SACEP

South Asia Co-operative Environment Programme

Marine litter

in the

South Asian Seas Region

UNEP Regional Seas GPA

SOUTH ASIA CO-OPERATIVE ENVIRONMENT PROGRAMME

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Marine Litter

in the South Asian Seas Region

Part-1: Review of Marine Litter in the SAS Region

Part-2: Framework for Marine Litter Management in the SAS Region

A Report by the South Asia Co-operative Environment Programme

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Cover design: Master Hari Krishna, Student of Kendriya Vidyala, Annanagar, Chennai India as part of the SACEP Coastal Clean up Campaign 2007

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FOREWORD

The SAS Region includes the seas bordering Bangladesh, India, Maldives, Pakistan, and Sri Lanka and comprises the Northern part of the Indian Ocean, along with parts of the Bay of Bengal and the Arabian Sea.

The countries constituting the SAS Region have almost a fifth of the world's total population. High population density, low income, low development indicators, and high dependence upon natural resources for livelihood characterise all these countries.

The Indian subcontinent has the most extensive beach area (more than half of its coastline). Beaches are also found in the other countries. The coasts of these countries are dotted with estuaries, which sometimes form lagoons or backwaters. Such areas are important for fishing. There are major lagoons in the region.

The major sources of coastal and marine pollution originating from land vary among the SAS countries, which show great disparity in size and demography. The nature and intensity of development activities, human population size, income level, and state and type of industry and agriculture are among the factors contributing to each country's unique pollution problems

In the SAS Region numerous cities and industries with inadequate waste management are situated along major rivers such as the Ganges, Narmada, Bramhaputra, Indus, Kelaniya & Mahaweli. Pollution from distant sources can also enter the marine environment through atmospheric deposition. The tsunami of 26 December 2004, which seriously affected Sri Lanka, India, and Maldives, demonstrated that in addition to land-based sources of pollution induced by human activity, natural events result in substantial but sporadic contributions mainly in the form of disaster debris and litter

Surveys have indicated that nearly 80 percent of marine debris originates from land-based activities. It is believed that around 70 per cent of litter entering the oceans lands on the seabed, 15 per cent on beaches and 15 per cent remains floating on the surface.

The threat and impacts of marine debris have long been ignored. The trash and other waste that drifts around the global ocean and washes up on the nation's shores, pose a serious threat to fishery resources, wildlife, and habitat, as well as human health and safety. While marine debris is a global problem requiring international cooperation, many of its negative impacts are experienced at the local level and require local involvement.

Marine litter was identified as one of the nine source categories of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, (UNEP, 1995). The issue of marine litter and the destructive effects of abandoned fishing gear were further emphasised in Resolution 59/25 of the UN General Assembly on 17 November 2004 on Oceans and the Law of the Sea – Sustainable Fisheries". Furthermore a decision 59/22 of 10 November 2004 on Oceans and the Law of the sea recommended that marine debris should be included in the discussions of the United Nations Consultative Process on the Law of the Sea (UNICPOLOS) as well as in the 2004 UN Secretary General's Report.

Considering the magnitude and the severity of marine litter problems, UNEP/Regional Seas programme has been developing activities relevant to the marine litter issue in consultation and in co-operation with many UN Agencies, such as the International Maritime Organization (IMO), Intergovernmental Oceanographic Commission (IOC) of UNESCO, the Secretariat of the Basel Convention, The Mediterranean Action Plan and the Food and Agricultural Organisation of the United Nations (FAO). One such programme is a "Feasibility Study on Sustainable Management of Marine Litter"

Based on the National Reports of the five Maritime Countries of South Asia, the Framework for Marine Litter drawn up will now be formally endorsed at the 4th Inter Ministerial Meeting of the South Asian Seas.

This activity is most timely especially to the South Asian Seas Region and on behalf of the member countries of the South Asian Seas programme, I am thankful to UNEP for initiating this activity

I am confident that the Institutions identified will assist SACEP in the implementation of the activities identified in the Framework Document

Dr. A. A. Boaz
Director General
South Asia Co-operative Environment Programme

ACKNOWLEDGEMENTS

At the outset, the South Asia Co-operative Environment Programme (SACEP) wishes to thank the United Nations Environment Programme (UNEP) for including the South Asian Seas region as one of the Regional Seas region for this Global Marine Litter Activity

SACEP also wishes to acknowledge the tremendous work done by the Regional Consultant, Dr. V. Sampath in the preparation of the Regional Review Report on Marine Litter and the Framework Document for Management of Marine Litter in the Region for the SACEP/SAS Regional Seas Programme.

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In the cover page of this publication we have incorporated the award winning painting done by Master Hari Krishna, Student of Kendriya Vidyala, Annanagar, Chennai India for the Poster Competition in connection with the SACEP, Indian Coast Guard and Ministry of Earth Sciences, India, Coastal Clean up Campaign Day Campaign 2007and we wish to acknowledge his contribution.

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The documents also contains information extracted from a number of publications including the State of Environment Reports, National Environment Action Plans, Environment Policies of our member countries, and a number of other published and unpublished documents obtained through personal contacts of the Regional Consultant and downloaded from the websites of UNEP-GPA, FAO, HELCOM, World Bank, The Ocean Conservancy, the authorised Government Websites. We wish to acknowledge with thanks these organisations for their contribution to enrich this document by making use of this valuable information.

Dr Arvind Boaz
Director General, SACEP

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Executive Summary

Part – 1: Review of Marine Litter in the SAS Region

Marine and other aquatic litter/debris is the world's most pervasive pollution problem along shorelines, coastal waters, estuaries, and oceans throughout the world, affecting our seas and waterways. Marine litter consists mainly of slowly degradable or non-degradable substances, which inevitably accumulate in the environment, causing an ever growing problem. The threat and impacts of marine debris have long been ignored. The trash and other waste that drifts around the global ocean and washes up on the nation's shores, pose a serious threat to fishery resources, wildlife, and habitat, as well as human health and safety.

State of Marine Environment in the SAS Region

The nature and intensity of development activities, human population size, income level, and state and type of industry and agriculture are among the factors contributing to each country's unique pollution problems. The priority issues in the SAS Region include:

- *Sewage:* About 7,000 million l/day of sewage is generated in the coastal areas of all the South Asian countries. The sewage treatment facilities are inadequate in almost all cities/towns/villages in the region.
- *Agricultural chemicals:* Nearly 90% of the applied pesticides reach the coastal and marine environments via rivers and by atmospheric transport.
- *Sediment:* Annually, 1.6 billion tonnes of sediment is reaching the Indian Ocean from rivers in the Indian sub-continent. Total sediment load in rivers in Bangladesh alone amounts to 2.5 billion tonnes, of which the Brahmaputra carries 1.7 billion tonnes and the Ganges 0.8 billion tonnes.
- *Oil hydrocarbons:* Contribution to marine oil pollution is mainly by oil tankers, which transport an estimated 500 million tonnes annually through the SAS Region. Approximately 5 million tonnes of oil enter the Arabian Sea each year and the Bay of Bengal receives some 400,000 tonnes from similar sources.
- *Solid waste:* The quantity of solid waste generated by the coastal population of the Region is 11,650 tonnes/day (average of 0.5 kg/person/day). The waste is mostly composed of paper, plastics, and biodegradable matter. In Bangladesh, India, Pakistan and Sri Lanka, only a fraction of the solid waste generated is collected; and the rest is dumped in a haphazard manner in open areas. Solid waste dumped at sea comes from shipping, commercial fisheries, and other offshore activities. The ship-generated waste accounts for nearly 80% of the solid waste in the coastal and marine areas.

All the countries in this region now have a framework Environmental Protection Law that allows for the setting up of an institution to control and regulate environmental pollution and other problems; and they have also adopted requirements of Environmental Impact Assessment (EIA) as part of their environmental protection law, to enforce better management practices and control environmental destruction.

Status of Marine Litter in the SAS Region

In the entire SAS Region, data/information of some utility on marine litter is available only from India, Sri Lanka and Maldives and in the other two countries the information available is scanty.

There are more weaknesses than strengths in the current marine litter management programmes of the countries in the SAS Region. There is no standard methodology adopted even in India, Pakistan and Sri Lanka where periodic coastal clean up activities are reported to be undertaken, for marine/beach litter removal and disposal. None of the National Environment Action Plans of the countries in the SAS Region includes any programme worth the name for marine litter monitoring, management and prevention.

From the available data it could be inferred that the major sources of marine pollution including debris/litter are domestic/industrial wastes, ports and harbours including fishing harbours and landing centres, ship breaking yards, fish/food processing industries, tourist resorts/beaches, solid waste dumping, urban runoff, oil rigs, coastal aquaculture, fishing industry including fishing gear, shipping including garbage from ships, recreational and leisure use, marine mining, construction activities, etc.

Except for scanty information on beach litter, there is no information/data available on the open ocean floating and submerged marine litter/debris, as no systematic monitoring/sighting of such debris has so far been undertaken in this part of the South Asian Seas.

In Bangladesh, excreta; scrap of iron piece; metallic fragment and other refused materials; oxidised iron, foam, pieces of wood and partex, glass wool, PVC, PCBs, black tar, grease balls and oil film and many other toxic chemicals left in the beach for a long time and accumulated in the beach soil finally get washed into the sea.

In India and Sri Lanka the types of marine litter include plastics, polystyrene, rubber, wood, metals, sanitary or sewage related debris, paper and cardboard, cloth, glass, pottery/ceramic, monofilament fishing line, waxed milk carton, fruit peel, cigarettes, cigarette fibre, cigar tips, and other tobacco related packaging/wrappers, used batteries, building materials, floats, marking buoys and abandoned cut pieces of used nets, etc.

The increase in non-degradables such as plastics, cans and bottles and hazardous wastes such as dry cell batteries and hospital wastes are threatening the aesthetics, and health of people on many islands in the Maldives.

Though data on the type and sources of marine litter are not available from Pakistan's coastline, it is generally observed that glass, wooden packs, paper, tin packing and thermoplastics are usually found in very small quantities in the solid waste of Karachi.

There is no information available on the factors controlling litter distribution in space and time and its dynamics in the SAS Region, except for some preliminary observations in the Great Nicobar area of Andaman and Nicobar Islands in India.

There are no data available either on the economic loss due to marine litter problem, or on the negative impact of marine litter. Stray instances of entanglement of fish and endangered marine fauna are reported from the Indian waters. Even though in India, Pakistan and Sri Lanka periodical coastal clean up operations are carried out, no effort has so far been made to make an assessment of the costs involved in such operations. There is also no systematic assessment of damages to the ecosystems, tourism or public health and safety due to coastal and marine litter in the region.

The International Coastal Cleanup day is being organised by the Indian Navy, Indian Coast Guard, National Institute of Ocean Technology at Andaman, and NGOs like Indian Maritime Foundation with the participation of school children, Industries and citizens, and in Bangladesh from the year 2002. There is no report from Maldives, Pakistan and Sri Lanka on ICC day campaign for beach cleaning.

There are no legal mechanisms/framework, institutional framework and policies specifically for marine litter management, but whatever mechanisms and framework are in place are all umbrella framework for environmental protection and management, in the SAS Region.

Part – 2: Framework for Marine Litter Management in the SAS Region

Marine Litter management is not a priority issue in any of the countries in the SAS Region. Currently, the SAS Region does not have any specific national or regional projects that deal exclusively with the issue of marine litter. There is also no useful information/data available on the open-ocean floating and sea floor marine litter/debris, as no systematic monitoring/sighting of such debris has so far been undertaken in the South Asian Seas (SAS) Region. Marine Litter activities in the SAS Region are limited to periodic beach-clean up and community clean up exercises. There are no exclusive legal mechanisms/framework, institutional framework and policies for marine litter management in this region, even though there are umbrella legislation for marine pollution control and prevention.

This framework document highlights

- The methodologies that could be adopted in the Region for assessing the quantities, composition, distribution and trends of marine litter;
- The proposed thematic areas and activities which could be considered for implementation in the SAS Region on the lines adopted in the other Regional Seas Programmes, which include *Monitoring/Data Collection and Research, Education and Outreach, Stakeholder participation, Economic Impact Analysis, Policy, Institutional and Legal frameworks, and Financing Mechanisms;*
- *Action Plan strategies, which include introduction/implementation of a National Marine Litter Monitoring Programme* incorporating the strategies for Development of a regional, web-based database on marine litter, Stakeholder/community participation, Assessment of the economic impacts of marine litter, Impacts of marine litter on wildlife and ecosystems, Improvement of the common knowledge base*; Education & Outreach* incorporating voluntary beach clean ups, introduction of information and educational programmes, development and dissemination of outreach materials, etc; *Solid Waste Management Strategies* incorporating strategies for developing specialised marine litter waste management systems, improving/expanding waste management strategies, recycling, reuse and waste diversion*; Institutional Frameworks & Stakeholder Involvement; Legislation, Policies & Enforcement; etc.*
- Specific actions and measures at source for reduction of marine litter from merchant ships, offshore platforms, pleasure crafts; fishing vessels; households; beach-goers, campers; economic aspects; information system on coastal waste; and development of quantitative and qualitative indicators for marine solid wastes.

The framework document also underscores the need for development of best practice guidelines for waste management which includes, waste avoidance, waste reduction, waste segregation, waste reuse, waste recycling or reclamation, waste treatment and waste disposal; Waste Management Plan incorporating waste reception facilities; and methods of disposal of different kinds of wastes as per MARPOL 73/78 Annex – I, II, IV & V.

Under the title 'Partnerships, voluntary agreements and cooperation with major stakeholders', the document touches upon the Role of Government agencies, NGOs and Community participation.

Plans for improvement of port reception facilities and services for garbage collection from the shipping and fishing industries; development and improvement of waste management policies and systems; and capacity building / human resource development, are the critical aspects dealt with and discussed.

The framework document also contains a section dealing with implementation of specific projects for marine litter management in the SAS Region under which a suggestion has been made for a comprehensive Integrated Marine Debris Management (IMDM) Programme that could be introduced in the region. This IMDM programme envisages setting up of a Regional Working Group and National level Monitoring Committees to formulate detailed work plans, review the implementation of the IMDM Programme, and provide necessary policy and advisory guidance to the Project implementing agencies and the concerned national governments on effective marine litter management in the respective countries, supported by a Project Directorate with supporting staff. At the Regional level, SACEP-SAS RSP would constitute a Working Group for the SAS drawing Members from UNEP, IMO, GPA, IOC, GEF, World Bank, WWF, etc., and the respective National Focal Points to review and guide the implementation of marine litter activities in the region. A dedicated survey of coastal and marine floating and sea-bed debris spread over a 3 year duration, using the vessel infrastructure, expertise, remote sensing capabilities, acoustic instruments etc., available in the region, is proposed for the entire region. The survey would be carried out in a phased manner with initial emphasis on tourism related sites and other land-based activities, where majority of marine debris is generated, which finds its way into the sea.

An exclusive project for upgrading the port reception facilities at select major and minor ports/harbours including major fishery harbours, pilot initiatives for treatment of MARPOL –Annex V wastes are also included in the Marine Litter Management project.

R&D activities would focus on collecting, collating and analysing baseline information on Marine Litter volume, distribution, composition, source identification and trend analysis; tracking experimentation of floating debris, experimental study of drifting and sinking of marine debris, impacts of marine litter, including plastic items and derelict and abandoned fishing gears, on the marine ecosystem, human health and the economy of coastal areas and communities. Research would be conducted to determine whether economic incentives on cleaning litter and trash are effective in motivating behavioural changes of the people. R & D component for marine debris management would be implemented with a major thrust on technology development for recycling and safe and environment friendly disposal of debris including the medical waste.

The conservation measures would focus on minimising and mitigating marine debris, with a mechanism for emergency response for recovery and maximisation of recycling with environment friendly treatment.

Lead Project Implementing Agencies would include the Nodal Ministries of Environment, Shipping, Ports and Harbours, Fisheries, Earth Sciences, Tourism, Pollution Control Boards, Environmental Organisations, National Oceanographic Research Institutes, Coast Guard and Navy, Industries and NGOs in close coordination / linkage with UNEP-SACEP SAS RSP, GPA, IOC-UNESCO, IMO, etc.

Marine Debris Outreach Campaign in the SAS Region would include Capacity Building through training, education, awareness and outreach, periodic Coastal clean-up operations; communication for information dissemination; and organising a network of NGOs.

The existing legislation, regulations and enforcement mechanisms/practices that deal with marine pollution would be evaluated and they would be strengthened or a new legislation/regulation – a *Marine Litter Act* – exclusively for marine litter management in the SAS Region countries would be enacted. In all institutional arrangements, representatives of the stakeholders would be given adequate representation and appropriate roles.

A close coordination/linkage among concerned Ministries and organisations would be established to address the issue of management of marine litter in the Region. This would be accomplished by setting up Inter-Ministerial Monitoring Committees at the National Level and a Working Group at the Regional Level coordinated by SACEP/SAS RSP.

The Strategy and Action Plan for marine litter management in the region will be finalised taking into consideration the needs of the national governments and at the conclusion of the consultations in the proposed Task Force meeting of the SAS Region, to be coordinated by SACEP/SAS, sometimes during mid-2008.

Part - 1

REVIEW OF MARINE LITTER IN THE SAS REGION

REVIEW OF MARINE LITTER IN THE SAS REGION

1. Preamble

The first to raise concern about the presence of human refuse in the marine environment was probably Heyerdahl (1971), who reported that during his "RA" expedition he observed significant quantities of tar and solid litter floating in the ocean. Since then, reports on the presence of litter in the marine environment have come from all over the world (UNEP, 1991).

Marine and other aquatic litter/debris is defined as any man-made, solid material that enters our waterways directly (e.g., by dumping) or indirectly (e.g., washed out to sea via rivers, streams, storm drains, etc.). It is the world's most pervasive pollution problem along shorelines, coastal waters, estuaries, and oceans throughout the world, affecting our seas and waterways. The terms "marine litter" and "floatable" are occasionally used in place of the "marine debris", connoting deliberate release(littering) of debris of a sewage or storm water origin(floating) (Coe, 1995). Marine litter consists mainly of slowly degradable or non-degradable substances, which inevitably accumulate in the environment, causing an ever growing problem. Objects ranging from detergent bottles, hazardous medical wastes, and discarded fishing line all qualify as marine debris. Marine debris not only is an aesthetic problem, but has become a serious threat to marine life, a marine transportation hazard, can threaten human health and safety as well as inflict serious economic loss and can wreak havoc on coastal communities and the fishing industry (UNEP, 2005c).

During the last 2-3 decades, there has been growing concern in the world due to an increase in the quantity of litter in the marine environment. This increase is a result of the fast development of plastic materials. Plastics are not the only persistent material discarded into the sea, but they consist of a large variety of other materials: metal, lumber, glass, rubber, styrofoam, cloth, foam rubber and others

Surveys have indicated that nearly 80 percent of marine debris originates from land-based activities. It is believed that around 70 per cent of litter entering the oceans lands on the seabed, 15 per cent on beaches and 15 per cent remains floating on the surface (The Ocean Conservancy 2004 and UNEP 2006a).

The threat and impacts of marine debris have long been ignored. The trash and other waste that drifts around the global ocean and washes up on the nation's shores, pose a serious threat to fishery resources, wildlife, and habitat, as well as human health and safety. While marine debris is a global problem requiring international cooperation, many of its negative impacts are experienced at the local level and require local involvement.

Marine litter was identified as one of the nine source categories of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, (UNEP, 1995). Decision 59/22 of 10 November 2004 on Oceans and the Law of the sea recommended that marine debris should be included in the discussions of the United Nations Consultative Process on the Law of the Sea (UNICPOLOS) as well as in the 2004 UN Secretary General's Report (UNEP, 2005). The issue of marine litter and the destructive effects of abandoned fishing gear were further emphasised in resolution 59/25 of the UN General Assembly on 17 November 2004 on Oceans and the Law of the Sea – Sustainable Fisheries".

UNGA Resolution A/60/L.22 - Oceans and the Law of the Sea - of 29 November 2005 in articles 65-70 noting the lack of information and data on marine debris, "encourages relevant national and international organisations to undertake further studies on the extent and nature of the problem," besides encouraging States to develop partnerships with industry and civil society raise awareness of the extent of the impact of marine debris on the health and productivity of the marine environment and consequent economic loss and calls for national, regional and global actions to address the problem of marine litter; "urges States to integrate the issue of marine debris within national strategies dealing with waste management in the coastal zone, ports and maritime industries, including recycling, reuse, reduction and disposal, and to encourage the development of appropriate economic incentives to address this issue, including the development of cost recovery systems that provide an incentive to use port reception facilities and discourage ships from discharging marine debris at sea, and encourages States to cooperate regionally and sub-regionally to develop and implement joint prevention and recovery programmes for marine debris". In response to the GA call, UNEP (GPA and the Regional Seas Programme), through its Global Marine Litter Initiative took an active lead in addressing the challenge, among others, by assisting 11 Regional Seas around the world (Baltic Sea, Black Sea, Caspian Sea, East Asian Seas, Eastern Africa, Mediterranean Sea, Northwest Pacific, Red Sea and Gulf of Aden, South Asian Seas, South East Pacific, and Wider Caribbean), in organising and implementing regional activities on marine litter.

Considering the magnitude and the severity of the marine litter problem, and in line with the UNGA Resolutions, UNEP/Regional Seas Programme has been developing activities relevant to the marine litter issue in consultation and in co-operation with UN Agencies**,** such as the International Maritime Organisation (IMO); Intergovernmental Oceanographic Commission (IOC) of UNESCO; the Secretariat of the Basel Convention; the Mediterranean Action Plan and the Food and Agriculture Organisation of the United Nations (FAO). One such programme is a "Feasibility Study on Sustainable Management of Marine Litter".

The Regional Seas Programme has proposed the development of a more comprehensive initiative and approach to Marine Litter Management. The initiative would provide a wide-ranging platform for co-operation and co-ordination of activities for the control and management of marine litter.

In this document, a Review of the status of marine litter in the South Asian Seas Region is given, which is based on both the published and unpublished reports on the State of Marine Environment of the SAS region countries, the Bay of Bengal Large Marine Ecosystem National Reports of Bangladesh, India, Maldives and Sri Lanka and those extracted from the National Reports of three countries in the SAS Region on marine litter, prepared by the National Consultants of India and Sri Lanka and Pakistan Country Report of the Ministry of Environment, on the basis of the Questionnaire provided to them (Anexure-1) and a host of other documents.

2. State of Marine and Coastal Environment in the SAS Region[1]

2.1 Regional Scenario

The SAS Region includes the seas bordering Bangladesh, India, Maldives, Pakistan, and Sri Lanka and comprises the Northern part of the Indian Ocean, along with parts of the Bay of Bengal and the Arabian Sea. Bangladesh, India, and Pakistan are parts of the Indian subcontinent, while the island of Sri Lanka shares a part of the continental shelf with India. Maldives is a group of coral atoll islands (Fig.1).

The countries constituting the SAS Region have almost a fifth of the world's total population (UNDP 2002a). High population density, low income, low development indicators, and high dependence upon natural resources for livelihood characterise all these countries (Table-1).

The South Asian Seas region has some of the largest biologically rich marine ecosystems, like the Gulf of Mannar, coral atolls of the Maldives, coastal lagoons like Chilika and Puttalam, vast mudflats of the Gulf of Kutch and Jaffna, and the mangroves of the Sundarbans.

Almost all of Bangladesh lies in the active delta of three of the world's major rivers: Ganga, Brahmaputra and Meghna (GBM system). The major part of the Gangetic floodplain is located in India. The high sediment load carried by the rivers has led to the continuous formation of new islands off the coast of Bangladesh, which the government is reclaiming by planting mangroves. Other major rivers with deltas on the eastern Indian coast include those formed by the Mahanadi, Godaveri-Krishna, Cavery and Tamiraparani rivers. The Indus flows through most of Pakistan and at the mouth are the remnants of the largest mangrove systems in arid zones. The Mahaweli is the largest river in Sri Lanka. The Maldives does not have any rivers.

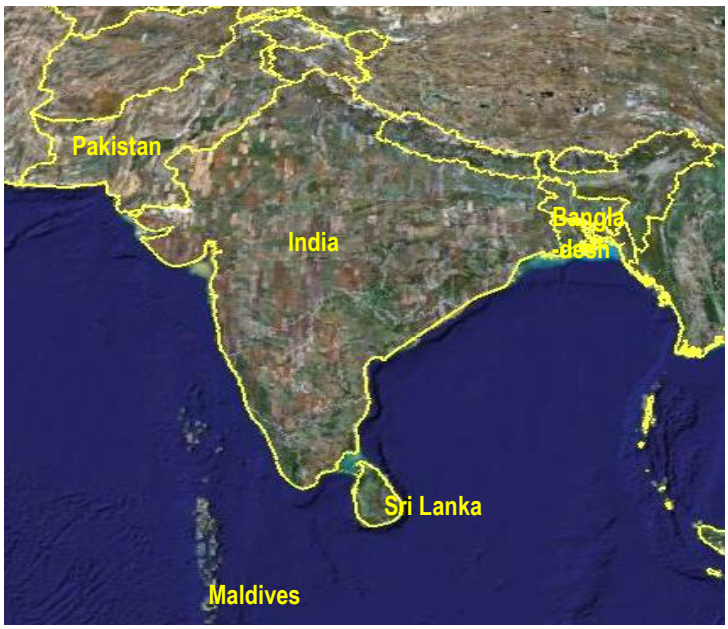

Figure-1: Satellite imagery of the countries in the SAS Region
(Source: Google Earth, 2007) .

[1]Part of this section of the report is drawn from a number of publications, which include UNEP/GPA "The State of Marine Environment – 6. South Asian Seas" (2005),BOBLME Country Reports (2003), National Reports on Marine Litter(2007)of India Sri Lanka and Pakistan Country Report on Marine litter, State of Environment of the five countries, National Environment Action Plan of Bangladesh and National Implementation of Agenda 21 of Pakistan, etc .

Table - 1: Major Socio-Economic Indicators (UNEP 2002a)

Country/ Region	Pop.in 2000 (in million)	Annual pop. Growth rate (%) 1995-2000	Pop. Density Persons /sq.km	Urban pop. as % off total	Annual urban pop. Growth Rate % (2000– 2005)	% pop. with in 100 km of coast line	Per capita GDP 1999 (constant 1995 US$) per person
Bangladesh	137.44	2.121	1055.8	24.5	3.98	54.8	362
India	1008.94	1.692	339.3	28.4	2.81	26.3	450
Maldives	0.29	3.015	969.9	26.1	3.52	81.1	1115
Pakistan	141.26	2.663	183.2	37.0	4.08	9.1	508
Sri Lanka	18.92	0.956	292.8	23.6	2.84	100	814
South Asia	1424.07	1.840	222.4	30.1	3.0	27.5	506

The Indian subcontinent has the most extensive beach area (more than half of its coastline). Beaches are also found in the other countries. The coasts of these countries are dotted with estuaries, which sometimes form lagoons or backwaters. Such areas are important for fishing. Major lagoons include the Pulicat and Chilika lagoons in India and Puttalam, Hikkaduwa and Rekawa in Sri Lanka.

The major sources of coastal and marine pollution originating from land vary among the SAS countries, which show great disparity in size and demography. The nature and intensity of development activities, human population size, income level, and state and type of industry and agriculture are among the factors contributing to each country's unique pollution problems (UNEP, 2005). The key environmental issues and their causes pertaining to the SAS countries are given in Table-2.

Table -2 : Key Issues and Causes with reference to the Environment (ESCAP 2000)

Country	Key Issues	Key causes
Bangladesh	Marginalised populations forced to live on and cultivate flood-prone land; loss of biodiversity; limited access to potable water; water-borne diseases prevalent; water pollution areas; arsenic pollution of drinking water; soil degradation; deforestation; severe overpopulation; natural disasters (floods and cyclones causing huge economic loses and destruction of property and life) every year; food security risks; industrial pollution; impact of hazardous waste.	High population density and urban primacy; reliance on private transport; urbanisation and deficits in urban infrastructure (including one of the world's 30 largest cities – Dhaka); increases in unmanaged marine –based tourism; green revolution / agrochemicals and run-off; high demand for bio-fuels; lack of controls on industrial effluent; over-exploitation and/or pollution of groundwater.
India	Deforestation; soil erosion; overgrazing; deforestation; loss of biodiversity; air pollution; water pollution; huge population base and large growth rate is overstraining natural resources; natural disasters such as floods, cyclones and land slides are common.	High rates of urbanisation and deficits in urban infrastructure (including in four of World's 30 largest cities); reliance on private transport; industrial effluents and vehicle emissions; increase in unmanaged marine-based tourism; green revolution/agrochemicals and run-off; reliance on bio-fuels.
Maldives	Climate change; beach erosion; depletion of freshwater aquifers; degradation of marine habitats.	High population densities; increases in marine-based tourism; sea level rise.
Pakistan	Water pollution; seasonal limitations on the availability of natural freshwater resources; majority of the population lacks access to potable water; deforestation; soil erosion; coastal habitat loss and degradation of marine environment; loss of biodiversity; natural disasters, mainly due to floods.	High rates of urbanisation and deficits in urban infrastructure; industrial wastes; population increases in coastal areas and rise in tourism; depletion of mangroves for aquaculture; over-fishing; increased demands for timber/bio-fuels; hunting/poaching; green revolution/ agrochemicals and run off.
Sri Lanka	Deforestation; soil erosion; pollution by municipal and domestic waste; loss of biodiversity; coastal degradation; limited access to potable water; water-borne diseases prevalent.	Excessive pressure on forests; increases in marine-based tourism; poaching; sea level rise; deficits in urban infrastructure; water pollution by municipal and industrial waste; and agricultural run off; extensive mining activities.

The priority issues for the SAS Region recently identified by UNEP/GPA (2005) are:

- Sewage;
- Litter - solid waste (industrial and municipal);

- Agricultural chemicals (insecticides, pesticides, inorganic fertilisers, etc);
- Oil hydrocarbons;
- Sediment; and
- Physical alteration and destruction of habitats.

In the SAS Region numerous cities and industries with inadequate waste management are situated along major rivers such as the Ganges, Narmada, and Indus. Pollution from distant sources can also enter the marine environment through atmospheric deposition. The tsunami of 26 December 2004, which seriously affected Sri Lanka, India, and Maldives, demonstrated that in addition to land-based sources of pollution induced by human activity, natural events result in substantial but sporadic contributions mainly in the form of sediment and litter. (UNEP 2005b).

Land-Based Sources of Pollution

Sewage

Sewage is one of the most significant pollutants affecting the coastal and marine environments of the SAS Region. It is estimated that 7,000 million l/day of sewage is generated in the coastal areas of all the South Asian countries. During the next decade, several cities in the SAS Region, including Mumbai, Kolkata, Dhaka, Chennai, and Karachi will rank among the largest in the world. As a consequence of steadily growing coastal population in the SAS region, the quantum of poorly treated or untreated sewage wastewater being discharged into coastal waters is increasing. This has serious implications for the health of the region's coastal and marine environments (UNEP/GAP 2005).

The sewage treatment facilities are inadequate in almost all cities/towns/villages along the coast of the SAS countries, except in very few urban areas such as Mumbai and Karachi, which are reported to have a treatment capacity of 15% and 6% respectively, of the waste generated in these cities, reflecting the gap that needs to be bridged in proper and complete treatment of urban wastes (SACEP/UNEP 2001).

Litter: solid waste and marine debris

In the SAS region solid waste generally arises from domestic and industrial sources. Domestic waste also includes hospital waste. The quantity of solid waste generated by the coastal population of the SAS Region is estimated at 11,650 tonnes/day (average of 0.5 kg/person/day). The waste is mostly composed of paper, plastics, and biodegradable matter (UNEP/GPA, 2005).

It is reported that in Bangladesh, India, Pakistan and Sri Lanka, only a fraction of the solid waste generated is collected; and the rest is dumped in a haphazard manner in open areas. Most often the emissions contain hospital wastes, plastics, and compostable matter, toxic compounds as well as harmful bacteria, which find their way into the coastal waters during the rainy season, via the rivers, streams, and mangrove swamps which are used as dumping sites. In India, local interventions by NGOs and community groups are demonstrating that a multi-pronged approach to urban solid waste management is both effective and cost-efficient (Venkatesan, 2007).

The increasing amounts of solid waste in the coastal zone are detrimental to the economies of many countries, especially those dependent on coastal fisheries (India, Sri Lanka in particular) and on tourism (particularly Maldives). Scientists have documented an increasing number of injuries and death among marine mammals, fish, sea turtles, and birds due to entanglement in solid waste. Furthermore, animals can mistake plastic items and pelagic tar as food and accidentally ingest them, eventually killing them.

Solid waste dumped at sea comes from shipping, commercial fisheries, and other offshore activities. As per UNEP/GPA (2005) assessment, the ship-generated waste accounts for nearly 80% of the solid waste in the coastal and marine areas. The disposal of solid waste by ships in near-shore areas is regulated by Annex V of the MARPOL 73/78 Convention. Compliance with this convention requires countries to provide port reception facilities for ship generated wastes. At present, the SAS countries lack such facilities. This could result in solid waste being disposed off at sea from where it is transported by wind and currents to the shore, often far away from the country/source of origin.

