organization of 8-member states, established in 1982, mandated to promote and support protection, management and enhancement of the environment in South Asia. Since 1982, SACEP is working along with its member countries to protect and conserve environment and to promote sustainable development in South Asian region. For the protection and conservation of marine environment, SACEP is hosting the South Asian Seas Programme (SASP), which is one of the eighteen Regional Seas Programme of the United Nations Environment Programme (UNEP). It was established, with the support from UNEP, in 1995.

The SAS region's constantly expanding coastal population and increased developmental activities has exacerbated pressure on the coastal and marine resources, with growing evidence seen in further degradation of the coastal and marine environment and continued exploitation of living as well as non-living resources. The coastal region of South Asia is rich in biological wealth, yet it is also known as an area of multiple vulnerabilities.
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South Asian Seas Programme (SASP) is the appropriate regional platform working on need-based actions for protection and sustainable management of marine environment including preparation of regional action plans, regional policy, coral reef taskforce, capacity development, awareness raising and experience sharing among the member countries.

Furthermore, we are strengthening our co-operation with international organization to improve our capacity in sustaining our marine environment.

Through active support from our member states and international partners, we have successfully implemented different activities including development of Coastal and marine Biodiversity Strategy as well as Regional Marine Litter Action plan, which will be formally adopted by our upcoming GC as well as IMM.

With the technical support from INMS and financial support by UK we have also established South Asia Nitrogen Hub in order to scientifically address nutrient pollution and improve Nitrogen management in South Asia. This programme will bring policy makers as well as scientific and research institutions together to develop a scientific base policy on nitrogen management. Under this programme, a draft resolution on nitrogen management was developed and forwarded by India to UNEA 4, which then adopted by UNEA 4 as a global resolution.

Apart from the above, we have plan to facilitate the adoption of London Protocol and OPRC-HNS by SAS region countries in collaboration with IMO very shortly and hope that this will also be adopted by GC and IMM.

I would like to appreciate the support extended by the member countries of the South Asian Seas Programme (SASP) in implementing these activities. Technical and financial support provided by the UNEP is also highly appreciated.

SACEP is highly obliged again to UN Environment for its support in developing a regional project proposal to address land-based pollution threats, caused mainly by agriculture, plastics, waste-water and sewage from industries and households to conserve coastal ecosystems around the South Asian Seas (SAS) region. In best of my knowledge this project will overall covers most of the thematic areas of the Coastal and Marine biodiversity strategy. It has accepted measures put forward to prevent pollution in rivers, lakes, groundwater and ultimately to the coast sea from agriculture.

Before starting to address the issue from regional prospective, we have initiated a small project from national prospective called:

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

It was a pilot project with the goal to 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

In this Regional Stakeholder Meeting we particularly will focus on the key coastal environmental issues contributing to the restoration of Marine coastal biodiversity in South Asian Seas region through lesson learned from the Sir Lanka pilot project and a new project proposal to GEF-7 though UN Environment will be developed. The new proposed project will serve as leverage to access larger financing to support investing in such scalable innovative pollution control measures within the region. 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. Furthermore, it will 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

I am confident that this workshop will go a long way in developing a strong foundation for addressing Coastal and Marine environmental challenges in South Asia and finding the best solutions. Finally, the SAS countries Government associated with SACEP and other International Marine environmental agencies will be extremely beneficial of such an initiative in the South Asian region for Protecting our Marine and Coastal ecology.

Thanks.

4.2.4

OPENING REMARKS

Mr. Gabriel Grimsditch
UN Environment, Nairobi, Kenya
Regional Stakeholder Meeting addressing on Sustainable Nutrient Management to reduce soil, water and coastal pollution in South Asian Seas region
1st April 2019, Colombo, Sri Lanka

Honorable Mr. Mapa State Secretary, Ministry of Mahaweli Development and Environment, Government of Sri Lanka.

Director General, SACEP

And the Government representatives from SAS country to the regional workshop.

It was great pleasure to be here in Sri Lanka for the Regional Workshop. Thanked SACEP and government of Sri Lanka for hosting and hospitality. Noted UNEA resolutions adopted at UNEA-4 specifically resolutions on nitrogen, coral reefs, mangroves, marine plastic litter and protection of the marine environment from land-based activities. Acknowledged that we cannot manage the ocean and coral reefs without managing what happens on land, and the first phase of the pilot project on pollution on coral reefs in Sri Lanka is a good step in that direction.

4.2.5

Inaugural Address

Mr M P D U K Mapa Pathirana, State Secretary, Ministry of Mahaweli Development & Environment
Regional Stakeholder Meeting to discuss the capacity building needs on Sustainable Nutrient Management to reduce soil, water and coastal pollution in South Asian Seas region
Colombo, Sri Lanka from 1-2 April 2019

AYUBOWAN !

Dr Abas Basir, Director General, South Asia Co-Operative Environment Programme
Representatives from SACEP Member States
Representatives from UNEP
Officials from State, Non State Sectors
Academicians
Ladies and Gentlemen

Two weeks after the Fourth Session of the United Nations Environment Assembly, we are meeting here in Colombo. First of all, let me appreciate, South Asia Cooperative Environment Programme for their success in drawing the global attention to a matter of serious regional significance, through the resolution on Nitrogen Management. Let me extend our gratitude to the Government of India in submitting the resolution.

One of the salient facts revealed with the resolution on Nitrogen Management is that more than 80% of nitrogen introduced by man is directly lost back to the environment contributing seriously to environment pollution as well as to climate change, which I believe is a serious concern to be addressed with appropriate policy and regulatory interventions.

Being located closer to the equator and with the blessing of the unique Himalayan region, South Asia is characterized by monsoonal rainfalls. Such rainfall with extensive network of waterways across the region distributes adequate nitrogen which we may utilize for agricultural purposes by adjusting our cropping calendars according to the natural nitrogen cycle.

Ladies and gentlemen,

We need credible research on such aspects, in order to ensure that the world is benefitted through the resolution on nitrogen management.

I foresee the proposed South Asian Nitrogen Hub as a productive venture in this regard, where Western World is collaborated in terms of knowledge, technology and finance to unveil ancient wisdom of South Asia. Let me propose, that SACEP involves unveiling fullest potential of the proposed Nitrogen Hub in a broader and meaningful sense, contributing to address the majority of land based chemical pollution issues as well as the health consequences associated with chemical fertilizer misuse in our region.

We are happy that Sri Lanka is hosting the headquarters of SACEP in Colombo and always willing to assist SACEP in delivering its mandate effectively. We observe that Member States are more benefitted through this historical environment cooperation, if Member States are made aware of a detailed annual action plan of proposed programmes and events of SACEP well in advance, enabling the respective countries to align their national programmes accordingly.

On the other hand, to ensure that both tangible and intangible resources are mobilized in expandable measures delivering long term benefits to Member States, it is expected that SACEP work closely with National Focal Points and all communication is channeled through appropriate channel.

Ladies and Gentlemen,

Under the able leadership of His Excellency Maithripala Sirisena, the President of the Democratic Socialist Republic of Sri Lanka, who is also the Minister in charge of the portfolio of Environment, Sri Lanka pursues a career of strengthening its environment charter while well contributing to the global agenda of environment conservation.

Proving the fact, Sri Lanka submitted four resolutions to the Fourth Session of the Environment Assembly and is with plans to implement the proposed actions through annual action plans while promoting innovations, one of which directed on transportation sector is well appreciated at the Fourth Session of the United Nations Environment Assembly. Sri Lanka seeks graceful support of United Nations Environment Programme and like-minded institutions and co-operations to leverage on such aspects.

Sri Lanka further believes such actions can be synergized effectively, collaborating with regional friends through SACEP. Therefore, as the host country, we request SACEP to harness on such aspects targeting effective long-term benefits.

One country alone cannot act on the trans-boundary movement of waste. Actions of South Asia Seas Programme can be synergized with the actions of Bay of Bengal Large Marine Ecosystem Project, specially to manage trans-boundary issues related to waste.

Ladies and Gentlemen,

Be it climate change, environment pollution, biodiversity loss or any other thematic area threatening not only the human life, but the life on earth as whole, we humans are responsible for altering the earth's natural balance. Only humans can work to reinstate the alterations. Let us collaborate and work closely through SACEP as regional members to deliver its mandate genuinely for the benefit of this world.

Let me wish this regional meeting a great success and I believe the outcomes of this workshop be productively used to deliver the mandate of SACEP.

Thank You !

05. Summary of Presentations

05.1 SACEP Presentation:

Dr. Sivaji Patra, Senior Programme Officer of South Asian Seas (SAS) Programme, from South Asia Cooperative Environment Programme (SACEP) made a presentation which covers the objectives of the project in general and the specific objectives of this workshop. He briefly presented the outline of the project starting from the first activity. He mentioned the importance of the workshops. He underlined the risk of Land-based pollution to regional marine in the South Asian Seas region. He presented the steps taken and historical background for the regional marine pollution related activities coordinated by SASEP for the SAS region. He mentioned the great achievement on the regional Action Plan could be the beneficiary countries and the supportive role of the SACEP as a secretariat South Asian Seas Program. He finalized his presentation by indicating the general provisions of making the Regional Project based on the Lesson learned from the pilot project as well as the seeking feedbacks form the member countries.

05.2 UN Environment Presentation:

Mr. Gabriel Grimsditch made presentation to build on the first phase of the Sri Lanka pollution and coral reefs project, a possible pathway for sustainability and upscaling of the project is the development of a regional project on pollution, coral reefs and the blue economy. A potential opportunity is to apply for a regional project with the GEF International Waters funding stream. Focal areas under International Waters to target are Objective 1 on strengthening the blue economy, with strategic actions 1.1 on sustaining healthy coastal and marine ecosystems, and strategic action 1.3 on addressing pollution reduction in marine environments. The regional proposal could also consider implementing parts of the Bay of Bengal Large Marine Ecosystem Strategic Action Plan, with a focus on Themes 2 and 3 on critical habitats and water quality respectively. Finally he mentioned about an important next step, a concept note for a regional proposal on mitigating pollution and sustainable management of coral reefs is necessary, which will lay the foundation for the development of a GEF Project Identification Form.

05.3 SAS-Member state Country Remarks:

05.3.1 Remark by Government of India:

Dr. Asha Devi briefed about the current activities of Centre for Marine Living Resources & Ecology and National Center for coastal research under the Ministry of Earth Sciences, Government of India which is mandated with implementing the Marine Living Resources Programme (MLRP) which inter-alia include mapping of the living resources, preparing inventory of commercially exploitable living marine resources. The contents included a brief introduction on the various aspects of nutrient pollution leading to biodiversity loss, eutrophication and other anthropogenic effects on the coastal and marine biodiversity. The SeaWater Quality Monitoring programme (SWQM) initiated by National Centre for Coastal Research, Ministry of Earth Sciences with the objective to detect periodical changes in coastal water quality, predict pollution levels and undertake associated activities like determination of sea water quality

criteria to facilitate actions that ensure protection and preservation of marine environment. The highlights of the study showed the map with locations for detecting the periodical changes in the water quality along the Indian coast taking into consideration of 54 parameters covering the physico-chemical, biological and sediment characteristics were explained. Based on these, Water Quality Index for 2011-2015 has been delineated for different zones. In addition, plastic pollution and Transfer of MPs from land to sea and their inclusion in the food web and adverse effects on the marine life and human health were highlighted. The ecosystem approach to understand inter-relationships between physical processes and impact on biogeochemistry, the expanse of oxygen minimum zones, hypoxia/anoxia etc were also dealt with. The coral reef ecosystem of Lakshadweep was highlighted as an initiative to be considered. The present monitoring surveys through Documentation of coral reef and its associated animals were done through SCUBA diving surveys and intertidal surveys. Reef associated faunal communities through underwater photography and collection of taxonomically important species were documented. These surveys were done in conjunction with the collection of environmental parameters and current measurements and therefore changes if any can be correlated with the environmental factors.

05.3.2 Remark by Government of Maldives:

Mr. Shimhaz Wafir presented the below specific points and highlighted about the importance of the future regional project proposal.

1. Nitrogen based fertilizers use in the country and amount applied
    - NPK+ Micro elements (1056.19 Metric Tons imported)
    - Nitrogen Fertilizers
        - Ammonium Sulphate (98.85 Metric Tons)
        - Calcium Nitrate (11.97 Metric Tons)
        - Urea (112.20 Metric Tons)
    - Pesticides (Fungicides, herbicides, algaecides, insecticides and plant growth regulators)

2. Nitrogen use efficiency of Different cropping system
    - Agriculture land is 26.67% as per 2009
    - Fertilizer use is heaviest in major agricultural land (Laamu, Thoddoo, Kaashidhoo, Shaviyani) and other industrial islands
    - The amount of fertilizers consumed in each island is not recorded and farmers also do not keep the records

3. GHG emission; water and land pollution due to N based fertilizers
    - The main GHG Emission reported in the inventory are CO2, CH4 and N2O
    - Total emission in 2011 is 1225.598Gg CO2e
    - 72.729 Gg CO2e is from waste sector
    - N pollution factors were not recorded
    - Sewage and waste water is pumped to sea, in Capital Male' and in islands
    - Chemical fertilizers used in farms pollute the land
4. Existing policy and new policy development on fertilizer management
    - Fertilizer companies have to be registered under Ministry of Fisheries Marine Resources and Agriculture

- Importers have to obtain prior license for all chemicals
- MoFMA keeps an updated list on chemicals that can be imported
- Ministry of Defense and National Security only authorizes permit
- Prohibited Substance Act (No. 4/75)

5. Public awareness on nutrient use and its impact and Capacity building activities carried out
   - Seminars and workshops on ad hoc basis
   - Pest management awareness
   - Agricultural Center (Hanimaadhoo) provide information on the use of nutrients locally to the community
   - Training staff stationed in different regions
   - Train locals on good agriculture practices
   - Pest management awareness trainings

6. Responsible Institutions (Government/NGOs)
   - Ministry of Environment
   - Environmental Protection Agency (EPA)
   - Ministry of Fisheries, Agriculture and Marine Resources
   - Ministry of Health
   - Health Protection Agency (HPA)
   - Maldives Food and Drug Authority
   - Ministry of Housing and Urban Development
   - Land Survey Authority

7. Scientific information available on land, water, air and sea pollution
   - We have a Research Center at Maldives National University. The center is involved in multi-disciplinary researches including environment and agriculture
   - Ilmee Foavahi – a research forum held by MNU. Recently had a session on micro plastics in food
   - FEST hosting, Environmental Management, Marine Science (forums and projects)
   - The National Communication Report 2015, reports about the Carbon emission mostly

8. Usage of plastics, Generation of plastic waste and existing management system of Plastics
   - Household
   - Local business, institutions
   - Restaurants (Straws, disposable cups & other)
   - Bottling (200,000 bottles of water are produced per day)
   - 280000 is usage in the Capital Male'
   - Plastic shopping bags (27 million non-biodegradable & 80 million Biodegradable imported in 2017)
   - Imports
   - Dumping
   - Unmanaged Burning

9. Level of plastic related pollution
   - No data have been collected on how much plastics and pollution occurs in the Maldives

- Plastic pollution in sensitive eco systems like wetlands and other terrestrial lands are not recorded
- 70% of the plastics are single-use plastics (PET bottles)
- No proper recycling facility in the Maldives
- Parley Maldives (NGO) collects 10% plastics for export

10. Policy of capacity building on control of plastics usage and management
    - Tariff for non-biodegradable plastic bags was hiked from 200 to 400 percent
    - Usage of oxo-degradable bags was endorsed by Environmental Protection Agency, Maldives
    - Waste Management Policy
    - Policy framework on Plastic Pollution in under draft stage

11. Current ways of managing wastewater and sewage and Information about their pollution status
    - No treatments for the waste water or sewage
    - Pumping out into surrounding sea, by pump stations
    - Public beach was closed due to leakage of raw sewage
    - We lack monitoring mechanism
    - We lack standards to check sea water quality and pollution sources
    - No data systems is established in any institution

12. Any policy to sustainable handling of waste water and sewage
    - No specific policy on sustainable handling of waste water and sewage
    - No treatment for waste water and sewage

13. Information on sea water quality, pollution sources and level of pollution
    - Beach sea water quality is tested in EIAs in building resorts
    - No proper record of sea water quality
    - It is identified that sewage is one of the main source, marine plastics as well
    - We lack monitoring mechanism
    - We lack standards to check sea water quality and pollution sources

14. Impacts on coral reefs and records on accumulation of garbage (plastic), sewage and nutrients on beaches, sea water and changes of diversity
    - Coral mining
    - Dredging
    - Reclamation
    - Construction of Maritime structures
    - These socioeconomic developments have impacts on coral reefs. However the scale is uncertain
    - Sea grass and coral removals in major developments
    - Due to lack of equipment and potential capacity, we do not have exact data on the accumulated garbage.
    - Plastic comprises 70% of the waste

15. Government regulation on protecting coastal ecosystem from these sources
    - Waste Management Regulation

- Sand Mining Act
- Reclamation and Dredging Regulation
- Penalty and Liability Regulation

05.3.3 Remark by Ms. Deepa Liyanage, Ministry of Mahaweli Development and Environment Government of Sri Lanka:

AYUBOWAN !

Let me welcome all the foreign delegates to Sri Lanka. Hope you have a wonderful stay here in this beautiful city of Colombo and enjoy the warm hospitality of Sri Lankans.

I take this opportunity to extend our sincere gratitude to the South Asia Co-operative Environment Programme for their supportive role in addressing important regional environment issues.

As you may already aware, the Global Climate Risk Index has identified Sri Lanka as the second most vulnerable country in the world in year 2019 to the adverse effects of climate change. Being an agriculture-based country and nearly 70 % of farmers are inhabitants of the Dry Zone, developing suitable strategies to combat the adverse effects of climate change is very important. Therefore, we encourage collaborations on ambitious projects to address issues related to the adverse effects of climate change.

Under the able leadership of His Excellency the President, Sri Lanka submitted resolutions on food loss and waste, mangrove restoration, waste management and marine litter and micro plastics at the recently concluded UNEA 4. This Ministry is with plans of further strengthening the mechanism of implementing the adopted resolutions.

Sri Lanka being an island has 103 river basins. Litter and pollutant chemicals accumulated through river basins end up in the ocean resulting in severe marine environmental issues. Sri Lanka is championing the Commonwealth Blue Charter in mangrove restoration and strengthening the country's capacity of exchanging technological know-how. Further, Sri Lanka has joined the United Nations Clean Seas Campaign and looking for elaborative projects to address the issues related to marine pollution. Therefore, Ministry of Mahaweli Development & Environment as the National Focal Point for SACEP, SASP, UNEP and GEF is very much willing to collaborate on developing the proposed regional project on addressing issues related to marine environment.

I hope this regional meeting would be a productive venture in outlining the proposed regional project.

0.5.4 Presentation: Development of best management practice guidelines on successful approach for plastic waste disposal and National Policies Reports by Dr.B.N. Desai, Jawaharlal Nehru University, India (Regional Consultant)

Marine Litter has emerged vital environmental threat for marine and coastal areas in recent times. It has impacted almost all the coastal states detrimental to their ecological benefits, economic costs and social interests at international, regional and national level. It has been estimated that around 2.41 million tons of plastic waste flow from river into ocean annually. About 70 percent of marine litter is on seabed, 15 percent is floating and 15 percent on seashore. (OSPAR, 1995). The top 20 polluting rivers are mostly located in Asia and they

accounted for 67 percent of the total global plastic waste. Bangladesh, India and Pakistan have large amount of marine litter in SAS Region.

SAS Countries are most vital and vulnerable to the impacts of the marine litter due to dense population, specific location, climatic zones, consumption and utilization of resources, waste generation and disposal, dependency on agriculture, aquaculture, tourism and transportation. There has been lack of effective legal instruments, management strategies and direct developmental activities for reduction, control and management of marine litter in SAS Region. There has been taken initiatives for 'Regional Action Plan on Marine Litter For SAS Region' by the UNEP and SACEP in recent time. This has been initiated on the request of the SAS member countries and institutions to combat marine litter pollution with international and regional cooperation and coordination. This is to examine the existing status, problems, regulation and management of the marine litter in SAS region, to trace the gaps and challenges and to suggests the necessary actions and deliberations for prevention and reduction of marine litter pollution in this region.

Marine Litter has been defined as "any persistent, manufactured and processed solid material discarded, disposed of and abandoned in to the marine and coastal environment." Marine Litter includes the items and materials that have been made or used by human and deliberately discarded in to sea or river or on beach; brought indirectly to the sea by river, sewage, storm or wind; accidently lost or deliberately left by people on beaches and shores. (UNEP, 2005) Marine Litter has been classified by different scientists, authors and experts as such: plastic, metal, glass, processed timber, paper, cardboard, rubber, cloths and tar balls etc. This is not exhaustive list but only indicative for the purpose of segregation and quantification of the amount of marine litter found in the marine environment.

There has been two basic sources indicated in the research and studies: Land-based Sources and Sea-based Sources. The land based sources includes the industrial and municipal wastes discharge through rivers, streams, flood, wind, storm and current. The sea based sources have been recognized as merchant shipping, ferries and cruise lines, fishing vessels, offshore oil and gas platforms etc. The causes for the marine litter have been assigned to dense population residing at coast and beaches, urbanization of the coastal cities and areas, consumption and utilization of resources, trade and transportation through sea and tourism and recreational activities at the coast and beaches of the sea. The prevalence of marine litter in the marine environment has ecological, economic and social impacts on national, regional and international level. The ill-effects are most disturbing and visible specially for the coastal states and cities having adverse effect on public heath and safty.

To combat and reduce the negative and trans-boundary impacts of the marine litter, there has not been developed and adopted any binding international legal instrument which would directly address this problem at international and regional level. Though , there are international and regional conventions, protocols, agreements, strategies, directives and action plans for the protection of marine environment. International Legal Instruments are: United Nations Convention on the Law of Sea (UNCLOS) {Part XII, Articles 192-237}; London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matters (1992) and Its Protocol (1996); MARPOL Convention for the Prevention of Pollution from Ships (1998); UNGA Resolution 2749/1982; Washington Declaration (1995); Honolulu Strategy, 2011. Regional Legal Instruments are: Convention on the Ban of the Import in to Africa and the Control of Trans-boundary Movement and Management of Hazardous Waste within Africa

(1998) better known as Bamako Convention; Convention for the Protection of the Marine Environment of the North-East Atlantic (1998) known as OSPAR Convention; Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (1986) known as Cartagena Convention; Convention for the Protection of the Marine Environment of the Baltic Sea Area (1992) known as Helsinki Convention. National Instruments have been also developed y some states such as: Unites Sates of America (USA), United Kingdom (UK), South Korea, Taiwan etc.`No international and regional legal instruments are directly applicable to the SAS region and no SAS countries have yet developed national instrument or strategies to combat the marine litter.

The SAS region includes the sea bordering countries such as Bangladesh, India, Pakistan , Maldives and Sri Lanka situated in the Indian Ocean, Bay of Bengal and the Arabian Sea. This region is densely populated and highly rich in biodiversity and wildlife along with wide area of marine environment. The marine litter and micro plastic with its quantity and intensity ending up in the ocean of the SAS region has been found in alarming stage. The origin and pathways are diverse and status and impacts are not fully known due to lack of research, analysis and assessment made in recent time. Basic information, data, plan, strategies and legal instruments are limited with regard to marine litter in the SAS region. There is also lack of proper regulation and management program, action and activities for the reduction, control and management of the marine litter in the SAS countries. All SAS countries are facing ecological, economic and social ill-effects of the marine litter detrimental to human health and marine environment. There has been no research outcome and assessment on the basis of ecological, economic and social parameters indicators for examining the impacts of the marine litter. There are several international conventions and protocols to control and prevent the marine pollution, but very few are applicable and implemented fully in the SAS region. However, some SAS countries have developed and implemented the national strategies and action plan for the solid waste and marine litters such as Sri Lanka and India.

Major barriers in the SAS region to address the problem of marine litters are inadequate research, area or site specific studies, education and participation of the stakeholders. There is also dearth of economic and market instruments, tools and techniques for effective management of marine litter. There has been suggested to consider the pathways for effective regulation and management of marine litters in the SAS region such as: constitution of dedicated institution/agency, effective legal instrument and policy, research and studies, involvement and participation of the all stakeholders.

SAS countries are Bangladesh, India, Pakistan, Maldives and Sri Lanka combating the problem of marine litter in this region. These countries do not possess consolidated database on quantities, density and impacts of the marine litter in the domestic jurisdiction. These countries are also lack of proper institutional mechanism and adequate legal instruments for regulation and management of marine litter. Despite of the several international and regional instruments, these countries are lagging behind in the implementation and enforcement of the regulatory and management regime of marine litter. No uniform and standard methods are used in the collection, management and disposal of the marine litter. There has been no strict mechanism to regulate the production and consumption of the plastic and other material disposed of in the sea and beaches. There is also lack of dedicated education and awareness programme for marine litter in the SAS countries.

SAS countries also lack the marketing and economic tools and techniques for effective management of Marine litter at production and consumption level. Private sector production, consumption and businesses have to be involved for the management of marine litters. There is need to evaluate the individual statues of the SAS countries for the better understanding and solution of the problem of marine litter. This individual analysis will also help in suggesting appropriate mechanism to deal with the marine litter. Policy, Legal and Institutional Responses in five countries: Bangladesh, India, Pakistan, Maldives and Sri Lanka.

In Bangladesh, Marine litter has not been much concern to the government as it has caused immense harm to the people and marine environment in recent time. No specific agency has been constituted for marine litter monitoring and management. The preliminary investigation was conducted in Nov. 2017 in Cox's Bazar and Chittagong districts in four sampling stations or beaches whereby 6705 numbers of marine litter in these area has been found specially the plastic or micro plastic from land based sources only. The amount of plastic found in large quantity in the Cox's Bazar than the Chittagong district. The preliminary report suggested that the sources of these marine litter in both districts were rivers and canals, dumping by ships and boats, surface drainage and other sources. But it has been found difficult to found the quantity and the exact source of the marine litter. Marine litter has caused serious damage to the ecological, economic and social health and life in these two districts specially with regard to fishing, transport and tourism. There is no marine litter policy as well as legislation in Bangladesh. Though, Government uses the provisions of the Environment Conservation Act and Regulations in this regard. There is also coastal Zone Policy, 2005 and Costal Zone Strategy, 2006. National Environmental Management Action Plan has been aslo prepared in 1995 for the reduction of marine litter pollution.

Marine litter has been major problem in India having long cost and big islands within its jurisdiction. Most of the marine litter originates from land based sources. The study has been made for certain areas such as Gujarat, Maharashtra, Goa, Kerala, Karnataka, Tamilnadu and Andaman and Nicobar Islands. Marine litter occur in all five compartments such as coastline, surface, main water column, seabed and biota in these region from both land based sources and sea based sources. It has impacted the human health and food safety, profession and occupation, trade and transportation, fisheries and aquaculture, ecology and biodiversity of the country. There is enough management institutions and agencies working for the environment including marine pollution. However, India does not have National Marine Litter Policy and legislation. Recent initiatives under ages of Swachh Bharat Abhiyan , coastal areas are cleaned and monitored for the marine litter pollution. Community participation, collaboration with industries and NGOs has been also initiated by the government. There has been need to strengthen the legal institutional regime, capacity building, public awareness, research and studies for the proper regulation and management of marine litter in India. India had promised to eliminate all single use plastics by 2022.

Marine litter has been one of the major environmental problem in the coastal zone of Pakistan. The marine pollution has been largely due to the indiscriminate discharge of effluents from land based sources. The sources of marine litter has been manmade through disposable of solid waise , untreated effluent, fishing activities tourism. The kind of marine litter found in Pakistan includes plastic bags balloons, glass bottle, fishing lying and nets and oil and ship garbage. The marine litter tremendous impact in Pakistan with regard to its ecological, economic and social areas. The social impact includes the human and animal health, food security and safety, life and livelihood of fishermen and tourist. The economic impact of the marine litter has been

basically in coastal areas and the cities harming the fisheries tourism, seabed resources transport and export services. There have been several environmental laws and policies in Pakistan for addressing coastal and marine pollution. But they are not adequate and do not exclusively deal with marine litter. Pakistan Environmental Protection Act 1997 imposed ban on plastic products and also designated the Pakistan maritime zone for monitoring and control marine pollution. No specific laws relating to marine litter have been developed at national as well as provincial level in Pakistan. There has no monitoring and enforcement mechanism to reduced and control the marine litter in Pakistan.

Maldives located in the Indian ocean is an island in south west India. Marine litter has been one of the major concern for the marine environment in Maldives. This problem has been aggravated due to growth in population changing consumption pattern and lack of waste disposal and management. Along with land based sources the sea based sources have also contributed to the marine litter. The marine litter mostly occurs from local sources like local communities, tourists, marine vessels and domestic waste. There has been also recognized social, economic and ecological impact harming the marine environment. Marine litter has diminished the intrinsic and social values, human health and food safety, social life and security in Maldives. The economic impact has been related with consumption and utilization marine resources, trade and transportation, tourism and recreational activities in Maldives. The ecological impact has been attributed to the human, animal and wildlife depended upon the marine environment. The main regulation for the solid waste management in the Maldives is the National Solid Waste Management Regulations , 2013 passed under the Environmental Protection and Preservation Act, 1993. Besides, there has been campaigns, strategies and activities to reduce marine litter and its management in Maldives. There have been certain gaps and challenges in the regulation and management of the marine litter such as: insufficient data and information, inadequate regulations and management strategies, monitoring and enforcement, lack of education and awareness about the marine litter.

Sri Lanka is one of the SAS countries located in the Indian Ocean. Without any exception, Sri Lanka is also facing the problem of marine litter and waste management. Marine litter has become major threat to the marine environment in all five provinces of Sri Lanka. The marine litter entering in to the ocean of the Sri Lanka has been categorized as sea based sources, costal base sources and Inland based sources. The land based litter is contributing more than 90 percent of the litter enter in to the marine and costal areas of Sri Lanka through rivers and canals. Marine litter has negatively impacted the ecological, economic and social status of Sri Lanka. It has impacted the coral reef, sea grass beds and mangroves along with biodiversity and marine ecosystem. It also affects the national economy, industries and tourism in country. It has adversely affected the human health and food safety, social life and security especially in the coastal areas. Major legislation includes the Marine Pollution Prevention Act, 2008. It provides the mandate to prevent, reduce and control the marine pollution. The Marine Environment Protection Regulations, 2012 has also prohibited the dumping of waste and other matters. There is no national level policy on the marine litter in Sri Lanka.There has certain gaps and challenges to the regulation and management of marine litter, institutional and enforcement mechanism, budget and infrastructure, education and awareness in Sri Lanka.

The waste management practices could be used for combating the marine litter through reduction and reuse, recycling, composting and fermentation, landfills and land application.

- ✓ For the marine litter, the best solid waste management practices could be adopted mainly in four ways:

- ✓ Waste Collection: organized and innovative method of collection, segregation and transport.
- ✓ Source Reduction: Eco- design, single use, waste reuse and recycling, port reception facilities.
- ✓ Scientific Landfills: Designing scientific landfills and dumping yards, prohibition of waste burning and landfills fire.
- ✓ Cleanup Activities: Promotion of cleanup activities and initiatives in collaboration of international and national agencies/organizations/institutions.
- ✓ Changing Human Behavior/Habits/Attitudes: Discourage polluting behavior and promotion of cleanness in beaches, coasts, tourism and recreation places.
- ✓ Economic/Market based Instruments: Imposition of the landfill taxes, product taxes, high fees and fines, deposit-refund schemes.

All these efforts/practices would contribute to the better marine litter management and reduction contributing towards sustainable waste management practices in SAS region. SAS countries have adopted best solid waste management practices, but not specifically for marine litter. Marine litter has been considered as solid waste only for the reduction , management and disposal within national jurisdiction. The best solid management practices have been adopted by some of the SAS countries include:

- ✓ Plastic Waste Collection, Handling, Transport and Disposal
- ✓ Plastic Waste Avoidance, Reduction, Reuse, Recycle or Treatment.
- ✓ Banning the Fishing Gear and Ghost Fishing.
- ✓ Construction of Proper and Scientific Landfills.
- ✓ Beach Cleanup and Conservation Activities.
- ✓ Strengthening Waste Management Rules/Regulations/Strategies/Practices.
- ✓ Use of Economic/Market based Instruments

For the SAS countries, it is essential to integrate the marine litter management practices with solid waste management practices beneficial to the marine environment and sea. The best regional practices should also be adopted like Wider Caribbean or Mediterranean region. The best solid waste management practices have also been adopted by some developed countries like USA,UK, Sweden, Japan and Netherland which could be useful for marine litter management practices in SAS region. The National Governments of the SAS region have to incorporate and coordinate best marine litter management practices through plan/program/funds/research/studies. The basic aim could be to convert the marine litter into wealth by keeping the sea clean.

Bangladesh: Dhaka City Corporation is responsible for adopting the best waste management practices for collection, transportation, disposal and treatment of the plastic waste in metropolitan areas including the costal and beach areas. However, it has only 50 percent

manpower and financial capacity to manage the solid or plastic waste. Regular beach clean up practices – e.g. *International Cleanup Day Campaign*.

India: Along with CRZ authorities, pollution boards and municipalities, the NGOs and research institutions are also contributing in the best solid management practices. Regular beach clean up practices and *International Cleanup Day Campaign*.

Pakistan: Karachi Municipal Corporation along with Maritime Security Agency is responsible for the plastic waste collection disposal and management. Less amount of waste is disposed with best waste management practices. No regular beach clean up activities. However no report on *International Cleanup Day Campaign*.

Maldives: No best and sound waste management practices effectively followed. Solid waste are collected, transported and disposed mostly by the private agencies. Organic waste are disposed at home backyard and plastic are dumped near beaches in Island. No regular beach clean up activities and no report on *International Cleanup Day Campaign.*

Sri Lanka: Local Authorities of the Islands are responsible to adopt the best management practices for the plastic waste in all the five provinces. But, the local authorities lack the funding, infrastructure, equipments, composting facilities, recycling plants and proper landfills. Regular beach clean-up activities; no report on *International Cleanup Day Campaign*. To sum-up, SACEP needs to take the lead in promoting education and awareness in consultation with SAS member countries.; e.g. the UN Clean Seas Campaign (launched in Jan.2017). UNEP needs to provide all possible assistance in technical and funding to SAS program as part of UNEP's 'jewel in the crown' –Regional Seas Program. SACEP and SAS can work on developing a Regional Action Plan/Guidelines that could encourage member countries to fine tune respective policies, legislative and institutional mechanisms. Need to employ variety of tools, techniques and legal instruments to make decisive dent on the menace of marine litter in a time bound manner. SACEP and UNEP need to work in unison to make SAS region plastic-free in foreseeable future.

0.5.5 Presentation: Development of protocol for joint assessment of water quality SDG Targets 6.3 and 14.1 freshwater and Marine pollution by Dr. P.B. Terney Pradeep Kumara, MEPA, Sri Lanka. (Consultant)

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 and 51 coral species. 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 nutrients from land based sources. 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 kilometers and receives an estimated 3,060 million cubic metres of rain per year, where approximately 26 percent of the water reaches the sea.

Kayankerni coral reef is highly diverse coral reef and it is facing threat of pollution owing to upstream anthropogenic activities. The highest amount of pollutant release due to upstream activities caries to the sea via river and due to this coral reef is facing serious threat. Mainly water quality deterioration due to nutrient and other pollutant is major issue. Accordingly measures should be taken to control upstream activities and reduce nutrient and other types of pollutant enter into water bodies to protect the coral reef. The land to sea pollution prevention mechanism should be adopted. Linkage of sustainable development goal 6.3. and 14.1 and water quality monitoring porgamme to assessment of targets.Sustainable Development Goals encompasses 17 goals and within these goals SDG 6 and 14 directly look into fresh water pollution and marine water pollution. The third target of the SDG (6.3.) is "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". The target 6.3 divided into two indicators. There are two proposed indicators to measure the achievement of target.

The first indicator: 6.3.1 "Proportion of wastewater safely treated" addresses the latter part of the target that calls for a halving of the proportion of untreated wastewater. The second indicator 6.3.2: "Proportion of bodies of water with good ambient water quality" aims to cover freshwater quality more generally by assessing the proportion of freshwater bodies with good ambient water quality.

The proposed indicator of 6.3.1 is 6.3.1 "Proportion of wastewater safely treated. This indicator designed to cover all wastewater, with focus on households and effluent from hazardous industries. The large amount of domestic waste water and industrial waste water discharge into water stream or rivers and finally end up with the sea. A halving of the proportion of untreated wastewater as defined and measured by indicator 6.3.1 is likely to relieve fresh and marine water recipients of a significant part of the (Biochemical oxygen demand BOD) and nutrient loads and greatly contribute to reducing marine pollution. It would also contribute significantly to reducing adverse impacts on the marine and coastal environments and allow for their restoration. It can be argued that reducing the nutrient load through the increase of proportion of waste water safely treated can be reduced marine pollution and therefore there is very good link among two indicators. In addition, Indicator 6.3.2 shall measure the areal proportion of water bodies in a country with good ambient water quality compared to all water bodies in the country. The word "Good" is defined as an ambient water quality that does not damage ecosystem function and human health. Rivers and other water bodies connected to the sea and all drains coming through the catchment finally end up with the sea. If the water bodies water quality can remain as a good condition, the pollution load coming from land base rivers and water bodies can be reduced.

The water quality parameters (Dissolved oxygen, Salinity, Electrical conductivity, pH, BOD, COD, Total inorganic nitrogen, Total phosphorous and Reactive silicate) should be measured to assess the SDG 6.3

Especially nutrients release from agriculture, aquaculture, municipal etc should be reduced to maintain water bodies in a good water quality condition. Eventually this finally reduces the pollution load. Therefore it is very clear that SDG goal 6.3 and 14.1 has very strong link and the achievement of 6.3 target eventually helpful to achieve the target of SDG 14.1. "Index of coastal eutrophication and floating plastic debris density. The main cause of hypoxic conditions,

is excessive nutrient pollution from land-based human activities. The proportion of floating plastic debris that enters the marine environment through rivers seems not to have been quantified but significant amount plastic litter entered to the sea by rivers is probably significant. It is therefore necessary to introduce joint assessment mechanism to monitor SDG 6.3 and 14.1. This will help to monitor the positive impact of the adopted pollution control practices and accordingly necessary measures can be adopted to control pollution.It is necessary to have a systematic approach to measure and monitor indicators through this evaluation can be done to understand the level of achievement of each target.