Agricultural chemicals

The SAS Region is one of the world's major agricultural regions. During the past decade the cultivation of high yielding varieties has expanded with the inevitable increase in the application of agro-chemicals. In Bangladesh, the rice cropping area in the coastal zone is about 5.6 million ha, about 40% of which is used for high yielding varieties (Islam 2004). In India average fertiliser consumption is about 75 kg/ha, while insecticides are used at the rate of about 13.3 kg/ha. In Pakistan, in areas adjoining the Sindh coast a large quantity of rice and other crops is produced, accompanied by fertiliser and pesticides application. In Sri Lanka, even though agricultural activities are not widespread in the coastal areas, the application of 77 kg/ha of fertilisers and 1.6 kg/ha of pesticides has been reported. Agricultural run-off containing residues of insecticides mostly belonging to organo-phosphorous and synthetic pyrethyroid groups reach the rivers and eventually the coastal waters (UNEP, 2005a).

Pesticides

It has been estimated that 90% of the applied pesticides (insecticides, herbicides, fungicides, etc.) reach the coastal and marine environments via rivers and by atmospheric transport. Frequent floods in the Indian subcontinent mobilise substantial quantities of pesticides into coastal waters. Data on the behaviour of these pesticides in the tropical marine environment, including degradation rates, fractionisation, partition, as well as biological uptake and transfer through the food chain to humans, are not available for the SAS region.

Nutrients

The discharge of nutrients associated with agricultural runoff is a major cause of eutrophication in coastal waters of the SAS Region, especially in areas of limited water circulation. The discharge of sewage into coastal waters in areas of tourism importance such as Hikkaduwa, Sri Lanka, has resulted in increased algal growth on coral reefs. Tourism at this and several other locations is directly linked to the health and beauty of the fringing coral reefs.

Oil hydrocarbons

Although the countries in the SAS Region are not major oil producers, land-based activities generate a considerable quantity of oil hydrocarbons that eventually enter the marine environment.

Contribution to marine oil pollution is mainly by oil tankers, which transport an estimated 500 million tonnes annually through the SAS Region. Approximately 5 million tonnes of oil enter the Arabian Sea each year and the Bay of Bengal receives some 400,000 tonnes from similar sources. Oil spills are rare, although serious episodes have occurred during the past decade, including the 2003 grounding of a tanker in Karachi in which about 27,000 tonnes of crude oil were released into the sea. In Bangladesh and India more than 50% of the oil pollution in the marine environment comes from the numerous river craft and steamers plying their waterways. In the Gujarat coast of India, there is a number of off-shore Single Point Moorings (SPMs) for Petroleum oil & gas exploration/exploitation, which also form the source of oil pollution.

Ship breaking yards are operational in India, Bangladesh and Pakistan. In India ship-breaking operations are carried out over a distance of about 10 km on the beaches of Alang in Gujarat – one of the largest and busiest ship breaking yards in the world. On an average 5 ships are broken per day (Fig. 2a & 2b). In Bangladesh, where ship breaking started on an industrial scale in recent years, nearly 50 ship breaking units operate on the seashore from Khulna to Fauzderhat in Chittagong and near Mongla port in Khulna. In Pakistan the ship-breaking industries at Gadani are the major sources of pollution to the adjoining coastal areas. The frequency of ship-breaking fluctuates from year to year in these countries. The lubricants, engine oil and debris form major pollutants during ship dismantling operations. The waste oil is not properly collected and is disposed of in the adjacent sea.

Fig.2a. Ship breaking activity at Alang, Gujarat, India

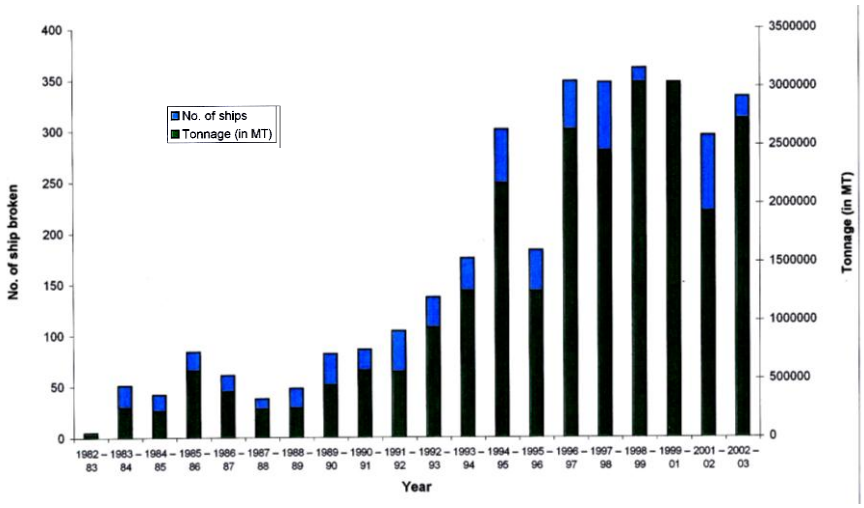

Fig. 2b. Trends in ship breaking activity at Alang and Sosiya Yards, Gujarat, India

Sediments

The SAS Region receives one of the largest sediment loads in the world. After the Amazon, the Ganges-Brahmaputra-Meghna (GBM) Rivers system constitutes the world's second largest hydrologic region. The total drainage basin of about 1.75 million km² is shared by Bangladesh, Bhutan, India, and Nepal, and discharges into the Bay of Bengal. India and Pakistan share the Indus River, which discharges into the Arabian Sea. Sediments discharged into the Bay of Bengal from the GBM River system constitute the highest sediment load in the world (Milliman *et.al.*, 1995).

Although the sediment loads discharged by the other major rivers in the SAS Region, mainly in India and Sri Lanka, are relatively small, they are of local significance, aiding in beach replenishment. Upstream deforestation and other land-use practices are the major causes of elevated river sediment loads.

Sediment load from erosion in coastal areas is high, mainly as a result of poor land- management and construction activities. Annually, 1.6 billion tonnes of sediment is reported to be reaching the Indian Ocean from rivers in the Indian sub-continent. Total sediment load in rivers in Bangladesh alone amounts to 2.5 billion tonnes, of which the Brahmaputra carries 1.7 billion tonnes and the Ganges 0.8 billion tonnes (UNEP 1987).

Physical Alteration and Destruction of Habitats (PADH)

Mangroves in Bangladesh, India, and Pakistan are large in aral extent and multiple uses, while in Sri Lanka, mangroves are sparsely developed. Timber extraction, coastal development and alteration of hydrographic regimes are the major factors, which contribute to degradation of mangroves in Bangladesh, India, and Pakistan. In Bangladesh and Pakistan changes in the quantity and quality of freshwater flows are the results of extensive degradation of mangroves.

Maldives is formed entirely from coral atolls. Extensive coral reefs also occur in the Palk Strait, Gulf of Mannar, and in the Lakshadweep and Andaman Islands. Sea grass beds occur in the Palk Strait, Gulf of Mannar, Lakshadweep and in some coastal stretches in Sri Lanka, and within estuaries and lagoons.

The issue of PADH is mainly focused on the impacts of sediment mobilisation caused by four sectors: tourism, ports, aquaculture, and mining (sand and aggregate extraction). In addition, dredging, reclamation and similar activities have also affected the inshore ecosystems. A number of studies so far conducted by a number of Institutions in the SAS Region, including the International Ocean Institute, India, and the GPA Coordinating Office concluded that globalisation and its changing trends have aggravated anthropogenic impacts on coastal habitats.

Persistent toxic substances

Available reports do not adequately show the status of the coastal and marine environments in the SAS Region with respect to pollution by persistent toxic substances (PTS). However, the studies have shown that mercury in groundwater in Ankleshwar was 118 - 176 times the WHO standard, while Vapi, situated in the same area, has 96 times this standard (Down to Earth, 1999). Ship-breaking is found to be the major source of toxic chemicals.

Tourism

Tourist arrivals in South Asia reached 6.3 million in 2000 (a growth rate of 9.0 per cent over 1999), which is expected to grow much faster in the coming years (WTO 2000). Destruction of mangroves and wetlands to make way for coastal infrastructure, increase in pollution due to increased transport, litter on the beaches and increased volume of sewage dumped into the sea, are the major ecological issues associated with unplanned and haphazard development of coastal tourism in this region.

Hotspots

Pollution hotspots include areas near the mouths of rivers situated in numerous cities such as Mumbai, Kolkata, Dhaka, Chennai, and Karachi, as well as industries with inadequate waste management. The combination of discharges of raw sewage and untreated industrial waste has caused degradation of the coastal and marine environments at several locations in the region.

Areas under particular threat from land-based pollution are those with little water exchange and circulation. Sewage is of particular concern in these hotspots. In addition, the common practice of discharging inadequately treated industrial wastewater into the domestic wastewater stream results in most sewers containing a variety of toxic and non-biodegradable substances. This situation is common in the vicinity of industrialised coastal townships in Bangladesh, India, Pakistan, and in Sri Lanka (UNEP/GPA, 2005).

Some major environmental hotspots include Thane creek (Mumbai), a number of major ports such as Haldia, Paradip, Vizag, Kakinada, Ennore, Chennai, Royapuram Fishing Harbour, Tuticorin, Kochi, Mangalore, etc., in India, Karachi Harbour in Pakistan and ship-breaking yards in Bangladesh, India, and Pakistan.

Legislation

In the South Asian sub-region, India was the first country to insert an amendment into its Constitution (42nd Amendment, 1976) allowing the State to protect and improve the environment for safeguarding public health, forests and wild life. Sri Lanka was the first to enact a specific law for environmental protection. All the countries in this region now have a framework Environmental Protection Law that allows for the setting up of an institution to control and regulate environmental pollution and other problems (Table -3). All the countries have also adopted requirements of Environmental Impact Assessment (EIA) as part of their environmental protection law. EIA is supposed to enforce better management practices and control environmental destruction (UNEP/GPA, 2003).

Sri Lanka was the first country in the region to enact a national level legislation for coastal management (The Coast Conservation Act No. 57, 1981). The Act defines the coastal zone and calls for a coastal management plan to be formulated and updated every four years by the Coast Conservation Department.

India issued the Coastal Regulation Zone Notification in 1991, under its 1986 Environmental Protection Act. The 'Coastal Regulation Zone' is defined and activities falling within this zone are controlled. Coastal Zone Management Authorities have been constituted at the national and state levels to help in protection and conservation of coastal areas. Each coastal state was directed to draw up its own Coastal Zone Management Plan.

The entire Maldives falls within the purview of the coastal zone, as the islands are very small. Their major concern is global warming and the consequent sea level rise, which threatens to engulf the islands. Tourism has brought in significant earnings in the last 30 years, but has also resulted in environmental degradation, and their laws reflect this aspect.

Table -3 : Environmental and Coastal Legislation in the Five Countries of SAS Region (UNEP/GPA 2003)

Item	Bangladesh	India	Maldives	Pakistan	Sri Lanka
Marine Pollution	Marine Pollution Ordinance 1989	Environment (Protection) Act 1986	National Environment Protection & Preservation Act 1993	Pakistan Environment Protection Act 1997	Marine Pollution Prevention Act No 39 (1981)
Coastal forests, mangroves	Forestry Act 1927. Forest Amendment Ordinance 1989	Indian Forest Act 1927. Forest Conservation Act, 1980	National Environment Protection & Preservation Act 1993	Forest Act 1927	The Forest Ordinance No. 3 (1945). Amendment No 13 (1966) and Act No. 13 (1988)
Flora / Fauna / Wildlife (including corals)	Bangladesh Wildlife (Preservation) (Amendment) Act 1974. Marine Fisheries Ordinance 1983.	Wildlife (Protection) Act, 1972, EPA 1986.	National Environment Protection & Preservation Act 1993, Fisheries Act.	State Wildlife Protection Ordinances of 1972 in Balochistan and Sindh	Fauna and Flora Protection (Amendment) Act 1993

Item	Bangladesh	India	Maldives	Pakistan	Sri Lanka
Umbrella Environment Act	Bangladesh Environment Protection Act 1995	Environment (Protection) Act 1986	National Environment Protection & Preservation Act 1993	Pakistan Environmental Protection Act 1997	National Environment Act No.47 of 1980.
Regulatory Authority	Department of Environment	Ministry of Environment & Forests	Ministry of Environment, Energy and Water (MEEW)	Ministry of Environment, Local Government and Rural Development	Ministry of Environment and Natural Resources

In 1999, Bangladesh's Ministry of Water Resources announced the government's intention to develop an Integrated Coastal Zone Management (ICZM) policy. A programme development office has been set up financed by the Governments of Bangladesh and the Netherlands.

In Pakistan, the Sindh Coastal Development Authority Act was enacted in 1994 and the Balochistan Coastal Development Authority Act was passed in 1998.

In all the countries, Forest Act (or Ordinance) is the general legislation that provides for the protection of (notified/reserved) forest areas. Typically, activities such as mining that can cause habitat destruction are not permitted in reserved forest areas. Mangroves are considered coastal forests and governed by this law. Corals usually come under wildlife protection legislation. This legislation also usually has the power to declare marine reserves. There are no specific regulations for protecting habitats such as sand dunes except in Sri Lanka and India, where they fall in the coastal regulation zones, where activities are strictly controlled. While some wetlands enjoy special protection, it is primarily the fishing activity that is controlled. Provincial or state governments usually control fishing near the coast (territorial waters) while fishing in the EEZ usually comes under the central/federal authorities.

As for activities in the PADH list, only Sri Lanka and Maldives have specific laws for regulating tourism. In the case of aquaculture (mainly shrimp aquaculture), only India and Sri Lanka have enacted legislation to control the industry. Sand mining comes under minor minerals and the state/provincial governments are responsible for controlling this activity. Maldives has coral mining as a major problem as it has no other source of building material, and coral extraction has been a main cause of coastal erosion. Hence, a number of laws have been enacted to prohibit/control mining of coral and aggregates from coastal areas in the Maldives. Ports and harbours have their own regulatory authorities set up by specific acts in each country. In most cases, the development of a port requires an EIA. Relatively little information is available for dredging activities and the consequence of dumping of dredged spoils.

2.2 Review of the State of Environment in the SAS countries – National Scenario[2]

2.2.1 Bangladesh

Bangladesh is one of the largest deltas in the world, formed mainly by the Ganges-Brahmaputra-Meghna (GBM) river system (Figure-3). A network of 230 rivers with their tributaries and distributaries crisscross the country and, therefore, the country is virtually a conglomerate of islands. In Bangladesh, about 36 million people (27.5% of the 131 million people) live in the coastal area and their livelihood primarily depends on agriculture, fishery, forestry, near shore transportation, salt production, etc (BBS, 2001).

The length of Bangladesh coastline is about 710 km and it hosts a unique diversity of ecosystems. The coastal areas of Bangladesh are broadly divided into three distinct regions *viz*. the eastern region, the central region and the western region. Out of 19 coastal districts (147 upazilas), a total of 48 upazilas in 12 districts exposed to the sea and or lower estuaries, are defined as the *exposed coast* and the remaining 99 upazilas of the coastal districts are termed *interior coast.*

The country has straight and continuous long coast along the Cox's Bazaar and Khulna region where there are no islands that could act as windbreaker. For this reason, sea remains very rough along the Bangladesh coast. The coastal zone of Bangladesh is under a process of active delta development and morphological changes by the Ganges-Brahmaputra-Meghna (GBM) river system (Figure-4). Heavy siltation, degradation of habitats and dislocation of resources are thus very common.

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[2] This part of the report is a compilation of the published documents viz. BOBLME country reports for Bangladesh, India, Maldives, Sri Lanka, National State of Environment Report of the SAS countries and the National Reports on Marine litter from Bangladesh, India, Maldives, Pakistan and Sri Lanka.

Fig. 3: Satellite imagery of Bangladesh
(Source, Google Earth, 2007)

All major rivers in Bangladesh bring billions of tons of sediments into the Bay of Bengal. A total of 6 million cusecs of water carrying an estimated amount of 2.5 billion metric tonnes of sediments is being carried down to the sea each year by the Ganges-Brahmaputra river system.

Other major sources of siltation in the region are increased run off during the rainy season, floods, increased erosion of topsoil as a result of coastal and inland vegetation depletion. Massive earthworks involved in coastal development projects and rapid horizontal expansion of other land use practices (e.g. aquaculture) replacing existing ones have brought changes in the siltation process of the in-shore and estuarine habitats.

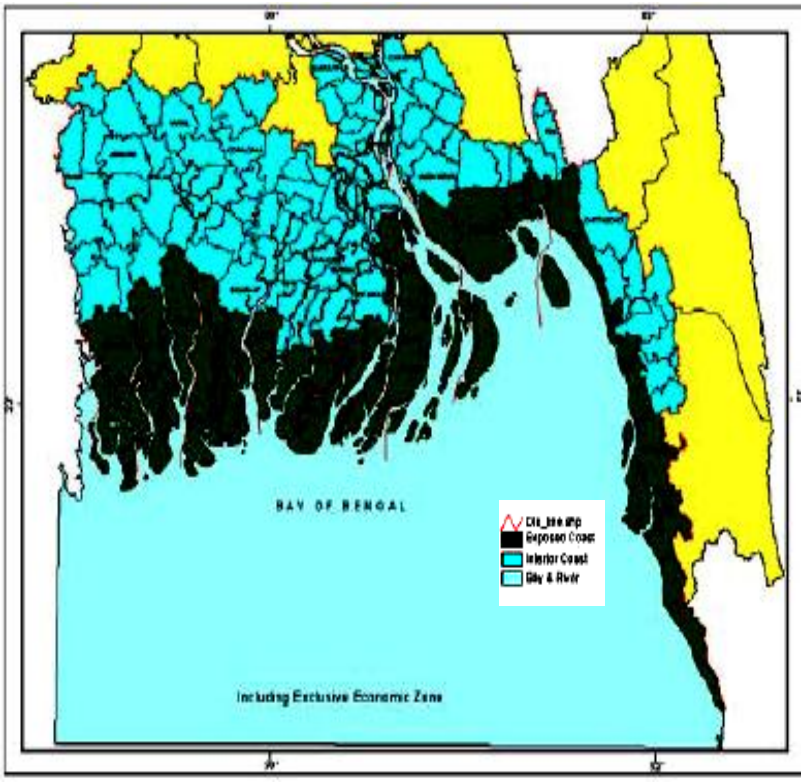


Fig. 4: Map of the land part of the coastal zone of Bangladesh *(ICZMP, 2003)*

Mass scale flattening and scarping of hills and foothills in the Chittagong region also appears to have changed the sedimentary process of the area in the recent years.

The accretion-erosion process of the islands like Hatyia, Sandwip and Bhola has indications of strong sedimentary process in the vast GBM estuary, which constitutes about 12800 km² of inshore fish habitat. Huge rate of accretion in the past indicates an extensive amount of deposit carried down by the rivers, likewise increased erosion in the recent years leading to increased transfer of sediments to the sea (Hossain, 2004).

The coast of Bangladesh is known as a zone of multiple vulnerabilities as well as opportunities. It is prone to severe natural disasters, such as cyclones, storm surges, floods, etc. In combination with other natural and man-made hazards, such as erosion, the high arsenic contents of groundwater, water logging, water and soil salinity and various forms of pollution, these disasters have made coastal dwellers very vulnerable (Islam, 2004) and made the whole coastal and marine environment threatened.

Land Based Sources of Pollution

Municipal Wastes

The cities and human settlements in the coastal areas of Bangladesh do not have domestic waste treatment facility and therefore effluents either directly or indirectly find their way untreated into the rivers and ultimately to the Bay of Bengal. Chittagong and Khulna - the two populous coastal cities have a major role in the contamination of the marine environment by municipal wastes, which are discharged in the Karnaphuli and Passur rivers, respectively. The largest and most populous capital city, Dhaka, although far away from the coast have also its contribution to coastal pollution. It produces huge amounts of domestic sewage and solid wastes, which mainly enter the tidal river Buriganga flowing in to the Bay of Bengal. According to 'Waste Concern' report in 2002, the amount of wastes produced daily was 17,000 tonnes and the amount of waste in 2025 will be 47,064 tonnes, which is 3 times more than the present load. Based on a survey by Dhaka City Corporation (DCC) during 1999, it was estimated that on an average 2.33 kg/family/day of waste was generated by high-income group, 1.26kg/family/day by medium-income group and 0.46 kg/family/day by the low-income group.

Khulna city falls victim to the solid and liquid waste of industrial plants which include newsprint mills, jute mills and fish processing units; large industrial units and scores of welding workshops situated at its fringes. With the increase in population, establishment of a medical college at Khulna, and a number of medical clinics, medical waste, blood stained cotton and bandages, used injection syringes etc., are found strewn all over. As per a recent estimate about 120-130 tonnes of wastes/day are generated in Khulna city (BUET, 2000).

About 480 tonnes of solid wastes and excreta generated daily by about 2.5 million people in Chittagong Metropolitan City find their way into the Karnaphuli River through 5 main open canals and finally into the Bay of Bengal. The city has no proper waste collection and sanitation facilities, no underground sewerage pipeline and sewage treatment plant.

Medical wastes in Chittagong City and its Potential threats

Medical waste includes the biological and non-biological wastes generated by hospitals, research centres and laboratories, which consists of infectious and non-infectious solid waste, hazardous waste and low-level radioactive waste. Some data on medical wastes generated by the Chittagong Medical Collage Hospital (CMCH) (Saifullah, 2001) are given in the Table – 4 & 5. It is estimated that about 3000 kg wastes are disposed daily from this hospital in Bangladesh, a major part of which could be infectious wastes.

Agriculture runoffs

In Bangladesh at least 20 insecticides, 18 fungicides and 2 rodenticides - potential toxic chemicals - are being used in the agriculture sector, which ultimately drain into the adjacent water bodies and is carried downstream through river waters.

Table: 4 - Categorization of Medical waste disposed off from CMCH

Categories of disposed waste	Description of the wastes
Sharps	Ampoules of drugs, vials from drugs and chemicals, saline bags with infusion sets, syringes and needles, broken glasses.
Pathological wastes	Dressing with body parts, amputations, body fluids, dialysis fluid, cloths soiled with blood and swabs, foetuses, cotton with blood and other liquids.
Radioactive wastes	60co. half life 5.3 years; 161cs. Half life 30 years.
Genotoxic and cytotoxic wastes	Nyrin, Cisplatin Endoxen, Dexorubicin, Vincristin, Taxotere, Camustin, Daunoubicin, Bleomycin.
Chemical wastes	Hexisol, Hexitane, Hexicub, Formaldehyde, Lysol, Paraffin wax, Tr. Iodine, Spirit, Savlon.

Table -5 : Monthly assessment of wastes (CMCH)

Name of the ward	Syringes & Needles	Ampoules & vials	Saline bags & infusion sets	Pathological waste
Skin/VD	226	373	47	Absent
Radio therapy	2249	2355	1514	Absent
Paediatric Surgery	1953	2122	1902	88.5 kg
Paediatric medicine	1897	2088	1861	Absent
Nephrology	275	375	317	Absent
Orthopaedic Surgery	7987	8284	294	57.5 kg
Neuro Surgery	6838	7180	870	Absent
Gynae	1206	1350	720	441.75 kg
Surgery Unit-2	2677	2987	721	109.15 kg
Surgery Unit-3	7421	7852	1614	121.75 kg

DDT was found in varying concentrations from 22 ppm to 428 ppm in dried fish collected from Bangladesh in the late 1990s, higher than the maximum permissible residue levels (MRL) for consumption and lethal for human health (Ali, 1997). The flood and rain waters carry a portion of the agro-chemical residues to the coastal regions.

It is assumed that 25 percent of the total amount of pesticides used may reach the coastal water flowing through inland water distribution system (ESCAP, 1988). Based on such an assumption, the estimated pollution load in the Bay of Bengal due to pesticides during 2000-2001, was 4054 MT/year from 16200 MT of pesticides used. The usage amount of such pesticide is increasing year after year - 1982-83: 2547 MT, 1990-91: 8656 MT and 2000-2001: 16200 MT. Fertiliser production is also increasing day by day -from it was 30,22,690MT in 1995-96 to 34,72,166 MT in 1999-2000 (BBS, 2001).

Industrial Pollution

As per reports available, during 2002, Bangladesh had a total of 26,446 Industrial units, of which 1200 were polluting industries under 13 categories, employing about 1.156 million persons (SEHD, 2002). Main polluting zones include Chittagong (Kalurghat, Nasirabad, Sholashahar, Patenga, Kaptai, Bhatiary, Barabkunda and Fauzdarhat) and Khulna (Shiromoni, Khalishpur, Boyra and Rupsha). Most of these industries discharge their waste directly without any treatment into the open water and finally into the Bay of Bengal.

Chittagong has 144 industries (19 Tanneries, 26 Textile units, 1 Oil refinery, 1 TSP plant, 1 DDT plant, 2 Urea plants, 2 Chemical factories, 5 Fish processing units, 1 Asphalt bitumen plant, 1 Steel mill, 1 Paper and 2 rayon mills, 2 Cement factories, 2 Detergent plants, 2 Pesticide plants, 2 Paint industries and 75 Other light industries) situated on the bank of Karnaphuli river and along the coast of the Bay of Bengal (ESCAP, 1988). All these units discharge solid waste and liquids effluents, persistent organic and inorganic substances, as well as toxic metallic compounds into the surrounding water bodies, which finally find their way into the Bay of Bengal. The Chittagong Urea Fertiliser Limited (CUFL) discharges 150-160 tonnes of effluent per hour in the river Karnafuli that contains a high load of pollutants.

In Khulna, 165 industries located in three industrial zones, discharge wastes into the Bhairab-Rupsa river system (ESCAP, 1988), which fall into the Bay of Bengal flowing through a very long distance. Khulna shipyard, a few match factories and fish processing units are located in the Rupsa industrial area, which discharge their effluents directly into the Rupsa river. The Khulna Newsprint mills, Hardboard mills, the Goalpara power station, steel mills of Khalispur zone discharge untreated waste directly into the Bhairab river, eventually polluting the coastal waters. Khulna Newsprint mill continuously discharges nearly 4500 m^3/h of waste water containing high level of suspended solids (300-500 mg/l) and sulphur compound.

In terms of waste-load generation, the principal polluting industries are paper and pulp, textile (dyeing and printing) and the tanneries. In addition, sugar industries, food and fish processing units and distilleries are also responsible for adding considerable waste load in the open waters including the Bay of Bengal. The effluents are ammonia, chromium and other heavy metals from fertiliser and tanneries, phenols from pulp and paper, refinery, plastic, pharmaceuticals and paint industries. There are also other acids, alkalis, organic and inorganic waste materials. Very few industries have taken steps to alleviate the pollution they cause; in fact they do not even assess its magnitude.

Ship Breaking Activities

Every year 60-65 ships are being dismantled or awaiting dismantling process in the Chittagong and Khulna ship breaking units. It has turned into an industry in which thousands of workers are employed. More than 150 companies are engaged in this business and the indiscriminate expansion of ship breaking activities pose a potential threat to the coastal inter-tidal zone and its habitat. Ship breaking industry earns the Govt. an annul revenue of about Tk 2.5 billion (SHED, 2002).

Refuse oil from ship-breaking activities at Fauzdarhat is estimated to be 400-kg/ year (ESCAP, 1988). Refused oil and oily substances; engine oil and other petroleum hydrocarbon used; different solid substances- which is responsible for beach litter formation.

Sea Based Sources of Pollution and Pollutants

Oil Pollution

International oil tanker route of the southern Bay of Bengal contributes to oil pollution in the Bangladesh territorial waters. Chittagong and Mongla are the two seaports of the country, and on an average deal with 1500 to 1600 vessels and 12,000 to 13,000 cargos annually (BBS, 1997). The Chittagong port region is the route for many types of ocean going vessels including oil tankers, military vessels, fishing vessels, general vessels, etc. These ports, however, do not have facilities to receive and treat bilge and ballast water and waters used for washing the cargo tanks or oil tankers, and thus ships throw wastewater into the territorial waters of Bangladesh. Oil and lube spillage also happens during refuelling of vessels and cargo handling. Localised oil pollution is reported to be heavy in the vicinity of Chittagong and Chalna harbours.

About 3000 registered power-driven river craft, including oil tankers and innumerable unregistered small-mechanised boats ply in coastal waters. There are about 1500 coastal ships and cargo boats. Operators of these vessels dump wastes, spillages and bilge washings, including burnt Mobile oil, in the water.

According to UNEP (1986) Crude oil and its derivatives are among the worst pollutants that enter the Chittagong coastal area owing to crude oil transportation operations in and around Chittagong Port. Approximately 1.2 million tonnes of crude oil per annum is handled through Chittagong port. There have also been reports of the risk of leaking pipelines and oil slicks in the territorial waters of the country and the upper Bay of Bengal. However, there is no monitoring system in place to document these occurrences systematically.

In addition to chronic spillage of oil into the sea during oil transfer and bunkering operations, there are possibilities of chronic oil discharge from the oil refinery at Chittagong and also oil-water emulsion from the repairing and manufacturing industries situated near the coastal areas. There is also the constant danger of severe accidental oil spills at Chittagong and Khulna in the case of extreme natural calamities causing ship collisions (ESCAP, 1988).

Details of the sources of oil pollution and the estimated quantum of discharge in the Chittagong area are given in Table -6.

Table -6: Oil and Oily substance in the Chittagong area (Source: ESCAP, 1988)

Oil and oil emulsion sources	Estimated amount of discharge
Chronic spillage of crude oil during transportation operations at Chittagong	6,000 metric tons/year *
Ballast waters	Not known
Bilge-waters	204 million gallons/year
Leakage loss of fuel oil from mechanized Vessels, dry docks, fish harbours etc.	Not known
Oil emulsion from workshops	Not known
Crude oil residue, process oil and wash water from refinery	50,000 metric tons/year
Refuse oil from ship breaking activities near Fauzadarhat	400 kg/year

* Assuming 0.5 per cent transportation loss during crude oil transfer at Chittagong Port.

Persistent Organic Pollutants (POPs)

Imports of organo-chlorine pesticides like, BHC, DDT, Endrin, Dieldrin, Methoxychlor, Lindane, Ethyl and Methyl Parathion, Telodrin and Mercury compounds, have been banned except for Sugarcane fields about 10 years age. But, environmental persistence and bio-accumulation is still evident. It is assumed that 25 percent of the total amount of pesticides used may reach the coastal water flowing through inland water distribution system (ESCAP, 1988). During 1994, approximately 7200 tonnes of pesticides were used and the pollution load was as high as 1800 tonnes/year (FEJB, 2001).

National Programme of Action (NPA)

With the commitment to promote integrated coastal management and contribute to reduce the pressure on marine environments, Bangladesh initiated a process to develop National Programme of Action (NPA) under the Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-based Activities in 1999. NPA in Bangladesh integrates the existing challenges and integrated coastal zone management, taking into account the coastal management background of the past and adopts the methodological framework suggested by the UNEP under GPA and the actions thereon.

2.2.2 India

The Indian peninsula, hemmed in by the Indian Ocean, Arabian Sea and the Bay of Bengal, boasts of a magnificent marine ecosystem (Figure-5). A combination of geo-morphological and climatic factors and the nutrients supplied by the rivers along the coast makes it exceptionally productive and biologically rich. The marine environment, which includes the adjacent coastal areas, supports productive and protective habitats such as mangroves, coral reefs and sand dunes. The

marine environment is facing a number of pressures, arising out of the needs of people, and the multiple uses that coastal and marine areas can be put into. These pressures contribute to the depletion of marine resources and degradation of the marine environment. In the absence of good management, these pressures might result in severe stress.

India has a long coastline of more than 7500 km. Its marine resources are spread over in the Indian Ocean, Arabian Sea and Bay of Bengal. The Exclusive Economic Zone (EEZ) of the country has an area of 2.02 million sq km comprising 0.86 million sq km on the west coast, 0.56 million sq km on the east coast and 0.6 million sq km around the Andaman and Nicobar islands.

In India, there are two major human inhabited island groups – Andaman & Nicobar and Lakshadweep islands. The Andaman and Nicobar islands comprise about 550 islands occupying an area of about 8249 sq km in the Bay of Bengal. The coastline alone is about 1926 km long and the EEZ comprises 30% of Indian EEZ. Most coastal areas support a rich growth of mangrove vegetation and fringing coral reefs.

The Lakshadweep is an archipelago of 37 coralline islands covering 32 sq km in Arabian Sea with an EEZ of about 0.4 million sq km. It has an abundance of living resources including microbes, sea grasses, seaweeds, mangroves, and varied marine fauna including marine ornamental fishes.

The other important group of islands includes the 20 odd islands that extend from Pamban to Tuticorin in the Gulf of Mannar. To protect its biological wealth, the Gulf of Mannar with vast diversity of marine flora and fauna, has been declared as a Marine Biosphere Reserve by the Ministry of Environment and Forests, Government of India.

The east coast supports activities such as agriculture and aquaculture while a number of industries are supported on the west coast. Tourism has emerged as a major economic activity in coastal states such as Goa, Kerala and Orissa.

Coastal population

A dense coastal population, still on the rise, is exerting increasing pressure -- both direct and indirect – on marine and coastal ecosystems. A study by Central Pollution Control Board, New Delhi, under the programme on Coastal Ocean Monitoring and Prediction System (COMAPS) showed that the human population in the metros, class I cities, and class II towns in the coastal area has registered a phenomenal increase during the 3 decades.

From 3 metro cities to 7, from 25 class I cities to 65 and from 31 class II towns to 56 and overall the total number of cities has grown up from 59 to 128. Consequently, the population in these cities has also grown from 23 million to 45 million people.

Fig-5: Satellite imagery of Peninsular India
(Source: Google Earth, 2007)

Marine Pollution

The coastal marine environment around India's coastline supports a variety of marine ecosystems including the fragile mangroves and coral reefs. Indian coastal waters are subjected to considerable pressure from sewage and industrial wastes, which are responsible for the contamination of the waters with consequent loss in biodiversity.

Major industrial cities and towns of the country such as Surat, Mumbai, Kochi, Chennai, Visakhapatnam and Kolkata are situated on or near the coastline. Demographic pressure in the urban cities and towns as well as an increase in the rural population and rapid industrialisation, have resulted in the production of enormous amounts of waste materials. These wastes reach the marine environment either directly or indirectly through rivers, creeks and bays, posing threat to ecosystems and India's coastal resources. The domestic sewage contributes to the largest amount of waste. Even though the quantity of these wastes varies from place to place, their chemical characteristics remain almost similar. Domestic wastes are discharged mostly in untreated condition due to the lack of treatment facilities in most of the cities and towns. Only primary treatment facilities are available in cities and towns where the population is more than 100,000 and the capacity of the plants is inadequate for the treatment of the total waste generated in these cities. Due to such partial treatment, the chemical characteristics of the waste waters remain unchanged causing severe damage to the water quality.

Estimates indicate that Mumbai city discharges around 2200 MLD of waste into the coastal waters. Similar is the case with some of the major cities such as Chennai, Kolkata and Visakhapatnam and the industrial areas of Gujarat, Pondicherry and Orissa, where the coastal and estuarine waters remain in degraded condition. Many pollution impacts on marine communities can be traced directly to the industrialised centres, which release an array of chemical contaminants into the open coastal waters. Others are more difficult to delineate because they are largely derived from contaminants supplied by diffused source such as run-off from land and atmospheric fallout.

Of even greater concern has been the adverse environmental effects associated with waste-disposal activities, particularly sewage sludge and dredged spoil dumping, oil spills and leakages, besides the municipal and industrial waste-water discharges. These wastes often contain a wide range of contaminants such as petroleum hydrocarbons, chlorinated hydrocarbons and heavy metals. Some of the studies in the Arabian Sea have shown that the petroleum hydrocarbons ranged from 1.8 to 11.1 mg/l in water, 1.84 to 5.81 mg/g dry wt in sediments and 0.33 to 3.67 mg/g wet wt in fish, while the total DDT in zooplankton samples in the Arabian Sea varied from 0.083 to 0.563 mg/l.

In the coastal waters off Mumbai, which receive large amounts of domestic and industrial waste, the Hg content fluctuated between 0.12 and 1.4 mg/l, in sediments from 0.08 to 0.36 mg/g dry wt and in fish muscle at Thane Creek from 0.217 to 0.512 mg/g wet wt. Also, off Karwar (Karnataka) Hg value recorded was as high as 2.68 mg/l in water and 1.32 mg/g dry wt in sediment. Eutrophication of estuarine waters often culminates into anaerobiosis, toxic algal blooms, mass kills of benthic and epibenthic organisms and change in the abundance and diversity patterns of fish.

Modern life-style with its emphasis on consumption and waste disposal has brought in its wake the acute problem of liquid and solid waste management. The urban solid waste consists of different materials - wet and dry. In a typical composition of Municipal Solid Waste (MSW), it is estimated that plastic waste constitutes 5-6 per cent. The liquid waste in the form of municipal sewage, land runoff, industrial effluents, agricultural wastes, etc., contributes to over 20,000 MLD.

Marine Debris

The trash in and on the water, on the seabed, and along the shoreline — has been of growing concern as the widespread use of plastics and other non-biodegradable wastes has led to an increase in persistent debris in the coastal and marine areas of the country.

The identified sources and an inventory of types of marine debris/litter in the coastal waters of India are given under the section Status of marine litter in the SAS Region.

The status of marine debris in India varies from place to place. The information collected from different sources explains the diversity of the problem. There appears to be no focus to address this problem in the country as a whole, except for a small but significant effort taken by a NGO – EXNORA in Elliots (Besant Nagar) beach in Chennai.

Liquid waste management

About 131 large and medium industries exist in the coastal areas of India and all of them have treatment plants. As per the guidelines of Coastal Aquaculture Authority (2005), Govt. of India, aqua farms having water spread area of above 5.00 hectares should have Effluent Treatment System (ETS). Most of the aqua farms are in the process of establishing ETS.

Solid waste management

The Coastal Aquaculture Authority (CAA) of India has evolved guidelines and regulations for shrimp waste management (www.http://aquaculture.tn.nic.in). The disposal of solid waste generated by 121 coastal cities and towns is partly disposed in landfill sites, partly dumped openly and partly converted into compost. These 121 Cities and Towns generate about 8914 tonnes of garbage every day of which nearly 70 % is not collected.

Marine biodiversity

Dense mangrove forests in the Sunderbans, the world's largest congregation of nesting sea turtles in Orissa, delicate sea grass beds in Palk Bay, enigmatic dugong in the Gulf of Mannar, majestic whale sharks in the Gulf of Kutch and some of the world's most beautiful coral reefs in the Lakshadweep, Andaman and Nicobar islands and Gulf of Mannar; are just a few of the rare treasures to be found along India's coast line.

Microbes

Bacteria and fungi are abundant in practically every habitat of the sea. Each habitat harbours unique assemblages of species. Organisms with novel and unique properties used in many biotechnological applications are present in the marine environment.

Plankton

Due to enrichment the coastal waters show higher biomass of phytoplankton in the range of 37 and 11300 cells/ml. The zooplankton density also exhibits a wide range of population from 2105 to 78046 Nos./m^3.

Seaweed

Over 806 species of marine algae have been reported from India. The annual production of seaweed is estimated at 77,000 tonnes (fresh weight) (MOEF, 2002).

Sea grass

Major sea grass meadows occur along the south east coast off Tamil Nadu and Lakshadweep. Flora comprises 14 species of sea grass. The total standing crop is estimated at 7000-8000 tonnes. Over 100 species of marine algae have been observed in the beds of sea grass. (MOEF, 2002).

Coral reefs

The reefs and coral shelves of the Indian islands, cover an area of 19,000 sq. km. 342 species belonging to 76 genera have been reported from the seas around India. A total of 50 genera and 13 sub-genera of reef-building corals are known so far from the Indian reefs representing more than half (97 genera and sub-genera) of those recorded from reefs all over the world. Gulf of Mannar, Andaman & Nicobar Islands and Lakshadweep are the three major areas where coral reefs are found. (MOEF, 2002).

The single most important living resource from the reefs is edible fish. The reef areas yield 20 tonnes of fish per sq km per year (MOEF, 2002). Ornamental Fish from the reefs are of greater commercial value than the edible fish, but in Indian islands, this still remains an untapped resource.

Crustaceans

Shrimp, crabs and lobsters constitute the commercial fishery. The Horse Shoe Crabs are reported along the coast of Orissa and no information is available about their population. Exploitation of Horse Shoe Crabs for commercial purposes is banned by the Government.

Fish & fisheries

2546 species belonging to 969 genera, 254 families and 40 orders are recorded from India, representing 11.72 % of species, 23.96% of genera, 57% of families and 80% of the orders, recorded globally. (MOEF, 2002).

Reptiles

5 species of sea turtles, 20 species of sea snakes and 3 species of salt/marsh crocodiles are present in Indian coastal/marine waters. (MOEF, 2002).

Marine mammals

The notable endangered species, which is of concern, is Dugong. The habitats of Dugongs in Gulf of Mannar particularly the sea-grass eco-system are fast diminishing due to human intervention. (MOEF, 2002).

Fisheries play an important socio-economic role – it supplies cheap and nutritious food, generates employment and income, earns foreign exchange through export, and stimulates subsidiary industries. More than ten million fishermen and fish farmers in the country depend on fisheries and aquaculture for their livelihood. India has a significant marine fisheries sector that has long been an important source of employment and livelihood for coastal communities. The sector is dominated by small-scale and artisanal fish workers, making a livelihood from fishing and small-scale trading activities. Out of the total marine fishery potential of around 3.94 million tonnes, over 2.9 million tonnes is presently harvested, mainly from the areas within 200 m depth zone.

Coastal Aquaculture is confined to a few coastal states in India. The total area under aquaculture in the country is about 0.14 million hectare and the quantity of wastewater discharged is 10 to 12 million m^3 from one harvest over a one hectare farm area – in most cases two harvests in a year (seasonal).

Indian coastline has 13 major ports and 181 minor/ intermediate ports, out of which 139 are operational. The major ports are located at Kolkata, Haldia, Chennai, Kochi, Ennore, Jawaharlal Nehru Port at Nhava Sheva, Kandla, Mormugao, Mumbai, New Mangalore, Paradip, Tuticorin and Vishakhapatnam. The 139 minor ports are under the jurisdiction of the respective State Governments. During 2001- 2002, the total cargo handled at major ports was 288 million tonnes as against 281 million tonnes during 2000- 2001. Even though IMO regulations are strictly followed, the quantity of solid waste handled due to these activities is enormous. They are also sources for marine debris.

Major ship yards are Garden Reach Shipyard, Kolkata; Vizag Shipyard, Visakhapatnam; Cochin Shipyard, Kochi; Goa Shipyard, Goa; Mazagaon Shipyard, Mumbai and minor private shipyards located at different places. In West Coast of India, the world's largest ship breaking yard is located at Alang in Gujarat. These activities generate peeled off paint and iron scrap and other types of non-degradable solid waste, which enter the marine environment as marine debris.

Negative impacts from tourism occur when the level of visitor-use is greater than the environment's ability to cope with its use within the acceptable limits of change. During the coastal cleanup campaign in Chennai, it was noticed that in the beaches where tourist activity was more, the marine debris was found in large quantities.

The December 26, 2004 tsunami which devastated the Indian coastline from Andaman & Nicobar Islands to Tamil Nadu and Andhra coast in the east and Kerala coast in the west has left behind huge quantum of solid wastes of different kinds along the coast. The Indian Government and some Non-Governmental Organisations have jointly cleared the debris accumulated due to the damages caused to coastal installations. There is no report available either on the quantum of debris left behind along the coast by Tsunami or on the impact of the debris on the marine ecosystem.

Measures taken by India for monitoring and abatement of marine pollution

In India, organised efforts were initiated since 1986 to assess the state and trend of marine coastal pollution in the seas around the country up to 5 km offshore through systematic monitoring network of 173 selected stations under a project" Monitoring of Indian Coastal Waters" which was continued up to March 1992. The project was administered jointly by the Department of Ocean Development (DOD) (presently the Ministry of Earth Sciences) and the Central Pollution Control Board (CPCB) with the National Institute of Oceanography (NIO) as Nodal Agency shouldering the responsibility for training of manpower and establishing monitoring methodology. Subsequently, the DOD launched a project entitled "Coastal Ocean Monitoring and Prediction System (COMAPS)", in almost a similar manner in 1992 extending the study area up to 25 km offshore through a number of executing agencies in the country which is still continued.

The national COMAPS project has been in operation at 82 locations for collection and analysis of data with respect to 25 parameters relating to physical, chemical and biological characteristics of water and sediments. Parameters including pesticides, heavy metals and other pollution indicators such as dissolved oxygen, pathogenic bacteria, etc., are being monitored to assess the health of the Indian seas. Depending upon the level and source of pollutants, 13 sampling points are designated as "Hot spots" and the remaining 69 sampling points as "Regular" stations. Intensive monitoring of 13 hotspots, four times in a year, is being carried out under this programme. These hotspots are Tuticorin, Cuddalore, Kakinada Bay, Visakhapatnam, Paradip, Puri, and Sandheads in the east coast and Kochi, Mangalore, Goa, Mumbai, Thane creek and Alang/Okha in the west coast.

Constant monitoring of the health of the seas and taking up remedial measures for preventing and controlling pollution from land based activities is another activity, for ensuring sustainable development of the seas around India. The various measures taken up by India for regulating the activities along the coastal zone, fishing and fisheries, etc., have a definite role to play in sustainable development and utilisation of the ocean and its resources.

Integrated Coastal & Marine Area Management (ICMAM)

Considering that the Integrated Coastal Zone Management could provide the best long term and sustainable use of coastal natural resources and for perceptual maintenance of the natural environment, during the Ninth Five Year Plan period (1997-2002), under the 'Environment Management Capacity Building' project coordinated by the Ministry of Environment and Forests, the Department of Ocean Development (presently the Ministry of Earth Sciences –MoES) took up for implementation infrastructure development and capacity building activities funded by the World Bank to facilitate adoption of the concept of ICMAM in India. These activities focus on development of expertise in ICMAM oriented activities and dissemination of knowledge gained to the users like coastal states through organised training programmes. The MoES established an ICMAM Project Directorate at Chennai during 1998, for implementing the various planned activities in the following main areas.

- Development of GIS based information system for 11 critical habitats like coral reefs, mangroves etc., in Gulf of Khambat, Gulf of Kutch Malvan, five islands off Karwar, three islands off Cochin, Gulf of Mannar, Pitchavaram, Coringa mangrove, Gahirmatha, Sunderbans and Kadmat (Lakshadweep).

- Determination of waste load allocation based on waste assimilation characteristics of selected estuaries (Tapi estuary, Ennore creek and Hooghly estuary).
- Development of EIA guidelines for major coastal developmental activities and processes like construction of ports, harbours and breakwaters, waste disposal from domestic and industrial wastes, marine transportation and coastal tourism.
- Development of Model ICMAM plans for Chennai, Goa and Gulf of Ketch.
- Under Infrastructure, Training, R&D and Survey component of the project, infrastructure facilities have been created to house a training facility. A state-of-the-art interactive training facility of international status has been set up in the ICMAM Project directorate at Chennai. Training is being provided to the coastal states and other stakeholders on development of ICMAM Plans and use of GIS in the management of critical habitats.
- R&D activities like determination of Use Classification of coastal waters and determination of No Impact Zone in critical habitats such as mangroves, lagoons etc., as part of the pre-requisites for adoption of ICMAM have also been implemented.

Besides these activities, Marine Eco-toxicology, Shoreline management, Shoreline changes, Tidal inlet management, Coastal engineering strategy for shore protection, and Ecosystem modelling of Chilika lake and Kochi backwaters, are the other major studies being conducted under the ICMAM Project.

Other initiatives

The Indian Government adopted *The National Conservation Strategy and Policy Statement on Environment and Development* (India Agenda 21) in June 1992. It lays down approaches and actions for integration of environmental considerations in the development activities of various sectors of the country.

The Environment (Protection) Act of 1986 is an umbrella legislation designed to provide a framework for coordination by the Central Government of the various central and state authorities created under previous environment related laws.

Environmental Impact Assessment (EIA) was made mandatory in 1994. The Environmental Impact Assessment Regulations of 1994 notification requires the project proponent to submit an EIA report, an environmental management plan, details of the public hearing and a project report to the impact assessment agency for clearance (here, the Ministry of Environment), with further review by a committee of experts in certain cases.

India signed the UNCLOS in 1995 and ratified it in 1996. India has also ratified the International Convention for the Prevention of Pollution from Ships (MARPOL Convention 73/78) and adopted the provisions in the Merchant Shipping Act. Fisheries are regulated under the *Marine Fishing Regulation Act* (MFRA) of the coastal States and Maritime Zones of India Act 1981 for regulating fishing by foreign flag vessels in Indian waters.

To specifically address integrated coastal zone management and sustainable development, a notification *called Coastal Regulation Zone (CRZ)* was made in 1991 under the *Environment Protection Act 1986*. There is a proposal with the Government to convert this into Coastal Management Zone (CMZ), which is likely to be notified shortly.

In addition, the following Acts/Rules & Regulations are also in force,

- *Forest Conservation Act, 1980,*
- *Water(Prevention and Control of Pollution) Act,1974.*
- Standards for discharging effluents are listed in the *Environmental Protection Act 1986.*

2.2.3 Maldives

Maldives is a nation of small reef islands located in the Indian Ocean, stretched over an area of 90,000 square kilometres, 900 kilometres south west of Sri Lanka (Figure-6). The archipelago consists of 26 natural atolls with about 1200 islands. Of these, 202 islands are inhabited, with a population of 270,000 (2000 census). The total land area is less than 1%. The islands are relatively small in size, with an average area of 25 hectares. The largest island is just over five km².

The islands are made of bioclastic sediments derived almost entirely from the reef. Currents and waves aided by unusual weather events help in the formation and development of the islands in the Maldives. Much of the geomorphologic characteristics of the islands such as island shape, size orientation, the proportion of the reef an island occupies, topography, elevation, sediment calibre and type can be explained by the type of reef platform and the level of exposure. The reefs are therefore, an integral part of the islands that provide the stability and protection to the islands. The phenomenon of beach erosion and accretion is highly common in Maldive islands.

Maldives being a linear string of atolls set in the Indian Ocean, strong latitudinal gradients in some environmental and morphological characteristics are evident. Features that increase from north to south are; lagoon depths, continuity of atoll rim reef, and the amount of rainfall, while the features that increase from south to north are; number of faros, number of

patch reefs inside the atoll, effects of storms, seasonal reversal and number of reefs with a single island. These climatic and morphological variations are expected to be manifested in some form in the distribution and utilisation of the coastal resources.

Tourism, Maldives' largest industry, accounts for 28% of GDP and more than 60% of the Maldives' foreign exchange receipts. Over 90% of government tax revenue comes from import duties and tourism-related taxes. Fishing is the second leading sector.

Tourism is exclusively nature-based and specifically reef-related. The Maldives entered 2007 in buoyant spirits, having welcomed 601,923 visitors to the archipelago of 1,190 islands during 2006; an increase of 52.3% on 2005. (Inner Maldives Holidays, 2007. www.innermaldives.com). Diving and snorkelling, sunbathing on white sandy beaches and swimming in clear waters are all attributed to the reef system for most part (Maldives Economy Profile 2007. Source: CIA World Fact Book).

Diversifying beyond tourism and fishing is the major challenge facing the government. Over the longer term Maldivian authorities worry about the impact of erosion and possible global warming on their low-lying country; 80% of the area is one metre or less above sea level.

State of coastal and marine environment of Maldives

The maritime area of the Maldives is relatively extensive with an exclusive economic zone of 1.2 million km². Being the only resources available, the Maldives have depended on the coastal and marine resources from time immemorial. Exploitation of the marine and coastal resources in the Maldives has been almost exclusively that of extracting from the wild. The largest and most important component is the pole-and-line tuna fishery, which has continued for centuries. However, today some of these resources are either threatened or have been exploited to its fullest.

Coastal erosion has been a major concern in the country. According to the Public Perception on the Environment; A Maldivian Perception, about 90% of these islands are in a state of severe erosion.

Coral reefs are the major types of ecosystem that exist in the Maldives in terms of area as well the diversity of life that exists in the system. Coral diversity is amongst the richest in the region and the coral reefs of the Maldives are significant on a global scale as well, being the 7th largest in the world, covering a total area of 8,920 Km² and contributing 5% of the world reef area.

Fig -6: Satellite Imagery of Maldives
(Source: Google Earth, 2007)

The “bay effect’ of the Bay of Bengal area along the Maldivian coast exerts unusual influences on the ocean dynamics, the effects of which may be the persistence of pollutants in the area. The ‘flushing’ of the area is very limited unlike that of the open oceans such as the Atlantic or Pacific. Being subjected to heavy maritime traffic and burdened for most part by discharges and run-offs, addition of nutrients and other pollutants to the Bay of Bengal area continues.

Available literature suggests that there is no comprehensive and coordinated monitoring of the background and changing status of environmental parameters such as pollution and other significant environmental aspects. Some of the environmental aspects that have significant bearing upon the state of the marine and coastal environments of Maldives, are furnished below.

Oil pollution

Although consistent data is not available, it appears that oil residues are present around the waters of the Maldives. This is due to the increase in size and number of oil tankers carrying oil from the Middle East to the Far East. According to studies by Sen Gupta and Kureishy (1981), over 480 oil slicks were sighted in the northern Indian Ocean. They have also reported a mean concentration of 35-29µg/kg of petroleum residues in the northern Indian Ocean from depths of 0 to 20m.

Domestic and agricultural disposal

As populations on islands are increasing and the level of development improving throughout Maldives, traditional sewage systems are being replaced by piped discharges off the island. Sewage and other nutrient discharges including toxic and other chemicals are reported to be affecting the reef and the water quality on many islands. It is mandatory for resorts to dispose the sewage outside the reef into the open sea. Some resorts undertake primary treatment, while others do not. Lack of proper sewage treatment on many islands is causing near coastal pollution and posing health risks. This is more evident on islands that occur on extensive reef flats. Where sewage is discharged into channel, with fast flowing currents causing rapid dispersion, the problems associated with such discharges are relatively minimal. The combined effects of industrial, agricultural and domestic pollutants in particular heavy metals, organo-chlorides and pesticides are of serious concern.

Excess nutrients and toxic or hazardous substances on the reefs from improper garbage disposal are likely to adversely affect the reef ecology, the reef resources and their utilisation. For instance, the bio-magnification in the food chain is well documented, and the possibility of such threats in the Maldives is evident from the quantities of dry cell batteries imported into the country of which 180,999 is mercuric oxide batteries. Year-wise import of dry batteries into Maldives from 1997 to 2002 is given below:

Amount of dry cell batteries imported (millions)

1997	3.4
1998	4.4
1999	3.9
2000	4.4
2001	3.7
2002	4.7

(Source: Maldives Customs Service)

Regional/global level threats

Other specific threats to the marine environment include oil pollution, heavy metals and pesticides, which can occur in the wider Indian Ocean/Bay of Bengal areas. While no comprehensive study on these aspects affecting the marine resources of Maldives have been attempted in the area, limited work carried out indicates presence of such toxins in pelagic fish resources.

Oil pollution, invasive alien species and flotsams

With the increase in size and number of tankers carrying crude oil from the Middle East to the Far East, the route to the north of the Maldives is extensively used. Oil residues are often discharged with bilge or with ballast water. The prospect of an invasive alien species discharged through ballast water making its way to the reefs of the Maldives is an increasing possibility, which can easily disrupt the functioning and upset the balance of the entire system. Flotsams carried across the water of the Maldives, such as carcasses and other animal debris can be a source of an alien introduction or a health risk. The other significant marine environmental issue associated with the increase in tanker and ship traffic in the area is the discharge/dumping of garbage in the open sea.

Garbage and Litter

Solid waste generation has increased manifold throughout the Maldives. Traditionally the solid wastes generated were small amounts of leaf litter, kitchen and other domestic wastes. Since these are biologically degradable, they were easily and readily disposed of. Traditionally much of the solid waste was disposed either on designated beach area or into the uninhabited parts of the island where they get decomposed naturally. Organic wastes are composted at home backyards in

some of the islands. Non-biodegradable waste such as plastics is dumped near the beach in many islands and buried in a few islands. With the increase in the pace of development and amount of goods imported into the country, the quantity and nature of solid waste generated changed very rapidly.

In the absence of an appropriate disposal system, particularly for small islands, the increase in non-degradables such as plastics, cans and bottles and in particular that of increase in hazardous wastes such as dry cell batteries or hospital wastes are threatening the aesthetics, and health of people on many islands.

National Environmental Action Plans

Two national action plans have been formulated and implemented. The first being in 1989, which emphasised the need for institutional and capacity building though human resource development and training, together with information collection about the status of the environment. The second action plan was implemented in 1999, with emphasis on approaches to issues and threats faced by the country, from local and global causes. Specifically this action plan identified the following environmental issues:

- Climate change and sea level rise
- Coastal zone management
- Biological diversity conservation
- Integrated reef resources management
- Integrated water resources management
- Management of solid waste and sewage
- Air Pollution and management of hazardous waste
- Sustainable tourism development
- Land resources management and sustainable agriculture
- Human settlement and urbanisation

The Sixth National Development Plan outlines policies and strategies to address the environmental issues. The policy of *promoting sustainable resource management through preservation of natural resources and biodiversity* is emphasised with the strategy for developing and implementing the National Biodiversity Strategy and Action Plan to ensure sustainable use of extractive and non-extractive resources.

Also included in the policy is to minimise dangers to the natural resource base and environment due to economic development and the rapid population growth. The Plan also includes a policy to promote integrated planning and administrative practices by developing meaningful principles and procedures for sustainable resource use and environmental protection, and a policy on improving and establishing new waste management systems and ensuring safe management of hazardous wastes. The strategies include strengthening the legal, technical and management capacity for enforcing natural resources utilization, and environmental monitoring and management.

These Plans and the proposed draft Seventh National Development Plan and the UNDP funded 'Barrier Report', establish the 'road map' for developing the broad policy and the infrastructure for solid waste management and set in place some critical policy decisions for solid waste management.

Seventh National Development Plan and Third Environment Action Plan (2008 – 2013) identifies a national strategy for solid waste management. The government is expected to endorse these plans in the near future.

Legal Mechanisms in force

Law No: 4/93: Environmental Protection and Preservation Act made the Ministry of Planning, Human Resources and Environment responsible for formulating policies, rules and regulations regarding the environment in areas that do not already have a designated government authority to carry out such functions.

Tourism Law, Law No. 2/99: This Act provides for the determining zones and islands for tourism development in the Maldives.

Law Prohibiting Extraction, Sale and Giving of Sand and Coral from state-owned properties and land in Malé, Law No. 55/78: It is prohibited to extract, give or sell to another party, sand and coral from state-owned properties or land that have been given to various parties.

Law on extraction of Coral, Sand and Aggregate from Inhabited Islands, Law No. 77/78: Extraction of coral, sand and aggregate from inhabited islands must be made after obtaining permission from the authority set by the Ministry of Atolls Administration.

Law related to fishing in the lagoons of the Maldives, 1975 and Fisheries Law 1987 are two important fisheries related laws of the Maldives.

Law prohibiting Disposal of Waste into Northern harbour/lagoon area of Malé, Law No. 33/78: It is prohibited to dispose waste into the northern harbour/lagoon area of Malé.

2.2.4 Pakistan

Pakistan has a total area of 796,095 square kilometres, with a total population of over 156 million. It has seven cities with a population of 1 million or more: Karachi (20 million), Lahore (6.5 million), Faisalabad (3.54 million), Rawalpindi (3.36 million), Multan (4 million), Hyderabad (1.4 million), and Gujranwala (1.13 million) (Figure-7a &b).

Coastal Ecosystem of Pakistan

Pakistan has a coastline of 990 km along with the adjacent coastal zone of 240,000 sq.km in the Northern Arabian Sea. It comprises two distinct units, the passive margin of Sindh and the active margin of Balochistan coast. The coastline of Pakistan is inhabited by about 16 million people out of which, 15 million live in Karachi (GoPK, 2005). There are rich living and non-living resources in the coastal zone of Pakistan. The living resources include mangrove forests along Sindh and Balochistan coast with Indus Delta harbouring 6th largest mangrove forest of the world. The commercially important marine fisheries resources of Pakistan are composed of about 350 different species. Associated with Pakistan's coastal ecosystem is a complex array of natural resources which provide economic goods and services.

Economic uses of coastal areas

The following economic sectors make use of the coastal and marine environment in Pakistan.

- Ports and shipping
- Fisheries and forestry
- Communication and roads
- Coastal aquaculture
- Boat building
- Ship building
- Oil and gas mineral exploration
- Salt industries and mineral industries
- Coastal power plants and energy sector.

Fig -7a: Satellite Imagery of Pakistan
(Source: Google Earth 2007)

Fig – 7b: Map of Pakistan

The coastal and marine areas of Pakistan produce about 596,980 metric tonnes of marine fish and 25,000 metric tonnes of shrimp, while it exports about 131,000 metric tonnes of fish worth Rs. 7272 billion. Karachi is the biggest trade and economic centre of Pakistan. The Karachi Port handles the majority of the country's sea-borne trade while the surrounding city of Karachi accounts for half of the government's revenues and contributes 20% of Pakistan's GDP. There are other ports, viz. Port Qasim, Gwadar and some small jetties. Port Qasim is Pakistan's second busiest port, handling about 35% of the nation's cargo (17 million tonnes per annum). It is located in an old channel of the Indus River at a distance of 35 km east of Karachi city centre.

About 35% of Pakistan's industries are located in Karachi and adjacent Hub Industrial Area on Balochistan coast. The rest of the coastal areas do not have any major industry except fisheries, small power plants, a sugar mill and ship breaking industry. The Balochistan coast has small towns with a population of about 1 million. Due to lack of industry and population, the coastal waters of Balochistan are relatively free from pollution except in a few areas. About 50% of waste generated in the urban areas is collected and disposed off.

Environmental Issues

The coastal strip of Pakistan is arid, with less than 20 centimetres precipitation a year. Pakistan has mangrove on approximately 800,000 acres of swamp. There are a number of environmental issues in the coastal zone of Pakistan which have direct bearing on public health in the coastal areas. The Pakistani coast is exposed to negative environmental impacts from thermal pollution, increased oil spills, tar balls, and plastic and toxic effluents, including heavy metal. The poor sanitation, poor drinking water supply and disposal of untreated sewage, domestic wastes and industrial effluents, causing contamination, pollution and public health risks, are the major concerns.

The Karachi Port is mostly polluted by non-port related activities. An estimated 90,000 tonnes of oil products from vessels and the port's terminals are dumped every year in the port's water. To address the problem, the Karachi Port Trust has signed MARPOL 1972-1978. A green belt around Karachi Port is being implemented. The project includes planting 150,000 mangroves and 350,000 various other plants.

The Port Qasim Authority has initiated a number of activities which include mangrove plantations and locating industries in large industrial estates to clear the coastline.

Marine Pollution

Pakistan is suffering from the adverse soil, air and occupational effects caused by the use of chemicals in the textile and leather industries. These problems have led to various projects aimed at reducing pollution from the industries. The projects address toxic effluent reduction by using appropriate technology transfer, recycling chrome recovery, establishing institutions for in-house pollution control in the tanneries, and by establishing industrial complexes which provide the leather industry with the infrastructure and utilities required. In Pakistan, around 250,000 tonnes of hazardous medical wastes are produced annually. Over 398 MGD of waste water is generated in Karachi daily. While its treatment capacity is 90 MGD due to inadequate collection practices. Management of this type of waste has not yet been achieved. Karachi sewerage is going into sea through outfalls of nallahs, drains and rivers and converting sea into cesspool, such as Layari river, Malir river, Nehra-e-khayam, Frere Nallah, Pitcher Nallah, Kalry Nallah, Railway Nallah. Major source of pollution in the Karachi Harbour is via Layari River, which drains 200 MGD of untreated mixture of Industrial/municipal waste water into it.

Industrial pollution

The pollution problems have arisen due mainly to the indiscriminate discharge of effluent from industrial and agriculture sources, besides the disposal of untreated liquid and solid wastes generated from domestic sources into the coastal environment. Karachi has about 8000 small and large industrial units, which can be grouped into different industrial zones. A significant percentage of the coastal pollution is contributed by the export industries, which ship their goods through Karachi Port. Much of these industries' effluents are untreated and released directly into the port area.

The Pakistan National Environmental Plan estimated that three main coastal industries located near the port with the largest volumes of effluents are the steel mill, power plants and refineries and noted that many smaller industrial units are having more significant polluting effects on the marine environment. In addition to the growing export industries contribution to the pollution, trade activity in the Karachi Port is expected to rise steadily. Heavy metals are accumulating in the sediments and marine organisms. The accumulation of eight heavy metals viz. As, Cd, Co, Cr, Cu, Hg, Ni, Pb and Zn, in the fauna of coastal waters of Karachi especially in higher concentration is reported.

Shipping of Oil

Major sources of oil pollution along Pakistan coast are oil refineries and shipping traffic, mechanised fishing vessels and oil terminals at Karachi Harbour, Port Qasim and occasional oil spills. Due to country's spiralling dependence on oil imports, oil is one of the major cargoes imported at the Karachi port. Due to the heavy sea traffic the estimated oil spills and discharge from ships in the ocean come to about 1.5 million tones a year. An estimated 90,000 tonnes per year of oily discharges are pumped out within port limits and there exists no system for monitoring trace metal in the dredged spoil which is likely to further deteriorate the environment. Oil spills are a continual hazard when importing oil.