As per the GEMS guideline using the target values, a simple index based on the compliance of the monitoring data with the selected target values is used to classify the quality of individual water bodies. The monitoring values of the water body in all locations of the water body are compared with the target values. The index is defined as the percentage of monitoring values that complies with the target values.

In order to assess the above indexers, it is necessary to measure the following water quality parameters in selected location of the water bodies, that are:Dissolved oxygen, Salinity, Electrical conductivity, pH, BOD, COD, Total inorganic nitrogen, Total phosphorous and Reactive silicate.

There is no internationally accepted methodology to assess the proposed indicator of the Index of coastal eutrophication potential (ICEP) However, there are proposed method and following can be adopted to measure the indicator.

$$\text{ICEP} = [\text{NFlx}/(14*16) - \text{SiFlx}/(28*20)]*106*12 \quad \text{if } N/P<16 \text{ (N limiting)}$$

$$\text{ICEP} = [\text{PFlx}/31 - \text{SiFlx}/(28*20)]*106*12 \quad \text{if } N/P>16 \text{ (P limiting)}$$

As per the above equation this indicator calculates the fluxes of nitrogen and phosphorus and finally it diverted carbon Kg per square Km per day. Hence this can be used only rivers and stream which flows to the sea. Based on that eutrophication potential can be decided. However actual eutrophication potential of the selected sea area cannot measure using the above indicator. It is essential to obtain the sea areas actual eutrophication level based on the nutrient load. Therefore, we proposed to use TRIX index which can use to measure eutrophication level of selected coastal areas.

$$\text{TRIX} = (k/n) \sum^{i=n} ((\log M - \log L)/(\log U - \log L))_i$$

it is necessary measure following parameters of the fresh and sea water for calculation of the above indicators.

ICEP

Dissolved organic nitrogen, Particulate nitrogen, dissolved inorganic nitrogen, Dissolved organic phosphorus, Particulate phosphorus, Total Prosperous and Reactive Silica

TRIX

Chlorophyll- a (µg/L), Oxygen as absolute % deviation from saturation (100-O%), Total nitrogen (µM), Total phosphorous (µM) and Reactive silicate (µM)

Water quality monitoring protocol was developed to monitor and joint assess the SDG target 6.3 and 14.1. The objective of the water quality monitoring program is measuring the effectiveness of source to sea pollution control mechanism and it will provide essential data to measure the target of SDG 6.3 and SDG 14.1. The water quality monitoring protocol is consisting of following steps, setting monitoring programme objectives, Study Design, Filed Sampling Programme, Laboratory Analysis, Data Analysis and Interpretation, Reporting and information dissemination

0.5.6 Presentation: Coral Monitoring Report of the Kayankerni and Paskudah coral reef ecosystems in Sri Lanka by Mr.Nishan Perera, Blue Resources,Sri Lanka (Consultant)

Mr. Neshan Perera highlighted that the Kayankerni and Paskudah reef is one of the last remaining healthy coral reefs in the country with relatively lower human impact compared to many other reefs and has had less impact from the 2016 coral bleaching event. These include unregulated and illegal fishing activities, ornamental fishing, recent developments in the tourism sector, setting up of aquaculture farms and a lack of community support and awareness at community level about the importance of coral reefs. The reef area has already been mapped out and zoned by the Government of Sri Lanka and Kayankerni reef area would be declared a protected area following gazette procedures and biodiversity assessment by the Wildlife Conservation Department. A survey on the users of this area, especially the reef region and procedures to register the fishermen and their fishing gear are also in the pipeline.

This reef region is potentially an important source of coral and fish larvae to repopulate other reefs along the East Coast. The reef may also provide important information on reef resilience in Sri Lanka to coral bleaching. Management efforts should, therefore, be focused towards conserving such important habitats as biodiversity refuges. It is also important to ensure that management actions are taken early for avoiding degradation. The Reef may be impacted by local biological and physical factors such as availability of coral larvae, wind and current patterns and temperature fluctuations. However, more research is needed to better understanding. Finally, he concluded that community-based management is more likely to succeed in areas with lower human pressure and less outside influence, as it enables to structure a management system before the situation becomes complicated.

0.5.7 Presentation: Best Management practice guidelines of land-based nutrient management within the Maduru Oya watershed region, Sri Lanka by Dr.S.P.Nissanka, University of Peradeniya, Sri Lanka.(Consultant)

Maduru-Oya watershed and coral area in Kalkudah, which are being affected from nutrient, wastewater and plastic pollution from Maduru-Oya watershed and surrounding areas was used as case study site in this study. This watershed belongs to 4 administrative districts namely Badulla, Ampara, Polonnaruwa and Batticaloa. In the baseline study, information on administrative boundaries, socio economic status and land use pattern was initially identified by

a literature survey while land use and sources of pollution were observed in the exposure visit. The GAP guideline and teaching materials were used in the awareness program.

Rice is the prominent crop in Maduru-Oya watershed cultivated as intensive farming systems manly under major (77%) and minor (8%) irrigation, while different plantation crops (coconut), fruits (banana, papaya) and other perennial crops (cashew) are also cultivated. Major livestock species in the area are cattle, buffalo, goat, swine and poultry.

Results of the questionnaire survey and the discussions with key stakeholders in the area clearly indicated that some farmers in the region use more than 25-50% of the recommended fertilizer amount (Department of Agriculture, 2013). Some farmers even use ammonium sulphate that is not normally recommended for paddy cultivation in the area. It was found that farmers use higher rates and inappropriate fertilizers with the objective of getting higher yield just based on field observations and/or following what others do whether it is necessary or not. Farmers were not aware on characteristics and impact of different fertilizers on crops (85% or respondents) and role of fertilizer and other agrochemicals on soil, water and air pollution (90%). Farmers maintain cattle and buffalo as free rearing; therefore, their dung and urine can always have a possibility to contaminate the water. Some farmers were already aware about health impacts of use of pesticides and they cultivate small plot with minimum use of agrochemicals for their own consumption. However, most of the farmers (90%) did not attend any training/awareness programs on waste management, best management practices (BMP), and good agricultural practices (GAPs). Therefore, a huge gap exists on BMPs and GAPs, and it was found that most of farmers are very much interested to know the possible ways of mitigating nutrient pollution.

The study highlighted the need of capacity building of the farmers and other related stakeholders in the Maduru-Oya watershed in nutrient pollution mitigation. The impacts of nutrient pollution are not localized as the non-point pollution sources can damage to wider range of communities/ecosystems. Therefore, mitigation of nutrient pollution needs clear understanding and attention of able stakeholders in all related sectors. It is also important to strengthen the linkage and collaboration between key stakeholders/institutes to execute appropriate actions in a sustainable manner and policy level intervention.

0.5.8 Presentation: Predict the impacts of environmental variability and change on marine and coastal social-ecological systems focused on coral reef systems. (Dr.Joseph Maina Mbui, Macquarie University, Australia)

Dr. Joseph Maina presented his work on catchment modelling in Africa and Pacific Islands in the context of providing decision support on one of the key strategies for coral reef conservation in a high CO_2 world: reducing sediment and nutrient pollution emanating from the adjacent land. This work emphasizes the combination of monitoring and modelling to produce outputs that decision makers can use to guide investment in catchment management.

06. Conclusion

The benefits of the regional workshop were numerous. The various delegations were very engaged and interested in the topic and project, and either keen to assist their regional partners in building preparedness and response capacity for further mitigation to demise from land-based pollution and also find out how other countries in the region are approaching this challenge. There was a lot of knowledge sharing, detailed discussion and offers of assistance made amongst the participants. The advantage and further value of the said meeting was very clear as in preparation to the regional project development.

In relation to the UN Environment-SACEP Project, the requirement for consultation with the SACEP Governing Council as well as Inter Ministerial Meeting of SACEP in relation to updating the Sri Lanka Pilot Project and Development of Regional Project with specific format mentioned in Annex-IV. Therefore, the updated project concept proposal as agreed by the delegations will submitted further to UN Environment for their further actions on securing the funds.

REGIONAL STAKEHOLDER MEETING TO DISCUSS THE CAPACITY BUILDING NEEDS ON SUSTAINABLE NUTRIENT MANAGEMENT TO REDUCE SOIL, WATER AND COASTAL POLLUTION IN SOUTH ASIAN SEAS (SAS) REGION

At

Colombo

01-02 April 2019

AGENDA

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

Objectives of the Meeting

- 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 Outputs 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 Co-operative 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 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.

Venue

- Salon Orchid, Galadari Hotel, 64, Lotus Road, Colombo, Sri Lanka

REGIONAL STAKEHOLDER MEETING TO DISCUSS THE CAPACITY BUILDING NEEDS ON SUSTAINABLE NUTRIENT MANAGEMENT TO REDUCE SOIL, WATER AND COASTAL POLLUTION IN SOUTH ASIAN SEAS (SAS) REGION

At

Colombo

01-02 April 2019

Day 1- Monday, 1st April, 2019	
08:30 - 09:00	Arrival and Registration of Participants
09:00 - 09:30	Opening Ceremony
	Opening Remarks by SACEP **(Dr. Abas Basir, Director General, SACEP)**
	Remarks by UN Environment **(Mr. Gabriel Grimsditch)**
	Inaugural address by Host Country **(Mr.M.P.D.U.K. Mapa Pathirana, State Secretary for the Ministry of Mahaweli Development and Environment, Sri Lanka)**
	Vote of Thanks **(Jacintha S.Tissera, Head of Chancery/Administrative Officer, SACEP)**
	Group Photo and Address to Media
09:30 - 10:00	**Coffee Break**
10:00 - 10:15	Introduction by the Participants
10:15 - 10:30	Land based Pollutions impacts to Coastal ecology and its further mitigation to demise from land-based pollution in SAS region **(Dr. Sivaji Patra, Senior Programme Officer, SASP, SACEP)**
10:30 - 10:45	Presentation by UN Environment **(Mr. Gabriel Grimsditch)**
10:45 - 11:00	Remarks by Government of Bangladesh
11:00 - 11:15	Remarks by Government of India
11:15 - 11:30	Remarks by Government of Maldives
11:30 - 11:45	Remarks by Government of Pakistan
11:45 - 12:00	Remarks by Government of Sri Lanka
12:00 - 12:30	Development of best management practice guidelines on successful approach for plastic waste disposal and National Policies Reports **(Dr.B.N. Desai, Jawaharlal Nehru University, India, Regional Consultant)**
12:30 - 13:30	**Lunch Break**
13:30 - 14:00	Development of protocol for joint assessment of water quality SDG Targets 6.3 and 14.1 freshwater and Marine pollution **(Dr. P.B. Terney Pradeep Kumara, MEPA, Sri Lanka: Consultant)**
14:00- 14:30	Coral Monitoring Report of the Kayankerni and Paskudah coral reef ecosystems in Sri Lanka **(Mr.Nishan Perera,Blue Resources: Consultant)**
14:30-15:00	Best Management practice guidelines of land-based nutrient management within the Maduru Oya watershed region, Sri Lanka **(Dr.S.P.Nissanka, University of Peradeniya, Sri Lanka: Consultant)**
15:00 -16:30	Reviews of draft reports/ technical discussion/suggestion by the UNEP
16:30	**Summary of the Discussion**

REGIONAL STAKEHOLDER MEETING TO DISCUSS THE CAPACITY BUILDING NEEDS ON SUSTAINABLE NUTRIENT MANAGEMENT TO REDUCE SOIL, WATER AND COASTAL POLLUTION IN SOUTH ASIAN SEAS (SAS) REGION

At

Colombo

01-02 April 2019

Day 2-Tueseday, 2nd April, 2019	
09:00-09:30	Predict the impacts of environmental variability and change on marine and coastal social-ecological systems focused on coral reef systems. **(Dr.Joseph Maina Mbui, Macquarie University, Australia)**
09:30-12:30	Review of 2nd cum final Drafts of the pilot project report **(Coffee Break 10:00 - 10:15)**
12:30-13:30	**Lunch Break**
13:30-15:30	Review on the Draft of Regional project proposal on pollution mitigation solutions **(Dr.S.P.Nissanka, University of Peradeniya, Sri Lanka: Consultant)**
15:30-16:00	**Coffee Break**
16:00-16:30	Closing Remarks
16:30	**End of Workshop**

Regional Stakeholder Meeting to discuss the capacity building needs on Sustainable Nutrient Management to Reduce Soil, Water and Coastal Pollution in South Asian Seas (SAS) Region			
1-2 April 2019 Colombo, Sri Lanka			
NAME OF DELEGATION	DESIGNATION	INSTITUTION & ADDRESS	Country
Bangladesh (Not able to participate due to prior commitments)			
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Dr. C.R Asha Devi	Scientist-D	Center for Marine Living Resources & Ecology Ministry of Earth Science, Prithvi C Block,6th Floor,Kendriya Bhavan,KAkkanad,Kochi-682037 Telephone-Mobile +91 9446452862 Telephone -Res-0091-484-2781057 Email: ashacr@cmlre.gov.in	India
Dr. P. Madeswaran	Scientist - G	National Centre for Coastal Research Chennai Ministry of Earth Sciences Telephone- Office +91 44 66783585 Telephone -Mobile +91 9444399819 Fax +91 44 66783487 Email : mades@nccr.gov.in	India (Absent)
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Mr. Shimhaz Wafir	Assistant Project Officer	Waste Management and Pollution Control, Ministry of Environment Green Building Hadhuvaree Higun, Maafannu Malé	Maldives

		Maldives Telephone- Office +960 301 8437 Telephone- Mobile+960 9652427 Fax – 960 301 8301 Email: shinhaz.wafir@environment.gov.mv	
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Mr.Roy Silva	Chief sub Editor/Editor THE SUNDAY LEADER	Leader Publications(Pvt.) Ltd No.24 Katukurunduwatte Road Ratmalana Sri Lanka Telephone-Office+ 94 11 4977217-20 Telephone- Mobile + 94 777310505 Fax +94 11 4641942 Email :roymarcussilva@gmail.com	Sri Lanka (News Media)

Land based Pollutions impacts to Coastal ecology and its further mitigation to demise from land-based pollution in SAS region

Dr. Sivaji Patra
Senior Programme Officer (Regional)
South Asian Seas Programme-SACEP

1st April, 2019

Content

- **About SACEP**
- **About SASP**
- **Environnent Situation Analysais in SAS**
- **About the Pilot Project**
- **Why-are-we-here**

SOUTH ASIA CO-OPERATIVE ENVIRONMENT PROGRAMME (SACEP)

- **Is an inter-governmental organization of 8 member states,**
- **Established in 1982 .**
- **Registered with the Secretariat of the United Nation as Multilateral Organization in accordance with the Article 102 of the Charter of the United Nations.**
- **Its mission is to promote and support protection, management and enhancement of the environment in South Asia**
- **Member countries:**
- **SACEP core programme, project activities and priority areas are:**
  - **+Waste Management**
  - **+Air quality**
  - **+Climate Change and Biodiversity**
  - **+Sustainable consumption and production**
  - **+Marine Environment**

SACEP and South Asian Seas Programme (SASP)

- The South Asian Seas Programme is under the umbrella of South Asia Co-operative Environment (SACEP) and is designated for implementation of the implementation of the SASP.
- The South Asian Seas Action Plan was adopted at Meeting of Plenipotentiaries by the five maritime countries of South Asia, on March 24th 1995,New Delhi, India.

- SASP is one of the 18 Regional Seas Programmes of the United Nations Environment Programme (UNEP).

SACEP Action Plans for SAS region

South Asian Seas Action Plan's main components :

- environnemental assessment,
- environnemental management,
- environnemental legislation and institutional

Identified priority areas:

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

PARTNERS

- IMO
- UNEP-GPA &Coral Reef Programme
- FAO
- Bay of Bengal Large Marine Ecosystem
- USDA
- Private Sector/Shipping Associations
- Other regional and sub-regional agencies

SAS Regional targets

- **Ensuring Ecosystem Services and Wellbeing**
- **Prevention of Species Extinction**
- **Control of Alien Invasive Species**
- **Sustainable Fisheries and Aquaculture**
- **Prevention of Marine Pollution**

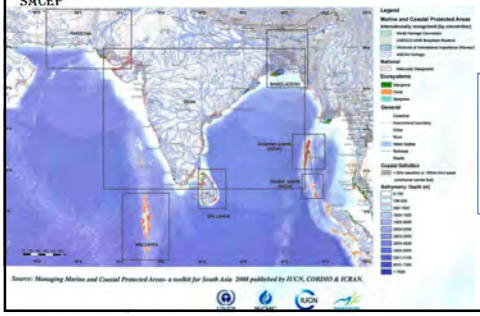
(Actions-Establishments-Regulations)

1- Nitrogen Hub
2- London Protocol and OPRC-HNS Implementations
3- Regional Marine Litter Action Plan
4- Coastal and Marine Biodiversity Strategy
5- Nitrogen Resolution
6- GoFouling Project

- **Effective and Equitable Governance of Marine and Coastal Protected Areas**

SAS Regional Steps towards restoring Environment

Coral Reef Map in SAS region



Global Importance of Coastal and Marine Ecosystems in SAS:

- **6% of the global coral reefs**
- **Two of the world largest estuaries (the Ganges and the Indus)**
- **Six of the Global 200 Ecosystems (Sudarbans, Indus delta, Rann of Kutch Flooded Grasslands, Maldives, Chagos, Lakshadweep Atolls, Arabian sea and the Andaman sea)**

Situation Analysis in SAS region-CORAL

	Reef Area (km^2) [1]	No of hard coral species	No. of reef fish species	Reefs at risk (%)[1]	% of Reefs now dead[3]
Bangladesh	<50	52 (25 living)[2]	86[2]	100	50
India	5,790	262[3]	1,087[3]	61	25
Maldives	8,920	250[3]	1,200[3]	11	55
Pakistan	< 50	na	na	na	na
Sri Lanka	680	190[3]	350	86	35

1.Spalding M.D; Ravilous C., and Green E.P., 2001. World Atlas of Coral Reefs. UNEP - World Conservation and Monitoring Centre. PP 212 - 225

2.Uddin A. M. K., 2004. Areas with Special Status in the Coastal Zone. Working Paper WP030. Program Development Office for Integrated Coastal Zone Management Plan (PDO-ICZMP)

3.Rajasuriya A., Zahir H., Venkataraman K, Islam Z., and Tamelander J., 2004. Status of Coral Reefs in South Asia: Bangladesh, Chgos, India, Maldives and Sri Lanka. In Clive Wilkinson (eds): Status of the Coral Reefs of the World: 2004. Volume 1. pp. 213-234

Globally Significant Coastal and Marine Ecosystems in SAS Region – Mangrove Forest

- **6.8% of the global mangrove forests** – Sundarbans (Bangladesh and India) form one of the world's largest contiguous mangrove forest, covering an area of 6,500 km^2

1. **Bangladesh** – Sundarbans
2. **India** - Sundarbans
3. **India** - Andaman and Nicobar Islands
4. **India** - Cauvery Delta
5. **India** - Gulf of Mannar
6. **India** - Gulf of Kachchh
7. **Pakistan** - Indus River Delta, Sindh
8. **Pakistan** – Balochistan coast
9. **Sri Lanka** - Gulf of Mannar and along the coastal lagoons and estuaries.