Ship Breaking Industry

Over 2000 foreign going ships and 700 country crafts call at Karachi port annually. Out of a total number of 13000 Fishing boats registered by MMD, around 1000 normally remain berthed in and around the Fishery Harbour. The ship breaking industry at Gadani has been a prominent source of pollution because of the booming business of ship breaking along the coast of Gadani. This industry has been the biggest source of heavy metal pollution in the area. In addition, waste oils, bilge oils, scrap steel and other scrap metals and scrap wooden products, etc., are also discharged directly into the inner-tidal area on the beach at sea-front.

Garbage/Marine Litter

A survey conducted by an Italian company during late 1990s revealed that each person in Karachi generates about half-a-kg of solid waste in a day. The Karachi Municipal Corporation (KMC) claims that it collects and disposes about 20-30% of the 8000-10000 tonnes/day solid waste generated. However, it is reported that in reality a much smaller percentage is actually disposed due to a variety of reasons. The remaining garbage either remains in the city or thrown near the riverbeds, which finally end up into the sea and can be seen as marine debris at certain locations of the coast.

Action Plan to reduce/minimise the adverse impacts of marine pollution

Pakistan has developed a National Action Plan (NAP) on Environment for the protection of Marine environment from land based sources of pollution. NAP recognizes the important role of environmental assessment in integrated coastal zone management. In 1994 the Pakistan government set up the Marine Pollution Control Board (MPCB) to supervise and implement pollution control and prevention measures along Pakistan's coastline. Considering that Pakistan's maritime sector is a vital component of her national economic and military power, a National Maritime Policy of Pakistan has been approved.

The National Oil Contingency Plan is based on the essence to provide vide international obligations *inter-alia* the International Convention on Oil Pollution Preparedness, Response and Cooperation, 1990 (OPRC-90), to which Pakistan is a party. Section 554 of Pakistan Merchant Shipping Ordinance 2001 stipulates that the discharge of sewage and disposal of garbage in to the sea is prohibited. Similarly section 54 of the Ports Act 1908 clearly states that if any person disobeys any rule or order he shall be punished for every such offence with fine which may extend to 50,000 rupees.

Pakistan's *Environmental Policy* is based on a participatory approach for achieving the objectives of sustainable development through legally, administratively and technically sound institutions. Pakistan has adopted a National Conservation Strategy in 1992 the core-issue of which is the environmentally sound management of sewerage, solid wastes and toxic chemicals. It comprises 14 core areas, namely, integrating population and environment programmes, supporting institutions for the common resources, preserving cultural heritage, preventing and abating pollution, conservation of bio-diversity, increasing energy efficiency, restoring range land and improving livestock, maintaining the soil in croplands, increasing irrigation efficiency, protecting watersheds, supporting forestry and plantations and protecting water bodies and sustaining fisheries, developing and deploying renewable, and managing urban waste. Consequently, National Environment Quality Standards have been implemented for issues related to this sector. This has led to some concrete measures being taken by some of the industries. The Fisheries Act 1997 also deals with environment degradation of the fishing areas.

Balochistan Conservation Strategy (BCS) 2000 was prepared by the government of Balochistan with the technical assistance of the IUCN. The BCS focuses on an action programme to be implemented over the next 10 years. An Integrated Coastal Zone Management (ICZM) Plan to address the socio-economic aspects as well as biodiversity conservation is proposed. In addition, Pakistan has prohibited the import of hazardous waste in accordance with the Basel Convention, which was ratified on 26 July, 1994.

A Committee has been appointed by the Pakistan Environmental Protection Council, to make surveys and recommendations concerning the alarming conditions of Hospital Waste. This committee is collaborating with the Ministry of Environment,

Urban Affairs, Forestry and Wildlife, and they have launched a joint action plan. The privatisation of solid waste management was initiated by the Ministry of Environment, Urban Affairs, Forestry and Wildlife. The Ministry is also responsible for the proposals in connection with the recycling of paper in Federal Government Offices. Communities are being encouraged to participate in enhancing solid waste treatment capacities.

2.2.5 Sri Lanka

Sri Lanka is located in the northern part of the Indian Ocean. The land area is about 65,610 sq. km and the length of the coastline is approximately 1620 km (Fig-8 & 9). The total population of the country is 19.668 million (Central Bank, 2006).

The land area of the country consists of three well marked peneplains; the lowest, middle and the highest. The coastal area is positioned in the lowest of the three peneplains forming the island, generally consisting of flat coastal plains averaging an elevation of less than 30 m. The lowest peneplain containing the coastal plains extends outward from the island and under the sea as the continental shelf for a width of about 8-40 km in most parts, and at an average depth of about 65 m below sea level. The continental shelf is narrow around the southern part of the island, but it widens considerably towards the north where it merges with the shelf around India (Joseph, 2003).

Sri Lanka and the southern tip of India stand on the same continental shelf and are separated by a shallow sea, the Palk Strait, which is barely 30 m deep. However, the shelf ends more abruptly in the south and east of Sri Lanka, averaging 22.5 km in width and rarely extending beyond 40 km. Within the shelf area, estimated to cover about 30,000 sq. km., the mean water depth is about 75 m, but the submarine elevations drop abruptly to 900 m within 3 km and 1,800 m within about 15 km of the shelf's edge. Beyond this there is a steep descent of over 5,500 m bringing it to the general bottom level of the Indian Ocean (Madduma Bandara, 1989).

Maritime Zones Law No 22 of 1976 (MZL, 1976), a national legislation to provide for the declaration of the territorial sea and other maritime zones of Sri Lanka, proclaims several zones for national use, viz. historic waters, territorial waters, contiguous zone, exclusive economic zone (EEZ), continental shelf and pollution prevention zone. The extent of the territorial sea and the EEZ is 21,500 km^2 and 517,000 km^2, respectively. The continental shelf area is 44,250 km^2. The area under the EEZ is 7.8 times the total land area of the country. In the Palk Bay, Palk Strait and Gulf of Mannar are proclaimed as Historic waters on the basis of traditional use by Sri Lankans.

Fig -8: Satellite Imagery of Sri Lanka *(Source: Google Earth, 2007)*

Fig -9: Loca ***onomic Zone***
(*from DeBruin, Russell and Bogusch, 1994)*

Coastal Zone

Sri Lanka's coastal zone is defined in the Coast Conservation Act No. 57 of 1981. The coastal region accommodates about 4.6 million people, which is about one fourth of the total population. The coastal areas under Municipal and Urban Councils cover 285 km^2 and comprise nearly half of such lands in the island. This has resulted in the concentration of a large share of urban growth and development activities within this region, as reflected by a high rate of construction activity - particularly in the Western Province (CZMP, 2004).

The area defined for management purposes as the coastal region extends to about 50 km inland from the coast and contains about:

- 23% of the islands covering 65,610 km² land area, and
- approximately one fourth of the population, including 65% of the total urban population.
- 62% of the industrial units
- 70% of the tourist infrastructure facilities (hotels), and
- the coastal seas provide nearly 65% of the marine fish production in the country, rich mineral resources such as ilmenite and monazite bearing beach sands, silica sands, miocene limestone, kaolin, china clays, copper, magnetite and peat.

Sri Lanka's varied coastal habitats include estuaries and lagoons (126,989 ha), mangroves (6083 ha), sea grass beds, salt marshes (23,797 ha), coral reefs and large extents of beaches including barrier beaches, spits (5621 ha) and dunes (15,546 ha). These habitats contain a rich component of the country's biodiversity. Many coastal and inshore resources associated with the coastal habitats support a thriving export industry based on export of shrimp, lobster, chank, Beche-de-mer, ornamental fish, etc., which earn on an average over Rupees 9000 million annually.

Natural causes and human interventions, accelerated by the increased coastal population during the last two decades, have combined to cause considerable degradation of the coastal habitats, resulting in the decline of their resources as well as extents at an unprecedented rate.

Sri Lanka follows a highly liberalised *industrial policy*, and the rate of industrial output, measured as the output of factory industries, is growing. The coastal region is the hub of industrial production and contains 61.6% of all industrial units. There are over 30 coastal divisions with industrial units; most of which are clustered in Colombo, Gampaha, Kalutara, Galle, Matara and Puttalam Districts. There are serious economic implications from the release of untreated industrial effluents and other wastes which affect the quality of coastal waters and the status of coastal habitats and the resources they contain.

The *fishery sector* had contributed about 2.7 % of the GNP in 2000 and continues to be an important source of foreign exchange. Estimates show that the marine fishery provided approximately 91 % of the total fish production in Sri Lanka in 2003, with the coastal fishery contributing 64 % of this share. This is largely contributed by the local fishing industry, which in 2004 produced 286,370 tonnes of fish. The sector currently provides direct employment to about 650,000 people

comprising 150,000 in fishing, 100,000 in associated service activities and 400,000 in fish trade. The sector provides sustenance to about 2.4 million persons.

Coastal/Marine Pollution

Many of the lagoons and estuaries and the biodiversity they contain are affected mainly by pollution, eutrophication, siltation, salinity changes, encroachment and over-harvesting of resources.

Coastal waters in Sri Lanka are polluted due to a number of threats, which can be ranked as follows:

- Release of untreated or partially treated wastewater and toxic substances from industries.
- The dumping of solid waste in coastal areas.
- The receipt of raw sewage.
- Waste from squatter settlements and other domestic sources.
- Release of untreated or partially treated wastewater and toxic substances from tourist resorts.
- Contamination with waste oil from fishing boats, ships, coastal service stations and oil spills.
- Release of untreated or partially treated wastewater and toxic substances from Aquaculture.
- Fertiliser and agro-chemical run-off from agricultural lands.
- Oil spills from ships.
- Exotic invasives associated with shipping.

Major causes of Coastal and Marine Pollution in Sri Lanka

Following are some of the major causes for pollution of coastal waters including Lagoons/ Estuaries:

a. Release of untreated or partially treated waste water and toxic substances from Industries.

Most of the industries located in the coastal area belong to either the medium or low polluting category. In 1994 Sri Lanka had 336 industries with a high or medium pollution potential in the Coastal Zone. Many of the coastal water pollution sources originate from specific point sources such as industries, urban sewers or sewage treatment plants and domestic sites, and transported through coastal waterways such as rivers, and streams, or through direct leakage and seepage (CZMP, 2004). Waste loads from industries located in coastal areas with high or medium pollution are given in Table -7.

Table 7: Industries located in coastal areas with high or medium levels of pollution

Type of industry or process	No. of units	Total waste water load (m^3/day)	Estimated pollution load (kg/day)		
			BOD_5	COD	Total toxic metals
Textiles	41	7100	4970	11360	--
Food and beverages	47	4111	6166	12333	--
Desiccated coconut	53	1200	4200	7200	--
Rubber processing	229	4840	9670	29040	--
Tanning	15	750	2000	5200	--
Metal finishing and preparation	76	6692	--	--	669
Paints and chemicals	33	928	--	--	*92.8

*- not measured. * based on assumed average concentration of 100 mg/l*
Source: ERM 1994 cited in Mubarak 2000; +MoEDIPIP 2002 (unpubl)

Industrial effluents that have undergone little or no treatment are frequently discharged into near shore waters, lagoons and estuaries through run-off, leakage and seepage. About seven large scale and 14 small-scale industries for dying and finishing of textiles/garments, washing plants and manufacturing foot wear directly by tourist establishments lack treatment facilities while those that possess such facilities seldom use them.

There are nine Export Processing Zones (EPZ) and two large scale Industrial Parks (IP) operating under the purview of the Board of Industries. Of these, two EPZs (Katunayake and Koggala) and one IP (of 20 ha in Mirijawilla) are located in the coastal region. In addition there are seventeen other Industrial Parks managed by the Ministry of Enterprise Development, Industrial Policy and Investment Promotion. Of these, four parks are located in the coastal region. Most industries are not yet equipped with the basic infrastructure for waste treatment, while others are constrained in the use of available waste treatment facilities due to the high costs involved. It is reported that only the Export Processing Zones at Katunayake (KEPZ) and Biyagama (BEPZ) have facilities for central treatment of wastewater prior to discharge.

b. Pollution from oil spills and other discharges

Waste oil from oil tankers, discharge of oil in bilge and ballast waters, cleaning out of fuel tanks and repair and maintenance work by motorised fishing boats and ships around ports and fishing harbours cause minor oil discharges and slicks. While they may not cause serious impacts, they result in visual pollution leading to depreciation of aesthetic quality of the beaches for recreation. Tar balls observed on the beaches in the south discharge their effluents into the lagoon.

Potential risk factors associated with oil spills and other discharges include the following:

- Oil transported in tankers (about 525 million tonnes annually) in the EEZ of Sri Lanka.
- High density of marine traffic, mainly the East-West Shipping Route used by ships plying between the industrial centres in the Far-east and the West.
- The offshore terminal of the Ceylon Petroleum Corporation (Approximately two tankers carrying 120,000 tonne parcels of crude oil are transferred to the tanks ashore every month),
- Operation of the Trincomalee Oil Tank Farm,
- Expansion and development of ports, and construction of ports and harbours,
- Existing marine services industry, including offshore supply of bunkers and ship repairing industry,
- Exploration of oil within the EEZ of Sri Lanka.

In the recent past, four moderate spills of crude oil were reported in Sri Lanka's marine waters and intrusions of tar balls on to the beaches. The M/V Komsomolets Azerbaydzhana reportedly spilt 100 tonnes of fuel oil after grounding outside Galle harbour in 1994. In June 1998, an oil spill occurred at the bunkering terminal due to the rupture of a connecting hose during loading. Investigations done by National Aquatic Resources Research and Development Agency (NARA) indicated very high concentrations of oil – 595 ppm near the vicinity of the spill (bunkering terminal) and 991 pm opposite the bunkering terminal (NARA, 1998). These values were very much in excess of the Sri Lanka standards for oil (20 ppm) in marine coastal waters.

An oil spill was reported in August 1999 when the 146 m M/V Melikash, carrying 10992 tonnes of fertiliser, broke into two and sank 1000 m off Bundala (south coast). The oil slick lasted about 10 weeks while about 40-50 km stretch of the beach was polluted with oil and tar balls (NARA, 2000).

Waste oil released from ships in the Colombo harbour increased from 879 tonnes in 1997 to 1258 tonnes in 1998. Waste oil and bilge from boats operating from various anchorages and fishery harbours are also discharged into the coastal waters. Waste oil from service stations also ends up in coastal waters, underlining the need for service stations to intercept the oil with separators. In addition, ships anchored in near shore waters discharge wastewater, which constitutes another source of coastal water pollution. Although there is no data on environmental impacts of such discharges, coastal water pollution arising from all these sources is considered to be significant.

Major commercial ports contribute to pollution of coastal waters due to accidental release of oil. Poor port reception facilities for waste oil, ballast and bilge waters cause the port waters to be polluted.

There are specific arrangements for the disposal of waste oil from ships that call at the Port of Colombo during loading or unloading of cargo. About 36 private companies are registered with the Marine Pollution Prevention Authority (MPPA) to collect the oil waste, which is pumped into bowsers directly from the ships. The waste oil collected by the operators during 1998-2001 from Colombo Port is given in Table-8. However, no regulating authority monitors the final disposal of this oil.

Table – 8: Amounts of waste oil collected or removed (in tonnes) by collectors in the Colombo Port *(Source: MPPA , 2002)*

1998	**1999**	**2000**	**2001**
1403.6	1667.5	2078.0	1878.0

c. Inadequate municipal sewage disposal facilities

Faecal pollution is a major problem in some coastal waters due to the direct discharge of untreated municipal sewage into land and waterways. Colombo is one of the few cities in Sri Lanka with an installed sewerage system, which however, is about 100 years old, needs frequent repairs and inadequate to cater for the entire city. Another problem is the illegal sewage connections to sewerage lines and unauthorised connections to storm water drainage systems and combined sewers. The growing urban population in coastal areas, with inadequate housing and sewage disposal facilities, compound faecal contamination of surface and ground waters.

d. Inadequate facilities for waste disposal in underserved settlements

At the turn of the last century, 51% of the population of Colombo city lived in 1,500 shanty settlements comprising around 66,000 households. These settlements are underserved in respect of sanitation, safe water and waste disposal facilities, compounding the problem of sewage disposal in the city.

Many highly populated coastal low-lying areas have a shallow water table and a high vulnerability for flooding. Inadequate drainage facilities and *ad hoc* development in these areas have further intensified the impacts of inappropriate sewage disposal in low-lying flood prone coastal areas leading to severe faecal pollution in internal and near shore waters.

e. Pollution from the tourism sector

About 70% of tourist hotels registered with the Tourist Board are located within the coastal region. The near shore waters receive untreated sewage, sullage in the form of kitchen and laundry wastewater, and solid waste including plastics. This causes pollution problems, as apparent in most major tourist centres along the south and southwest coasts. Tourism expansion in Hikkaduwa, Beruwala and Unawatuna areas has led to water quality degradation as well as visual pollution on beaches and near shore waters. The problem of sullage is particularly perceived as a problem associated with the larger hotels. The development of squatter settlements connected with tourism development is another cause for concern as it contributes to faecal pollution, a severe threat to recreational activities such as contact sports in coastal waters (CZMP, 2004).

f. Pollution from the Fisheries and Aquaculture sector

In the absence of proper management, fishery harbours and fish landing sites contribute to pollution of coastal waters due to improper disposal of used oil from fishing boats and accidental release of oil. Much of the coastal pollution in the North-western Province has been attributed to *ad hoc* development of aquaculture leading to the discharge of high amounts of waste water from shrimp ponds. High levels of nitrates and phosphates released from shrimp farms into the coastal waters have caused eutrophication of nearby watercourses in the region and pollution of ground water (Joseph, 2003).

g. Pollution from Agriculture Practices

Pesticide pollution, eutrophication and ground water pollution are the major water pollution issues related to agricultural practices. The use of chemical fertilisers in Sri Lanka has increased from 20,000 t of N, P, K during 1950-51 to 612,000 t in 1999. It is significant that the annual average level of chemical fertiliser use in Sri Lanka is estimated to be 77 kg/ha, which is 2-8 times more than that used in other Asian countries.

There is heavy use of chemical pesticides, herbicides and fungicides in agriculture, some of which are persistent. These substances degrade the soil as it adsorbs contaminants in the leachate, culminating in pollution of ground water. Polluted ground water used for agriculture and the resultant run-off from agricultural lands contaminates coastal surface waters. In addition, the excessive use of fertilisers causes nitrate pollution in coastal areas.

h. Pollution from the power sector

At present Sri Lanka depends mainly on hydropower, which is low in terms of environmental pollution, for power generation. In 2001 hydropower contributed 61 % to the total installed capacity of 1,909 MW. However, its contribution towards annual power generation is steadily decreasing. The shortfall between power demand and hydropower output is expected to be bridged in the future by the establishment of coal powered thermal power plants and the establishment of such plants in the coastal region can result in the thermal pollution of coastal waters.

i. Pollution of surface and ground water

Colombo, Kandy and Jaffna have serious problems in the disposal of liquid wastes, sewage, industrial effluents and industrial solid wastes. Out of a total of 370,000 m^3 of wastewater generated in the Greater Colombo Area per day, 90,000 m^3 /day is discharged through ocean outfalls and the remaining 280,000 /day re-enters the environment as wastewater.

Shrimp farms in high saline areas in the northwest Sri Lanka utilise ground water to control salinity in ponds. In an area where lack of adequate supplies of fresh water for drinking and other uses is a major problem and 80% of the required water for domestic and agricultural purposes is drawn from ground water, the use of ground water for shrimp aquaculture further aggravates the situation in regard to the availability and use of ground water.

j. Development activities in the coastal zone

Some development activities in the Coastal Zone, including inadequately planned tourism, have resulted in adverse impacts. Examples are the pollution of beaches and coastal waters due to the release of sewage, solid waste and wastewater. Infrastructure - including dwellings - located too close to the coastline restricts coastal processes and promotes erosion.

k. Development activities landward of the Coastal Zone

Activities having an impact on river discharge - including establishment of irrigation schemes and tanks - which thereby reduce the supply of sand to the coast, contributing to coastal erosion.

Impacts of pollution

The impacts of pollution on the coastal and marine ecosystems and their resultant biological and socioeconomic implications are many and varied. There are strong indications that the cost of coastal water pollution in Sri Lanka is on the rise. For example the cost to human health from coastal water pollution in the Colombo Metropolitan Area is estimated to have increased from SL Rs 2 million in 1992, to SL Rs 14 million in 2002.

There are also losses associated with decreased biological diversity; reduced aesthetic, recreational, cultural and archaeological value; declining land prices and reduced revenue from tourism, fisheries and other development activities. There are some definite links between increasing levels of pollution and decreasing coastal land values and fishery productivity.

- The estimated annual loss of income from fish sales in the Lunawa lagoon due to pollution is approximately SL Rs 1,963 million, and the total annual land value decline in the area is estimated to be SL Rs 712 million.
- The clean up costs due to water pollution is Rs. 454 million for Ja-ela and Ratmalana waste water collection system and Rs. 500 million for Beira lake rehabilitation.

3. Current Status of Marine Debris

3.1 Marine Debris/litter - Global status

In 2002, more than 8.2 million pounds of debris were collected and analysed as part of a worldwide beach cleanup effort. The largest source of marine debris was from land-based human activities; shoreline and recreational activities alone contributed almost 58 % of the number of items collected (Figure-10). Over 1 million cigarette butts, 444,000 food wrappers or containers, 220,000 bottles, 190,000 plastic bags, 32,000 pieces of fishing line, and 8,000 tires were collected (Ocean Conservancy, 2003).

It is estimated that about 6.4 million tonnes of marine litter are disposed in the oceans and seas each year. According to other estimates and calculations, some 8 million items of marine litter are dumped in oceans and seas every day, approximately 5 million of which (solid waste) are thrown overboard or lost from ships. Furthermore, it has been estimated that over 13,000 pieces of plastic litter are floating on every sq. km of ocean today (UNEP, 2005c).

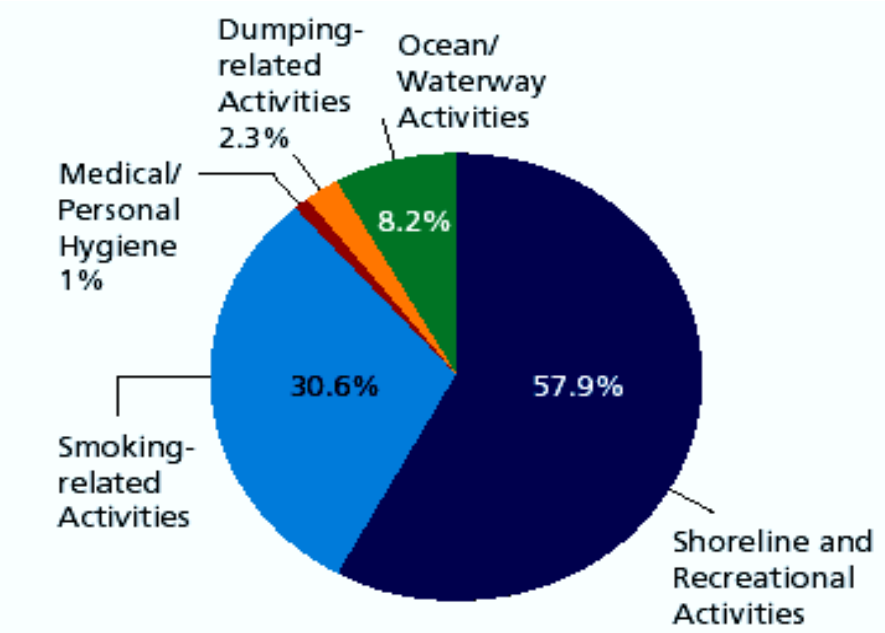


Fig -10: Source of Marine Litter
(Source: The Ocean Conservancy. *The 2002 International Coastal Cleanup.* Washington, DC, 2003)

3.1.1 Australia

According to a report published in 2003, up to 90 % of the marine debris on the northern Australian coast (in the Arafura Sea, *e.g.*, sandy beaches on Arnhem Land) originates from marine sources, mainly from fishing operations and with a large part (roughly 79 %) coming from non-Australian sources and only about 21 % from Australian sources.

In northeast Arnhem Land, around 200 turtles were found ensnared in fishing nets over a period of four years; apparently around 80 per cent of the nets were foreign. A beach survey in the same area in 2000 found 7,561 items, including 500 derelict fishing nets along a narrow strip of hardly 8.5 km of coastline (DEH 2001).

A number of NGO initiatives and programmes, and beach cleaning and awareness activities, are undertaken in many parts of Australia. The responsibility for addressing litter relevant issues is divided between the Commonwealth (the federal level) and States/Territories.

Clean Up Australia Day, organised by Clean Up Australia since 1990, has been very successful at cleaning beaches along the Australian coast. Unfortunately little information is recorded on the types and quantities of litter collected. World Wide Fund for Nature, WWF, Australia, is coordinating marine debris surveys and clean-ups in partnership with local volunteer groups in several places in northern Australia.

As a result of the widespread concern about marine litter in Australia, the country has enacted a number of legislative acts and regulations that directly or indirectly address marine litter issues.

In the Australian Environment Protection and Biodiversity Conservation Act of 1999, "injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris" is listed as a key threatening process. This listing is expected to lead to the development of a Threat Abatement Plan.

The Department of Environment and Heritage recognising that plastic bag litter is a serious environmental concern, is currently working to undertake a package of actions to reduce the impact of plastic bags on the Australian environment. The Department's Marine Waste Reception Facilities Programme (MWRF) assists ports and marine facilities to assess their need for waste reception facilities, funding of demonstration projects and development of best practice management guidelines.

3.1.2 Baltic Sea

The International Coastal Cleanup is organised every year by an international NGO, The Ocean Conservancy (The Ocean Conservancy 2004 and 2005). Almost 58 % of the litter found in ICC has been attributed to shoreline and recreational activities. In the Baltic countries in 2004 and 2005 the amount of litter varied between 2-328 kg/ 4-181 pieces of litter per 500m of coast.

Experts in Estonia estimated the amount of litter per 500 m to be in the level of 20 kg. In Poland the amount of litter on beaches per 500 m is 12 000 kg. In four Polish ports collection of marine litter has been done in 2006. The total amount of marine litter in the summer months of 2006 was 9 300 kg. at 23 kg/ha.

The amount of litter found and collected in the seven biggest Latvian coastal towns at beaches during 10 months in 2006 was 9537 m³, of which 63 % was paper, packaging material (other than plastic), glass and clothing.

Amount of litter collected in the city of St. Petersburg in Russia (including banks of Neva River) in 2006 from 540 m² area was 1128 m³, of which 48 m³ was seaweed. In the port waters in 2005 the amount of litter collected in St. Petersburg was 1016 m³, in Vyborg/Vysotsk 19 m³ and in Kaliningrad 132 m³.

In Pärnu region it is estimated that the amount of marine litter at the sea has decreased from 100-200 tons in 1995-1996 to 1 ton in 2006.

Types of marine litter in different parts of the Baltic Sea

Plastic bottles were the most common type (31-43%) of litter pieces found. Also in a study on marine litter on the sea floor along European coasts (Galgani *et al*. 2000) plastic bottles were the most common items found (36 %). Plastic bags were registered only on some years of Naturewatch Baltic and constituted 19-27% of all the litter. Plastic items constituted 50-63% of all the litter when both plastic bags and bottles were reported. In a study made in Helsinki University (Tuomisto 1994) plastic items constituted 54% of litter pieces found in 15 beaches along the coast of Finland and 33% of the total weight of litter. In the *Baltic Sea* plastic debris has greatly increased in the last decades, which now accounts for over 90 per cent of the total.

Five countries reported tourism- and recreation-related litter to be the most common type of litter. This includes plastic and glass bottles, plastic bags and packaging materials from plastic, polystyrene, paper and cardboard as well as cans and tins. In the data from Estonian Coastwatch, plastic items constituted on an average 52% of all the litter items. Other common litter in the coast of Estonia is plywood. It is a decreasing item whereas the amount of plastic bottles is constantly increasing. The

data provided by Board of the Protection of Fisheries from Poland showed that 48% of total weight of litter was plastics (bottles, bags, ropes, packaging material and so on).

Other common findings in Baltic coasts are fishing related litter (fishing nets, fishing floats), wood, food waste, sanitary and sewage-related litter, clothing and rubber. The amounts of these items are uncertain. Three countries also mentioned detached vegetation (sea grass, seaweed or thatch) accumulating on the shore to be a major problem in certain areas.

3.1.3 European Union

Between 1992 and 2002, over 73,000 m³ of marine litter was collected along 300 km of beaches in Sweden (between 6,000 – 8,000 m³/yr). In Poland, annual clean-ups collect 50-100 m³ of waste (HELCOM 2003). In spite of this large amount, solid waste is not a big problem as beaches are cleaned regularly and litter from ships is limited (GIWA 2005).

Contamination by marine litter is highlighted as a general problem in all European seas. The main sources are identified as shipping (fishing and commercial shipping) and tourist/recreational activities. It is also noted that, in addition to other well-known impacts of litter on marine life, marine litter has been found to carry a variety of epiphytic organisms to sea areas that these organisms would normally not reach. It is also emphasised that the litter problem may get worse as pressure for tourism, urban and industrial development in the coastal zone increases.

The proposed Objective 8 of the European Marine Strategy is "to eliminate marine litter arising from illegal disposal at sea by 2010". According to the Draft Action 13 of the strategy the European Commission will, prepare a report on the extent and sources of marine litter and consider possible remedial measures.

EU Directive on Port Reception Facilities for Ship-generated Waste and Cargo Residues was adopted in 2000 with the objective of reducing the discharges of ship-generated waste and cargo residues into the sea, especially illegal discharges, from ships using ports in the Community, by improving the availability and use of port reception facilities for ship-generated waste and cargo residues, thereby enhancing the protection of the marine environment. The Directive is one of the measures forming part of the EU policy on safe and clean seas.

The EU "is seriously concerned about the pollution of seas and coastlines of the Member states caused by discharges of waste and cargo residues from ships, and in particular about the implementation of MARPOL 73/78". All EU Member States have ratified MARPOL 73/78. The Directive is aimed at ensuring a major reduction in marine pollution by the provision of adequate waste reception facilities and a waste management plan to be developed in all EU ports, including recreational ports and marinas.

3.1.4 Gulf of Guinea countries (Benin, Cameroon, Cote d'Ivoire, Ghana and Nigeria) (UNESCO/IOC, 2004)

National production of solid wastes in **Benin** in 1991 was about 230000 tonnes and 60% of these from Cotonou town. In rural areas, garbage is evacuated out from the concession and burned sometimes. In urban zones, wastes are used to fill in low or marshy areas. In towns, rate of waste collection is under 30%. Most of the solid wastes are composed of organic matters (animal and vegetable) and sand. Other material like paper, carton, rubber, wood, glasses, bottle, synthetic material, metal etc, have also been recorded. Garbage production in principal towns of Benin ranges from 4050 tonnes to 143000 tonnes annually.

The impact of human activity on marine and coastal ecosystems in **Cameroon** is from industry, agriculture, fishing etc. The government has set up an environmental programme to monitor the pollution in the marine and coastal area. The programme will identify the source and the type of pollution, their quantification, the inventory of marine debris; the evaluation of the impacts of pollution and marine debris on the marine and coastal ecosystems, the implication of local population on the management of marine and coastal resources.

In **Nigeria** though some refuse bins are provided behind important beaches like the Victoria beach, most beaches are littered by all sorts of debris. In most cases, bins are not even collected and disposed in time by the refuse collecting agency. Much of the cleaning and disposal of beach debris are usually done by local owners of tourist facilities on the beach since there are no coordinated system of beach debris collection and disposal.

The types/number of debris reported from the beaches of Nigeria are given in the following Table (Table-9).

For the first time ever in Nigeria**,** a beach clean-up was organised in Lagos on September 24 1994 in connection with the international beach cleanup day involving well over 100 volunteers.. A total of 10.872 pieces of debris weighing 531.l kg were collected from the 2.5km stretch of the Victoria beach during the clean up operation. The results show that plastics constituted 87% of the debris collected from the beach.

In **Cote D'Ivoire** the marine debris are not assessed and monitored as such for the purpose of developing scientific programmes in this domain. The domestic wastes production in Abidjan is estimated at 2300 tonnes/day of which about 600 tonnes are not collected which mainly comprise plastics, followed by the organic matters, bottles and batteries.

Table-9: Summary of debris collected from the beach of Nigeria

Type of Debris	Number of debris
Plastic	3974
Foamed Plastic	1129
Glass	730
Rubber	785
Metal	1393
Paper	1755
Wood	785
Cloth	335
Earthenware Pots	13
Total Number	**18872**
Total Weight (Kg)	**531.1**

There are areas in **Ghana** where marine debris pollution is so severe that land and aquatic ecosystems are threatened owing to technological and industrial activities. This is due to the concentration of about 30% of Ghana's manufacturing industries within the Greater Accra Metropolitan Area.