Mangroves are also present along coastal lagoons and estuaries on east and west coasts of India and Sri Lanka

Mangroves are scare in the Maldives.

Situation Analysis in SAS region-MANGROVE

The original area occupied by mangroves in South Asia has declined markedly over the past decades with estimated reductions of 85% for India, 78% from Pakistan and 73% reduction in the Bangladesh (values of 1996, in Macintosh and Ashton 2002). In Sri Lanka, there has been about a 50 percent reduction of the mangrove cover between 1986 and 2002 (Joseph, 2003).

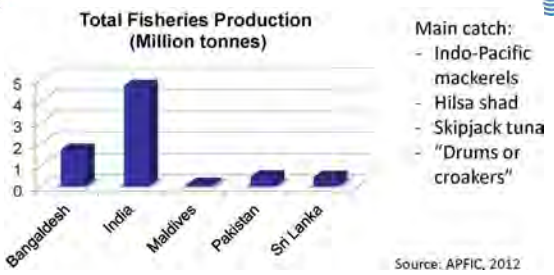
- Macintosh D. J. and Ashton E. C. 2002. A Review of Mangrove Biodiversity Conservation and Management. http://www.biology.au.dk/cenTER/MCB_Files/2002_Review_WB_MCB_Final.pdf
- Joseph L., 2003. National Report Of Sri Lanka on the Formulation of a Transboundary Diagnostic Analysis and Strategic Action Plan for the Bay of Bengal Large Marine Ecosystem Programme. http://www.fao.org/fi/boblme/website/nat_rep/Nat_Sri%20Lanka.PDF

Globally Significant Coastal and Marine Ecosystems in SAS Region – Seagrass

- The largest seagrass meadows in SA is in the Gulf of Mannar and Palk Bay (India and Sri Lanka) and Andaman- Nicorbar areas

1. **Bangladesh** - Mainly along the eastern coast (scanty)
2. **India** - Andaman and Nicobar Islands
3. **India** - Gulf of Mannar & Palk Bay
4. **India** - Lakshadweep
5. **Maldives**
7. **Pakistan** (Information is lacking)
6. **Sri Lanka** - Gulf of Mannar & Palk Bay

Fisheries Production in SAS region

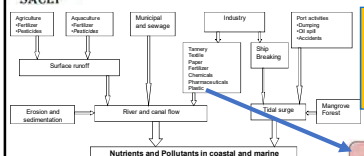


Main catch:
- Indo-Pacific mackerels
- Hilsa shad
- Skipjack tuna
- "Drums or croakers"

Source: APFIC, 2012

13

POLLUTANTS-Significant to Coastal and Marine Ecosystems in SAS Region



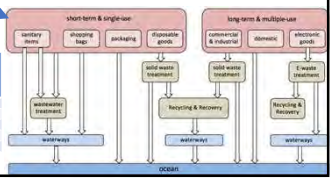
Main Facts on Marine Pollution in SAS

- The world's largest natural hypoxic zone develops seasonally over the Western Indian continental shelf which appears to have intensified in recent years most likely because of enhanced nitrogen loading
- South Asia is the second largest fertilizer consuming region in the world with consequent pollution especially related to fertilizer overuse.
- Large urban centers within the coastline are without adequate sewage treatment facilities, and in many instances raw sewage are directly disposed to the marine environment

SOURCE: BOBLME,NUTRIENT SCOPING STUDY

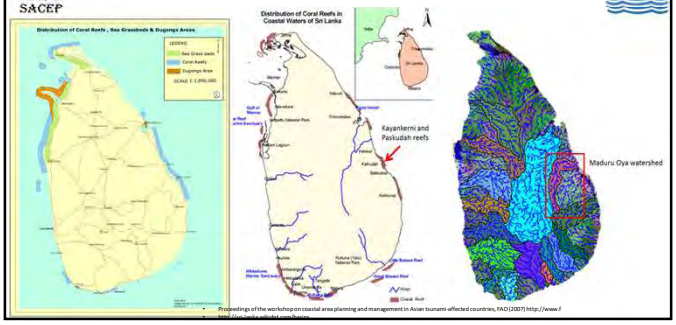
Country	Availability of Separate Act for Marine Litter	Availability of Separate Agency for Marine Litter	Availability of Separate Regulations for Marine Litter	Availability of Separate team for Regulation Marine Litter
Bangladesh	No	No	No	No
India	No	No	No	No
Maldives	No	No	No	No
Pakistan	No	No	No	No
Sri Lanka	Yes	Yes	Yes	No

SOURCE: REGIONAL MARINE LITTER ACTION PLAN



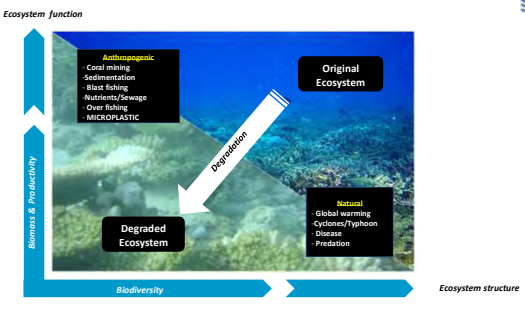
Reducing the risk of degradation of the Kayankerni and Pasikudah coral reef ecosystems in Sri Lanka by addressing nutrient, wastewater and other land-based sources of marine pollution within the Maduru Oya watershed

Coral Reefs and watershed distributions in Sri Lanka



Proceedings of the workshop on coastal area planning and management in Asian tsunami-affected countries, FAO (2007) http://www.f

Function *vs.* Structure of Coral Reefs



-:Pilot Project :-

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.

-:Pilot Project :-

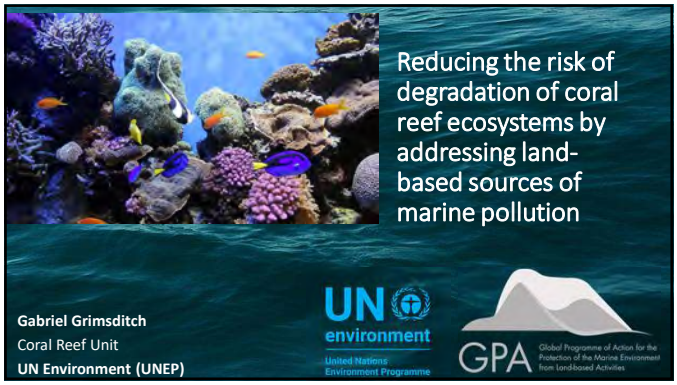
- **Task 1: Develop best management practice guidelines:**
  - Output 1. Field best management practice guidelines on nutrient pollution mitigation
  - Output 2. Best management practice guideline on successful approaches for plastic waste disposal
- **Task 2: Conduct training activities:**
  - Output 1. At least 3 national and 1 regional training event on implementing best practices for pollution mitigation
  - Output 2. Suite of training resources in electronic format
  - Output 3. Training reports
- **Task 3: Conduct a technical exchange for stakeholders:**
  - Output 1. One inter-regional technical exchange for at least 10 relevant industry practitioners/users and professionals from Sri Lanka
  - Output 2. Report on main lessons and experiences
- **Task 5: Formulate a water quality monitoring protocol and conduct field training:**
  - Output 1. A protocol for joint assessment of the SDG Targets 6.3 and 14.1 on freshwater and marine pollution by
  - Output 2. Training resources for technical professionals
  - Output 3. At least one training workshop for technical professionals
  - Output 4. Training report and summary assessment

We-Are-Here

- **Task 4: Develop a detailed project proposal for investment:**
  - Output 1. One project proposal on pollution mitigation solutions

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); Da'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)

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



UNEP Marine and Coastal Strategy
UNEA Resolutions

- **UNEP/EA.4/L.12** Protection of the Marine Environment from Land-Based Activities
- **UNEP/EA.4/L.13** Sustainable Management for Global Health of Mangroves
- **UNEP/EA.4/L.14** Sustainable coral reefs management
- **UNEP/EA.4/L.16** Sustainable Nitrogen Management

1. Establish a knowledge base on marine and coastal ecosystems to inform policies on the human activities that affect their functions

3. Support policies and strategies that enable the integrated management and sustainable use of marine and coastal ecosystem services
4. Innovate financing instruments and initiatives to facilitate a sustainable blue economy transition

Project phase 1 – Sri Lanka

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

- Best management practice guidelines for nutrients and plastics
- Training resources and national workshops
- Technical exchange regionally
- Protocol for joint assessment of SDG Targets 6.3 and 14.1 on freshwater and marine pollution

Project Phase 2 – Regional upscaling

Potential for a regional GEF project under the International Waters stream

Protecting coral reefs and reducing pollution for the Blue Economy

Implementation of the Bay of Bengal Large Marine Ecosystem Strategic Action Plan

GEF International Waters Focal Area Objectives for GEF-7

Objective 1: Strengthen Blue Economy Opportunities

- *Strategic Action 1.1: Sustain healthy coastal and marine ecosystems*
- Strategic Action 1.2: Catalyze sustainable fisheries management
- *Strategic Action 1.3: Address pollution reduction in marine environments*

Objective 2: Improve management in the Area Beyond National Jurisdiction

- Strategic Action 2.1: Ensure sound maritime legal frameworks for the protection and sustainable use of biodiversity in the ABNJ

Objective 3: Enhance water security in freshwater ecosystems

- Strategic Action 3.1: Advance information exchange and early warning systems
- Strategic Action 3.2: Enhance regional and national cooperation of shared freshwater surface and groundwater basins
- Strategic Action 3.3: Invest in water, food, energy and environmental security

GEF Project Identification Form


GEF-7 PROJECT IDENTIFICATION FORM (PIF)

PART I: PROJECT INFORMATION

A. INDICATIVE FOCAL/NON-FOCAL AREA ELEMENTS

B. INDICATIVE PROJECT DESCRIPTION SUMMARY

Bay of Bengal Large Marine Ecosystem Strategic Action Plan

- Theme 1 – Marine living resources
-
-
- Theme 4 – Social and economic considerations

Coral Reef Community of Ocean Action

https://oceanconference.un.org/coa/CoralReefs

UN Oceans Conference 2017

Co-chaired by UNEP and International Coral Reef Initiative (ICRI)

130 Voluntary Commitments so far

https://www.youtube.com/watch_v_L0ktCOe_JH0

UN environment

GPA

Thank you

Gabriel Grimsditch
Email:: gabriel.grimsditch@un.org

www.unenvironment.org

REGIONAL STAKE HOLDER MEETING

CAPACITY BUILDING NEEDS ON SUSTAINABLE MANAGEMENT TO REDUCE SOIL, WATER AND COASTAL POLLUTION IN SOUTH ASIAN REGION

COLOMBO
01-02 APRIL 2019

C.R. Asha Devi
Scientist, CMLRE
Ministry of Earth Sciences, INDIA

Ministry of Earth Sciences
Government of India

SUSTAINABLE NUTRIENT MANAGEMENT

BIODIVERSITY

BIOGEOCHEMISTRY

MARINE LIVING RESOURCES PROGRAMME

Centre for Marine Living Resources & Ecology (CMLRE) under the Ministry of Earth Sciences, Govt. of India was established at Kochi for implementing Marine Living Resources (MLR) Programme. CMLRE has been organizing, coordinating and promoting ocean development activities in the country which inter-alia include mapping of the living resources, preparing inventory of commercially exploitable living marine resources, their optimum utilization through ecosystem management and R&D in basic sciences on Marine Living Resources and Ecology.

COASTAL AND MARINE ECOSYSTEMS

Nutrient enrichment, biodiversity loss, and consequent declines in ecosystem productivity

Eutrophication caused by the nutrient loading alters biomass production disturbs the natural ecological cycles, Direct and Indirect effects
Gradual change in pelagic ecosystems

Coastal biodiversity is more vulnerable to eutrophication
Negative effects include blooms

Anthropogenic influences like sewage etc

Objectives: To detect periodical changes in coastal water quality, predict pollution levels and undertake associated activities like determination of sea water quality criteria to facilitate actions that ensure protection and preservation of marine environment.

Purpose: To monitor the coastal water quality and alert the government and other stakeholder on the status of coastal health.

Potential uses: The data and information generated under this program are disseminated to end-user through INCOIS web-server.

Activities

Monitoring
- 28 Transects, each transect with minimum 5 stations
- Period: 1990-2010 (88 Transects), 2011 to 2017 -24 Transects, Active – 28 transects
- Sampling frequency : Seasonal (4 per year)
- Habitat: Surface, bottom and sediment
- Impacts of marine pollutants on human health

Parameters
- 54 parameters
- Physical, Chemical, Biological, Microbiological, Metal

ILCE (Inter Laboratory Calibration Exercises)
- Frequency: Once in two months

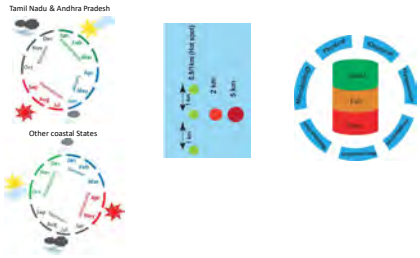
Training
- Hands-on training (ILEC)- WQ parameters
- Microbial

MMRF
GIS Database

Sea Water Quality Monitoring Programme

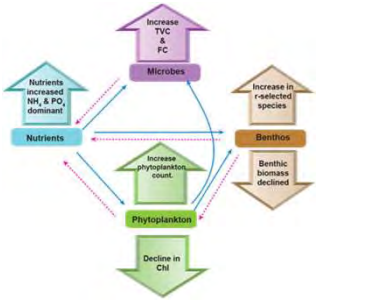
Objective: To detect **periodical** changes in **water quality** along Indian coast.

Over view of SWQM



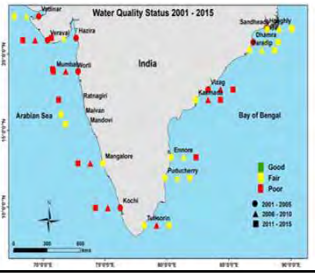
Parameters (54 Nos.)

Description	Physico-chemical	Sediment	Biology	Microbiology
Institute	Temperature	Sand	Primary Production	Total viable count
State	SSC	Silt	Pigments	Pathogenic bacterial count
Location	Transparency	Clay	Phytoplankton	
Station name	pH	ORGC	Zooplankton	
Station code	Salinity	Heavy metals (12 Nos.)	Benthos	
Lat.	CO_3			
Long.	HCO_3			
Year	Alkalinity			
Month	DO			
Season	Oxygen Saturation			
Date	BOD			
Time	Nutrients (NO_2, NO_3, NH_4, TN, IP, TP, SIO_4)			
Dist	Heavy metals			
Depth	PHC			
Zone				
Source				
Tide				



Water and sediment showed deteriorating conditions up to 2 km from shore

Water Quality Index (2011-15)

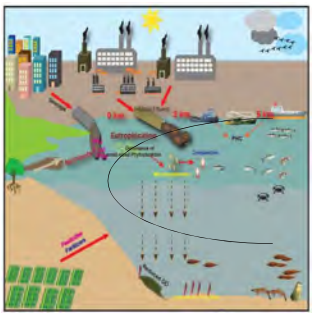


Poor : Veraval, Mumbai, Kochi & Vishakhapanam.

Fair to Poor: Hazira, Mangalore, Ennore Kakinada

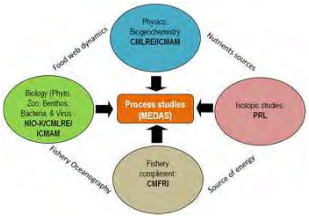
Fair : Hooghly, Puducherry Paradip

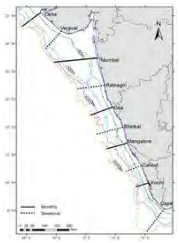
Impact of Anthropogenic activities on Coastal waters



Plastic Pollution -Transfer of MPs from land to sea and their inclusion in the food web has a significant adverse effect on the marine life and human health.

ECOSYSTEM APPROACH





Inter relationships between physical processes and impact on Biogeochemistry
Biological Response and trophic dynamics
OMZ/Hypoxia/Anoxia
Pelagic Benthic Coupling

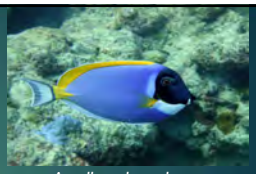
CORAL REEF ECOSYSTEMS

- Documentation of coral reef and its associated animals
- SCUBA diving surveys and intertidal surveys
- Reef associated faunal communities underwater photography and collection of taxonomically important species.
- Environmental parameters and current measurements.

Polyps of

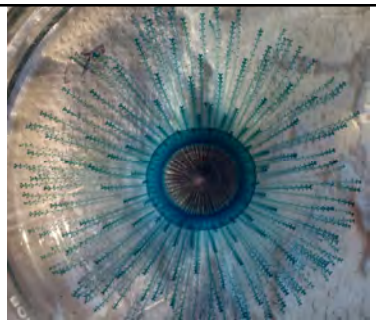
Fauna collected/ photographed:

- Corals – 42 species
- Soft Corals – 4 species
- Hydroids – 3 species
- Sea anemones – 3 species
- Gastropods – 4 species
- Heterobranchs (opisthonbranchs) – 18 species
- Polyclads – 16 species
- Echinoderms – 23 species
- Crustaceans – 2 species
- Annelids – 3 species
- Pisces – 30 Species
- Sea turtle – 1 species



Acanthurus leucosternon

Heteractis magnifica



THANK YOU

Regional Stakeholder Meeting to discuss the capacity building needs on Sustainable Nutrient Management to reduce soil, water and pollution in South Asian Seas region

01 – 02 April 2019
Colombo, Sri Lanka

Ministry of Environment
Male', Republic of Maldives

Nitrogen based fertilizers use in the country and amount applied.

- NPK+ Micro elements **(1056.19 Metric Tones imported)**
- Nitrogen Fertilizers
  - Ammonium Sulphate **(98.85 Metric Tones)**
  - Calcium Nitrate **(11.97 Metric Tones)**
  - Urea **(112.20 Metric Tones)**
- Pesticides (Fungicides, herbicides, algaecides, insecticides and plant growth regulators)

(Maldives National Chemical Profile 2016)

Nitrogen use efficiency of Different cropping system

- Agriculture land is 26.67% as per 2009
- Fertilizer use is heaviest in major agricultural land (Laamu, Thoddoo, Kaashidhoo, Shaviyani) and other industrial islands
- The amount of fertilizers consumed in each island is not recorded and farmers also do not keep the records.

(Maldives National Chemical Profile 2016)

GHG emission; water and land pollution due to N based fertilizers

- The main GHG Emission reported in the inventory are CO_2, CH_4 and N_2O
- Total emission in 2011 is 1225.598Gg CO_2e
  - 72.729 Gg CO_2e is from waste sector
- N pollution factors were not recorded

(Second National Communication Report 2011)

- Sewage and waste water is pumped to sea, in Capital Male' and in islands
- Chemical fertilizers used in farms pollute the land

Health related information due to N fertilizer based pollution

- So far there is no research done locally to identify the health hazards caused by the N fertilizers
- Farmers are exposed to the toxic pesticides due to lack of awareness and improper handling
- GAP standard was established in 2015

Existing policy and New policy development on fertilizer management

- Fertilizer companies have to be registered under Ministry of Fisheries Marine Resources and Agriculture
- Importers have to obtain prior license for all chemicals
- MoFMA keeps an updated list on chemicals that can be imported
- Ministry of Defense and National Security only authorizes permit
- Prohibited Substance Act (No. 4/75)

Good Agricultural practices introduced

- We have huge challenges including shortage of land, labour, technical skills and capital investment.
- Pests, diseases and weeds attacking plantations
- Absence of national support for adequate training
- Agriculture Centers established in two regions. Ad hoc trainings
- Hydroponics system introduced
- Irrigation systems (drip systems) established in selective islands

Public awareness on nutrient use and its impacts

- Seminars and workshops on ad hoc basis
- Pest management awareness
- Agricultural Center (Hanimaadhoo) provide information on the use of nutrients locally to the community

Capacity building activities carried out

- Training staff stationed in different regions
- Train locals on good agriculture practices
- Pest management awareness trainings

Responsible Institutions (Government/NGOs)

- Ministry of Environment
- Environmental Protection Agency (EPA)
- Ministry of Fisheries, Agriculture and Marine Resources
- Ministry of Health
- Health Protection Agency (HPA)
- Maldives Food and Drug Authority
- Ministry of Housing and Urban Development
- Land Survey Authority

Scientific information available on land, water, air and sea pollution

- We have a Research Center at Maldives National University. The center is involved in multi disciplinary researches including environment and agriculture
- Ilmee Foavahi – a research forum held by MNU. Recently had a session on micro plastics in food
- FEST hosting, Environmental Management, Marine Science (forums and projects)
- The National Communication Report 2015, reports about the Carbon emission mostly

Most affected, highly polluted and vulnerable farming system

Plastics

Usage of plastics

- Household
- Local business, institutions
- Restaurants (Straws, disposable cups & other)

Generation of plastic waste

- Bottling (200,000 bottles of water are produced per day)
- 280000 is usage in the Capital Male'
- Plastic shopping bags (27 million non-biodegradable & 80 million Biodegradable imported in 2017)
- Imports

Existing management system of Plastics

- Dumping
- Unmanaged Burning

Level of plastic related pollution

- No data have been collected on how much plastics and pollution occurs in the Maldives
- Plastic pollution in sensitive eco systems like wetlands and other terrestrial lands are not recorded
- 70% of the plastics are single-use plastics (PET bottles)
- No proper recycling facility in the Maldives
- Parley Maldives (NGO) collects 10% plastics for export

Policy of capacity building on control of plastics usage and management

- Tariff for non-biodegradable plastic bags was hiked from 200 to 400 percent
- Usage of oxo-degradable bags was endorsed by Environmental Protection Agency, Maldives
- Waste Management Policy
- Policy framework on Plastic Pollution in under draft stage

Waste water and sewage

Current ways of managing wastewater and sewage

- No treatments for the waste water or sewage
- Pumping out into surrounding sea, by pump stations
- Public beach was closed due to leakage of raw sewage

Information about their pollution status

- We lack monitoring mechanism
- We lack standards to check sea water quality and pollution sources
- No data systems is established in any institution

Any policy to sustainable handling of waste water and sewage

- No specific policy on sustainable handling of waste water and sewage
- No treatment for waste water and sewage

Information on Coastal Ecosystem

Information on sea water quality, pollution sources and level of pollution

- Beach sea water quality is tested in EIAs in building resorts
- No proper record of sea water quality
- It is identified that sewage is one of the main source, marine plastics as well
- We lack monitoring mechanism
- We lack standards to check sea water quality and pollution sources

Impacts on coral reefs

- Coral mining
- Dredging
- Reclamation
- Construction of Maritime structures

- These socioeconomic developments have impacts on coral reefs. However the scale is uncertain
- Sea grass and coral removals in major developments

Records on accumulation of garbage (plastic), sewage and nutrients on beaches, sea water and changes of diversity

- Due to lack of equipment and potential capacity, we do not have exact data on the accumulated garbage.
- Plastic comprises 70% of the waste

Governments regulation on protecting coastal ecosystem from these sources

- Waste Management Regulation
- Sand Mining Act
- Reclamation and Dredging Regulation
- Penalty and Liability Regulation

Most vulnerable coastal ecosystem, their significance, awareness on community on these aspects

Thank you

Development of Best Management Practice Guidelines for Plastic Waste Disposal in the SAS Region

Regional Stakeholder Meeting, SACEP, Colombo; 01 April 2019

By Professor Dr. Bharat H. Desai
Jawaharlal Nehru Chair & Professor of International Law
Chairman, Centre for International Legal Studies
School of International Studies
Jawaharlal Nehru University, New Delhi
Email: desai@jnu.ac.in

Challenge of the Marine Litter –Plastic Pollution

- Marine Litter has emerged vital environmental threat for marine and coastal areas in recent times.
- It has impacted almost all the coastal states detrimental to their ecological benefits, economic costs and social interests at international, regional and national level.
- It has been estimated that around . million tons of plastic waste flow from river into ocean annually. About percent of marine litter is on seabed, percent is floating and percent on seashore. (SPAR,).
- he top polluting rivers are mostly located in Asia and they accounted for percent of the total global plastic waste. Bangladesh, India and Pa istan have large amount of marine litter in SAS Region.
- SAS Countries are most vital and vulnerable to the impacts of the marine litter due to dense population, specific location, climatic zones, consumption and utilization of resources, waste generation and disposal, dependency on agriculture, a uaculture, tourism and transportation.
- here has been lac of effective legal instruments, management strategies and direct developmental activities for reduction, control and management of marine litter in SAS Region.
- There has been taken initiatives for 'Regional Action Plan on Marine Litter For SAS Region' by the U EP and SACEP in recent time. his has been initiated on the re uest of the SAS member countries and institutions to combat marine litter pollution with international and regional cooperation and coordination.
- his paper aims to examine the existing status, problems, regulation and management of the marine litter in SAS region, to trace the gaps and challenges and to suggests the necessary actions and deliberations for prevention and reduction of marine litter pollution in this region.

Marine Litter Pollution: Sources, Causes and Effect

- Marine Litter has been defined as "any persistent, manufactured and processed solid material discarded, disposed of and abandoned in to the marine and coastal environment." Marine Litter includes the items and materials that have been made or used by human and deliberately discarded in to sea or river or on beach brought indirectly to the sea by river, sewage, storm or wind accidently lost or deliberately left by people on beaches and shores. (U EP,)
- Marine Litter has been classified by different scientists, authors and experts as such plastic, metal, glass, processed timber, paper, cardboard, rubber, cloths and tar balls etc. his is not exhaustive list but only indicative for the purpose of segregation and uantification of the amount of marine litter found in the marine environment.
- here has been two basic sources indicated in the research and studies Land-based Sources and Sea-based Sources. he land based sources includes the industrial and municipal wastes discharge through rivers, streams, flood, wind, storm and current. he sea based sources have been recognized as merchant shipping, ferries and cruise lines, fishing vessels, offshore oil and gas platforms etc.
- he causes for the marine litter have been assigned to dense population residing at coast and beaches, urbanization of the coastal cities and areas, consumption and utilization of resources, trade and transportation through sea and tourism and recreational activities at the coast and beaches of the sea.
- he prevalence of marine litter in the marine environment has ecological, economic and social impacts on national, regional and international level. he ill-effects are most disturbing and visible specially for the coastal states and cities having adverse effect on public heath and safty.

Marine Litter Pollution: Regulation and Management

- o combat and reduce the negative and trans-boundary impacts of the marine litter, there has not been developed and adopted any binding international legal instrument which would directly address this problem at international and regional level. hough , there are international and regional conventions, protocols, agreements, strategies, directives and action plans for the protection of marine environment.
- International Legal Instruments are United ations Convention on the Law of Sea (U CL S) Part II, Articles - London Convention on the Prevention of Marine Pollution by Dumping of astes and ther Matters ( ) and Its Protocol ( ) MARP L Convention for the Prevention of Pollution from Ships ( ) U GA Resolution ashington Declaration ( ) onolulu Strategy, .
- Regional Legal Instruments are Convention on the Ban of the Import in to Africa and the Control of rans-boundary Movement and Management of azardous aste within Africa ( ) better nown as Bama o Convention Convention for the Protection of the Marine Environment of the orth-East Atlantic ( ) nown as SPAR Convention Convention for the Protection and Development of the Marine Environment of the ider Caribbean Region ( ) nown as Cartagena Convention Convention for the Protection of the Marine Environment of the Baltic Sea Area ( ) nown as elsin i Convention.
- ational Instruments have been also developed y some states such as Unites Sates of America (USA), United Kingdom (UK), South Korea, aiwan etc.
- o international and regional legal instruments are directly applicable to the SAS region and no SAS countries have yet developed national instrument or strategies to combat the marine litter.

Marine Litter Pollution in South Asian Sea (SAS) Region

- he SAS region includes the sea bordering countries such as Bangladesh, India, Pa istan , Maldives and Sri Lan a situated in the Indian cean, Bay of Bengal and the Arabian Sea. his region is densely populated and highly rich in biodiversity and wildlife along with wide area of marine environment.
- he marine litter and micro plastic with its uantity and intensity ending up in the ocean of the SAS region has been found in alarming stage. he origin and pathways are diverse and status and impacts are not fully nown due to lac of research, analysis and assessment made in recent time.
- Basic information, data, plan, strategies and legal instruments are limited with regard to marine litter in the SAS region. here is also lac of proper regulation and management program, action and activities for the reduction, control and management of the marine litter in the SAS countries.
- All SAS countries are facing ecological, economic and social ill-effects of the marine litter detrimental to human health and marine environment. here has been no research outcome and assessment on the basis of ecological, economic and social parameters indicators for examining the impacts of the marine litter.
- here are several international conventions and protocols to control and prevent the marine pollution, but very few are applicable and implemented fully in the SAS region. owever, some SAS countries have developed and implemented the national strategies and action plan for the solid waste and marine litters such as Sri Lan a and India.
- Ma or barriers in the SAS region to address the problem of marine litters are inade uate research, area or site specific studies, education and participation of the sta eholders. here is also dearth of economic and mar et instruments, tools and techni ues for effective management of marine litter.
- here has been suggested to consider the pathways for effective regulation and management of marine litters in the SAS region such as constitution of dedicated institution agency, effective legal instrument and policy, research and studies, involvement and participation of the all sta eholders.

Marine Litter Pollution in SAS Countries

- SAS countries are Bangladesh, India, Pa istan, Maldives and Sri Lan a combating the problem of marine litter in this region. hese countries do not possess consolidated database on uantities, density and impacts of the marine litter in the domestic urisdiction.
- hese countries are also lac of proper institutional mechanism and ade uate legal instruments for regulation and management of marine litter. Despite of the several international and regional instruments, these countries are lagging behind in the implementation and enforcement of the regulatory and management regime of marine litter.
- o uniform and standard methods are used in the collection, management and disposal of the marine litter. here has been no strict mechanism to regulate the production and consumption of the plastic and other material disposed of in the sea and beaches. here is also lac of dedicated education and awareness programme for marine litter in the SAS countries.
- SAS countries also lac the mar eting and economic tools and techni ues for effective management of Marine litter at production and consumption level. Private sector production, consumption and businesses have to be involved for the management of marine litters.
- here is need to evaluate the individual statues of the SAS countries for the better understanding and solution of the problem of marine litter. his individual analysis will also help in suggesting appropriate mechanism to deal with the marine litter.
- Policy, Legal and Institutional Responses in five countries Bangladesh, India, Pa istan, Maldives and Sri Lan a.

Bangladesh

- In Bangladesh, Marine litter has not been much concern to the government as it has caused immense harm to the people and marine environment in recent time. o specific agency has been constituted for marine litter monitoring and management.
- The preliminary investigation was conducted in Nov. 2017 in Cox's Bazar and Chittagong districts in four sampling stations or beaches whereby numbers of marine litter in these area has been found specially the plastic or micro plastic from land based sources only. The amount of plastic found in large quantity in the Cox's Bazar than the Chittagong district.
- he preliminary report suggested that the sources of these marine litter in both districts were rivers and canals, dumping by ships and boats, surface drainage and other sources. But it has been found difficult to found the uantity and the exact source of the marine litter.
- Marine litter has caused serious damage to the ecological, economic and social health and life in these two districts specially with regard to fishing, transport and tourism.
- here is no marine litter policy as well as legislation in Bangladesh. hough, Government uses the provisions of the Environment Conservation Act and Regulations in this regard. here is also coastal one Policy, and Costal one Strategy, . ational Environmental Management Action Plan has been aslo prepared in for the reduction of marine litter pollution.

India

- Marine litter has been ma or problem in India having long cost and big islands within its urisdiction. Most of the marine litter originates from land based sources. he study has been made for certain areas such as Gu arat, Maharashtra, Goa, Kerala, Karnata a, amilnadu and Andaman and icobar Islands.
- Marine litter occur in all five compartments such as coastline, surface, main water column, seabed and biota in these region from both land based sources and sea based sources.
- It has impacted the human health and food safety, profession and occupation, trade and transportation, fisheries and a uaculture, ecology and biodiversity of the country.
- here is enough management institutions and agencies wor ing for the environment including marine pollution. owever, India does not have ational Marine Litter Policy and legislation.
- Recent initiatives under ages of Swachh Bharat Abhiyan , coastal areas are cleaned and monitored for the marine litter pollution. Community participation, collaboration with industries and G s has been also initiated by the government.
- here has been need to strengthen the legal institutional regime, capacity building, public awareness, research and studies for the proper regulation and management of marine litter in India.
- India had promised to eliminate all single use plastics by .

Pakistan

- Marine litter has been one of the ma or environmental problem in the coastal zone of Pa istan. he marine pollution has been largely due to the indiscriminate discharge of effluents from land based sources.
- he sources of marine litter has been manmade through disposable of solid waise , untreated effluent, fishing activities tourism. he ind of marine litter found in Pa istan includes plastic bags balloons, glass bottle, fishing lying and nets and oil and ship garbage.
- he marine litter tremendous impact in Pa istan with regard to its ecological, economic and social areas. he social impact includes the human and animal health, food security and safety, life and livelihood of fishermen and tourist. he economic impact of the marine litter has been basically in coastal areas and the cities harming the fisheries tourism, seabed resources transport and export services.
- here have been several environmental laws and policies in Pa istan for addressing coastal and marine pollution. But they are not ade uate and do not exclusively deal with marine litter. Pa istan Environmental Protection Act imposed ban on plastic products and also designated the Pa istan maritime zone for monitoring and control marine pollution.
- o specific laws relating to marine litter have been developed at national as well as provincial level in Pa istan. here has no monitoring and enforcement mechanism to reduced and control the marine litter in Pa istan.

Maldives

- Maldives located in the Indian ocean is an island in south west India. Marine litter has been one of the ma or concern for the marine environment in Maldives. his problem has been aggravated due to growth in population changing consumption pattern and lac of waste disposal and management.
- Along with land based sources the sea based sources have also contributed to the marine litter. he marine litter mostly occurs from local sources li e local communities, tourists, marine vessels and domestic waste.
- here has been also recognized social, economic and ecological impact harming the marine environment. Marine litter has diminished the intrinsic and social values, human health and food safety, social life and security in Maldives. he economic impact has been related with consumption and utilization marine resources, trade and transportation, tourism and recreational activities in Maldives. he ecological impact has been attributed to the human, animal and wildlife depended upon the marine environment.
- he main regulation for the solid waste management in the Maldives is the ational Solid aste Management Regulations , passed under the Environmental Protection and Preservation Act, . Besides, there has been campaigns, strategies and activities to reduce marine litter and its management in Maldives.
- here have been certain gaps and challenges in the regulation and management of the marine litter such as insufficient data and information, inade uate regulations and management strategies, monitoring and enforcement, lac of education and awareness about the marine litter.

Sri Lanka

- Sri Lan a is one of the SAS countries located in the Indian cean. ithout any exception, Sri Lan a is also facing the problem of marine litter and waste management. Marine litter has become ma or threat to the marine environment in all five provinces of Sri Lan a.
- he marine litter entering in to the ocean of the Sri Lan a has been categorized as sea based sources, costal base sources and Inland based sources. he land based litter is contributing more than percent of the litter enter in to the marine and costal areas of Sri Lan a through rivers and canals.
- Marine litter has negatively impacted the ecological, economic and social status of Sri Lan a. It has impacted the coral reef, sea grass beds and mangroves along with biodiversity and marine ecosystem. It also affects the national economy, industries and tourism in country. It has adversely affected the human health and food safety, social life and security especially in the costal areas.
- Ma or legislation include the Marine Pollution Prevention Act, . It provides the mandate to prevent , reduce and control the marine pollution. he Marine Environment Protection Regulations, has also prohibited the dumping of waste and other matters. here is no national level policy on the marine litter in Sri Lan a.
- here has certain gaps and challenges to the regulation and management of marine litter, institutional and enforcement mechanism, budget and infrastructure, education and awareness in Sri Lan a.

Best Marine Waste Management Practices in SAS Countries

- he waste management practices could be used for combating the marine litter through reduction and reuse, recycling, composting and fermentation, landfills and land application.
- or the marine litter, the best solid waste management practices could be adopted mainly in four ways
  - aste Collection organized and innovative method of collection, segregation and transport.
  - Source Reduction Eco- design, single use, waste reuse and recycling, port reception facilities.
  - Scientific Landfills Designing scientific landfills and dumping yards, prohibition of waste burning and landfills fire.
  - Cleanup Activities Promotion of cleanup activities and initiatives in collaboration of international and national agencies organizations institutions.
  - Changing uman Behavior abits Attitudes Discourage polluting behavior and promotion of cleanness in beaches, coasts, tourism and recreation places.
  - Economic Mar et based Instruments Imposition of the landfill taxes, product taxes, high fees and fines, deposit-refund schemes.
- All these efforts practices would contribute to the better marine litter management and reduction contributing towards sustainable waste management practices in SAS region.

Contd…

- SAS countries have adopted best solid waste management practices, but not specifically for marine litter. Marine litter has been considered as solid waste only for the reduction , management and disposal within national urisdiction. he best solid management practices have been adopted by some of the SAS countries include
  - Plastic aste Collection, andling, ransport and Disposal
  - Plastic aste Avoidance, Reduction, Reuse, Recycle or reatment.
  - Banning the ishing Gear and Ghost ishing.
  - Construction of Proper and Scientific Landfills.
  - Beach Cleanup and Conservation Activities.
  - Strengthening aste Management Rules Regulations Strategies Practices.
  - Use of Economic Mar et based Instruments
- or the SAS countries, it is essential to integrate the marine litter management practices with solid waste management practices beneficial to the marine environment and sea. he best regional practices should also be adopted li e ider Caribbean or Mediterranean region. he best solid waste management practices have also been adopted by some developed countries li e USA,UK, Sweden, apan and etherland which could be useful for marine litter management practices in SAS region.
- he ational Governments of the SAS region have to incorporate and coordinate best marine litter management practices through plan program funds research studies. he basic aim could be to convert the marine litter into wealth by eeping the sea clean.