The major pollution problem caused by marine debris, however, arises from domestic activities. The main factors are inadequate provision of basic sanitary facilities especially in the economically depressed, high density areas; accelerated and unplanned urbanisation; and the non-enforcement of pollution control measures leading to uncontrolled discharges of untreated wastes. Thus, sewage and garbage are either directly deposited on lagoon banks and beaches or reach the coastal zone via surface runoff, drains or culverts.

3.1.5 Mediterranean Sea

Eighteen countries border the Mediterranean Sea. A pilot survey which lasted for 12 months (May 1988 - May 1989) was conduced in the Mediterranean Sea region to study marine pollution caused by marine litter.

An analysis of the quantitative information/data on the litter found on several Mediterranean beaches in Spain, Sicily, Cyprus and Israel (IOC/FAO/UNEP, 1989) shows a wide range of litter concentration, from a mean of 0.53 to 1105 pieces/frontal metre of beach in counts, or from 4.2 to 6,628 g/m in weight. Collection and measurement of floating litter was conducted by Marino et al. (1989) in two expeditions off the northern Spanish Coast in the Mediterranean, in July 1988 and March 1989. The results show that the mean concentration of plastic was 867 pieces per km², Styrofoam 522 pcs/km² and wood 23.3 kg/km².

Sea bed litter

During a dive with the submersible "Cyana" in the submarine canyon off Toulon, France, in 1989, large quantities of litter, consisting of plastic bags, bottles and crates were observed on the sea bottom. In recent sediment sampling by dredging the sea bottom at depths ranging from 200 to 1400 m off Israel, all the collected samples contained litter consisting mostly of shredded plastic sheets, but plastic bottles and plates were also present. Bingel (1989) in his attempt to assess the quantity of litter on the Mediterranean sea bed estimated the total quantum of litter in the whole continental shelf of the Mediterranean to be around 16,000 tonnes.

In all of the study areas, plastic debris was the most abundant component in the litter, ranging between 34 and 75%. Considering that unspecified garbage pieces (termed as "various" or "others") were between 10 and 20%, the relative abundance of other components, such as glass or metal, was only a few percent each.

Most of the metal components were tins used for beverages; the rest were either food cans or aerosols. In a similar way the glass fraction contained mostly soft drink bottles and other items such as electric bulbs. Wood included driftwood as well as crate fragments. In addition to these, cartons, styrofoam, garments and foam rubber were found in smaller numbers.

Relative abundance of plastic debris was higher in the Mediterranean whereas the metal and glass components were less. Also, remnants of fishing gear were rather rare in the Mediterranean - 2.8% was the highest abundance recorded.

The composition of the floating litter which was found off the Spanish coast in the Barcelona area (Marino et al., 1989) consisted of (in number of pieces) 74.5% plastics, 15.2% styrofoam and 3.05% wood. In terms of weight, the percentages are 55.5%, 1.1% and 36.2, respectively.

In the seabed litter, plastics constituted only 1.4% of the litter by weight but more than 45% by number of pieces. Off the southern coast of Turkey the most abundant material by weight was wood - 43%, whereas plastics constituted 32%.

3.1.6 North-East Atlantic (OSPAR)

Marine litter in the marine and coastal environments has been an issue of concern in the North-East Atlantic region, and particularly in the North Sea sub-region, during at least the last two decades. People in most of the countries of the region have become increasingly aware of and concerned about the effects of marine litter. Coastal and beach clean-up operations are being conducted on a regular basis in most of the countries. These are mostly carried out by local communities and nongovernmental organisations – and at high costs.

Due to the prevailing current and winds in the North Sea area, the Skagerrak coastal area (which comprises only about two per cent of the total North Sea coastline) receives about 10 per cent of marine litter. During the 1990s, the amount of marine litter removed from the beaches annually was on average 6,000–8,000 m³. The annual beach cleaning operations are mainly conducted by and paid for by the local municipalities.

A six-year OSPAR Pilot Project on Monitoring Marine Beach Litter was initiated in 1999. In its second phase (2003–2006), the project included close to 40 reference beaches in eight countries, which are surveyed 3–4 times a year according to an agreed protocol. Civil society actors in the Northeast Atlantic region include a number of national and international networks of environmental organisations. The goal of the six-year "Save the North Sea" project is to reduce marine litter by changing the attitudes and behaviour of people using the area (OSPAR, 2007).

3.1.7 Northwest Pacific (NOWPAP) Action Plan

The Fisheries Agency in Japan surveyed the drift garbage in the North Pacific Seas between 1986 and 1990. The study showed that the drift garbage was found all over the survey area, and the number of drifting items was found to be in the range of 25,000 to 30,000 pieces. The types of garbage included polystyrene foam, shopping bags, food containers and other plastic materials, metal, glass bottles, fishing gear, driftwood, etc. More than 70% of the garbage consisted of daily household items, of which plastics constituted 50-70%. Fishing nets and other fishing gear accounted for around 10% of all the debris. In Japan, an organisation called Marine Blue 21 has been surveying the cleanliness of the Japanese coast for over a decade and as per the estimates about 30,000 – 1,00,000 tonnes of litter have been recovered through coastal clean-ups. Of this, the plastic items alone account for over 10,000-20,000 tonnes.

In China during 2003, the total waste discharged in the sea, was estimated to be around 126.81 million m³, most of which were dredge wastes and land wastes. The output of industrial solid waste from the coastal cities along the Bohai Sea was reported to be more than 100 million tonnes.

Plans to develop joint initiatives to combat and reduce marine litter and its harmful and costly effects were developed within the NOWPAP programme of work for 2004/2005, with the co-operation between China, Japan, Korea and Russia, which is expected to lead to a slow but gradual improvement of the situation. The generation of marine litter will be reduced at source by implementing better waste management strategies and practices, and large scale cleanup campaigns will be run as part of public awareness and education activities. The NOWPAP countries are expected to contribute efforts and resources to the marine litter work beyond the scope of present NOWPAP activities (NPRECC, 2005).

3.1.8 Pacific Islands

In 2002, 107 tonnes of nets and fishing gear were gathered from the northern islands in Hawaii (NOAA 2002) and a further 90 tonnes were collected in 2003.

3.1.9 Republic of Korea

In Korea also marine litter has become one of the serious environmental, economic (especially fisheries) and social problems. Since the late 1990s, the Korean Government has initiated special national R&D projects to develop integrated management strategies and practical guidelines on marine litter problems at the national level.

The survey of marine debris was carried out at all the ports of Korea during two 1999-2000. The field surveys were mainly carried out using the Side Scan Sonar (SSS) method, which might be regarded as a cheap and simple technique for the survey of marine litter in shallow waters such as ports (Jae Heung Chun, 2005). The number and types of marine debris were analysed from the SSS images and then converted to weight basis. Major portion of debris contained ropes, followed by steel (or metals), wires, wood, and tyres. The result showed that the most abundant debris was related to shipping and/or fisheries activities. Also it is interesting that tire is one of the most abundant litters in Korean port.

A project was initiated in 2001 to elucidate the status of marine debris on the seafloor of fishery grounds. Some major results are listed below:

a. trawl method : total area surveyed – 166.70ha, marine litter collected by trawl-7.293 tonnes (fishing net-83%)---- the survey indicates that a total 14,300 tonnes of marine litter is laid on the sea floor in the fisheries ground (average: 18.9 kg/ha).

b. SSS method: the total area has been covered by the SSS. The results show spatial distribution of marine litters in the survey area.

A Marine litter management project, initiated in Korea, includes the development of the technical equipment and/or facilities for practical prevention of inputs of land-based litters through rivers, survey and recovery of marine litter on marine shallow and deep sea bottom, treatment and/or reuse of marine litter. This also includes the development of relevant national policies and educational programmes to raise public awareness on marine litter problems.

3.1.10 ROPME Sea Area

An estimated 1.2-2.6 kg of litter is generated on board ships per person per day, most of which is dumped overboard. In Kuwait, 18 fishing nets weighing more than three tonnes and measuring more than 3,000 m² were recently collected (Butayban 2005).

3.1.11 South Atlantic Sea

Polyethylene and polypropylene pellets, together with tar balls, were found to be the most common contaminants of the sea surface in the Cape Basin area of the South Atlantic Ocean. Estimated density of tar balls ranged from 21.6 g Km^{-2} to 585.7 g Km^{-2} and that of the plastic pellets from 1333 to 3600 numbers/ Km^{-2} at different locations (Morris, 1980).

3.1.12 Unites States of America

The Environmental Protection Agency (EPA) along with other federal agencies, has designed the National Marine Debris Monitoring Programme (NMDMP), and the EPA is supporting the implementation of the study by the Ocean Conservancy. The NMDMP is designed to gather scientifically valid marine debris data following a rigorous statistical protocol. To date, 163 study sites have been designated and 128 sites are collecting data. The surveys will measure trends of 30 specific items found within each 500-metre site by sampling monthly for a period of five years by teams of trained volunteers.

The U.S. component of the International Coastal Cleanup comprises clean-up activities in all coastal U.S. states, including those bordering the Great Lakes. In 2002, more than 165,000 volunteers cleaned U.S. beaches with a length of approximately 14,000 km, removing about 1,800 tonnes of marine litter (USEPA, 2002).

All of the five sea turtle species found in the United States are found entangled in different types of floatable debris, such as fishing line, rope, and fishing nets. Cases of turtles swallowing balloons, tar balls, and debris that has become covered with algae also have been reported (USEPA, 1992).

Seabirds are some of the most frequent victims of abandoned nets. As many as 100 birds have been found in a single abandoned net. Many birds, including ducks, geese, cormorants, and gulls, have been found entangled in six-pack rings and other encircling debris. The ingestion of plastic resin pellets (the small, round pellets that are melted and used to form plastic products) is a major concern. Many types of birds have been found to feed on these pellets, most likely because they mistake them for fish eggs or other types of food (USEPA, 1992). Fish and crustaceans such as lobsters and crabs are frequently caught in lost or discarded fishing gear in a phenomenon known as ghost fishing.

Legislative measures introduced by USA for marine litter management include:

- *Beaches Environmental Assessment and Coastal Health Act of 2000,*
- *Marine Plastic Pollution Research and Control Act (MPPRCA)*, which prohibited any ship in U.S. waters from dumping plastics.
- *The Shore Protection Act of 1988 (33 U.S.C. 2601 et seq.) (SPA)* was enacted to minimise trash, medical debris and other unsightly and potentially harmful materials from being deposited into the coastal waters of the United States by vessels transporting wastes on U.S. coastal waters and at associated loading and offloading facilities.
- *Regulations under the Marine Protection, Research, and Sanctuaries Act (33 U.S.C. 1401 et seq.) (MPRSA),* promulgated in 1977, implement the London Convention nationally.
- *Water Quality Act of 1987, the Clean Water Act (33 U.S.C. 1251 et seq.)* requires EPA to establish regulations that treat storm water as point source discharges that must be regulated.

3.1.13 UAE (Arabian Gulf & Gulf of Oman)

In a study conducted by Khordagui and Abu-Hilal (1993) in the eastern beaches of Arabian Gulf and the Gulf of Oman, UAE, they found 22771 items from 27000 m^2 of beaches, and an estimated 13.5×10^6 man-made items stranded along 800 km of Arabian Gulf and Gulf of Oman shorelines. Plastic fragments constituted 27.1% of the total items encountered. Fishing floats and nettings represented 16.9% of the total items examined.

3.1.14 Wider Caribbean Sea

Marine Debris, ranging from plastics, metal cans, bottles, tyres to fishing lines and nets are fouling the beaches, polluting the environment, killing wildlife and pose a health and safety hazard to coastal residents and tourists.

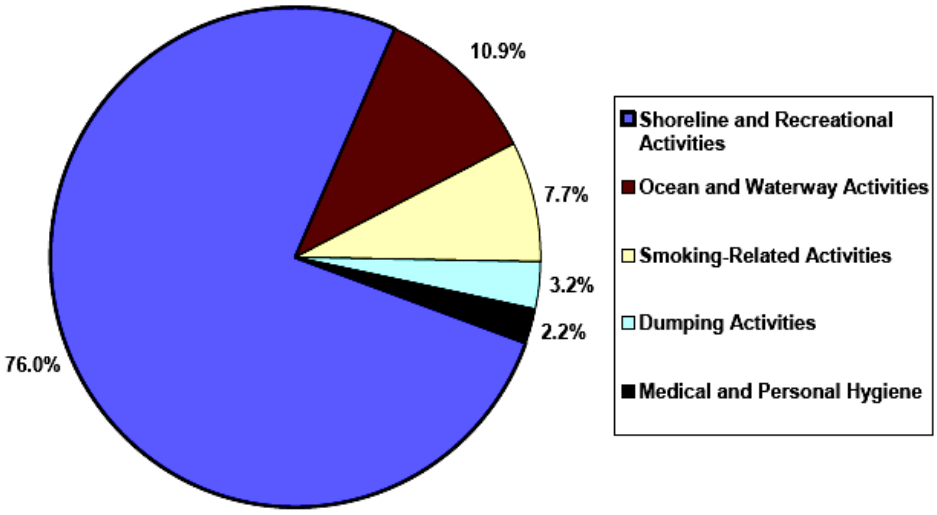


Fig. -11: ICC Data on source of marine litter in the Wider Caribbean
Source: The Ocean Conservancy 2005. www.oceanconservancy.org/ICC

International Coastal Cleanup (ICC) data collected in the Caribbean Region from 1989 to 2005 show that 76.0% of the marine litter is from Shoreline/Recreational Activities, 10.9% from Ocean/Waterway Activities, 7.7% from Smoking Activities, 3.2% from Dumping Activities and 2.2% from Medical/Personal Hygiene activities (Figure-11).

The overwhelming dominant source of marine litter documented in the ICC data from the Caribbean Region is attributable to *land-based-sources* (LBS) at *89.1%, and ocean-based sources* (OBS) at *10.9%.*

Land-based sources of debris are reported to have a profound impact on tourism (and other economic indicators), as well as human health and safety. The following "Top Ten" listing of the debris collected in the Caribbean Region from 1989-2005 (Table-10) is a roadmap to what people are doing to create the litter problem:

Table -10: Top Marine Litter Forms Collected in the Caribbean Region on the ICC day (1989-2005):

Sl. No	Types of debris	Percentage
1	Caps & Lids	11.9
2	Cups, Plates, Forks, Knives, & Spoons	11.3
3	Bags	10.6
4	Beverage Bottles (plastic – 2 litres or less)	10.6
5	Food Wrappers & Containers	7.6
6	Beverage Bottles (glass)	6.9
7	Cigarettes & Cigarette Filters	6.3
8	Straws & Stirrers	4.8
9	Beverage Cans (metal)	4.3
10	Clothing & Shoes	3.1
	TOTAL	**77.4**

3.2 Marine debris/litter - SAS Regional Status

3.2.1 Methods adopted for collecting information on marine litter

In the entire SAS Region, data/information of some utility is available only from India and Sri Lanka and in the other three countries the information is either unavailable or even if available it is scanty. There are also no accepted or standard uniform methodologies being followed in the Region for collecting, analysing and interpreting the marine litter data.

As observed by Tudor *et al*.(2003) and Tudor & Williams (2004) elsewhere, the methodologies adopted in the SAS Region, particularly in India tabulate the material composition of the litter without addressing the origin of the litter. The data available from India are from the periodic beach clean ups/coastal surveys conducted by local community/NGOs, conservancy groups, students and the public. Such data are of limited value in evaluating impacts and formulating management plans. Beach surveys allow large amounts of data to be collected at low cost (Rees & Pond, 1995). The use of volunteers in surveys is commonplace, and provides impartial data with no statistical difference between that gathered by experience and inexperienced surveyors (Tudor & Williams, 2001).

3.2.2 Sources of marine litter (Land-based / sea based) in the SAS countries

Major sources of marine litter, derived from National Reports on Marine litter for India, Pakistan and Sri Lanka and from published reports on liquid and solid wastes polluting the coastal and marine areas in Bangladesh and Maldives, are listed in Table - 11.

Bangladesh

Over 92 per cent of the annual runoff generated in the *Ganges-Padma*, the *Brahmaputra-Jamuna* and the *Meghna (*GBM) catchment areas flows through Bangladesh (Coleman, 1969). The combined flow of the *Ganges* and *Brahmaputra* typically vary between less than 5000 m^3/s in the driest period (March-April) to 80,000-140,000 m^3/s in late August to early September (WARPO, 2000).

The 144 industrial units in the Chittagong and 165 industries in Khulna districts discharge solid waste and liquid effluents, persistent organic and inorganic substances, as well as toxic metallic compounds into the surrounding water bodies, which find their way finally to the Bay of Bengal.

Pollutants that enter the marine and coastal environment originate on land in the form of runoff from municipal, industrial and agricultural wastes, and from commercial seafaring activities (Hossain, 2004).

Table - 11: Major sources of Marine Litter

Sl.No.	Source	Bangladesh	India	Maldives	Pakistan	Sri Lanka
Land based Sources						
1	Sewage treatment works (STWs)		✓	✓		
2	Combined sewer overflows (CSOs)		✓		✓	✓
3	Other industrial discharges	✓	✓	✓	✓	✓
4	Urban runoff	✓	✓	✓	✓	✓
5	Municipal waste	✓	✓	✓	✓	✓
6	Agricultural waste	✓	✓		✓	
7	Recreational & leisure usage	✓	✓	✓	✓	✓
8	Aquaculture	✓	✓			
9	Medical wastes	✓	✓	✓	✓	
10	Faecal pollution	✓	✓	✓		
11	Fish/food processing		✓	✓	✓	
12	Tourism resorts /beaches	✓	✓	✓		✓
Sea-based sources						
13	Harbours	✓	✓	✓	✓	✓
14	Fishing industry including gear from fishing vessels	✓	✓			✓
15	Shipping including garbage from ships/ ship breaking	✓	✓	✓	✓	✓
16	Ministry of Defence munitions		✓		✓	
17	Dereliction (piers, wrecks,)		✓			
18	Oil rigs/Oil spill/Oil transportation/Oil refineries	✓	✓	✓	✓	✓
19	Marine mining		✓			

India

The identified sources of garbage to the coastal waters of India are:

- Industrial Effluents
- Ports and Harbours including fishery harbours and fish landing centres
- Ship Building Yards
- Ship Breaking Yard
- Fish/food Processing Industries
- Coconut Husk Retting in Kerala coast
- Salt Pans
- Tourist Resorts / Beaches
- Solid Waste Dumping
- Urban runoff including municipal waste
- Shipping including garbage from ships
- Oil rigs
- Agricultural runoff
- Fishing industry including gear from fishing vessels
- Aquaculture
- Recreational & leisure usage
- Marine mining

Maldives

A major pressure on the environment arises from the wastes and pollutants produced as a by-product of domestic, industrial and construction activities (Figure-12). Environmentally unsound practices in solid waste and sewage disposal pose the most serious threat from tourism to the delicately balanced coral reef ecosystem of the Maldives. Marine litter originates from many different sources, circulates through a range of pathways, and accumulates at various locations. The sources of marine litter include offshore marine and coastal. The major sources include:

- Municipal waste
- Sewage treatment works
- Harbour activities
- Sea Swell and Run-off
- Marine Transfer of Wastes

Figure 12: Coastal debris on the beach

Pakistan

The main source of marine litter is untreated mixture of industrial and municipal waste water enriched with insoluble solid ingredients. The untreated waste water of metropolitan Karachi drained by Malir, Hub, and Lyari rivers into Karachi Harbour and sea leads to high level of pollution including marine litter in Karachi harbour.

Sri Lanka

Marine litter entering the marine and coastal environment in Sri Lanka has multiple sources (Figure -13) that can be divided into three major sources as shown in Table – 12.

Table-12: Sources of Marine litter in Sri Lanka

Main sea-based sources	Coastal-based sources	Inland-based sources
Merchant shipping, ferries and cruise liners.	Tourist reports and hotels.	Discharge of untreated municipal sewage and storm water (including occasional overflows).
Fishing vessels.	Restaurants and boutiques found along the coastal belt.	Riverine transport of waste from landfill sites (authorised), waste dumps (unauthorized) or other sources along rivers and other inland waterways (canals).
Waterway recreational activities (such as diving, boating and other water sports).	From domestic households which are found underdeveloped state.	From indiscriminate dumping sites in marsh lands and other low lying wetland areas.
Drifting.	Fishery harbours, fish anchorages, and fish landing sites. Urban centres boarding the coasts Illegal dumping of domestic and industrial waste along the shore.	

Fig -13: Fishery harbour – One of the sources of marine litter in Sri Lanka

3.2.3 Types/composition, quantity and distribution of marine litter.

A comparative statement of the types of coastal/ marine litter reported by the SAS countries is given in the Table - 13.

Table-13: Types of Marine/Coastal Litter Recorded in the SAS Region

Sl. No	Types of marine/coastal Litter	Bangladesh	India	Maldives	Pakistan	Sri Lanka
1	Plastics (fragments, sheets, bags, containers)	✓	✓	✓	✓	✓
2	Polystyrene (cups, packaging, buoys), foam, PVC, etc.	✓	✓	✓	✓	✓
3	Rubber (gloves, boots, tyre)	✓	✓	✓		✓
4	Wood (construction timbers, pellets, plywood, fragments of both)	✓	✓	✓	✓	✓
5	Metals (drink cans, oil drums, aerosol containers, scrap)	✓	✓	✓	✓	✓
6	Sanitary or sewage related debris (tampons, diapers, condoms, faeces)	✓	✓	✓	✓	✓
7	Paper and cardboard,		✓	✓	✓	✓
8	Cloth (clothing, furnishings, shoes)	✓	✓	✓		✓
9	Glass (bottles, light bulbs), glass wool	✓	✓	✓	✓	✓
10	Pottery/Ceramic					✓
11	Monofilament fishing line	✓	✓			✓
12	floats, marking buoys and abandoned cut pieces of used nets		✓	✓		
13	Plastic beach chairs*		✓			
14	Computer monitors and refrigerators*		✓			
15	Waxed milk carton/Tetra Pack	✓	✓			✓
16	Fruit peel		✓			✓
17	Cigarettes, cigarette fibre, lighters, cigar tips, and other tobacco related packaging/wrappers	✓	✓			✓
18	Used batteries,	✓	✓	✓		✓
19	Building materials, etc.		✓	✓		✓
20	Tar/grease balls, oil film, black tar, etc	✓		✓		
21	PCBs	✓				
22	Others	✓	✓	✓	✓	✓

** reported in the Andaman & Nicobar Islands after 2004 December Tsunami,*

Bangladesh

Excreta of the workers; scrap of iron piece; metallic fragment and other refused materials; oxidised iron, foam, pieces of wood and partex, glass wool, PVC, PCBs, black tar, grease balls and oil film and many other toxic chemicals left in the beach for long time and accumulated in the beach soil finally get washed into the sea. There are reports on scarcity of fish kill and fish, occurrence of glass wool (carcinogenic) in the stomach of fish in that region (Hossain, 2004).

- Shoreline and Recreational Activities

  Bags 7121, Balloons 32, Beverage Bottles (Plastic) 2 litre or less 180, Beverage Bottles (Glass) 155, Beverage Cans 389, Caps/Lids 215, Clothing/Shoes 205, Cups/Plates/Forks/Knives/Spoons 224, Food Wrappers 2982, Shotgun Shells 345, Straws/Stirrers 87 and Toys.

- Ocean/Waterway Activities

  Fishing Lines 13, Fishing Lures/Light Sticks, Light Bulbs 34, Oil/Lube Bottles 20, Pallets 3, Plastic Sheeting 2, Rope 1, Strapping Bands 59

- Smoking-Related Activities

  Cigarettes/Cigarette Filters 5152, Cigarette Lighters 413, Cigar Tips 104, Tobacco Packaging 1475

- Dumping Activities

  Appliances 5, Batteries 152, Tires 3

- Medical/Personal Hygiene

  Condoms 34, Syringes 8.

India

An inventory of the types of marine litter in India includes:

- Plastics (fragments, sheets, bags, containers)
- Polystyrene (cups, packaging, buoys)
- Rubber (gloves, boots, tyre)
- Wood (construction timber, pellets, plywood, fragments of both)
- Metals (drink cans, oil drums, aerosol containers, scrap)
- Sanitary or sewage related debris (tampons, diapers, condoms, faeces)
- Paper and cardboard
- Cloth (clothing, furnishings, shoes)
- Glass (bottles, light bulbs)
- Pottery/Ceramic
- Monofilament fishing line
- Waxed milk carton
- Fruit peel
- Cigarettes, cigarette fibre, lighters, cigar tips, and other tobacco related packaging/wrappers
- Used batteries,
- Building materials,
- Fishing lines, floats, marking buoys and abandoned cut pieces of used nets,
- Plastic beach chairs (in many places in the Nicobar Islands after the tsunami) and computer monitors and refrigerators (in Nicobar).
- Grenade, Urea and wicks used by Thai fishermen poaching in Andaman waters to dynamite fish in the Nicobar islands, etc.

Surveys were conducted in March 2003 and again in 2004 in the Great Nicobar by A & N Centre for Ocean Science and Technology, National Institute of Ocean Technology, Port Blair, Andamans. Assorted types of marine debris in large quantity consisting of plastics, were recorded. Various objects such as detergent bottles, hazardous medical waste, robe, rubber gloves, plastic scoops, plastic gallons, large carboys, variety of fishing buoys, net fragments, trawl webbings, fishing lines, fishing ropes and fishing traps, fish basket, plastic crates, water bottle, liquor bottles, milk containers, egg cartons, brush and broom, incandescent light bulbs, florescent light bulbs, gallon, oil and fuel filters, cargo strapping bands, cooking utensils, refrigeration gas cylinders, cigar lights, insulation pipings, HDPE and plastic pipes, plastic toys, footwear and umpteen number of man-made domestic items (more than 20 different types of materials), were recorded from a stretch of about 1 km, the total quantity of which was more than 200 kg.

Maldives

An example of the rapid growth in solid waste is exemplified by the amount of plastic bags imported into the country shown in Table-14. Many of these bags are likely to end up on the house-reefs of many islands.

Table -14: Amount of plastic bags imported by Maldives (No. in millions)

1994	16.73
1995	15.77
1996	32.30
1997	21.87
1998	18.66
1999	38.85
2000	82.57
2001	77.15
2002	52.97

(Source: Maldives Customs Service)

The amount and the rate of solid waste generated vary throughout the country and there is a significant difference between the amount of waste generated in Malé and that in the atolls. On average 2.48 kg of waste are generated per capita per day in Malé while in the atolls this value is around 0.66 kg of waste per capita per day. Average waste generation in the resorts stands at 7.2 kg per guest per day (JICA 1999). The rapidly developing construction industry is contributing significantly to the composition of the waste. The amount of solid waste generated in Malé has been increasing at an alarming rate over the past 10-15 years. The solid waste generated almost doubled within the period 1990 to 1995 and in the next five years (1995 to 2000) the amount of waste generated increased by eight fold.

The increase in non-degradables such as plastics, cans and bottles and in particular that of hazardous wastes such as dry cell batteries or hospital wastes are threatening the aesthetics, and health of people on many islands.

The main types of litter found in Maldives waters include:

- Glass (bottles and others)
- Plastics (sheets, bags and containers)
- Foams (disposable cups, rigifoam, packaging and buoys)
- Wood (construction timbers, pallets)
- Cloth (clothing, furnishing, shoes)
- Metals (cans, aerosol containers, scrap)
- Paper and cardboard
- Rubber materials
- Sanitary or sewage related debris

Because there is no baseline data and no study has so far been carried out the marine litter in the Maldives, it is difficult and or quite impossible to determine the volume and quantity of these wastes find their ways into the sea.

Pakistan

Overall, the problem of marine debris/litter is located to the coastline near Karachi. There are a few recreational beaches located near Karachi city. However, due to the absence of proper systems for collection of marine debris and solid waste, plastic and packed paper materials can be seen on beaches in the vicinity of Karachi.

Though data on the type and sources of marine litter is not available, it is generally observed that materials of resale value in the market like glass, wooden packs, paper, tin packings and thermoplastics are usually found in very small quantities in the solid waste of Karachi because segregation of these items from solid waste is done first by the residents followed by the scavengers.

The following are the main items of marine debris reported from Pakistan (Country Report, 2007).

Land Based

a) polyethylene bags & Sheets

b) Styrofoam pieces

c) Oil

d) Industrial Solid Waste

e) Rags, Plastics and Nylon items

Marine Based

a) Oily Waste
b) Plastics, Dunnage & Packing Material
c) Bottles, Cans & Cartons
d) Shrubs
e) Paints
f) Municipal Waste

Sri Lanka

A general inventory of the types of marine litter was attempted using personal experiences, information from relevant organisations through personal contacts, information obtained from other researchers, environmentalists and enthusiastic personnel through informal procedures. Marine litter observed along the coast line on beaches, fishery harbour and port environment in Sri Lanka include a vast category of items (Table – 15) (Sureshkumar, 2007).

Table - 15: General inventory of marine and beach litter observed in Sri Lanka

S.No	Category of litter	Types of beach and marine litter
1.	Polythene	Shopping bags, Packaging bags, Wrappers of soap, butter, toffee, chocolates.
2.	Plastics	Bottles, yogurt and ice cream cups, sachet of milk powder, milk , shampoo, hair gel, washing powder, plastic spoons, broken pieces of containers, pieces of plastic sheets, Parts of Plastic story books, torn Rexene covers, tooth paste tubes, medicine tubes, toys, broken plastic buckets, cargo strap bands
3.	Polystyrene	Cups and plates, discarded food packaging boxes, rigiform pieces, sponges.
4.	Rubber	Used garden gloves, disposable medical gloves, damaged boots, used tyres.
5.	Wood	Wastes from construction timbers, pieces of plywood materials, small decayed logs, broken pieces of chairs, tables and other furnishings
6.	Metals	Drink cans, used perfume aerosol containers, small pieces of scrap metal, old and corroded vehicle parts of various kinds, old car/lorry frames.
7.	Discarded medical and sanitary equipment	Sanitary napkins, tampons, baby and adult diapers, condoms, baby soothers.
8.	Sewage, related debris	Faeces deposited by people living in underdeveloped settlements adjacent to shores, visitors and domestic animals
9.	Paper and cardboard	Discarded exercise books, parts of school text and story books, packaging boxes of various products like mild food packs, perfume bottles, etc.
10.	Glass	Empty/Broken beer bottles and other Liquor (mainly arrack) bottles, medicine bottles, light bulbs and tube lights,
		Discarded / broken jam bottles and cordial bottles.
11.	Tins	Empty canned fish tins, Parts of drums from tar and chemical containers, Engine oil containers.
12.	Fishery sector	Fish offal from landing sites and way side fish markets, Discarded and torn fishing nets, fishing boxes, ropes, discarded buoys and other floating devices used in fishing crafts, fibre glass pieces.
13.	Tetra packs	Waxed milk carton, Fruit juice cartons.
14.	Discarded waste materials from Natural products	Fruit peel, Coconut husks and shells, Cut down tree branches, Old banana trees, dried coconut leaves.
15.	Waste from households	Used torn cloth, hats and caps, cut garment pieces, pieces of old PVC pipes and connections, parts of toilet cisterns, brooms and brushes, broken slippers, damaged shoes, cigarette packaging/ wrappers, cigarette lighters, aluminium cooking utensils.
16.	Building materials	Discarded / demolished building materials – broken cement blocks and bricks, parts of brick and cement block walls.
17.	Pottery/Ceramic	Broken sanitary wares and wash basins, flower vases, old pottery items.
18.	Used batteries	Pen torch batteries(AA and AAA size), Broken pieces of car battery.

3.2.4 Factors controlling litter distribution in space and time and litter dynamics.

There is no information available on the factors controlling litter distribution in space and time and its dynamics in the SAS Region, except for some preliminary observations in the Great Nicobar area of Andaman and Nicobar Islands in India.

India

In a survey of marine debris conducted in the east coast of Great Nicobar in 2004 to assess the magnitude of the debris accumulation, rate of accumulation, quantitative and qualitative assessment of the marine debris, assessment of current and drift pattern and occurrence of floating debris, the magnitude of the foreign bound marine debris was found to be steadily increasing when compared to that of the previous year. Floating debris including long line marker buoys with beacon lamp, fishing buoys, water bottles, oil cans and thermocol were recorded in the offshore region.

The surface current prevailing in that area of Great Nicobar might have resulted in the debris being circulated continuously in the open sea & coastal areas and subsequently washed ashore in the coastal areas of Great Nicobar. The generalised circulation pattern of the ocean currents in the Indian Ocean shown in Figure – 14 corroborates these observations. It is inferred that the garbage generated along the coastal areas of South East Asian countries and / or by the international shipping services may not have been disposed off properly but dumped into the sea, which is carried by the currents and washed ashore on the pristine beaches of Great Nicobar and Nancowry group of Islands.