National Reports: Some Observations

- Bangladesh Dha a City Corporation is responsible for adopting the best waste management practices for collection, transportation, disposal and treatment of the plastic waste in metropolitan areas including the costal and beach areas. owever, it has only percent manpower and financial capacity to manage the solid or plastic waste. Regular beach clean up practices – e.g. *International Cleanup Day Campaign*.
- India Along with CR authorities, pollution boards and municipalities, the G s and research institutions are also contributing in the best solid management practices. Regular beach clean up practices and *International Cleanup Day Campaign*.
- Pa istan Karachi Municipal Corporation along with Maritime Security Agency is responsible for the plastic waste collection disposal and management. Less amount of waste is disposed with best waste management practices. o regular beach clean up activities. owever no report on *International Cleanup Day Campaign*.
- Maldives o best and sound waste management practices effectively followed. Solid waste are collected, transported and disposed mostly by the private agencies. rganic waste are disposed at home bac yard and plastic are dumped near beaches in Island. o regular beach clean up activities and no report on *International Cleanup Day Campaign.*
- Sri Lan a Local Authorities of the Islands are responsible to adopt the best management practices for the plastic waste in all the five provinces. But, the local authorities lac the funding, infrastructure, e uipments, composting facilities, recycling plants and proper landfills. Regular beach clean up activities no report on *International Cleanup Day Campaign*.

If You Can't Reuse, Refuse it

The Tribune — OPED — 09

Break up with the 'plastic' menace

The World Environment Day celebration today comes with a focus on beating the menace of plastic pollution. As India hosts the global event, there is need to underscore the mantra 'If you can't reuse it, refuse it'.

To Sum Up

- SACEP needs to take the lead in promoting education and awareness in consultation with SAS member countries.; e.g. the UN Clean Seas Campaign (launched in Jan.2017).
- UNEP needs to provide all possible assistance in technical and funding to SAS program as part of UNEP's 'jewel in the crown' – Regional Seas Program.
- SACEP and SAS can work on developing a Regional Action Plan/Guidelines that could encourage member countries to fine tune respective policies, legislative and institutional mechanisms.
- Need to employ variety of tools, techniques and legal instruments to make decisive dent on the menace of marine litter in a time bound manner.
- SACEP and UNEP need to work in unison to make SAS region plastic-free in foreseeable future.

A protocol for joint assessment of the SDG Targets 6.3 and 14.1 on freshwater and marine pollution

Jagath Gunasekara
Manager Operations
Marine Environment Protection Authority
Sri Lanka

Importance of coral reef

Coral reefs are one of the world's most productive ecosystems and Many coral reefs around the world have developed along shorelines which are influenced by rivers and streams flowing out of the nearby catchment areas.

Coral reefs provide valuable resources and services
- fisheries,
- coastal protection
- tourism

survive, coral reefs need specific environmental conditions
- low nutrient
- sediment levels

The corals on these reefs have adapted to grow in the presence of some materials coming down the rivers and streams from the catchments.

Increase of flow and pollutant due to anthropogenic activities has degraded many coral reef

Activities in Catchment Areas

People, Towns and Cities
Agriculture and Farming
Industry
Urban development
Damming rivers

What Catchments Deliver to the Coast

Sediments from deforestation, farming, mining and development

Nutrients in sediments, from farming (fertiliser losses) and industrial and domestic wastes;

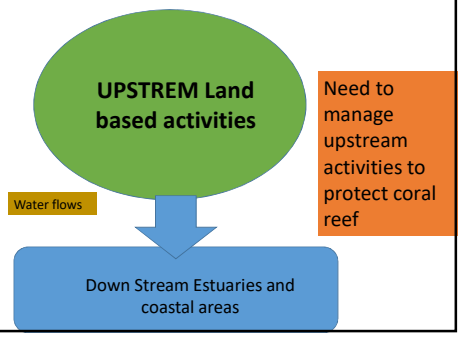
Pesticides principally from farming and Persistent Organic Pollutants;

Heavy metals from mining operations and industrial wastes;

Solid wastes especially plastics and other litter;

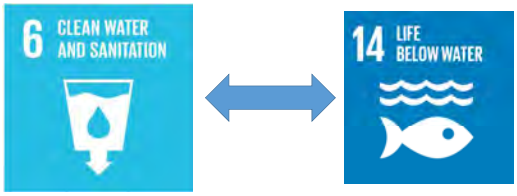
Large volumes of fresh water

Link Between upstream and down stream



Sustainable Development Goals

Sustainable Development Goals 6&14



SDG 14-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**

14.1.1: Index of coastal eutrophication and floating plastic debris density –Tier III

Sub indicators to measure the target

- Indicators for the cause of eutrophication (nutrient input and concentrations),
- Indicators for the direct effects of eutrophication (e.g. Chlorophyll a concentrations, biomass growth, water clarity/turbidity),
- Indicators for the indirect effects of eutrophication (e.g. dissolved oxygen levels),
- Modelled indicators of the potential for coastal eutrophication (the Index of Coastal Eutrophication Potential (ICEP), based on analysing nutrient load ratios and expected influence on eutrophication due to land based activities).

Floating Marine Plastic Debris

- Plastic debris washed/deposited on beaches or shorelines (beach litter),
- Plastic debris in the water column,
- Plastic debris on the seafloor/seabed,
- Plastic ingested by biota (e.g. sea birds).

Target 6.3

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

Improve water quality, wastewater treatment and safe reuse

Sub indicators

6.3.1. proportion of wastewater safely treated

6.3.2. Proportion of bodies of water with good water quality

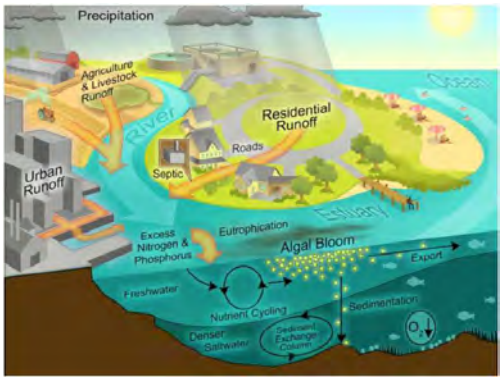
Linkage between SDG 14.1 & 6.3

Marine pollution is linked to freshwater pollution.
'Source to sea' or 'ridge to reef' approach

Upstream

Downstream

RIDGE TO REEF



Proportion of bodies of water with good water quality

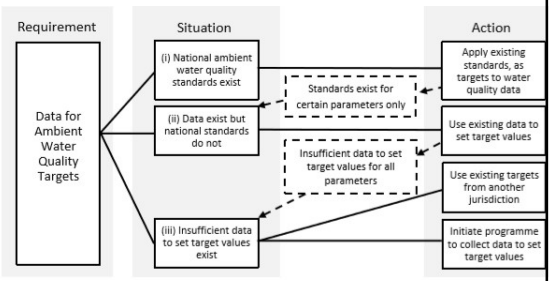
Parameters monitored according to target 6.3

- Dissolved oxygen
- Salinity
- Electrical conductivity

n situ

- pH
- BOD
- COD
- Total inorganic nitrogen
- Total phosphorous
- Reactive silicate

Ambient water quality and target situation



Classification of Water Quality

Classify the quality of individual water bodies

$$C_{wq} = \frac{n_c}{n_m} \times 100$$

Where

C_{wq} is the percentage compliance [%];
n_c is the number of monitoring values in compliance with the target values;
n_m is the total number of monitoring values.

A threshold value of 80% compliance is defined to classify water bodies as good quality. Thus, a body of water is classified as having a good quality status if at least 80% of all monitoring data from all monitoring stations within the water body are in compliance with the respective targets

Calculation of Indicator

$$WBGQ = \frac{n_g}{n_t} x100$$

Where

$WBGQ$ is the percentage of water bodies classified as having a good quality status;

n_g is the number of classified water bodies classified as having a good quality status;

n_t is the total number of monitored and classified water bodies

Parameters monitored according to target 14.1

Chlorophyll-a lab or remote sensing methods

Dissolved oxygen *in situ*

Dissolved inorganic nitrogen

Total phosphate

Reactive silicate

Floating macro plastic debris

e situ

Flow rate

Indicator for Coastal Eutrophication Potential (ICEP)

$$ICEP = [NFlx/(14*16) - SiFlx/(28*20)]*106*12 \quad \text{if } N/P<16 \text{ (N limiting)}$$

$$ICEP = [PFlx/31 - SiFlx/(28*20)]*106*12 \quad \text{if } N/P>16 \text{ (P limiting)}$$

kg C km^{-2} day^{-1}

NFlux DINFlux DONFlux PNFlux, and
PFlux DIPFlux DOPFlux PPFlux,

where DON dissolved organic nitrogen; PN particulate nitrogen; DIP dissolved inorganic phosphorus; DOP dissolved organic phosphorus; and PP particulate phosphorus
Si- Reactive Silica

Tropic Index (TRIX)

$$TRIX = (k/n) \sum^{i=n}((\log M - \log L)/(\log U - \log L))_i$$

Where;

n number of the variables (in our case five),
M measured value of the variable,
U upper limit,
L lower limit.
K Constant

Parameters to be considered in TRIX

Chlorophyll- a (g/L)

Oxygen as absolute % deviation from saturation (100-O%)

Total nitrogen (M)

Total phosphorous (M)

Reactive silicate (M)

Reference values of the TRIX

Conditions	TRIX units	Trophic state	Water quality condition
Oligotrophic	< 4	Elevated	Scarcely productive water
Mesotrophic	4 << 5	Good	Moderately productive water
	5 << 6	Mediocre	Very productive waters
Eutrophic	> 6	Bad	Strongly productive water

Geographical distribution of the trophic index TRI in August 1998 based on one cruise in Danish waters (Eutrophication in Europe's coastal waters; Topic report 7/2001)

Development of water quality Monitoring protocol

- Setting monitoring programme objectives
- Study Design
- Filed Sampling Programme
- Laboratory Analysis
- Data Analysis and Interpretation
- Reporting and information dissemination

Water Quality Monitoring Objectives

Long-term environmental monitoring is essential to determine baselines, measure change and assess overall ecosystem health. Enhanced monitoring can improve the management and protection of marine resources and can also protect human health

Background/ baseline monitoring

Carried out to understand the spatial and temporal range of water quality parameters important to aquatic ecosystem health in water bodies

Issue-based monitoring

Trend monitoring

Management effectiveness monitoring

Study Design

The ultimate goal of any sampling strategy is to guarantee the acquisition of valid data.

The sampling strategy is governed by the objectives of the monitoring program and by the expected or known spatial and temporal variability of the analyte concentrations

Site selection for monitoring

Following factors have to be considered when sampling sites are being selected;

- Representative of cross-sectional variability
- Constraints of channel configuration
- Velocity of streamflow
- Turbulence
- Range of values for water-quality physical properties
- Safety hazards

Determining Floating macro plastic debris

- Floating Plastic debris -The manta net (mesh size should be decided
- Coastal Marine Debris density – shoreline survey protocol

Current Status of ayankerni Reef

Nishan Perera
www.blueresources.org

Introduction

- Located north of Pasikudah in the Batticaloa district.
- Consists of several small fringing and patch reef systems.
- In relatively good condition compared to other reef systems in Sri Lanka.
- Has shown resilience to coral bleaching.
- Nutrient impact from Valachchenai lagoon and several small water bodies.
- Research carried out by NARA, Dilmah Conservation and BRT.
- Proposed as a new MPA

Ongoing Research by BRT

Underwater Surveys

- Live coral cover, coral genera, growth forms, other substrate categories, anthropogenic impacts.
- Indicator groups fish / species

Physical Parameters

- Wind speed and direction, air temperature, cloud cover, water temperature, light penetration, salinity

Fisheries

- Small scale fisheries - catch composition, fishing effort, fishing grounds, methods etc.
- Elasmobranch fisheries - catch composition, methods and fishing effort.

Objectives

Ecological

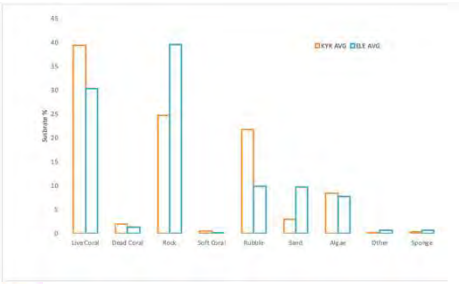
- Understand reef resilience to disturbance events.
- Document community phase shifts and changes over time.
- Habitat connectivity
- Impacts of human and natural events on reef ecology

Social

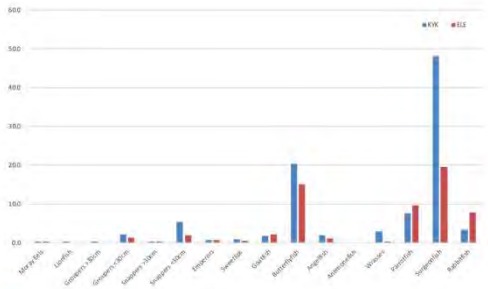
- Identify the importance of Kayankerni reef to local livelihoods.
- Document reef based fisheries.
- Evaluate potential for community based management.
- Understand local perceptions towards management.

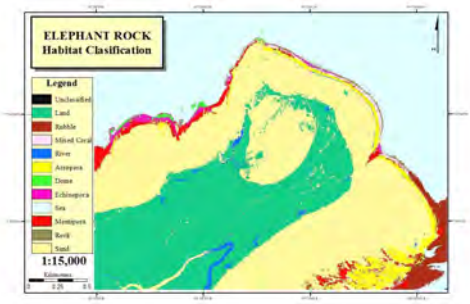
Survey Sites

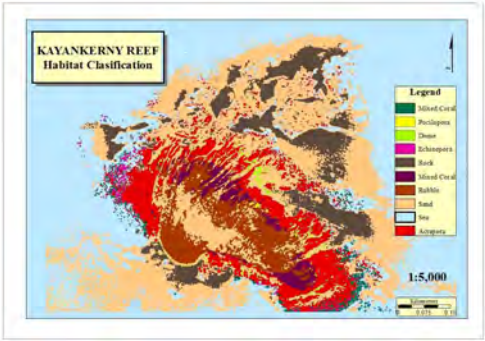
Substrate Composition



Reef Fish Assemblages

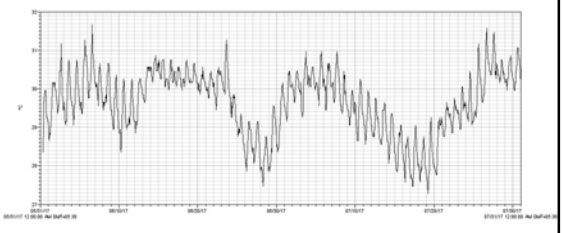


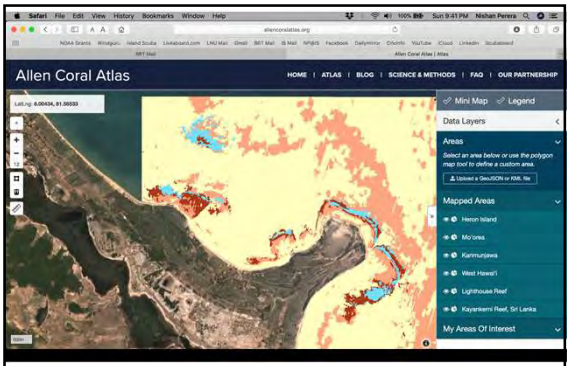




Coral Bleaching

Temperature Variation in Kayankerni





www.allencoralatlas.org

Fisheries & Aquaculture

Reef Fisheries

- Mainly fish outside proposed sanctuary are between Vakarai and Pasikudah.
- Target mainly small pelagic, demersal species and squid.
- Traditional methods used within proposed sanctuary area.
- Set gill nets used for small pelagics within proposed sanctuary area during rough season.
- Night diving for parrotfish, chanks and lobsters.

Aquaculture

- Live rock culture.

Local Management

- Prohibition on ornamental fish collection within Kayankerni reef.
- Enforcement of regulations through Fisheries Society.

Current and Potential Threats

- Overfishing of high value target species
- Destructive fishing methods
- Unregulated tourism
- Pollution
- Climate change / coral bleaching
- Invasive species

Nutrient Based Pollution

- Agricultural runoff (fertilizer and pesticides)
- Sedimentation from poor land use practices
- Aquaculture (shrimp farm effluent)
- Urban waste water
- Solid waste

Research & Management Needs

- Monitoring of coastal water quality including Valachchenai lagoon and around Kayankerni reef.
- Monitoring of bio-indicators of nutrient pollution.
- Documenting circulation and current patterns
- Identifying sources of nutrient pollution and impact of agriculture.
- Implement better land use and agricultural practices.
- Improve solid waste management within the Valachchenai lagoon.

Assessing nutrient pollution of soil and ater bodies from Agriculture related activities in Maduru Oya atershed

S.P. Nissan a

Department of Crop Science,
Faculty of Agriculture,
University of Peradeniya

Content

Agriculture in Sri Lanka
Fertiliser usage
Impact of fertiliser on environment
Nutrient pollution
Case study – Maduru Oya watershed

Agriculture in Sri Lanka

Gross omestic Product (G P) from agriculture 6. (2 1 entral Ban Annual eport)

Agricultural land
27400 sq. Km
43.69 % of land area

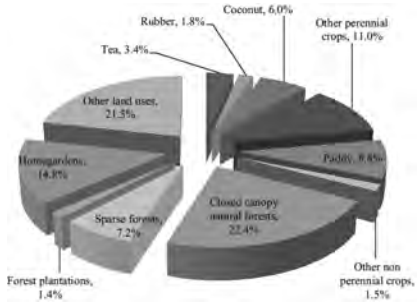
Arable land - 0.062 ha/ person

Annual freshwater withdrawals of agriculture - 87.34 % (of total freshwater withdrawal)

Employment in agriculture (of employed) 26

Crop production index (1999-2001 100) - **11**

General land use pattern in Sri Lanka



Land utilisation ithin agriculture sector

Land use	Area (thousand ha)	Percentage ( )
Major plantation crops (tea, rubber, coconut)	798.1	**3 .**
Other permanent crops	176.5	**.**
Paddy	557.0	**2 .**
Annual crops other than paddy	195.0	**.**
Wood and forest land	54.1	2.7
Pasture land	20.1	1.0
Cultivable area but not cultivated	91.6	4.6
Area under roads and buildings	73.4	3.7
Rocky and waste land	40.8	2.1
Total	2008.7	**1**

6

Paddy

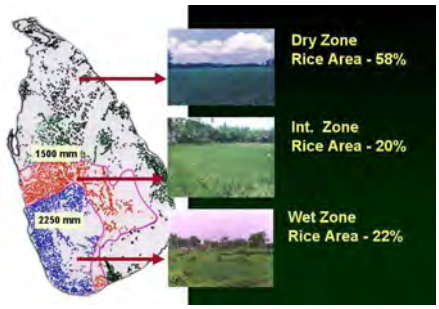
Single most important crop

34 % - (0.77 million ha) of the total cultivated area

About 1.8 million farm families

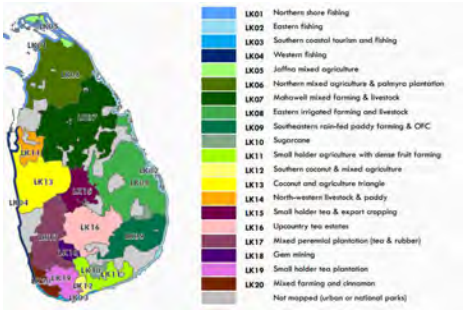
Source: ricepedia.org

Rice Cultivation



Livelihood

Livelihood ones of Sri Lan a



Source: World Food Program 2017

Land use and economic activity

Agricultural land: 43.5%

- arable land 20.7%
- permanent crops 15.8%
- permanent pasture 7%

Forest: 29.4%

Other: 27.1%

Source: www.globalsecurity.org

Fertili er consumption- kilograms per hectare of arable land

Sri Lanka **26th** (out of 161 countries)

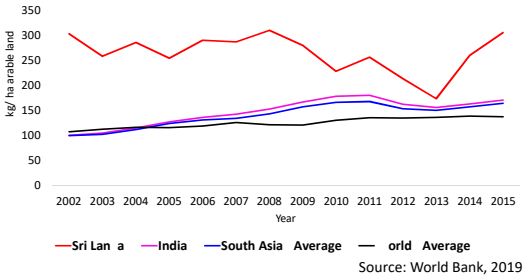
Animal and plant manures - are not included

Source: www.knoema.com

Fertiliser usage in Sri Lanka

Sri Lanka – a country with heavy fertiliser usage

ertili er consumption (ilograms per hectare of arable land)



Source: World Bank, 2019

Fertiliser usage in Sri Lanka

In year 2 16

Fertiliser imports in year 2016 – 512,647 t

Fertiliser consumption in 2016 (total) – 474,830 t

Fertiliser consumption for rice – **4** (of total fertiliser consumption)

Urea for paddy – **6** (of total urea consumption)

Source: National Fertiliser Secretariat, 2017

Pesticide use in Sri Lanka

Item	olume (t)	
	2015	2016
echnical material		
Insecticides	115.84	3.08
Herbicides	751.70	107.0
Fungicides	-	-
ormulations		
Insecticides	1759.06	1126.50
Herbicides	2862.74	2088.15
Fungicides	1233.80	902.40

Source: Registrar of Pesticides, Department of Agriculture

N emission in Sri Lanka

irect emission of N_2O from agricultural fields

Synthetic Fertiliser 1.27 Gg N_2O - N/yr – 1994

Animal Waste - 0.04 Gg N_2O - N/yr – 1994

Source: UNFCC National Communication - Sri Lanka, 2000

N_2O from livestock

Cattle and buffaloes are mostly free grazing.

Manure (dung and urine) directly deposit on the soil without storage or treatment.

Estimated total emission of N_2O -

0.14 Gg in 1994 and 0.12 Gg, which is equivalent of 37.2 $GgCO_{2eq}$ in 2000.

Source: UNFCC National Communication - Sri Lanka, 2000 and 2011

Indirect emission of N_2O from agricultural lands in year 2

Source	N_2O Gg
Indirect emissions	
Atmospheric deposition of volatilized N from managed soils	
Synthetic fertilizers	0.243
Organic amendments	0.013
Grazed soils (pasture, range and paddock)	0.002
Leaching/ runoff from managed soils	
Synthetic fertilizers	0.546
Organic amendments	0.014
Grazed soils (pasture, range and paddock)	0.002
Crop residues	0.001
Mineralized soil organic matter	0.002
otal indirect emissions	**. 23**

Total indirect N_2O emission is equivalent to **2 .13 Gg O_{2e}**

Source: UNFCC National Communication - Sri Lanka, 2011

N_2O emission from leaching

1.57 Gg in 1994

0.58 Gg in 2000

As a summary

Total emissions and removals of N_2O in Sri Lanka - 3.46 Gg (in 2000)

Emissions from agriculture - 2.65 Gg (821.5 $GgCO_{2eq}$)

(**6.6**)

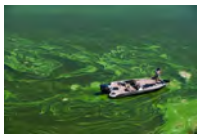
Environmental and health issues from fertiliser

Eutrophication

Enrichment of water bodies by nutrients, specially nitrogen and phosphorus.

Excessive growth of aquatic plant/algae

Resulting in the depletion of dissolved oxygen

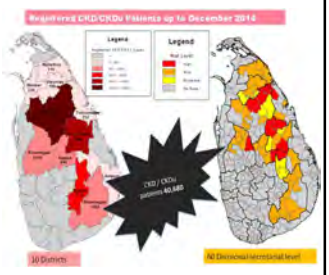


Chronic idney isease ith unkno n aetiology C u in Sri Lanka

Etiology - not known yet

Possible causes
- Fertilizers
- Pesticides
- Herbicides
- Heavy metals
- Hardness of water

Mainly - water pollution from **agrochemicals**



Blue baby syndrome

Known as infant methemoglobinemia

Due to decreased amount of hemoglobin in the baby s blood

Cause - water contaminated with nitrates

Potential risk in Sri Lanka (Kalpitiya, Jaffna)

Case study – Maduru Oya

Nutrient pollution in the form of excess nitrogen and phosphorus have impact on coastal ecosystem.

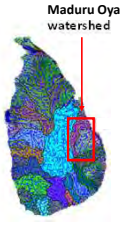
Nutrient pollution in Maduru Oya watershed – impact on Kayankerni and Pasikudah reefs.

Sources of pollutants - mostly agricultural.

Mismanagement practices from agricultural sector.

Maduru Oya Cont

Maduru Oya reservoir



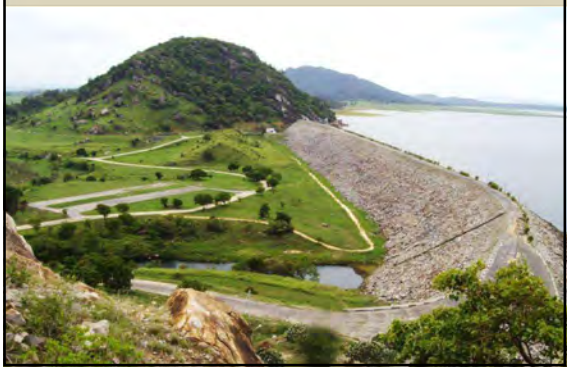
River Basins in Sri Lanka

Distribution of coral reefs

Kayankerni reefs

Pasikudah reefs

Major Irrigation Projects



ater polluted sites sources of pollution and ey land use types observed in Maduru Oya watershed during the e posure visit

Some rice growing eco-systems in Sri Lanka

Methodological procedure

Literature survey

To gather information on
- Geographical information/ administrative boundaries
- Socio economic status
- Land use pattern

Data collected from
- government data sources (Department of Census and Statistics, Department of Agriculture)
- reports (from Department of Irrigation, Mahaweli Authority)
- scientific literature

Methodological procedure Cont

ield observations e posure visit

Covered the whole watershed from Maduru Oya reservoir to the Kayankerni and Paskudah costal belt

Discussions with key stakeholders

(Departments of Agriculture, Forest and Wildlife, Fishery and Irrigation, Mahaweli Authority, and fishing and farming community leaders)

Situation assessments on major land use types

Observed – pollution sources

Methodological procedure Cont

Sta eholder meeting Aralaganwila 12th ebruary 2 1

Key stakeholders in the area (Dept. of Agriculture, Irrigation, Mahaweli Authority)

Exchanged ideas and experience on
- crop cultivation and how the fields are managed
- types and amounts of fertilizer and other agrochemicals used
- knowledge on mismanagement and their impacts

Farmer survey

Stakeholder meeting at Aralagan ila - 12th February 2 1

Methodological procedure Cont

Awareness program Aralaganwila 2 th March 2 1

Good Agricultural Practices to mitigate land based nutrient pollution

Resource person - Dr. (Mrs.) M.G.D.L. Priyantha - Additional Director of Seed Certification Service at Department of Agriculture

Evaluation before and after the program - to evaluate

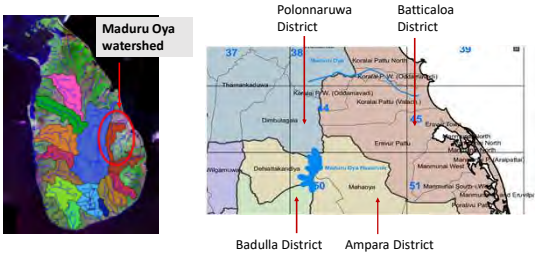
- level of awareness on fertilisers
- environmental pollution
- best management practices/ good agricultural practices

A areness program at Aralagan ila - 2 th March 2 1

Geographical administrative socioeconomic and ecological details of Maduru Oya atershed

Reservoir - constructed under the Accelerated Mahaweli Program in 1983

Extends to North Central, Uva and Eastern provinces



Biodiversity

Prominent forest type - Dry mixed evergreen forest

Rich diversity of mangrove forests

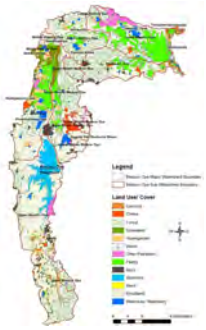
Lot of flora and fauna species

196 bird species that include nationally threatened (14) and globally threatened (3) species

Land use pattern

Nature of land	istrict							
	Badulla		Ampara		Polonnaruwa		Batticaloa	
	Area (ha)		Area (ha)		Area (ha)		Area (ha)	
Forest	60.73	21.23	142.10	32.19	169.35	48.85	42.38	14.85
Home gardens	1.56	0.54	35.32	8.00	48.93	14.12	12.29	4.31
Paddy lands	31.05	10.85	97.24	22.02	83.45	24.08	69.22	24.26
Perennial crops	16.99	5.94	29.72	6.73	n.a.	-	2.41	. 4
Plantation crops	32.11	11.22	2.04	0.46	0.89	0.26	6.69	2.34
Other field crops (seasonal crops)	12.54	4.38	23.67	5.36	2.18	0.63	22.01	. 1
Large inland waters	5.72	2.00	17.65	4.00	20.40	5.88	24.40	8.55
Abandoned land	1.12	0.39	27.29	6.18	7.21	2.08	8.34	2.92
Build up land (roads/buildings/ playgrounds)	13.09	4.58	11.70	2.65	0.73	0.21	9.94	3.48
Scrub/ Chena	29.51	10.31	29.71	6.73	11.48	3.31	61.94	21.7
Other	142.42	49.78	25.05	5.67	2.01	0.58	68.16	23.88
Total	286.10		441.50		346.64		285.40	

Land use pattern



Major crop
- Paddy

Plantation crops
- Coconut

Fruit crops
- Mango
- Banana
- Papaya

Other perennials
- Cashew

Paddy cultivation in Maduru oya atershed

High intensive large scale commercial paddy farming

High potential area (production 4.5 – 5.0 t/ha)

Irrigation (Ampara, Batticaloa and Polonnaruwa districts)

- Major irrigated fields – 274,141 ha (77.0%)
- Minor irrigated fields – 24,073 ha (6.8%)
- Rainfed fields – 57,590 ha (16.2%)

} 4

Fertiliser usage and N losses in Maduru Oya atershed

Fertiliser recommendation for 3.5 month old rice variety

- Urea – 225 kg/ha
- Muriate of potash (MOP) – 60 kg/ha
- Triple superphosphate (TSP) – 55 kg/ha
- Zinc Sulphate – 5 kg/ha

In year 2016

Consumed Urea - **6 t**

N in Urea – 46%

Used N – 36826 t

N use efficiency – around 30%

N losses – **2** **t**

Approximate values

Nitrogen losses from agricultural activities

For paddy - farmers apply **2** more fertilizers than the recommendation of Department of Agriculture (increase N losses)

Fertilizer for other land use types (coconut, cashew, fruits, home gardens) – not well documented

Livestoc

Types

- Free rearing cattle, buffalo and goat
- Swine
- Poultry

No detailed information on nutrient pollution

Water uality status and pollution levels in Maduru Oya atershed in Sri Lanka

Lack of detailed study

pH of the reservoir exceeded the WHO standards for drinking water (Kasthuriarachchi et al., 2016)

Salinity content of Maduru Oya reservoir was 0.161 g l^{-1} (Silva, 2004)

Accumulation of nutrients can lead to the eutrophication that makes the spreading of toxic algal species in Maduru Oya (Kasthuriarachchi et al., 2016)

Several phytoplankton types (*yanobacteria, osmarium, Pseudanabaena, Microcystic and Pediastrum*) - as a reason of nutrient enrichment (Silva and Wijeyaratne, 1999)

Water uality status and pollution levels in other atersheds in Sri Lanka

Uma Oya - total suspended solids (17.87 17.96 mgl^{-1}) and turbidity (37.84 59.88 NTU) were higher than the standard limits (Weerasekara et al., 2015)

Vulnerability of coastal aquifers in Kalpitiya to nutrient pollution from agriculture (Jayasingha et al., 2011).

Nitrate level of ground water in Kalpitiya (44% out of 225 locations) above the safe levels of WHO (Liyanage et al., 2000)

Potential for methaemoglobinaemia (blue baby syndrome) expected (Liyanage et al., 2000)

Nutrient pollution in Mahaweli - leading to a chronic renal failure epidemic in North Central part of the country (Bandara et al., 2010).

Water uality status and pollution Cont

As a summary

Agricultural activities cause nutrient pollution in water sources, rivers and watersheds in Sri Lanka including Maduru Oya watershed

Need further research attention

ey comments findings of the stakeholder meeting

1. Main income source for many is the paddy farming
2. **Apply e cess fertili ers** to increase the yield
3. Many has the concern that the quality of fertilizers has been going down
4. Changes in government policies on the fertilizer subsidy programs which determine the amount of usage, yield, and income generated

. **Not getting the correct fertili er types as correct time**

6. Difficulty in finding quality inputs, high cost (seeds, agrochemicals etc), and lack of labour

. **Inappropriate use of pesticides** and other agrochemicals due to lack of knowledge

ey comments findings Cont

. **Lac of ade uate e tension services** when it is needed and availability of advanced technologies.

. **Lac of nowledge on best management practices (BMPs) and good agricultural practices (GAPs**).

10. Some farmers are already aware about health impacts of use of pesticides and cultivate small plot with minimum use of agrochemicals for their consumption.
11. Farmers were not aware on the impact of livestock management on nutrient pollution.
12. **Need of capacity building on nutrient pollution mitigation was identified**.

ey findings of the evaluation

Farmers are lack of aware on

- Importance of soil analysis to measure the nutrient status (80%)
- Identification of nutrient deficiency/overuse at the field (85%)
- Use of colour charts to identify nutrient deficiencies (90%)
- Site specific fertiliser application (75%)
- Characteristics and impact of fertilisers - on basal dressing, top dressing and urea (85%)
- Impact of fertiliser and other agrochemicals on soil, water and air pollution (90%)
- Best management practices (85%)

eaching materials used in a areness program

Environment riendly Sustainable technologies in rice farming

Importance of future intervention for sustainable management of of land and marine ecosystems

The impacts of nutrient pollution - not localized

Mitigation of nutrient pollution needs attention from all the stakeholders in Agriculture and related sectors

Farmers – major role (who contribute to nutrient pollution)

Required knowledge on BMPs

Need of capacity building on nutrient pollution mitigation

It is a must to conserve the environmental

References

Kasthuriarachchi TDW, Wickramaarachchi WDN, Premaratne WAPJ. 2016. Assessment of Water uality Status and Pollution Levels in Maduru Oya Reservoir in Sri Lanka. International Postgraduate Research Conference 2016 - University of Kelaniya. 161.

Silva EIL, Wijeyaratne MJS. 1999. The occurrence of Cyanobacteria in the reservoirs of the Mahaweli river basin in Sri Lanka. Sri Lanka Journal of Aquatic Science 4:51-60.

Silva EIL. 2004. uality of Irrigation Water in Sri Lanka - Status and Trends. Asian Journal of Water, Environment and Pollution.1(1 & 2) 5-12.

Jayasingha P, Pitawala A, Dharmagunawardhane HA. Vulnerability of Coastal Aquifers Due to Nutrient Pollution from Agriculture: Kalpitiya, Sri Lanka. Water, Air and Soil Pollution. 219:563–577

Liyanage CE, Thabrew MI, Kuruppuarachchi DSP. 2000. Nitrate pollution in ground water of Kalpitiya: An evaluation of the content of nitrates in the water and food items cultivated in the area. Journal of National Science Foundation of Sri Lanka.28(2):101-112

Weerasekara KAWS, Amarathunga AAD, RRAR, Sureshkumar N, Wickramaarachchi WDN, Azmy SAM. 2015. Assessment of water pollution status in Uma Oya, Sri Lanka. Sri Lanka Journal of Aquatic Science. 20(2):31-38

han you

Waste ater

Approximately major industrial parks of Sri Lanka generate 30 million cubic meters of waste water per year (Central Environmental Authority)

Agricultural sources

Waste ater management in Sri Lanka

In primitive stage

Sewer connections available for restricted areas in the Colombo city and few other major cities

Wastewater collected from the Colombo sewerage system is dumped in to the sea

Poor investment on standard public wastewater disposal facilities

Waste ater management in Sri Lanka Cont

Approximately 10% of wastewater produced by industries are discharged to environment without any treatment

Crop/ livestock farmers – no treatment

Use of untreated wastewater for crop cultivation and livestock farming

Health risks for the farmers/ farm animals and communities

Solid aste

About 6,400 tonnes of solid waste per day

About 2,500 tonnes are collected by local authorities

Municipal Solid Waste (MSW) generation in major cities – approximately 0.80 kg per capita per day

Source: UNFCC National Communication - Sri Lanka, 2011

Solid aste Cont

MSW generation – 1 kg per capita per day by 2025

Only 10-40% of MSW collected and rest remains either piled or dumped in low lands

Nutrients leaching

Source: UNFCCC National Communication - Sri Lanka, 2011

Livestock

Urine and faeces directly contaminate water bodies

Sri Lanka – free raring cattle and buffaloes

- **GBR Proposed actions include..**

'(iv) Fund catchment and coastal management to the required level to solve pollution issues for the Greater GBR by 2025, before climate change impacts on Greater GBR ecosystems become overwhelming'

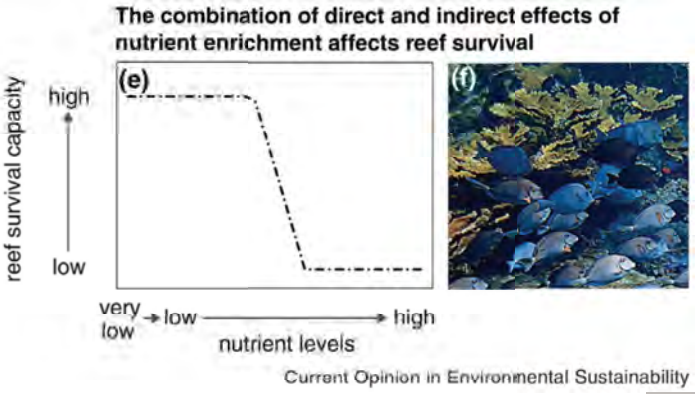
Impacts of turbidity on coral reefs

- What we know:

The bad...

The good...