3.3 Organisational Mechanism for Addressing Marine Litter Issues

3.3.1 National Government Ministries/Departments/Organisations

Bangladesh

Ministry of Environment & Forests, (Department of Environment), Department of Environmental Pollution Control, Ministry of Land, Bangladesh Internal Water Transportation Authority, Ministry of Shipping, Mercantile Marine Department (MMD), Ministry of Shipping, Ministry of Industry, Ministry of Law, Ministry of Fisheries & Livestock, Ministry of Local Government; Ministry of Health, Ministry of Agriculture , Water Resources Planning Organisation (WARPO), Ministry of Water Resources, Institute of Water Modelling (IWM), Centre for Environment and Geographic Information Services (CEGIS), etc., are all collectively responsible for prevention and control of environmental pollution. However, the Department of Environment (the nodal Department) is directly responsible for coastal and marine pollution control. Marine litter has not been identified as a separate entity for exclusive monitoring and management in the National Plan of Action for Environmental Protection.

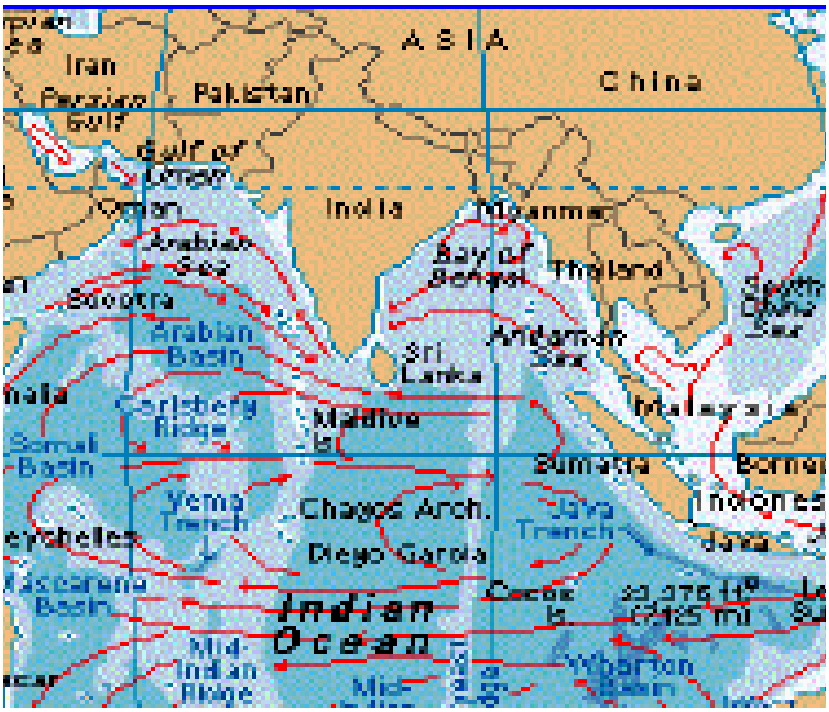


Fig.-14: The generalised circulation of the ocean currents in the Indian Ocean
(Source:http://wrc.navair-rdte.navy.mil)

India

The following Indian Government Ministries/Departments and Organisations, have the mandate for addressing the marine pollution and protection of coastal environment related issues in general, but not specific to marine debris:

Central Government:

- Ministry of Environment and Forests,
- Ministry of Agriculture,
- Ministry of Earth Sciences (erstwhile DOD),
- Ministry of Science and Technology,
- Ministry of Surface Transport including Directorate of Shipping, Ports and Harbours,
- Customs Department – some minor ports are manned by the Indian Customs,
- Ministry of Urban development,
- Ministry of Tourism,
- The Indian Coast Guard,
- The Indian Navy,
- Central Pollution Control Board,
- Coastal State Governments (Tamil Nadu, Pondicherry, Andhra Pradesh, Orissa, West Bengal, Kerala, Karnataka, Goa, Maharashtra, Daman & Diu, and Gujarat; UTs of Andaman & Nicobar Islands and Lakshadweep),
- Department of Town Planning,
- Department of Fisheries,
- Department of Environment & Forests,
- State Maritime Board,
- State Pollution Control Board,
- Coastal District Administration,
- Municipalities/Panchayats of coastal cities/towns, etc.

Maldives

Ministry of Environment Energy and Water (MEEW) is mandated with waste management issues in the country. Fisheries sector in the Maldives is mandated with the Ministry of Fisheries, Agriculture and Marine resources. The Ministry has under it the Marine Research Centre, with a mandate to conduct fisheries related research and development. Ministry of Tourism and Civil Aviation (MTCA) facilitates and regulates the resorts islands and the regulatory authority of waste management in these resort islands. *Male' Municipality* is responsible for the management of wastes of Male', Villingili and Hulhumale'.

Pakistan

The Ministry of Environment, Local Government and Rural Development is responsible for overall policy, planning, coordination and implementation/execution of various activities in this sector. Protection of High Seas, territorial waters and Port related matters are vested with the respective Port authorities for administration and management. A Marine Pollution Control Board has been established to handle matters, which are related to marine life and environment and resources at risk; to provide advisory services to relevant organisations; and to review monthly progress in combating and controlling marine pollution (JoBurgPk 2002).

The responsibility for management of marine litter presently is not vested with Government or any other organisation. However, the issue of Marine Litter Management involves a number of organisations like Municipal Authorities and authorities dealing with distribution of water and treatment of waste-water. Enforcement Agencies/Organisations include Ministry of Environment, Ministry of Ports and Shipping, and Maritime Security Agency. A close coordination among concerned Ministries and organisations is required to address the issue of management of marine litter in Pakistan.

Marine Pollution Control Board (MPCB) constituted with representation of concerned departments including MOE, KPT, POA, SEPA, Fisheries Department, is responsible for implementation of the activities/programmes for controlling and preventing marine pollution in Pakistan:

- Oil Spill Response
- Ships Inspection
- Harbour Surveillance
- Harbour Cleaning
- Environmental Audit in Oil Installation Area

- Water Quality Monitoring
- Fitness of Oil Water Barges
- Pollution Control Notices to Concerns
- Fencing of Oil tankers by Oil boom
- Monitoring Shore Disposal of Wastes
- Cooperation with other Agencies
- Promotion of Awareness
- Rehabilitation of Mangroves

Sri Lanka

Waste management is the primary responsibility of municipal councils, urban councils and other local authorities. Maintenance of clean beaches also falls within the purview of these local authorities. However, at present, removal of marine litter-floating or deposited on the sea bed is not dealt by any of these authorities. However, two important state institutions in Sri Lanka are mainly vested with the responsibilities of management and pollution abatement in coastal zone and marine sector. They are Coast Conservation Department (CCD) and Marine Pollution Prevention Authority (MPPA).

The Central Environmental Authority (CEA) was established by National Environmental Act (NEA) No 47 of 1980. NEA was amended by Acts No. 56 of 1988 and 53 of 2000. The main functions of the CEA include;

- making necessary provisions for protection, management and enhancement of the environment,
- regulation, maintenance and control of the quality of the environment.
- prevention, abatement and control of pollution.

Ministry of Environment and Natural Resources is the foremost policy making entity with regard to any matters related to environment in the country. The Ministry has put forward "National Environmental Policy and Strategies" and "National Strategy for the Solid Waste Management".

3.3.2 NGOs, conservancy and other civic groups

Information on this aspect is available from Bangladesh, India and Sri Lanka only.

Bangladesh

The Dhaka City Corporation is responsible for solid waste Management (collection, transportation, disposal and treatment of solid waste) in the metropolitan area (Kazi, 1998). In addition to DCC, some NGOs also have come forward in solid waste management.

The major NGOs, Federations and Private Agencies addressing marine litter related issues in Bangladesh include:

IUCN Bangladesh, BCAS, CARDMA, Prattay – an NGO (programme funded by Dept of Environment), Kewkradong Bangladesh – an NGO, Federation of Chambers and Commerce, Khulna Chambers of Commence and Industries, Chittagong Chambers of Commence and Industries, Barisal Chambers of Commence and Industries, Beach Management Committee, Cox's Bazaar, Banglalink – a mobile phone operator assisting to collect wastes only form the Cox's Bazaar main beach.

India

The following are the NGOs and other groups which are involved in India in the management of marine litter.

- NGOs such as EXNORA Chennai
- Indian Maritime Foundation, Pune,
- Green Peace- India,
- Toxilink,
- Kadal Ammai Padukappu Sangam, Chennai,
- Indian Council for Plastic Environment (ICP), WWF, India

Sri Lanka

Local authorities are responsible for the collection and disposal of solid waste in the country. In this regard, legal provisions for solid waste management are adequately provided under Local Government Acts. The sections 129, 130 and 131 of the Municipal Council Ordinance, the sections 118, 119 and 120 of the urban Council Ordinance, and sections 93 and 94 of the Pradeshiya Sabha Act clearly and adequately provide provisions for management and disposal of solid waste in the respective areas.

3.4 Social, physical, biological and economic ramifications of marine debris

No detailed assessment on the social, physical, biological and economic ramifications of marine debris, seems to have been carried out in any of the countries of the SAS Region. However, Bangladesh, India, Maldives and Sri Lanka report in a general way impacts of marine litter on these socio-economic aspects.

Bangladesh

Deterioration of the beach soil is a severe environmental problem in the ship breaking area. The fragments of iron/rust of the metallic substances contaminated the soil of the zone and neighbouring coastal area. A thin layer of burned oil (tar ball) and lubricants is reportedly found in the soil at a depth of 1-2 cm. Extensive human activities in the affected area appear to have accelerated the rate of shore erosion resulting in high turbidity in the ship breaking area. Nearby recreational beach (Sitakunda, Reserve Forest), having a potential for "ecotourism" has been affected by iron corrosion and due to lack of environmental suitability.

India

Social: Human health is affected in many ways. Broken glasses, ropes and lines dangling in ocean pose threat to beach goers, boaters & divers. There is lack of awareness on biomedical waste disposal. Outbreaks of cholera and infectious hepatitis are occurring with increasing frequency among coastal populations.

Physical: Impact is mostly on the quality of coastal marine waters and sediment quality. Land runoff carries a heavy silt load along with agricultural pesticides and fertilisers, into the marine environment. Dredging of ports and harbours for increased access and maintenance represents a threat to adjacent or down-stream biodiversity. Sand-mining represents another source of threat from particulate matter. This exposes the coastline to greater wave action, as well as creating high levels of coastal turbidity, affecting the critical coastal habitats supporting mangroves, coral reef, sea grass beds, etc.

Biological: Marine debris causes tremendous threat to wildlife such as endangered species-fish, turtles and sea birds through entanglement and ingestion. Many entanglements involve fishing nets and line causing “Ghost fishing”.

Economic: Some impacts on coastal activities affecting tourism by contamination of coastal amenity areas, thereby affecting recreational activities such as bathing and boating in the beaches, have been evident along the Indian coast. The cost of beach cleanup exercises is a very pertinent issue. Every time a beach was cleaned by NGOs in Thoothukudi in Tamil Nadu, the same quantity of waste was dumped on the shore in a week. This is because the people have no sense of proper waste disposal, and the indifferent attitude of Municipalities and other departments which collect and discharge the untreated / partially treated liquid and solid wastes in an unorganised manner, as the dumping yards are not available. The repeated clean up of the beach not only involves huge manpower but also a sizeable expenditure for engaging coastal community in collecting and disposing the wastes/litter in an organised manner.

Maldives

The large quantity of waste generated coupled with limited land area and technology makes the disposal of waste a challenge for the country. The environment is being placed under increasing pressure from a growing population changing lifestyles and improvements in living standards. Waste are being generating in ever-growing volumes. A major pressure on the environment arises from the wastes and pollutants produced as a by-product of domestic and industrial activities. Solid waste disposal is now one of the most critical environmental issues in the Maldives. Impacts resulting from the absence of basic infrastructure and environmental services in the atolls have been further aggravated by the damage that followed the high waves and flooding of the Indian Ocean Tsunami.

Sri Lanka

Litter in the marine environment in general gives rise to a range of adverse ecological impacts, including visual pollution, entanglement, ingestion, smothering, disturbance and removal of habitat through beach cleaning activities; transport of invasive species, and poisoning by breakdown products. It also affects various sectoral activities such as tourism, fisheries, religious, health, etc. In Sri Lanka impacts due to marine litter is felt mostly by tourism sector, which has economic ramifications. Further, recent beach cleaning activities too had brought financial burdens to concerned authorities. Visual pollution too was highlighted by general public from time to time (Sureshkumar, 2007).

4. Current initiatives to manage Marine Debris/Litter in SAS Region

4.1 National, sub-regional or regional projects and programmes for the management of marine litter.

Currently, the South Asian Seas Region does not have any specific national or regional projects that deal exclusively with the issue of marine litter.

In *India*, as a part of beach clean up activity a NGO called EXNORA at Chennai is involved in this activity for the past eight years. In the *Maldives*, the increasing number and magnitude of coastal modifications on the islands, including reclamation, harbour dredging and beach replenishment are serious environmental issues that need to be addressed. Some Government agencies in *Pakistan*, monitor marine pollution in the EEZ and Ports/harbours and beaches, respectively. To reduce marine pollution due to merchant ships, waste reception facility from ships visiting Pakistani Ports has been introduced. In Sri Lanka Coast Conservation Department and Marine Pollution Prevention Authority operate beach cleanup programmes with the participation of local community, school children and non-governmental organisations from time to time.

4.2 Marine litter management activities/practices in SAS Region

Marine Litter activities in some of the countries of the SAS Region are limited to periodic beach-clean up and community clean up exercises which are coordinated by the Central and State Government Ministries/Departments, Coast Guard, non-governmental organisations, schools, private sector organisations, community groups, Pollution Control Boards, coastal zone agencies, local public, etc.

4.2.1 Beach cleanups

Regular beach clean up is reported to be carried out in India, Pakistan and Sri Lanka only.

India

Chennai Elliot's beach - January 1998: Elliot's Beach, a 2 km long part of the Marina coastline in suburban Chennai, witnessed a truly remarkable movement, in January 1998, when a group of people led by Mr. A. Shankar, an Adyar-based businessman, formed an organisation named Friends of the Beach, under the aegis of Exnora International. Their objective was to make a contribution to the environmental wellbeing of their neighbourhood beach.

Elliot's Beach is not very different from many of the beaches that dot the long stretch of the Marina, among the longest urban coastlines in the world. Growing crowds generate tons of garbage every day; this is often left unattended to by a grossly inefficient garbage disposal system. Further aggravating the situation is that the nearby slum and hutment dwellers often use the shoreline as an open-air toilet. The sea washes ashore floating debris from time to time, some of this is a flotsam of rugged and abrasive pollutants. These have the potential to cause harm, especially to children playing on the shore.

The Friends of the Beach campaigners established the infrastructure for periodical beach clean up. Some of the hutment-dwellers were employed on a daily basis from 6 AM to 11 AM to clean the beach. They were provided uniforms, footwear and relevant accessories. Mass cleaning campaigns were held on the first Sunday of every month. Students, members of Exnora, Rotractors, and neighbourhood youth zestfully came forward to participate in the beach cleanup campaign. The physical involvement and feeling of shared responsibilities quickly led to an exchange of thoughts and ideas, as well as increased awareness.

Since Chennai Corporation has limited resources to maintain the beaches, the Friends of the Beach volunteers made arrangements with the civic body to place 15 garbage collection bins in the beach area. It has been very encouraging to them to see that the bins are being used. According to the campaigner's assessment, the beach requires at least fifty bins.

The stretch of the sandy area of the Elliots Beach is about 1200 m x 560 m. Every day the beach used to be full of throwaways of all sorts indulged in by the floating casual beach visitors, who remained an undisciplined lot despite the efforts of the local Exnora. A group of 10 women from the adjoining fishing hamlets manually pick up the garbage daily from the sandy stretch and the water front between 5 and 8 am. They are being paid Rs. 900/- pm sponsored by a corporate body. With the help of the local police they keep the vendors and hawkers on the Beach properly lined up. They observe "Beach Day" on the Chitra Pournami Day every year (in the month of April-May) and stage a variety folk entertainment programmes and organise clean foods and beverages.

The total volume of the litter in this area is reported to be about 30 m^3 with an approximate weight of about 1.5 MT during week days (Figures 15 and 16). It is about twice the volume and weight during week ends and holidays and 2.5 times more during the summer vacation. It also consists of discarded disposables like clothing and beddings of the dead, dismantled pandals put up for domestic and public functions by dwellers along the coast which are thrown into the sea and washed ashore. Thus, it is a mixed form of litter varying in kind and quantity on a day-to-day basis. No attempt was made before, for

Fig.-15 : A heap of coastal debris collected by local community at Nainarkuppam Village, Chennai, Tamilnadu

such quantification, for want of necessary facilities. It is opined by EXNORA that the upkeep and safety of the beaches should be a Government function under a composite authority of a multi-task outfit. There is no waste management scheme and waste is being taken by local municipality and dumped in the city garbage dumping yard in the outskirts of the city.

Pakistan

It is reported that beach cleaning campaign in some areas is regularly conducted. However, there are no details of such events and the outcome of such campaigns.

Sri Lanka

In Sri Lanka, the marine litter issues were firstly seen as a beach litter problem about two decades back. The responsibility of beach cleanup activities was expected from the local authority. Periodic beach clean up programmes were initiated by Coast Conservation Department to cleanup selected beach fronts under various projects.

As the tourism activity was flourishing along the coastal areas, targeting beautiful beaches around the country, management issues with regard to beach litter were taken up in many fora. As a result of this, special tourism promotion areas such as "Bentota" in the southern province were established with the objective of planned development of tourism activities.

Fig.- 16: Marine Debris collected at Utthandi beach, South of Chennai City, Tamil Nadu

Four out of six tourist development regions are situated in the coastal belt (Jinadasa and Ajantha de Alwis, 1999). However, due to erosion of management mechanisms, of late, the private tourist establishments have started to maintain their beach front and this practice is still on.

It is estimated that about 900,000 tonnes of debris was generated due to tsunami in Sri Lanka. In some areas tsunami back wash dragged most debris into the sea and deposited it in deep water (UNEP and ME&NR, 2005). However, no efforts were taken to cleanup marine environment, except for a few cleanup activities of coral reef areas. In early 2005, Marine Pollution Prevention Authority (MPPA) took up a coral reef clean up programme in Hikkaduwa jointly with local communities and active non-governmental organisations with a view to restore marine and coastal environment after the tsunami impacts in December 2004. Further, in the same year to mark the World Ocean day, clean up of a two kilo metre beach stretch in Hikkaduwa was organised by MPPA. MPPA also organised beach cleanup programmes in a two kilo metre beach stretch behind Mirissa Maha Vidyalaya, behind Holcim Cement plant and a two kilo metre beach stretch next to Galle Fort towards Matara during 2005. It is reported that eight tractor loads of waste were removed from Galle fort beach clean programme and on an average two tractor loads of refuse were removed during other cleanup programmes (Sureshkumar, 2007). It is reported that waste constitute mostly plastic bottles, discarded plastics and polythene bags.

MPPA further took up beach cleanup activities in Kalutara and Unawatuna in 2006. In Unawatuna, it was implemented in collaboration with Unawatuna Environmental Conservation Group, Fisheries societies and HELPO. Further during this year (2007), MPPA undertook litter cleanup programme in three fisheries harbours namely, Beruwala, Mirissa and Devundara. It is estimated that on an average six tractor loads of wastes were removed from each of the harbour premises (Sureshkumar, 2007).

To sustain the pollution prevention programmes of MPPA, it has recruited 64 "Marine Pollution Guards" into its cadre. They will be stationed in selected locations to monitor the marine pollution issues.

The Coast Conservation Department (CCD) also implemented beach cleanup programmes in selected locations. These programmes were spearheaded after tsunami in December 2004. CCD conducted two beach cleaning programmes under Negombo Special Area management Component of Coastal Resources Management Project (CRMP) in the later part of 2006. It also in association with Disaster Management Secretariat, conducted a beach cleaning programme in one and a half kilometre stretch of Mount Lavinia beach and in collaboration with Sri Lanka Police in one kilometre of Wellawatte beach in March 2006. Further, CCD in a more organised manner is conducting beach cleaning exercises in Crow Island beach park every month on 'Poya (full moon) holiday' from mid 2006, in collaboration with the Crow Island Beach Park Management Society. It is reported that about two tractor loads of refuse mainly polyethylene bags, logs, plastic things and leftovers of beach goers are removed during these cleanup programmes.

4.2.2 International Coastal Cleanup Day

Bangladesh

International coastal cleanup day is being observed every year since 2005 in a very small scale by an NGO named 'Kewkradong-Bangladesh'. This NGO collected 510 pounds of marine debris on the ICC Day in the year 2006 from 14 km stretch of coastline in Cox's Bazaar sea beach.

India

The International Coastal Cleanup day is being organised by the Indian Navy, Indian Coast Guard, National Institute of Ocean Technology at Andaman, and NGOs like Indian Maritime Foundation with the participation of school children, Industries and citizens, from the year 2002.

The Indian Coast Guard, in coordination with International Maritime Foundation, Pune (a NGO) conducted the coastal clean up during 17 September to 2 October 2005, in the west coast. Nearly 14850 people participated to clean a small coast line of 238.5 km and removed 253.6 tonnes of marine debris which was carried in 14428 bags.

In 2006, International Coastal Clean-up (ICC) day was successfully organised by the Indian Coast Guard, National Institute of Ocean Technology, Chennai, and Indian Navy under the auspices of SACEP in different parts of Indian coast (Figure- 17).

The types/composition of marine debris collected on the International Coastal Cleanup day in 2006 from the Indian coastline is depicted in the pie chart (Figure -18). The efforts taken in India on the ICC day by various agencies location-wise are given in Annexure-2.

Other SAS Region countries

There is no report from Maldives, Pakistan and Sri Lanka on ICC day campaign for beach cleaning.

Fig-17:A good haul of coastal litter collected from Pondicherry beach on ICC day- 16 Sept. 2006

4.2.3 Solid waste handling, collection, transport, disposal (including waste avoidance, reduction, reuse/recycling, treatment) and constraints in sound waste handling

Bangladesh

The Dhaka City Corporation (DCC) is responsible for solid waste Management (collection, transportation, disposal and treatment of solid waste) in the metropolitan area (Kazi, 1998). It was estimated that approximately 3500 tons (Bhuiyan, 1999) of solid waste are generated everyday in Dhaka city from various residential, commercial and industrial activities with the per capita generation of about 0.5 kg/day (Kazi, 1998). DCC can manage only about 55% of generated solid waste with its current manpower and financial capacities (Bhuiyan, 1999). As per recent projections, waste that is likely to be generated by every person in Dhaka City during 2010 and 2020 would amount to 0.75 kg and 1.0 kg, respectively.

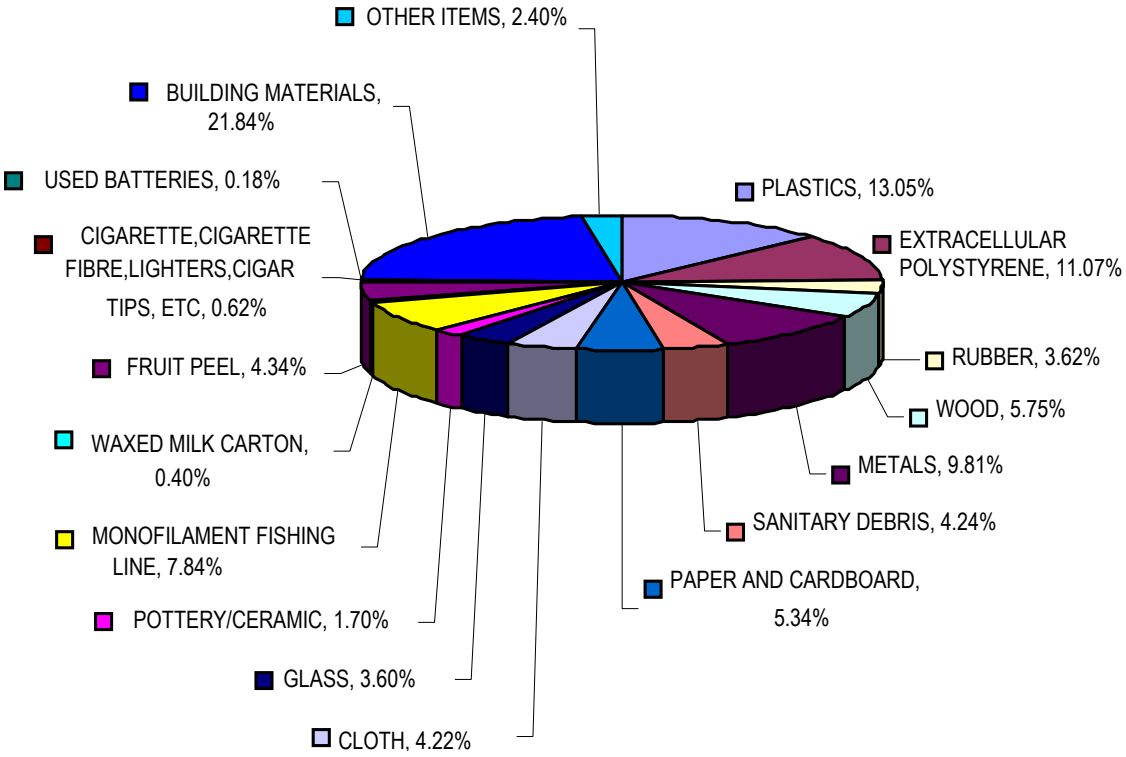
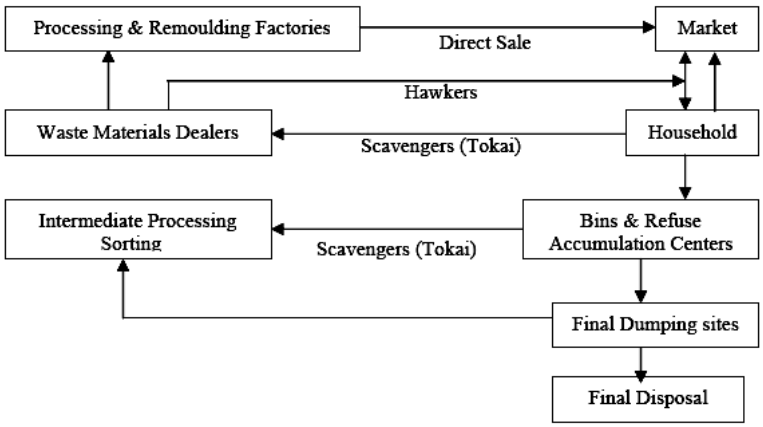
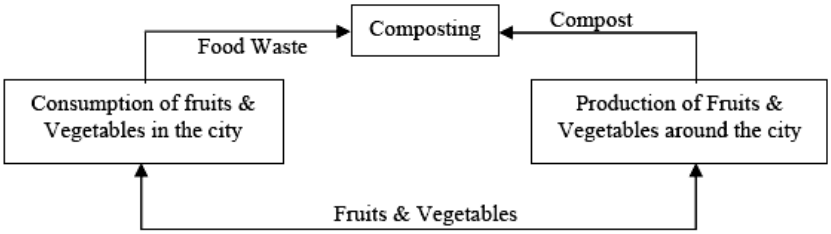


Fig.- 18: India - Percentage of different types of Marine Litter collected on ICC day, 16 September 2006



Flow Chart- 1: Recycling Pattern of Municipal Wastes in Bangladesh (Ahmed, 1994)



Flow Chart - 2: Proposed recycling of Organic Fraction of Municipal Waste (Ahmed, 1994)

Hospitals, clinics and diagnostic centres usually do not maintain safe management of wastes generated from their establishments. The hazardous wastes are discharged at the City Corporation's storage waste bins, which are then mixed up with domestic solid waste and disposed at the City Corporation common dumping place.

Flow Chart -1 shows the present utilization of municipal wastes in Bangladesh and Flow Chart- 2 the proposed recycling process of organic fraction of municipal waste.

India

Indian Centre for Plastics in the Environment (ICPE) has been set up as a non-profit body in India to work with governments, non-governmental organisations and industry to advance solid waste disposal solutions that optimise use of all 3 Rs- Recover, Reuse & Recycle. In working towards this mission/goal, ICPE has been joining hands with local bodies & municipalities that are willing to accept that the industry can play a proactive role in the community to help protect the environment. There is wealth in the waste that the communities are generating and the answer to disposal of this waste is no longer the landfills & garbage dumps, but intelligent segregated waste collection & recycling. ICPE has demonstrated that the present day problems of solid waste disposal can be effectively tackled by a multipartite arrangement of the community if all in the area want it to improve.

Over the years a countrywide network for collection of plastic waste through rag-pickers, waste collectors, waste dealers and recycling enterprises, consisting of over 20,000 units, has sprung up. In 1998 around 800,000 tonnes representing 60 per cent of plastic wastes generated in the country was recycled involving 2,000 units. This level of recycling is the highest in the world. Europe is 7 per cent, Japan 12 per cent, China 10 per cent, and South Africa 16 per cent. Collection of plastic waste is a source of livelihood for innumerable "rag-pickers", or "waste collectors". Plastic waste collection is a lucrative business when compared to that of other items. Typical rates for other waste material in India are: Newspapers in English: Rs. 4-5/kg; Newspapers in Hindi/Tamil: Rs. 3-4/kg, Magazines: Rs. 3-3.50/kg; Iron scrap: Rs. 5.50/kg; Plastic waste: Rs.12-15/kg; Beer bottle (per bottle): Rs. 2. The plastic waste commands the highest rate in the recycled market.

Maldives

There are no marine litter management activities/practices in the Maldives. In response to the 1998 JICA study, a municipal landfill site was created on the island of Thilafushi, located approximately 5 Km away from Male'. Solid wastes generated in Male' (the Capital) is collected and taken to a transfer station privately and from the transfer station, the waste is transported to Thilafushi landfill site, which is a landfill for the central region of the country. In addition to waste from Male', it now receives waste from islands in Male' atoll, the resorts and industrial areas within the catchments. Three barges operate daily between Male' and Thilafushi landfill. Each barge makes two crossings per day carrying five (15 tons) tipping trucks. All the wastes are collected, transported and disposed for free of charge to the consumer. Barging of solid waste collected at the transfer station from Male' to Thilafushi has proved practical and efficient.

The management of solid wastes is identified as a key environmental issue in the Second National Environment Action Plan.

The Ministry of Home Affairs, Housing and Environment, is currently in the process of developing a national waste management strategy for the country. An interagency technical committee was formed in April 2000 to advice the Ministry on the national waste management strategy. Under the South Regional Development Project, and with the guidance of the technical committee, a solid waste disposal site in Hithadhoo has been developed. A similar site at Kulhudhufushi has been developed under the Northern Regional Development Project for waste disposal.

Barging of solid waste collected at the transfer station from Malé to Thilafushi has proved practical and efficient. The experience gained from this operation is utilised in all the inhabited islands of Malé Atoll. Plans have been put in place to barge the solid waste collected from the inhabited islands in Malé atoll to the Thilafushi landfill to significantly improve the problem of solid waste disposal in Malé Atoll.

Solid wastes generated in the atolls are disposed using various methods. Organic wastes are composted at home backyards in some of the islands. Non-biodegradable waste such as plastics is dumped near the beach in many islands and buried in a few islands. Burning of combustible waste at designated areas in the islands is also widely practiced in many islands. Islands with heavy population concentrations are facing similar situations as experienced in Malé.

Until recently there was little in the way of infrastructure investment in the waste sector on outer islands. In 2001 under its Regional Development Project, the Asian Development Bank (ADB) invested in the construction of two regional waste management facilities, one in the North and the other in the South.

Several options were tried in Male', and eventually an offshore landfill option was implemented. All resorts are required to install incinerators and compactors to manage the solid waste generated by tourism activity. Following the Malé disposal method several islands are trying to pursue similar system. This option is expensive and perhaps ineffective for the outer islands as the quantities are small to make it viable. Several islands have opted to dispose the garbage in confined plots adjoining the island on the house-reef. These may be ad hoc alternatives, but not a solution.

Pakistan

The 1995 statistics show that Pakistan generates 46920 tonnes of solid waste per day, out of which 19190 tonnes comes from urban areas and 27730 tonnes from the rural areas.
The city of Karachi alone generates 3000-5000 tonnes of solid waste, while the city's treatment plants have a capacity to handle only 20-33% of its solid waste. Karachi Municipal Corporation is responsible for collection and safe disposal of land based solid wastes. The ocean-based marine pollution including marine debris is monitored by Maritime Security Agency and Ministry of Ports and Shipping.

The Karachi Municipal Corporation claims that it collects and disposes about 50% of the total solid waste generated by the city population. However, in reality a much smaller percentage is actually disposed due to a variety of reasons. The remaining garbage either remains in the city or is thrown near the river beds, which finally ends up into the sea and can be seen as marine debris at certain locations of the coast.

Pakistan is making efforts to reduce marine litter load on coasts. In this regard, following steps have been taken.

- Some beaches are regularly cleaned, some times involving local population and general public.
- Solid waste generated from ships and submarines are collected in the waste bins placed on the jetties.
- Throwing any material in the harbour is strictly banned.
- Bilges from ships are collected in container for safe disposal.
- Floatable materials in the Karachi harbour near some jetties are regularly collected through contractors.

Sri Lanka

Solid waste includes non-liquid garbage and refuses from houses, institutions, markets, medical, commercial and industrial establishments as well as street and garden wastes. Such waste includes discarded organic waste (i.e. food, vegetation, paper, cardboard, rubber, leather, discarded clothing, etc.), packaging in the form of metals, plastics or glass and cut pieces from garment factories. About 2,694 tonnes of waste is reported to be collected daily by the Local Authorities island-wide. Of this, nearly 75% is collected from the five Maritime Provinces. While western province accounts for 54% (1448 tonnes) of the total solid waste, Colombo district alone has a daily collection of 1171 tonnes (43%). Other coastal towns also have problems of waste disposal. In the eastern province, the amount of solid waste produced is estimated to be 45.75 tonnes/day in Ampara, 124.5 tonnes/day in Batticaloa and 87.4 tonnes/day in Trincomalee (ADB, 2003). Though the issue is more prevalent in urban areas, it is rapidly becoming a problem in rural areas as well.

Many Local Authorities face problems in finding suitable vacant sites for safe disposal of solid waste. There is little or no infrastructure for collection and disposal of solid waste. Waste is often disposed at open dumps, sometimes in low-lying marshy lands within the coastal region. There are 746 open dumping sites in the island and 200 of these are located within

the coastal region between Puttalam and Hambantota (CCD, 2003). There is also the problem of garbage littering beaches near squatter settlements and tourist resorts and indiscriminate solid waste dumping within the shore area.

A survey by the Department of Census & Statistics in 1998 found that a Solid Waste Collection Programme covers 32% of the housing units in the country (Anon, 1998). While there were variations among districts, the highest coverage was in Colombo (77%). Out of the total workforce of 40,761 employees in Local Government Agencies (Municipal Councils, Urban Councils and Pradeshiya Sabhas), 10,108 (25%) were involved either directly or indirectly in solid waste collection and removal. The daily collection of solid waste was estimated at 2,694 t; consisting of organic matter (65%), paper (13%), plastic (8%), metal (8%) and glass (2%). The annual collection of 906,660 t was dumped in 746 solid waste disposal yards. In addition to poorly planned solid waste management, inadequate staff, facilities (vehicles and machines) and financial resources have been identified as the major constraints in implementing a proper municipal solid waste collection programme.

Quantity of fish waste generated over a period of seven months at Tangalle and Kirinda fishery harbours, in 2002 is given in Table-16.

Table -16: Quantity of fish waste generated at Tangalle and Kirinda fishery harbours.

Month	**Quantity of fish waste generated (kg)**	
(2002)	**Tangalle Fishery harbour**	**Kirinda Fishery harbour**
January	**1162**	**169**
February	**562**	**117**
March	**1062**	**419.5**
April	**1452**	**336**
May	**837.5**	**769**
June	**950**	**409**
July	**850**	**428**

(HICZP report on Environmental quality of fish landing site improved, 2001 - Sureshkumar, 2007)

Several studies on pollution of fishery harbours were done by National Aquatic Resources Research and Development Agency (NARA) from 1994 to 2002. The source and types of waste generated in the fishery harbours of Sri Lanka are given in Table 17.

No sanitary landfills are available in the country. Incineration has also not found favour due mainly to toxic air pollution and disposal of resultant ash. Although 75% of the waste generated can be recycled and there are many recycling programmes, only a very few are run properly. For example, only 16% of the 186,000 tonnes/year of cardboard and paper in western province is recycled. The Ministry of Environment currently implements a pilot project, where 3000 households are involved in a waste recycling programme. Another approach to garbage disposal is garbage composting. Composting is also less common and only a few urban authorities have their own small composting facility. Approximately 16% of the revenue generated by the Local Government Agencies in these provinces has been spent on solid waste disposal.

Table- 17: Source and types of waste generated in the fishery harbours of Sri Lanka

Harbour Area	Source Area	Type of waste generated
Main Building complex	Harbour office	Toilets and Garbage
	Toilets	Sewage
		Waste water from bathing & washing areas
	Canteen	Kitchen waste
		Packaging materials
		Waste from wash area
		Litter and food scraps
	Boat repair	Oil and grease
		Paint cans, paint
		Anti-fouling paint cans
		Used batteries
		Fibreglass coating
		Wood shavings, steel scrap
	Net mending shed	Torn nets and rope

	Ice plant	Wasted ice
Landing jetty and adjacent areas	Auction hall	Fish waste
		Blood water
		Trash fish
		Hose down water
	Gutting area	Fish offal
		Hose down water
	Fuel dispensing facility	Oil spills
		Accidental Oil leaks
	Breakwater structures and sand dunes, beaches	Human defecation
Harbour basin	Fishing vessels	Bilge water
		Lubrication oil
		Sewage
		Toilet waste
		Packaging materials (plastics)
		Un used provisions
		Kitchen waste
		Deck washing waste water
		Fish hold cleaning waste water
	Current	Floating garbage

(HICZP report on Environmental quality of fish landing site improved, 2001 as quoted by Sureshkumar, 2007)

A silage plant has been established in the Beruwala fishery harbour in 2006 and fish offal from the Fishery harbour of Beruwala and nearby fish landing sites are channelled to this recycling plant.

4.2.4 Strengths and weaknesses in current marine litter management programme and lessens learnt

There are more weaknesses than strengths in the current marine litter assessment/management programmes of the SAS Region countries.

Strengths

All the member countries of the Region have their own legal and institutional mechanisms to address marine environmental issues. They have also signed and ratified major international conventions on marine environmental management and resources utilisation. Only requirement is that these environmental laws/rules etc., should recognise and incorporate marine litter/debris as an important issue to be tackled by strengthening the institutional mechanisms adequately to deal with the marine litter aspects.

Weaknesses

The weaknesses in the marine litter management programme in this Region include technological and managerial gaps, lack of effective mechanisms to control the land-based sources of debris, there are no regional or national level cooperative activities in any of the countries of this Region. The other weaknesses include low public awareness, lack of funding resources; there is no standard methodology adopted even in India, Pakistan and Sri Lanka where periodic coastal clean up activities that are reported to be undertaken, for marine/beach litter removal and disposal; none of the National Environment Action Plans of the countries in the SAS Region includes any programme worth the name for marine litter monitoring, management and prevention; except for scanty information on beach litter, there is no information/data available on the open ocean floating and submerged marine litter/debris, as no systematic monitoring/sighting of such debris has so far been undertaken in this part of the South Asian Seas.

4.3 Assessment of the economic loss due to marine litter problem in SAS Region

There are no data available on the economic loss due to marine litter problem in any of the countries of the SAS region.

4.4 Evidence of the negative impact of marine debris

4.4.1 Impact of lost and abandoned fishing gear on marine organisms. ("Ghost Fishing" and entanglement of marine mammals, birds, turtles)

There are no reports from Bangladesh and Maldives on the negative impact of marine litter particularly of lost and abandoned fishing gear on marine organisms.

India

Stray instances of entanglement of fish and endangered marine fauna is reported from the Indian waters. Off Jakhau in Gujarat there is a report on the stranding of a dolphin due to entanglement in an abandoned fishing gear. In addition, many incidences of the abandoned fishing net entangled to the boat propeller, were reported in Tamil Nadu and Gujarat coast. (Venkatesan, 2007).

Pakistan

Every effort is made by the fishermen to recover fishing nets/gears from the sea. However, fishing nets/gears occasionally cause problem to navigation, marine animals and ecosystem.

Sri Lanka

Although fishermen lose their fishing gears in the sea due to various reasons, the details are not properly enumerated or assessed so far by any of the institutions. However, it is reported that during coral reef studies in different parts of the island by NARA, ghost fishing was encountered (Sureshkumar, 2007). Entanglement of marine turtles and other endangered species are not officially recorded so far, the possibilities of which are very high in the Sri Lankan waters.

4.4.2 Costs of beach cleanup exercises

There are no reliable data available on the cost of beach clean up exercises in any of the countries of the SAS region, as reported in the Country Reports on Marine Litter. Even though in India, Pakistan and Sri Lanka periodical coastal clean up operations are carried out, no effort has so far been made to make an assessment of the costs involved in such operations.

4.4.3 Damage to ecosystems, tourism, human/public health and safety

There is no systematic assessment of damages to the ecosystems, tourism or public health and safety due to coastal and marine litter in the SAS countries. However, scanty reports on the possible damages to the ecosystem and tourism are available from Sri Lanka in particular.

In Sri Lanka, beach users, beach front tourist establishments, to some extent fishers and local authorities are the major stakeholders who are affected by the issue of marine debris. Requirement of man power in maintaining clean beaches and lack of funds are the major problems to all local authorities. For beach front establishments it is additional burden in maintaining its beach front at its own cost. Many beautiful shores and beach stretches, which were patronised in the past are now being shunned by pilgrims and local tourists due to their neglected state. Therefore local economical development is affected (Sureshkumar, 2007).

4.5 Legal mechanisms and legal frameworks, and policies for marine litter management in the SAS Region

There are no exclusive legal mechanisms/framework, institutional framework and policies for marine litter management, but whatever mechanisms and framework are in place are all umbrella framework for environmental protection and management, in the SAS Region.

Bangladesh

The government of Bangladesh has adopted a number of policies and plans concerning environment and development. Specially, after Rio-Summit in Brazil (Earth Summit, 1992) like all other participating nations, Bangladesh also prepared a blue print of action towards sustainable global development in the form of "National Environment policy and Action programme". Under the arena of International Convention, Treaties and Protocols, the govt. of Bangladesh signed a number of treaties, conventions, protocols, each having a number of commitments and consequent implications. They vary in the importance, effectiveness, and level of commitments. For example, 'Law of the Sea' is very old, but very few steps have been taken to implement that law in Bangladesh (FEJB, 2002).

Bangladesh has more then 200 rules and regulations on Environment (FEJB, 2002). Even though there is a National Programme of Action (NPA) for Protection of the Coastal and Marine Environment from the Land based Source of Pollution for Bangladesh, it does not specify the proposed action or strategy for management of marine litter, except for the solid waste

generated in Bangladesh. NPA has been approved by the Ministry of Environment and Forests, Govt. of Bangladesh on 15-08-2006.

The first major law that has been promulgated for the specific purpose of conservation of nature and protection of environment is the Environmental Conservation Act (ECA) of 1995, which was followed by the Environmental Conservation Rules (ECR) of 1997. Besides this, the Government has passed the Environmental Court Act, 2000, for dealing with the environmental offences more effectively. The Act provides for the establishment of one or more Environmental Courts.

Bangladesh has signed the Basel Convention under which transportation of hazardous wastes and their disposal between countries is prohibited. Any import of wastes into Bangladesh even for energy or other uses under consideration would violate the Convention.

Virtually there is no marine litter policy in the country. However, to tackle the environmental pressures created by solid waste disposal, ship breaking and lube oil discharge at sea, the Bangladesh Government uses the provisions of the Environmental Conservation Act and Regulations.

India

Indian Shipping Policy is not isolated or any different from the global maritime environment policies. The main source of maritime law, besides domestic law, has been international conventions to which India is a signatory. Under the Constitution of India, merchant shipping is dealt with by the Ministry of Surface Transport. The principal legislations dealing with combating of oil pollution are:

• The Merchant Shipping Act of 1958 (MS Act)

• The Marine Insurance Act of 1963

• The Merchant Shipping (Prevention of Pollution of the Sea by Oil) Rules, 1974.

Section 331 of the MS Act regulates the carriage of dangerous goods, while sending an un seaworthy ship to sea is an offence under Section 334 of the Act. The MS Act does not apply to pollution on the high seas. However, for a peninsular country like India, it is extremely important to have provisions to prevent pollution of the high seas adjoining its EEZ. Furthermore, the MS Act empowers the court to hold formal investigations, arrest witnesses, board vessels, commit trial, and censure or remove masters, mates or engineer. These provisions play an important role in combating pollution.

The International Convention relating to Intervention on the High Seas in case of Pollution Casualties, 1969, extends the jurisdiction of a coastal state to the high seas, but only when it poses a grave and imminent danger to fishing, tourism and wildlife. India has not yet ratified this convention.

The International Convention for the Prevention of Pollution from Ships, 1973 (ICPPS), in an attempt to deter ship-owners, introduced criminal liability. India ratified ICPPS in 1986. ICPPS covers pollution by oil, chemicals, harmful substances in packaged form, sewage, garbage, etc. It deals with operational pollution and some aspects of accidental pollution too. It provides that any violation within the jurisdiction of any state, which is a party to the convention, shall be punishable under the law of that state. Under ICPPS, very limited discharge is permitted, but when the discharge is due to *force majeure*, the polluter is exempted.

A number of Laws, Acts and Rules regulate activities on the Indian coast. India has regulatory agencies such as the Central Pollution Control Board (CPCB) at the central level and State Pollution Control Boards (SPCB) at the state levels, constituted under Water (Prevention and Control of Pollution) Act, 1974.

A Coastal Aquaculture Authority (CAA) of India has been constituted in 2005 and guidelines for sustainable coastal aquaculture development and for regulating coastal aquaculture have also been evolved and put in place. A National Oil Spill Contingency Plan has been formulated to combat oil spills in the EEZ of India with the Coastal Guard as the nodal agency.

The disposal of ship-based wastes is regulated by the Merchant Shipping Act, 1958 and by the adoption of MARPOL 73/78. Standards for discharging effluents are listed in the Environment (Protection) Act (EPA) 1986. This serves as an umbrella Act, providing for the protection and improvement of the environment including coastal and marine areas. The effluents/discharges from various sources have to meet these standards before being discharged into the coastal/marine waters.

The Coastal Regulation Zone (CRZ) Notification was issued in 1991 by the Government of India, under the EPA, 1986. The Notification aims at protecting and improving the quality of the coastal environment. The notification declares the limits of the Coastal Zone and classifies it into four categories for the purposes of regulation. CRZ I includes areas which are ecologically sensitive, areas of outstanding natural beauty, historical heritage or rich genetic diversity. CRZ II includes the areas that have already been developed up to or close to the shoreline. Areas that are relatively undisturbed are classified under CRZ III. CRZ IV includes the coastal stretches in the Andaman and Nicobar, Lakshadweep and other small islands except those designated as CRZ I, II and III.

The Notification lays down certain prohibitions and also exceptions to prohibitions. Prohibited activities include setting up of new industries (except those which are directly related to the Water front or which directly need foreshore facilities) and expansion of existing industries including fish processing units, manufacture, handling, storage or disposal of hazardous wastes and substances, discharge of untreated wastes and effluents and dumping of municipal wastes as landfills or otherwise. Withdrawal of groundwater within 200 metres of the High Tide Line (HTL) is prohibited with some exceptions. In most of these areas, an area of 200 metres from the high tide line (HTL) has been declared a no development zone. Several restrictions have been imposed for carrying out development in the area between 200 and 500 metres from the HTL. These measures have been adopted to protect fragile ecosystems which exist in the area and are vital for sustaining the ecological balance.

Mangroves and coral reefs have been declared ecologically sensitive areas (CRZ I) under this Notification and regular monitoring using satellite imagery is in progress. A state-wise Mangrove Committee has been formed for effective management of the mangrove ecosystem. Mining of corals and coral sands has been banned. The CRZ notification also offers protection to coastal communities such as traditional fishermen.

The Recycled Plastics Manufacture and Usage Rules, 1999; Municipal Solid Wastes (Management and Handling) Rules, 2000; Ozone Depleting Substances (Regulation) Rules, 2000; The Prevention and Control of Pollution (Uniform Consent Procedure) Rules, 1999, etc., are some of the rules framed under EPA, 1986, with an aim to providing environmental protection and are relevant to the coastal environment.

Legislation has helped in the treatment of industrial wastes. In India, the Water (Prevention and Control of Pollution) Act includes tidal waters, unlike some other countries. The Act is applicable up to 5 km into the sea. Though the discharge of effluents from small-scale industries is still a problem, efforts are being made to set up common treatment plants. This will help in minimising the waste load in the sea, sustainable use and conservation of marine living resources under national jurisdiction and in the high seas.

The Indian Coast Guard is empowered to prevent capture of endangered marine species under the Wild Life (Protection) Act, 1972. A number of threatened marine species have been placed in Schedules I and III of this Act. Some of these are the whale shark, sea horse, sea cucumber, sea shells and different types of corals.

To protect and conserve biodiversity, the Biodiversity Bill, 2000, was passed in the Indian Parliament through which the National Biodiversity Authority was established.

State/Union Territory Pollution Control Boards, are taking necessary steps for safe environmental management of hospital wastes under the Bio-medical Wastes (management & Handling) Rules, 1998.

National Environmental Tribunal Act 1995 has been introduced to award compensation for damages to persons, property and the environment, arising from any activity involving hazardous substances.

In 1993, Coast Guard under the Ministry of Defence was made directly responsible for combating marine pollution. In 1996 National Oil Spill Disaster Contingency Plan was formulated under Coast Guard Act, which lays down action to be taken in the event of oil spills.

National Environment Appellate Authority Act addresses appeals with respect to restrictions of areas in which classes of industries etc. are carried out or prescribed subject to certain safeguards under the EPA. The objective is to bring in transparency and accountability and to ensure the smooth and expeditious implementation of developmental schemes.

In order to strengthen international, including regional cooperation and coordination, India is a member of various international/regional programmes and some of them relevant to marine debris are given below:

- Global Ocean Observing System (GOOS).
- Global Coral Reef Monitoring Network (GCMRN).
- International Commissions and Organisations such as the United Nations Convention on Law of Sea (UNCLOS), Antarctic Treaty Consultative Committee etc.
- Regional Seas Programme.
- South Asia Co-operative Environment Programme.
- Intergovernmental Oceanographic Commission (IOC) Executive Council and other groups/committees of IOC.
- International Sea Bed Authority (ISBA).
- UN Commission on Sustainable Development (UNCSD).
- International Geosphere-Biosphere Programme (IGBP).
- Land-Ocean Interactions in the Coastal Zone (LOICZ).

Some of the other international conventions on environment ratified by India which are closely associated with marine debris are

- International Convention for the Prevention of Pollution from Ships (MARPOL Convention 73/78).
- International Convention on Civil Liability for Oil Pollution Damage, 1969.
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972, (London Convention of 1996).
- Special Trade Passenger Ships Agreement, 1971.
- Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora, 1973.
- International Convention for the Safety of Life at Sea, 1974.
- Convention on Biodiversity, 1992.
- Convention on Wetlands of International Importance, Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, Vienna.
- Convention for the Protection of the Ozone Layer.
- Convention on Migratory Species.
- Basel Convention on Trans-boundary Movement of Hazardous Substances 1992.
- Montreal Protocol on Substances that Deplete the Ozone Layer.
- Sustainable Development of Small Islands.

Maldives

The Environmental Protection and Preservation Act of Maldives (Act 4/93) was enacted by the People's Majlis in 1993. This act established a framework upon which regulations and policies can be developed to protect and preserve the natural environment and resources for the benefit of present and future generations. Act 4/93 contains important provisions on environmental advice, environmental policy formulation, biodiversity conservation, environmental impact assessment, waste disposal and hazardous wastes. A programme for strengthening of national environmental legislation began in 1996.

The Regulation on Protection of the Environment in Tourism and Related Activities, under the Tourism Act of Maldives (1999) requires resort operators:

- To segregate the wastes from each resort into categories such as into organic waste, plastic (bottles must be crushed), glass, tin cans (which must be compacted), toxic hazardous waste; and
- To dispose of the waste by incineration on the island or by disposal to a site designated by the Government. Biodegradable waste may be dumped in the sea if there is no designated waste disposal site in the region.

The Regulation on Handling of Waste requires waste to be segregated and managed in different ways depending on their location. The Regulation on the Conduct of Clinics requires medical wastes to be incinerated at each hospital.

The Second National Environment Action Plan, the Sixth National Development Plan and the proposed draft Seventh National Development Plan and also the UNDP funded 'Barrier Report', establish the 'road map' for developing the broad policy and the infrastructure for solid waste management and set in place some critical policy decisions for solid waste management.

The Second National Environment Action Plan (NEAP) (1999-2006) of Maldives was adopted in 1999 to address the pressing environmental challenges, which identifies the need to take an integrated approach to the management of the environment and to work towards the goal of sustainable development. The aim of this NEAP II is to protect and preserve the environment of the Maldives, and to sustainably manage its resources for the collective benefit and enjoyment of present and future generations. The NEAP identifies climate change and sea level rise; coastal zone management; biological diversity conservation; integrated reef resources management; integrated water resources management; management of solid wastes and sewage; pollution control and managing hazardous wastes; sustainable tourism development; land resources management and sustainable agriculture; human settlements and urbanisation and sustainable fisheries management, as the key issues to be addressed.

Sixth National Development Plan (2001 – 2005) committed the Government to implementing a strategy to introduce Regional Waste Management Facilities into Maldives as a rationalized solution to the solid waste problem. In addition, the Plan identified the need to restrict the importation of non-biodegradable products and to introduce incentives to import biodegradable products into Maldives.

This Plan has played a critical role in determining broad national strategic directions for solid waste in Maldives, the most significant being the decision to pursue Regional Waste Management Facilities for the treatment of waste in Maldives. This Plan also led to the decision to introduce a 200% duty on the importation of plastic bags and empty PET bottles.

Seventh National Development Plan and Third Environment Action Plan (2008 – 2013) identify the national strategy for solid waste management. The government is expected to endorse these plans in the near future. The plans are expected to set strategies to:-

- Define roles and responsibilities, principles and practices, enforcement provisions and waste reduction targets;
- Establish at least 5 Regional Waste Management Facilities (RWMFs);
- Support the construction of and provision of equipment, to Island Waste Management Centres (IWMCs);
- Establish collection and transfer facilities for hazardous, residual and recyclable wastes where financially viable;
- Implement cost sharing arrangements based on the polluter pays principle at national, regional and island levels;
- Encourage private sector participation in waste services; and
- Provide infrastructure and equipment for the safe management of chemical, medical and oil wastes and guidelines to support hazardous waste management by industry.

Maldives has become a member of the MARPOL 73/78 Convention of the International Maritime Organisation. Maldives became a member by endorsing 3 out of 6 regulations of the Convention. They are the regulation for the prevention of pollution by oil, regulation for the control of pollution by noxious liquid substances in bulk and the regulation for the prevention of pollution by garbage from ships.

Maldives also has ratified the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal, and the Vienna Convention although this has not yet been incorporated into the Country's legislation.

Maldives had also endorsed 3 other protocols of the IMO Conventions. They are the International Convention on the Safety of Life at Sea, Protocol 88 of SOLARCE 1974, the International Convention on Civil Liability for Oil Pollution Damage, Protocol 92 of CMC 1969, and the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, Protocol 92 of Fund Convention 1971. Maldives signed the International Convention for the Control and Management of Ships' Ballast Water and Sediments, on the 31st of May 2005.

The endorsing of the SOLARCE Protocol 88 would bring further improvements and conveniences to marine safety of local and foreign ships operating in the country. The endorsement of the CMC Fund Convention would allow foreign aid in compensation for sea pollution disasters.

Maldives is party to the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal. The Environment Protection and Preservation Act of the Maldives (Law 4/93), provides a statutory framework enabling the control and regulation of the transboundary movement of hazardous waste controlled under the Basel Convention in the Maldives.

Laws, Presidential Decrees, and public notices are the major forms of regulatory mechanisms that exist in the Maldives. Laws are passed by the Parliament, often with provisions for formulating subsequent rules and regulations with regards to the implementation of such laws. Residential Decrees are notices set out by the President's Office, and usually deal with issues of day to day running of the Government. A Decree that may have bearing on the fisheries resources include instruction regarding institutional, management or broad policy issues.

Public notices are issued by the concerned Ministry or government agency and it can cover very broad or very specific issues pertaining to regulatory, management or policy issues. For instance, Public Notices can be issued to address concerns under a passed law, from time to time. It can even advocate banning or restricting access to resources in a particular site, time or extent.

Pakistan

Presently, there is no legislation specifically covering litter in marine and coastal regions. However, Pakistan is a signatory to a number of conventions, protocols and international treaties on environment and related issues, which include:

- Convention on Biological Diversity (CBD)
- MARPOL
- Convention on Trade of Endangered Species (CITES)
- The Pakistan Fisheries Ordinance
- International Seabed Authority
- RAMSER Convention
- Kyoto Protocol, etc.

Sri Lanka

The Coastal Zone Management Plan (CZMP) was published in 1990 in accordance with the provisions of the act and revised in 1997. The second revision was done in 2004. Although initial CZMP document was only dealing with coastal zone management aspects, subsequent revisions recognised the importance of pollution control and included a special chapter on Coastal pollution control. The CZMP of 1997 as a management objective proposes the following on solid waste management in coastal zone;

Objective :- Improve the coastal environment by reducing the types and volume of solid waste disposed in the coastal zone.

Policy 1:- Assist in preparing solid waste management plans for identified coastal urban centres, coastal tourist centres and fishing harbours.

Policy 2:- Discourage local authorities to disposal solid waste in the coastal zone.

Policy 3:- Collaborate in public education and awareness programmes and join with other agencies in promoting public participation in solid waste management.

Further, draft revision of Coastal Zone Management Plan 2004 places emphasis on the solid waste management as follows;

Policy 2.1:- Solid waste management within the Coastal Zone will be promoted to minimise coastal water pollution.

Strategy 2.1.1:- Solid waste management plans will be prepared to reduce adverse impacts on coastal water pollution.

The Coast Conservation Act and its Coastal Zone Management Plan have the mandate to monitor, control/reduce/prevent dumping of litter in the coastal zone as defined by CCD Act. Further MPPA Act also stipulates provisions for preventing dumping activities in marine environment. Section 4 of MPPA Act prohibits dumping of oil or any other pollutants into Sri Lankan waters.

Relevant International conventions

- MARPOL 73/78, the International Convention for the Prevention of Pollution from Ships.
- London Convention 1972, Convention on the Prevention of Maritime Pollution by Dumping of Wastes and Other Matters (formerly London Dumping Convention LDC).
- UNEP Regional Seas Programme
- UNEP GPA: The Global Programme of Action for the Protection of the Marine Environment from Land-based Activities
- Basel Convention.

4.6 Gaps and needs in coverage of marine litter management.

Inputs on this aspect are available from India, Maldives and Sri Lanka only.

India

Curbing the marine debris problem in the Indian coast is not an easy task. This requires:

- Steps to reduce marine debris will require preventing litter from entering the marine environment in the first place by pursuing a long-term public education and awareness campaign. While the existing education and cleanup initiatives can make a substantial contribution to improving the ocean environment, the volumes of trash that continue to appear on beaches and in the oceans indicate that many people and communities living in coastal areas have not yet changed their behaviour.
- In addition to educating the public, marine debris education campaigns should target the tourism industry, packaging companies, local government officials, recreational boaters, and fishermen (both traditional and commercial). For example, it is important to educate both commercial fishermen and recreational boaters who take items out to sea with them to ensure that they are returning to shore with their plastic and other trash.
- Proper solid - waste disposal practice, which is lacking presently to be addressed.
- Setting up of small scale plastic recycling plants in the affected coastal areas, is another requirement for disposal/recycling of solid wastes.
- Importance has to be given to bio-waste management.

- Implementation and enforcement of local anti-litter regulations. At the same time issues such as beach cleaning activities should be considered, as pressure from recreational and leisure interests necessitate routine beach cleaning with machines, the biota living in or on the beach is threatened.
- Active management of debris entering and exiting the sewer systems. Floatable controls can help reduce or eliminate solid waste emitted from sewer systems. Placing sufficient trash receptacles at regular intervals in a coastal colony/village, can also make it easier for people to dispose of the materials that might otherwise end up in the marine environment.

Maldives

Still there is lack of understanding of the interactions and impacts of human activities on the environment of Maldives. Information on the current state of the environment is weakened by lack of data on important components.

Whilst the overall state of the environment is unclear, beach erosion, climate change and sea level rise, loss of biological diversity, solid waste disposal, and freshwater degradation can be seen as the critical environmental concerns facing the Maldives.

The Government has developed very good action plans that establish a stronger strategic framework for the policy and waste management infrastructure and introduction the notion of waste reduction targets. However, only limited action has been undertaken to implement these plans in practice. In addition, the plan does not provide for an integrated solid waste management strategy that incorporates the principles of sustainability, cradle-to-grave waste management and other important waste principles.

The Maldives is party to the following conventions relating to solid waste but has not yet incorporated their standards into domestic law. The legislation does not apply modern principles for waste management, such as the 'cradle-to-grave' concept, the waste management hierarchy, the 'polluter pays' principle and the other best practice approaches. The legislation is also silent on many critical aspects of waste management. It does not specify, for example, which is responsible for waste disposal or its method of disposal. Furthermore, the law does not specify any standards for how landfills should be designed and operated, how waste should be transported or how information about waste should be provided. As the Government has assumed responsibility for most aspects of waste management, there has been no need to introduce any standards. However, with the recent proposal to introduce private sector participation in waste management, these standards will become essential for to the establishment of effective quality controls over private operations.

Sri Lanka

Many national reports on status of environment of Sri Lanka in the recent past have identified solid waste management as an important and priority issue. The State of the Environment report 2001 published under the auspices of UNEP by Ministry of Environment and Natural Resources recognises 'Waste disposal' as a key national issue. Further, National Report of Sri Lanka to World Summit on Sustainable Development titled "Sri Lanka's middle path to sustainable Development in the 21st century" published in August 2002 too spells out immediate need for a integrated solid waste management approach to environmental degradation of the country. However, none of the national action plans or institutional implementation plans has identified "marine litter" as a priority or important issue. Thus, present efforts by state agencies to alleviate marine litter problem is found to be only *ad-hoc* and a superficial approach. Efforts of both the Marine Pollution Prevention Authority and Coast Conservation Department are directed towards treating the symptoms and not the cause.

In order to have an effective mechanism to combat marine litter issue in the country there is a need to recognise it as an important or priority issue in the first hand. Apart from taking up public attractive programmes such as beach clean-up, etc, concerned institutions should address the main root causes and take remedial actions. In this regard, several steps could be taken by concerned agencies.

a. During revision of respective enactments, marine litter issue should be included. The MPA Act is being revised at present.
b. Future Coastal Zone Management plan to address the coastal or beach litter management issues.
c. Develop a strong cooperative mechanism between major stakeholders to combat marine litter issue through establishment of a Steering Committee.
d. Develop state – private partnership programmes and to involve other stake- holders such as non-governmental organisations, community based organisations, fishermen societies, etc.
e. Different angles of marine litter issues to be addressed differently with the willing participation of connected stakeholders. Example litter problem in Fishery harbours to be tackled through active participation of Ceylon Fishery Harbour Corporation (CHFC) and litter problem in tourist areas to be tackled through Ceylon Tourist Board and hotels / resorts concerned.
f. Combating beach litter issue through regular programmes involving local authorities and communities.
g. Public awareness programmes to be conducted. Presently island wide coverage is not received by any of the beach cleaning programmes.

5. Summary Assessment and Conclusion

The problem of marine litter is continuously getting worse and posing an increasing threat to the marine and coastal biodiversity in productive coastal areas. Most of the marine litter consists of material that degrades slowly, and pieces of litter are also the potential carriers of invasive species between seas. Though a wide range of marine litter-related instruments already exists, the threats are still growing, which suggests that much more remains to be done. According to a recent study "deficiencies in the implementation and enforcement of existing international and regional environment-related agreements, as well as national legislations and standards, are contributing to the problem" (UNEP 2005c).

In so far as the South Asian Seas Region is concerned, no concerted efforts appear to have been made so far to make a realistic assessment of the coastal and marine litter (both floating and submerged) and take remedial measures to manage and contain the incidence of marine litter in the coastal areas and on the high seas both from the land and sea based sources. Virtually no valuable information is available from the Region on marine litter (its source/origin, the factors influencing the distribution and dispersal of the litter, its negative impacts, etc). Even though there are a number of legal and institutional mechanisms and framework existing in the countries of the SAS Region, none of them appears to be effectively addressing the marine litter issue.

Therefore, the need of the hour is to introduce and implement a comprehensive marine litter assessment and management programme covering the entire SAS Region drawing the available expertise and infrastructure facilities from the five countries viz. Bangladesh, India, Pakistan, Maldives and Sri Lanka, pool them together, on the lines of the Mediterranean or Wider Caribbean or Baltic Sea Marine Litter Management Programme.

Part - 2

Framework for Marine Litter Management in the South Asian Seas Region

Framework for Marine Litter Management in the SAS Region

1. Background

The data available from the countries of the SAS Region, indicate that the major sources of marine pollution including debris/litter in the SAS Region, are domestic/industrial wastes, ports and harbours including fishing harbours and landing centres, ship breaking yards, fish/food processing industries, tourist resorts/beaches, solid waste dumping, urban runoff, oil rigs, coastal aquaculture, fishing industry including fishing gear, shipping including garbage from ships, recreational and leisure use, marine mining, construction activities, etc.