Impact – response conceptual framework

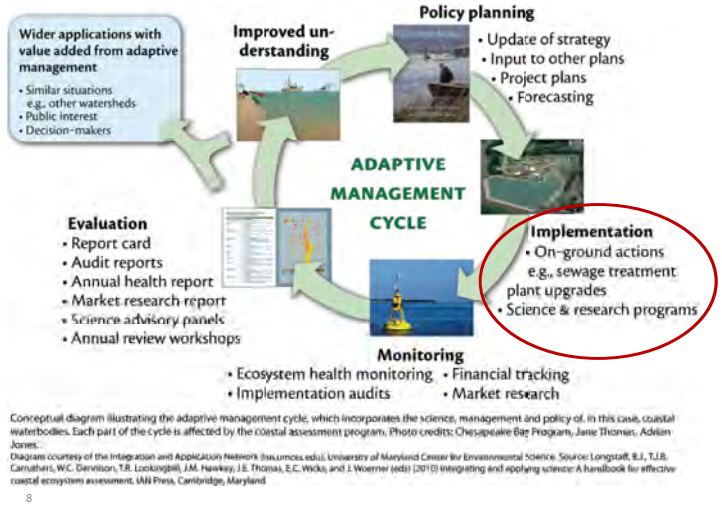


- Understanding the thresholds

Supporting decisions on Land-sea management

- How much sediment?
- Present relative to baseline?
- Explicit sediment reduction targets - landsea planning
- Dynamics of the climate-mediated changes

Brown, Maina, et al. 2017 Scie. Reports 2017
Tulloch, Maina, et al. 2016 Cons. Biology
Maina et al. Nature Communications, 2013
Maina et al. Marine Pollution Bulletin 2012



Conceptual diagram illustrating the adaptive management cycle, which incorporates the science, management and policy of, in this case, coastal waterbodies. Each part of the cycle is affected by the coastal assessment program. Photo credits: Chesapeake Bay Program, Jane Thomas, Adrian Jones.
Diagram courtesy of the Integration and Application Network (ian.umces.edu). University of Maryland Center for Environmental Science. Source: Longstaff, B.J., T.J.B. Carruthers, W.C. Dennison, T.R. Lookingbill, J.M. Hawkey, J.E. Thomas, E.C. Wicks, and J. Woerner (eds) (2010) Integrating and applying science: A handbook for effective coastal ecosystem assessment. IAN Press, Cambridge, Maryland

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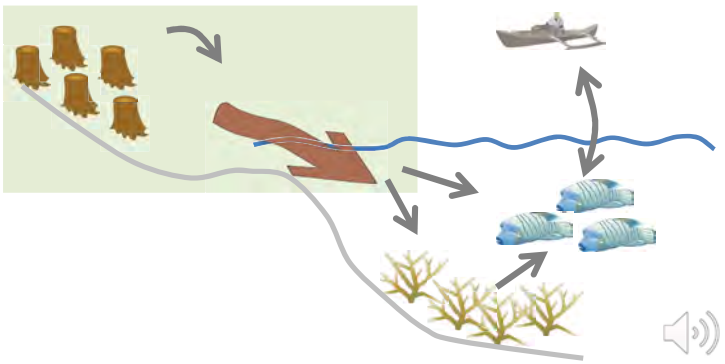
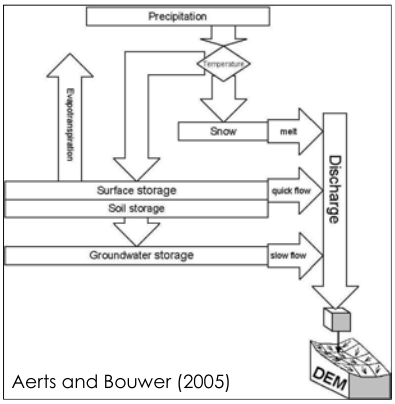
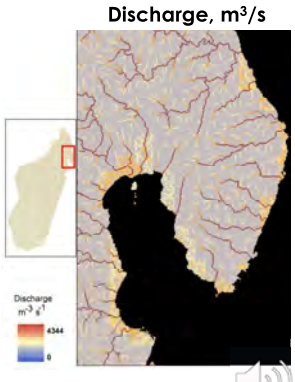
(1) Part 1 of the puzzle: how land-use impacts on turbidity



Tools: Hydrological models

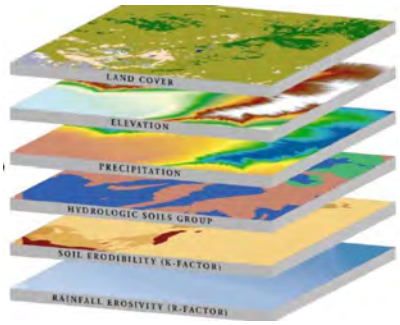


Aerts and Bouwer (2005)

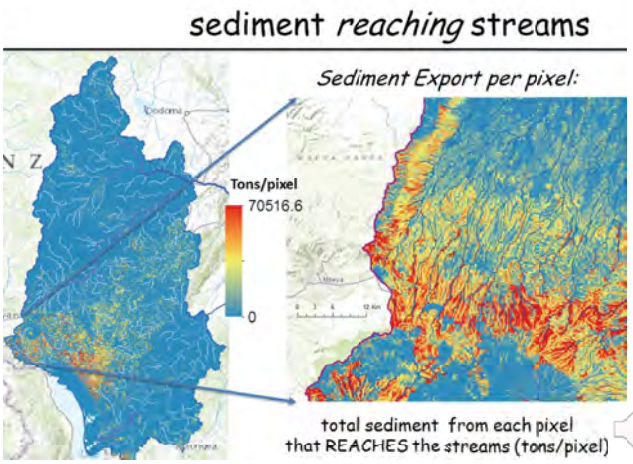


Tools: Hydrological models

- N-SPECT Tool by NOAA Coastal Services Center

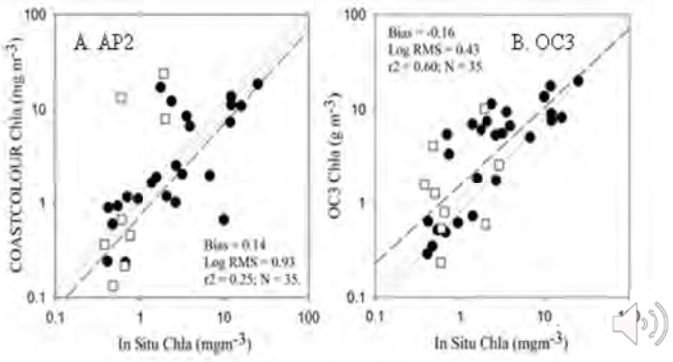


Outputs: erosion vulnerability maps

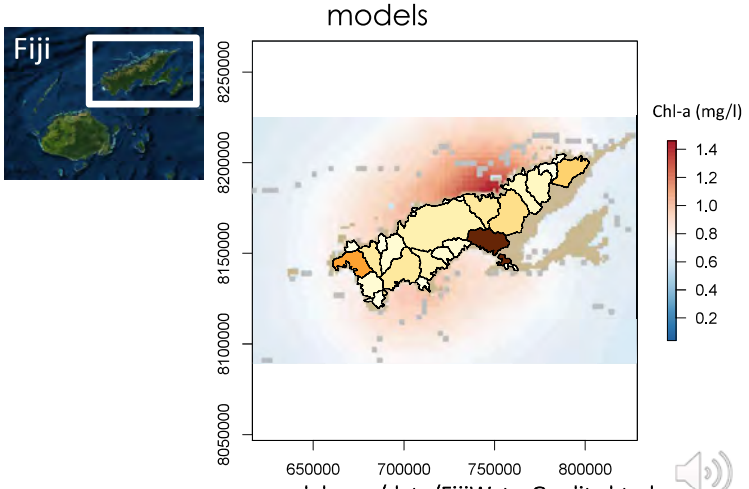


Tools: Remote Sensing

- retrieving water optical properties and concentrations from reflections spectra in coastal waters: validating satellite data for two sites in *Tulear - SW Madagascar*

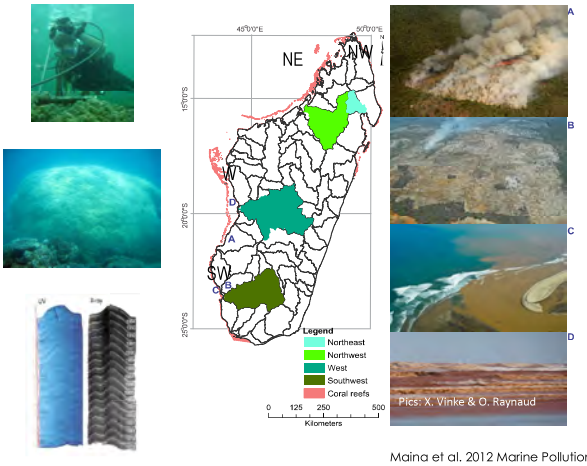


Tools: Coupling Remote Sensing & Hydrological models



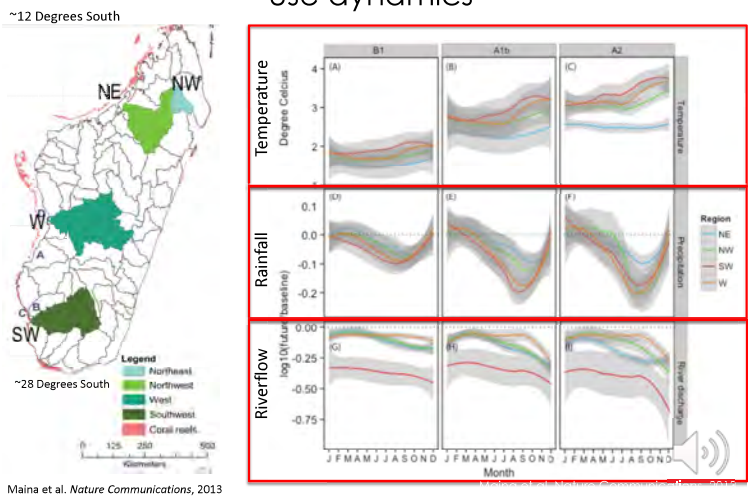
www.seascapemodels.org/data/FijiWaterQuality.html

Tools: coupling hydrological models with Geochemistry/sediment cores



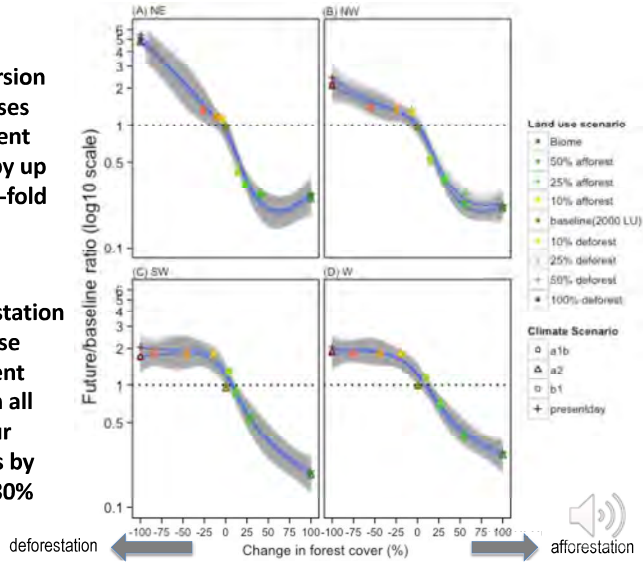
Maina et al. 2012 Marine Pollution Bulletin

Global Environmental Change: Climate & Land use dynamics

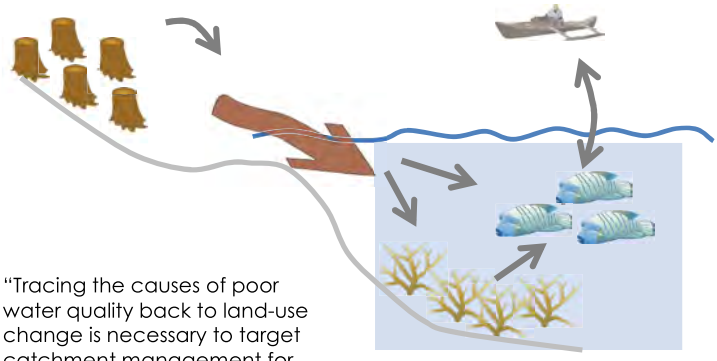


Maina et al. *Nature Communications*, 2013

- **Forest conversion increases sediment yield by up to five-fold**
- **Afforestation decrease sediment yield in all the four regions by 75% - 80%**



(2) Part 2 of the puzzle: Fish responses to habitat change/catchments



"Tracing the causes of poor water quality back to land-use change is necessary to target catchment management for coastal zone management"

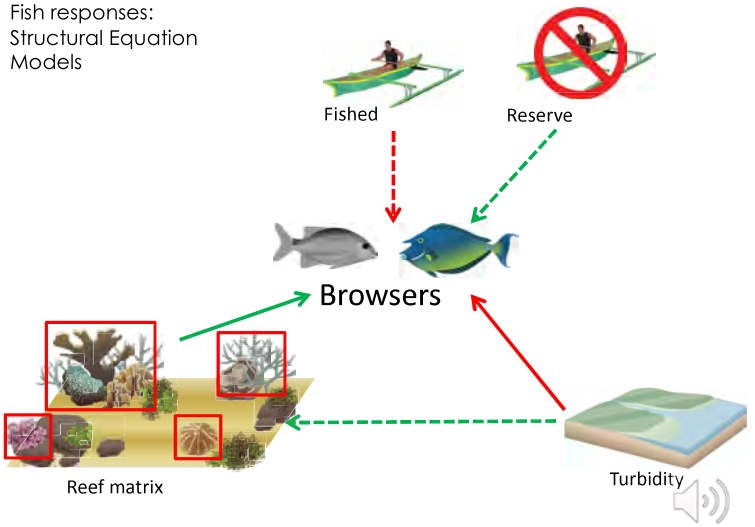
Brown, Maina et al. 2017

Abundance of fish across gradients of fishing pressure and turbidity - Fiji

Data-sets

- Landcover from Sentinel-2 (S2)
  - ~14 Million pixels (10 x10 metres) for Vanua Levu
- Water quality
  - 650 000 pixels (260 x 300 metres) by 214 *MERIS* images by 6 variables = ~844 million data points
- Reef surveys (2010 – 2012)
  - 158 sites
  - >58 000 point observations of benthic cover
  - >230 000 individual fish
  - 3.6 tons of fish
  - 374 fish species

Fish responses: Structural Equation Models



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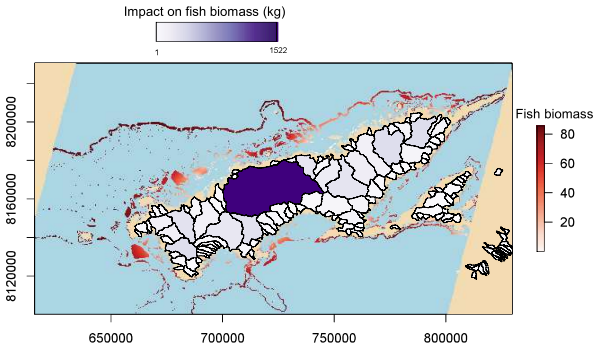
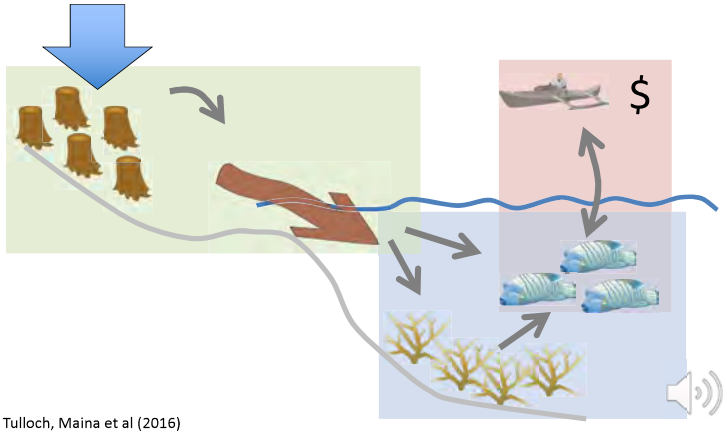


- **These findings suggest that terrestrial run-off modifies the composition of reef fish communities indirectly by affecting the benthic habitats that reef fish use**

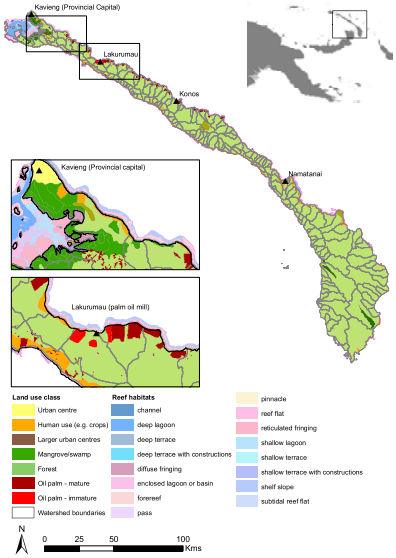
(3) Part 3 of the puzzle: linking processes to planning

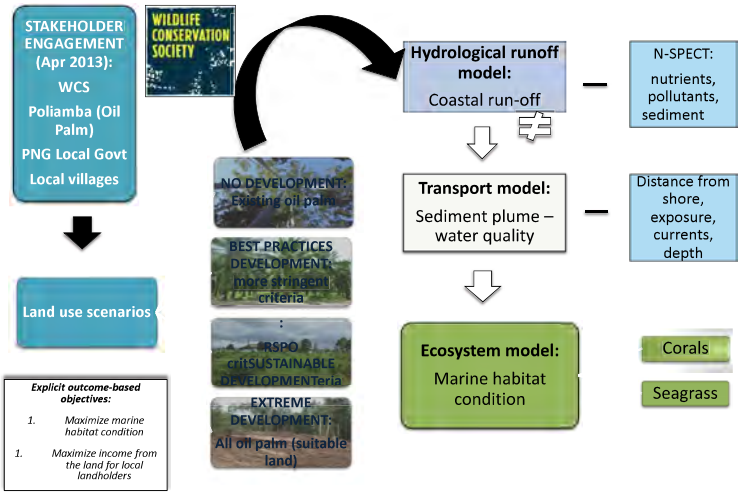
Future land-uses



Tulloch, Maina et al (2016)

Papua-New Guinea: Coupling land/sea models to simulate impacts of oil palm development

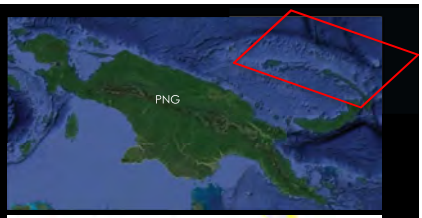


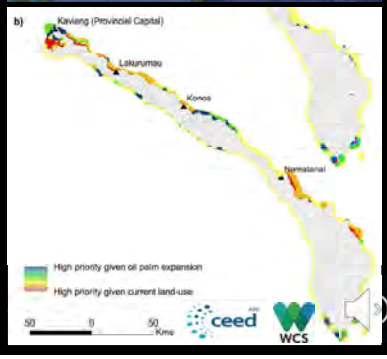


Tulloch, Maina et al (2016) "Improving conservation outcomes for coral reefs affected by future oil palm development in Papua New Guinea", *Biol Cons*

Coupling land/sea models to simulate impacts of oil palm development

- current land-use: 50% of reef ecosystems in marine reserves will be heavily degraded
- Using best practices ensured there was minimal risk of future reef retrogression





Tulloch, Maina, et al. 2016 Cons. Biology

Key points

- Need to plan for future development (it's going to happen!)
- Can't assume that things we protect now will be protected in the future
- Act now, use best available data, don't delay or it might be Too late

Appreciation

Hugh Possingham
Vivian Tulloch
Carissa Klein
Maria Berger
Stacy Jupiter
WCS staff in Fiji/PNG
Nature Conservancy staff
Blue Ventures Staff
Hans de Moel
Jens Zinke