In Bangladesh, scrap of iron piece; metallic fragment and other refused materials; oxidised iron, foam, pieces of wood and partex, glass wool, PVC, PCBs, black tar, grease balls and oil film and many other toxic chemicals left in the beach for long time and accumulated in the beach soil finally get washed into the sea.

In India and Sri Lanka the types of marine litter include plastics, polystyrene, rubber, wood, metals, sanitary or sewage related debris, paper and cardboard, cloth, glass, pottery/ceramic, monofilament fishing line, waxed milk carton, fruit peel, cigarettes, cigarette fibre, cigar tips, and other tobacco related packaging/wrappers, used batteries, building materials, fishing lines, floats, marking buoys and abandoned cut pieces of used nets, etc.

In the Maldives, increase in non-degradables such as plastics, cans and bottles and in particular that of hazardous wastes such as dry cell batteries and hospital wastes are threatening the aesthetics, and health of the people.

From the data available from Pakistan's coastline, it is generally observed that polyethylene bags & sheets, styrofoam pieces, oil, rags, plastics and nylon items, dunnage & packing material, bottles, cans, cartons, etc., are usually found in the solid wastes discharged into the sea.

Currently, the South Asian Seas Region does not have any specific national or regional projects that deal exclusively with the issue of marine litter. Marine Litter activities in three countries of the SAS Region are limited to periodic beach-clean up and community clean up exercises.

There are more weaknesses than strengths in the current marine litter management programmes of the SAS Region countries. There is no standard methodology adopted even in India, Pakistan and Sri Lanka where periodic coastal clean up activities are reported to be undertaken, for marine/beach litter removal and disposal. Except for scanty information on beach litter, there is no useful information/data available on the open ocean floating and submerged marine litter/debris, as no systematic monitoring/sighting of such debris has so far been undertaken in the South Asian Seas Region. No detailed or systematic assessment on the damages to the ecosystems, tourism or public health and safety, economic loss due to marine litter problem, social, physical, biological and economic ramifications of marine debris including that of lost and abandoned fishing gear on marine organisms, seems to have been carried out in any of the countries of the SAS Region. There are also no reliable data available on the cost of beach clean up exercises in the SAS region.

None of the National Environment Action Plans of the countries in the SAS Region includes any programme worth the name for marine litter monitoring, management and prevention. There are no exclusive legal mechanisms / frameworks, institutional framework and policies for marine litter management, but whatever mechanisms and framework are in place are all umbrella framework for environmental protection and management, in the SAS Region.

The situation, therefore, warrants introduction of a comprehensive and a well designated programme, both at regional and national level to tackle the marine litter and related issues in this Region.

2. Suggested approaches/strategic framework for marine litter management in the SAS Region.

2.1 Objectives

- To undertake a detailed survey of marine litter, to establish the source, quantum of production, patterns of distribution and accumulation, and impacts of marine litter in the SAS region.
- To recognise the problem of marine litter as a priority issue in the region.
- To prevent the discharge of persistent litter from the land and the sea faring vessels reaching the coastal and marine areas.
- To create/improve garbage collection systems in coastal cities/towns and to ensure proper disposal of non-degradable/persistent materials.
- To minimise the disposal of fishing gear in coasts and at sea.
- To create capacity and awareness among all stakeholders on marine litter issues.
- To establish a regional policy on marine litter.

2.2 Approaches to the problem

The major solutions to tackle the marine litter related problems include:

- Source identification and monitoring through detailed surveys,
- Research and Information Transfer,
- Establishment of marine litter management system,
- Reduction through Removal, Treatment and disposal improvement,
- Prevention, including Education and Outreach,
- Public Involvement,
- Regulations & Enforcement,
- Emergency Response.

2.2.1 Methodologies to assess the quantities, composition, distribution and trends of marine litter

There are many ways and methods to monitor/assess floating and submerged/sea bottom marine debris/litter which have been followed in the Mediterranean, Caribbean sea, Baltic Sea, the Pacific and Atlantic Seas and a few other countries. Following are some of the successful examples of methods/protocols employed in other regions, which could be applied for marine litter management in the SAS Region with suitable modification for each country:

a. Use of skimmer vessels to contain and remove floatable debris before it escapes from the harbour; helicopter flyovers, which provide aerial surveillance to potentially reduce the impact of debris slicks spotted off the coasts; and the involvement of local community, NGOs and others to remove shoreline debris.

b. For Combined Sewer Overflows (CSO) two-component study design could be followed –

   one for monitoring, which includes:

   - Outfall reconnaissance,
   - Outfall selection,
   - Outfall sampling,
   - Discharge event response and sample analysis;

   and another one focusing on characterising debris, which includes:

   - Identification and selection of sewage treatment facilities for sampling man-made debris;
   - Sampling of measured volume of debris (relative to the daily volume of debris) collected by the screening units for the settling and clarifying tanks and scum from the skimmer tanks;
   - Separation of all natural materials and polystyrene foam from man-made debris;
   - Counting the numbers of dead animals, food items and large pieces of man-made debris, and estimating the amount of faecal matter;
   - Record types and numbers of items removed from the man-made material;
   - Sorting of man-made debris from scum and screening samples and enumerate items.

c. Candidate CSO and Sewage Waste Disposal outfalls could be selected according to the following criteria:

   - Accessibility.
   - Outfall water depth.
   - Representativeness.
   - Outfall dimensions.

   In addition to these four criteria, sewage treatment facilities could be selected on the basis of the accessibility of screens and the sedimentation tank clarifiers.

d. *Beach cleaning* is another approach to control coastal litter. The public beaches which are frequented by large masses of people should be cleaned daily, or close to daily, by the local authorities and the cost of the cleaning operation needs to be borne directly or indirectly, by the beach users or through sponsorship from private industries/organisations/NGOs.

e. The *International Coastal Cleanup Campaign* (ICCC) is designed to provide an annual "snapshot" of floatable debris pollution affecting the shorelines. The SAS region countries participating in the ICCC should have a designated Cleanup

Coordinator who, by the early spring of each year, should begin preparations for the ICC Day to be organised on the 3rd Saturday of every September. Within each country, a local network of site Coordinators/Leaders are to be designated who should be supplied with the materials and information necessary to conduct the local events. Supplies, which include data cards, trash bags, gloves, posters, and associated educational material, could be obtained from The Ocean Conservancy. The duration of the ICCC event could be for 3-4 hours preferably starting from around 7 hrs and closing by 11 hrs, during which time the volunteers could collect, catalogue, and weigh the debris found on their beaches and shorelines, record and catalogue the information on the ICCC data cards by the volunteers, and the information is made available to the SACEP/SAS Regional Office and to The Ocean Conservancy, which would compile the data and produce annual debris summary reports.

f. Methods for monitoring coastal litter should consist of drawing transects on beaches where objects are counted, weighed and their nature defined. The operation is to be repeated several times by taking into account the coefficient of tide, the weather report and the orientation of the beach and the counting performed many times.

g. The floating debris in the sea could be monitored by undertaking detailed surveys using research vessels, sightings and by using the satellite remote sensing data and the sea-floor debris with the help of acoustic/other underwater instruments including side scan sonar, remotely operable vehicles, underwater cameras, diving, etc.

h. Modelling of the marine litter distribution and dispersal under simulated conditions.

i. When designing an assessment and monitoring programme, the following variables should be considered particularly for assessing the factors influencing distribution and dispersal of the marine litter:

- Wind direction and speed.
- Current direction and speed.
- Location of outfalls in the path of the wind and current.
- Size and type of debris.
- Discharge-specific debris.
- Tidal range.

UNEP under a MoU with UNESCO/IOC is taking up a joint project for the development of practical and operational guidelines for survey and monitoring of marine litter. The output of this MoU will be the document "UNEP/IOC Operational Guidelines on Survey and Monitoring of Marine Litter" (i.e., floating, on shore and on the sea floor for consistent and harmonised application worldwide). The document shall include (among others) a comprehensive description of scientific surveys and monitoring protocols and also simplified surveys and monitoring procedures suitable for application by community-based or other non-research trained personnel. These guidelines / methodologies should be taken into account when monitoring/survey programmes are proposed and implemented in the SAS region.

2.2.2 Action Plan to reduce the impact of marine litter

Marine littering is a cultural problem and has to be treated as such, by education, legislation and law enforcement. In addition, innovative technologies for treating garbage also would also be useful in controlling this problem. These avenues of treating the litter pollution should be adopted by local authorities, national governments and international organisations.

The following are the proposed thematic areas and activities which could be considered for implementation in the SAS Region, in line with those implemented in other Regional Seas:

i. Monitoring/Data Collection and Research

- Consolidating the existing data (where and if available) on debris types, amount, sources and where necessary conducting more comprehensive assessments to determine scope of the problem;
- Undertaking R&D activities for developing alternative technologies for use in assessing accurately the source and types of floating and sea bed debris, their distribution and dispersal, fishing gear and accessories;

ii. Education and Outreach

- Implementing comprehensive education and awareness programmes;

iii. Stakeholder participation

- Promotion of national and regional mechanisms to enable involvement of all stakeholders in land-based and vessel-based waste management including clearing-houses for sharing of lessons learnt and information dissemination;
- Adopting a regional approach involving IMO, FAO and UNEP and relevant regional and national agencies.

iv. Economic Impact Analysis

- Undertaking economic and environmental analyses to quantify the costs of lost fishing and shipping time due to immobilisation; fouled gear; damaged vessels; and habitat loss or damage;
- Quantifying the value of fish or seafood lost to derelict gear;

v. Policy, Institutional and Legal frameworks

- Improving port reception facilities especially in smaller non-commercial ports;
- Strengthening policy, regulatory and enforcement frameworks;
- Developing comprehensive strategy for discarded fishing gear;

vi. Financing Mechanisms

- Promotion of partnerships to ensure sustainability of activities by NGOs and community organisations;
- Promoting the development of economic incentives for proper disposal of the coastal and marine litter;

2.2.3 Action Plan Strategies

The following is the framework for the development of a regional action plan to address marine litter management in the SAS Region. Most of the proposed actions would need to be implemented at the national level, with a select group of activities at the regional level. These actions incorporate a prevention and/or responsive approach to addressing marine litter issues in the SAS Region. UNEP-SACEP/SAS should function as a coordinator of information and facilitator of new strategies and initiatives for addressing marine litter issues in the region and ensuring synergies with other regional strategies and initiatives for prevention, reduction and control of coastal and marine pollution and evolving and adopting an integrated approach to solid waste management in the region.

2.2.3.1 Monitoring Programmes & Research

A *National Marine Litter Monitoring Programme*, to support an expanded understanding of the problem in each of the five countries of the SAS Region, needs to be initiated.

The guidelines/methodologies, on the lines of those adopted elsewhere, should be followed in the SAS Region for monitoring the marine litter and those which are likely to be available for world-wide adoption on completion of the UNEP-UNESCO/IOC joint Project for development of practical and operational guidelines for survey and monitoring of marine litter.

The methodologies currently followed in some of the countries, that could be considered with suitable modifications are as follows:

- The coastline of each country to be divided into a number of zones based on available information on the logistics, the prevailing wind conditions, tidal amplitude, currents, and types of marine debris found.
- In each zone, a number of sites covering 500-metre each should be surveyed every month. The potential sites to be selected based on specific criteria advocated by other marine debris monitoring studies elsewhere and by a geographically stratified random selection process.
- For assessing more accurately the floating debris, Remote Sensing data and for sea-bed data, side scan sonar and other acoustic/underwater instruments, need to be used.
- A minimum of 30 indicator items should be surveyed every month, on the same day at all the sites within a zone. This approach would facilitate zonal as well as national comparisons.
- The programme should adhere to all scientific protocol, and quality assurance procedures to ensure quality at all levels.
- The change in the frequency of indicator items, its percentage of change, etc., over a long period of 3 to 5 years should be assessed and the data collected should be statistically analysed.
- Monitoring to be conducted by trained and certified personnel, who could be guided and checked by a survey coordinator/leader, who in turn is to be supervised by a Project Team.

Monitoring can be used to address various issues relating to marine litter – e.g., the sources, the types, its abundance, its implications/impact on the coastal and marine environment – ecological, biological, social, and economic and whether current interventions, practices or policies (if in vogue) are effective. Data and research on marine litter can be used to help formulate management solutions including waste reduction strategies. Policy could be developed through monitoring efforts to bring out new or strengthen the existing legislation and providing funds for source-reduction programmes, to assess trends, to identify pathways by which debris gains access to the water, to assess wildlife and habitat impacts, to identify point sources and to help enforce regulations.

Development of a regional, web-based database on marine litter.

A regional web-based database needs to be established to serve as a data bank of marine litter data, for easy accessibility and exchange of information between the countries of the SAS Region. Inputs for this web-site to flow from all government authorities, NGOs, fishers and other stakeholders. This database, to be coordinated, updated and maintained by UNEP-SACEP/SAS Regional Programme, should be easily accessible by one and all including school children/college students for promoting the use and value of marine litter monitoring and for developing relevant programmes and sharing it with SACEP, UNEP and The Ocean Conservancy for compilation into their global report.

Stakeholder/community participation.

Communication efforts to engage NGOs, government agencies and regional intergovernmental organisations would be needed to develop a good foundation of interested parties in this regional effort. A web-based communications system would facilitate engaging these groups and sharing information related to the plans for Marine Litter management and abatement.

Assessment of the economic impacts of marine litter.

Economic information that tracks the costs associated with solid waste management activities, special clean-ups and maintenance of beach areas and costs associated with loss of recreational usage of coastal areas and lost commercial fishing nets and gear, shipping time lost due to immobilisation, fouled gear, damaged vessels, habitat loss, etc., would be useful to government agencies dealing with solid waste, fisheries and marine litter issues.

Adequate resources would be required to support management and educational efforts to address marine litter issues. Research on the economic impacts of marine litter can assist in justifying the need for adequate appropriations based on tourism and coastal management concerns. In addition, the economic impacts of marine litter need to be assessed to help prioritise and quantify the economic impact of this issue within government programmes, business and industry groups, and the public.

Impacts of marine litter on wildlife and ecosystems.

Research needs to be conducted to determine the various impacts of marine litter on wildlife and habitats and other indicators (e.g. invasive species transport and toxicity due to ingestion of materials). Towards this, information and research from fisheries, wildlife, and other resource management agencies and programmes throughout the region has to be sought and included in the marine litter regional database. In addition, efforts to conduct this type of research could be promoted to facilitate the acquisition of updated information for management programmes.

Improvement of the common knowledge base

In order to provide a solid basis for action at the regional and national levels, there is a strong need to improve and consolidate the knowledge base on marine litter through further research and monitoring activities. This holds particularly true with reference to the socio-economic aspects of marine litter.

Long-term and well-designed research and monitoring programmes and studies would be required to detect and determine statistically significant trends in the composition, quantities and effects of marine debris. Results from such studies would be needed as a basis for decision on which types and sources of marine litter should be given priority in relevant action programmes.

Regular and continuous monitoring of marine litter would also be essential as a follow-up of any actions taken. Monitoring is essential for the provision of reliable information about the effectiveness of actions taken to reduce marine litter in marine and coastal environments.

Marine litter monitoring programmes are already operational in various parts of the world, and the survey protocols used are in some cases rather similar. However, in order to provide consistent data and information about quantities and trends in marine litter, and thus build a common basis for action, better co-ordination, coherence and compatibility between ongoing monitoring activities is required. One way of doing this could be through the development of a limited number of basic marine litter indicators to be used in all monitoring activities.

2.2.3.2 Education & Outreach

Information, education and outreach activities have generally been viewed as essential and integral components of strategies to prevent, reduce and eliminate marine litter. The ultimate goals of the programmes are, generally, to bring about a change in attitudes and behaviours of the polluters (target groups).

Increase in awareness of marine and coastal littering may be achieved by involving the public in voluntary beach clean-ups. The gains made by these operations are not only clean beaches and additional statistical information on coastal litter, but also, most importantly, the increasing awareness of young people to environmental problems.

A regional strategy needs to be developed for a marine litter education campaign that can be accessed by government agencies, NGOs and other related organisations in the South Asian Seas Region. The government agencies and other organisations should routinely conduct public education campaigns to support their missions and programme objectives. Outreach materials for marine litter including radio and television advertisements, web-accessible materials, and printed educational materials (brochures, posters) have to be developed by the Government agencies, coastal zone management authorities, pollution control boards, Industries and NGOs. An effort to collect, collate and publish these materials and provide free access of these materials in the region would be an effective strategy to help targeting the marine litter issue through education and outreach activities.

The major activities to be undertaken under this action plan would include:

- ❖ Developing and implementing community-based public education campaigns for marine litter prevention.
- ❖ Developing and implementing specialised marine litter prevention outreach programmes for key user-groups and stakeholders.
- ❖ Developing a regional campaign for the International Coastal Cleanup (ICC).
- ❖ Incorporating cultural issues, in outreach programming.
- ❖ Incorporating marine litter issues into other community/ environmental events.
- ❖ Exploring opportunities for integrating issues on marine litter into formal education curricula and materials.
- ❖ Collating best management practices, case studies and lessons learnt on marine litter management at the community and national levels and communicate these with UNEP-SACEP/SAS RSP for compilation and dissemination.

2.2.3.3 Solid Waste Management Strategies

Solid waste management strategies of the region do not effectively integrate marine litter management. For the countries of the SAS Region, it is essential and critical that there is an integration of marine litter management strategies with solid waste management strategies. An effort to coordinate programme activities, waste management strategies, and resources would prove beneficial for the peoples and natural resources of the SAS Region.

Some of the major initiatives and actions that could be initiated in the SAS Region on the lines of what has been done/being done in the Wider Caribbean or Mediterranean or Baltic Sea, include the following:

- Developing specialised marine litter waste management strategies – either as a separate strategy or part of an existing waste management strategy.
- Improving and/or expanding waste management strategies for the public at local beaches, sporting events and festivals where appropriate receptacles are used.
- Reviewing the Management Plans of hotel and restaurant industries, for waste management practices and strengthen collaboration with the tourism sector for sharing of best practices and lessons learnt.
- Developing and promoting activities for national/regional recycling, reuse and waste diversion for plastics, glass, metal and other materials.
- Identifying/promoting international environmental certification programmes which include waste management and minimisation for possible inclusion into national marine litter/waste management strategies/action plans.

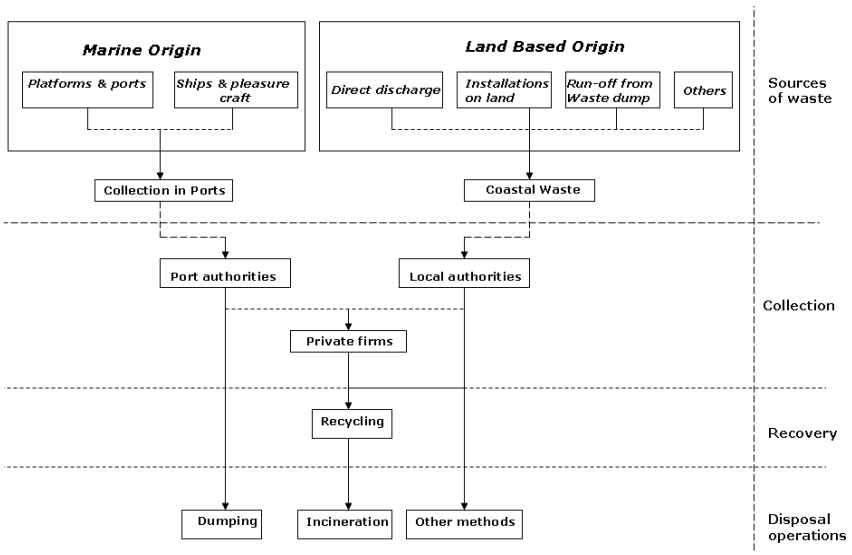


Chart -3: Flow chart showing Coastal Waste management plan
(Source: Mediterranean Action Plan, UNEP, 2003)

- Maintaining/developing specialised waste management strategies for marine litter problems associated with seasonal and/or weather related events.
- Establishing emergency response waste management strategies, where necessary, which deal with the aftermath of natural disasters.

A flow chart showing the process route for coastal waste management followed in the Mediterranean Sea Region is at Chart-3. A strategy similar to this one, with suitable modifications should be adopted in the SAS Region for coastal/marine litter management.

2.2.3.4 Institutional Frameworks & Stakeholder Involvement

There is no agency in the SAS Regional Countries which is assigned the specific responsibility of management of the marine litter issue. This has lead to ineffectiveness in overall management of marine litter-related issues in the region. Therefore, clear lines of responsibility and authority need to be identified in order to be more effective in marine litter management. Collaborations between NGOs and government agencies where authority is defined and authorised between these groups could strengthen management and control efforts. Some of the major actions required in this regard include:

- Developing and implementing a model of a management plan for marine litter.
- Establishing a SAS Marine Litter Regional Working Group and National level Monitoring Committees to coordinate and advice on appropriate actions for marine litter management.
- Provide training for enforcement officers and sensitisation for different stakeholders on marine litter issues.

2.2.3.5 Legislation, Policies & Enforcement

A vast array of international and national policies currently exists in the Region that forms a strong basis for dealing with marine litter problems. The MARPOL 73/78 Convention and its Annex V has been in force for many years, but solid waste items from shipping (including fishing vessels and leisure craft) still constitute a significant proportion of the marine litter found in the marine and coastal environments.

Other important international agreement related to the prevention of marine pollution by persistent synthetic materials is the London Convention which was agreed upon in 1972. In the list of wastes and other materials prohibited from dumping are persistent plastics and other persistent synthetic material. This convention does not include, however, garbage generated in the course of normal operation of the ship.

The Global Programme of Action for the Protection of the Marine Environment from Land-based Sources and Activities encompasses the issues associated with land-based sources of marine litter and is working to deal with this global problem through UNEP's Regional Seas Programme.

There are a host of national regulations and policies that are country-specific addressing liquid/solid waste management and other pollution concerns. However, specific marine litter legislation does not exist in any of the SAS Regional countries.

The policy and regulatory framework for marine litter management in the SAS Region need to be enforced by strengthening the legal enforcement mechanisms. Port reception facilities need to be improved and a comprehensive strategy for preventing discarding of fishing gear framed and enforced.

2.2.4 Specific actions and measures at source for reduction of marine litter

Merchant ships, offshore platforms and pleasure crafts

Efforts should be made to reduce the generation of waste onboard ships and platforms according to existing legislation. Waste management plans are needed for larger vessels and platforms, and preparations for proper waste management should be made in advance also by those onboard smaller vessels and pleasure craft. These management plans must be shown on board in very visible places for everyone. Waste should be stored onboard and discharged ashore in a proper reception facility. Also, ships should not be deterred from discharging waste to port reception facilities. The waste left in reception facilities should be taken care of properly by the coastal local authorities, in a manner that is optimal in terms of caring for the environment and human health.

Fishing Vessels

Efforts should be made to reduce the generation of waste onboard and preparations should be made for storage of waste onboard until one comes ashore (waste produced by the crew or waste coming from fishing nets). The return of waste collected at sea by the fishermen must be encouraged. Fishing gear, particularly drift nets, should be marked to make it possible to find them again if they are lost at sea. No fishing gear should ever be deliberately discarded but taken ashore for proper disposal.

According to the FAO Code of Conduct for Responsible Fisheries, management measures include that States should take appropriate measures to "minimise waste, discards, catch by lost or abandoned gear,.....". States are also to ensure that IMO requirements relating to the organisation of marine traffic, protection of the marine environment and the prevention of damage to or loss of fishing gear" are met. Furthermore, States should "cooperate to develop and apply technologies, materials and operational methods that minimise the loss of fishing gear and the ghost fishing effects of lost or abandoned fishing gear". States should take measures to protect the aquatic environment – "introduce and enforce laws and regulations" – in accordance with the MARPOL 73/78 Convention. Owners, charterers and managers of fishing vessels "should consider fitting a shipboard compactor or incinerator to relevant classes of vessels in order to treat garbage and other shipboard wastes generated during the vessel's normal service. Apart from this, they should "minimise the taking aboard of potential garbage through proper provisioning practices". Adoption of the above mentioned responsible fishing practices as advocated in the FAO Code of Conduct for Responsible Fisheries in the fishing sector, to be encouraged.

A strong public-private partnership would be needed to prevent, remove, and dispose of derelict fishing gear. Appropriate education and incentives can minimise the practice of throwing unwanted nets overboard and encourage all boaters to bring abandoned gear back to shore if possible. Other options include: attaching locator devices to gear; providing incentives to industries that are developing biodegradable fishing gear; increasing gear recycling and reuse; and providing compensation to those who bring discarded gear back to shore.

Municipal landfills - sewage treatment – hazardous wastes management

Sewage treatment, in adequately equipped facilities, should be a priority for coastal municipalities, in order to avoid litter mixed with sewage. The municipalities should take actions to encourage the public to dispose of waste in garbage containers rather than in trenches, open landfills or on roads.

Households

Sewage-related waste should never be flushed down the toilet but treated as any other kind of household waste and it should be sorted and taken proper care of.

Beach-goers, campers, etc.

All beaches and camping grounds should be sufficiently equipped with waste bins to cater to the needs of visitors using these locations. Organised beaches usually are well equipped with waste collecting facilities and are within the responsibility of the administration to dispose properly the coastal wastes produced by the swimmers. In the case of unorganised beaches, people preferably should be advised to take home their own trash and make sure that it is properly sorted and disposed of for maximum recycling.

Economic aspects

One of the most useful tools for the better management of coastal litter consists of the identification of financial and legal incentives and instruments. Their application, as in a number of other cases, would considerably contribute to the improvement of the existing situation.

The economic and financial strategy in this sector should be based on two principles:

- the polluter pays, and
- the production/recovery principle.

The cost of environmental degradation, resulting from improper solid waste management, and its mitigation, should be calculated and integrated within the economic analysis. A financing system should be introduced which reflects costs, and it should be proportional to the type and the volume of waste.

Mobilisation of the resources required for the proper management of waste is a priority for the sector. To ensure its viability and its financial balance, it is imperative that:

- the waste management issue is included in the fiscal reform programme and considered as a priority public service;
- the marine debris issue is integrated into the management of waste;
- the results of this local reform are monitored and its effectiveness enhanced;
- other cost recovery systems are explored and developed;
- any deficit is made good by a State contribution.

Information system on coastal waste

The marine waste sector lacks quantitative data, particularly on waste streams. Accurate and reliable information is essential in order to:

- identify the priorities for action and plan effectively;
- enlighten decision-making;
- inform and promote awareness amongst all generators of waste and monitor the environmental impact of the sector.

Development of quantitative and qualitative indicators for marine solid waste.

The indicators should be common among the different SAS countries and should be compiled and analysed based on set time intervals, using the same methodology and techniques. These would enable proper monitoring and provide scientific criteria for evaluation of changing trends and needed mitigation measures.

Such an information system should be designed and proportioned according to needs. It could be implemented in a modular and progressive fashion based on the developed indicators. For this purpose it would be necessary to:

- assess needs and identify the relevant data to be collected;
- define the optimum frequency for the collection and updating of data;
- identify the actors involved in data collection;
- define the methods and conditions for disseminating information;
- assess the cost of setting up and running such a system; and
- identify sources of financing.

2.2.5 Development of best practice guidelines

Waste management principles

The principles of cleaner production should be practiced in the management of reception facilities as well as in the management of wastes on vessels. Waste can be categorised into various types depending on the physical properties and ultimate destination of the material. Typical vessel waste categories as relevant to MARPOL 73/78 are shown below.

Typical vessel waste categories

Waste Category	**Waste Description**	**Reusable or Recyclable**	**Relevant MARPOL 73/78 Annex**
Quarantine Waste	Various types	Generally No	IV, V
Solid	Hazardous substances	No	V
	Paper	Yes	V
	Metals, glass	Yes	V
	Plastics	Some	V
	Fishing nets & other equipment	No	V
	Medical wastes	No	V
	Hold sweepings	No	V
	Galley waste	No	V
	Fish, animal or livestock wastes	Some	V
	General garbage	No	V
Liquid	Waste Oil	Yes	I
	Oily mixtures residues including fuel	Yes	I
	Oily mixtures containing chemicals	Possibly	I, II
Waste Category	**Waste Description**	**Reusable or Recyclable**	**Relevant MARPOL 73/78 Annex**
	Tank wash water	Yes	I, II
	Sewage	No	IV
	Grey waters	No	IV
	Noxious liquids	No	II

(*Source: IMO 1995; Australian & New Zealand Environment and Conservation Council, 1997)*

The following options form a hierarchy of waste management priorities, for which suitable guidelines should be developed and put in place:

- waste avoidance - practices which prevent the generation of waste altogether;
- waste reduction - practices which reduce waste produced;
- waste segregation - separate wastes making it useable or less difficult to dispose off;
- waste reuse - direct reuse of waste materials for the same grade of use;
- waste recycling or reclamation - using valuable components of waste in other processes;
- waste treatment - to reduce hazard or nuisance, preferably at the site of generation; and
- waste disposal (Non-quarantine Wastes and Quarantine Wastes) - if necessary, this should be done in the most environmentally sound manner.

Waste Management Plan

The main objective of waste management planning is to ensure that the design and operation of facilities minimises the risk of adverse environmental impacts. The development of a waste management plan involves identifying risks to the environment from activities at the facility, identifying options for reducing that risk and evaluating options for managing the facility to reduce risks.

The waste management plan should outline management objectives for:

1. Operational

- waste management, including consideration of seasonal variations
- facility management/maintenance
- responsibilities/contractual arrangements
- emergency responses
- infrastructure
- signage
- compliance with approval conditions, including auditing
- training and education

2. Technical

- facility requirements
- standards for equipment/capacities, incorporation of new technologies

3. Environmental

- avoid, remedy or mitigate any adverse environmental effects
- water quality, including storm-water management
- noise
- visual
- odour
- natural character
- coastal processes

4. Community

- public access
- recreational use
- consultation

Methods of disposal of different types of wastes (Source: IMO, 1995)

Oily Wastes (MARPOL 73/78 Annex I)

The choice of disposal methods should be based on environmental outcomes of the options. Where several potential options exist, the costs need to be considered against the benefits of each option.

• Incineration

- there are several types of incinerators for oily wastes. Not every type of waste can be handled by a specific incinerator;
- pollution should not be transferred to the air as waste compounds can cause serious air pollution.

• Land farming

- the naturally occurring microbial population in the soil degrades oil; 80-90% of the oil is destroyed within 2-3 years;
- More expensive than landfill as more land is needed and more maintenance of the disposal site is required.

• Landfill Storage

- should only be applied to oily wastes with a low hydrocarbon content and a high solids content. Oil or liquid oily wastes should never be dumped on a landfill. Waste can be treated with binding agents such as lime with additives to render it more suitable to serve as filling material;
- groundwater should regularly be checked for contamination.

Chemical Wastes (MARPOL 73/78 Annex II)

The industry for which the cargo is shipped generally has the best facilities to dispose / recycle chemical wastes, resulting from the tank washing of their chemical carriers. Chemicals which can neither be discharged into the sea nor be treated biologically or chemically would have to be disposed off in another way:

• Incineration

- preferred option as it converts wastes into harmless substances and substantially reduces the waste volume;
- certain components in the waste would require special techniques, leading to higher incineration costs e.g., the presence of chlorine, sulphur, sodium, potassium, PCBs, volatile metals and brine wastes.

• Landfill Storage

- May require extra provisions which are dependent on percolation behaviour of the waste and its hazardous characteristics.

Garbage (MARPOL 73/78 Annex V)

- The disposal of garbage is very closely linked with the municipal disposal system and should be incorporated into this.
- Garbage received in a reception installation in a port would generally be transported to a shore waste disposal facility unless possibilities for recycling exist - the reception installation for Annex V type wastes serves as a link between the ships and the land disposal systems.
- Some wastes e.g. quarantined wastes may not be easily transportable to normal land disposal systems and may require special provisions. (Source: IMO Manual, 1995).

2.2.6 Partnerships, voluntary agreements and cooperation with major stakeholders

Role of Government agencies

The local administration/Municipality or the local body would need to see that there are bins at regular intervals preferably separate ones for dry and wet waste to minimise opportunities for littering and prevent good waste getting poor by mixing it all up at collection points. The Central/Provincial Government should formulate and put in place stringent and enforceable rules for anti-litter and waste segregation at source and enforce them effectively at the local level to change age-old practices of disposal.

Role of NGOs

The NGOs would need to work on community awareness programmes involving commercial establishments, hotels, resident associations, schools, etc., to effectively convey the need and merits of an improved waste management system and recycling programme and support the change. There is a need for short-term and long-term communication strategies based on local conditions.

Community participation

Partnerships between communities, community groups, businesses and governments, should be encouraged in a sustainable effort to manage wastes responsibly. The message is simple: waste minimisation and recycling are essential for managing waste, and this requires responsible partnerships.

Housing societies for citizens, hoteliers and commercial establishment heads for reaching out to tourists would also need to get involved to pass on the message of "Segregated Waste Collection at Source" and BIN Culture is adopted by all in this area. This would ensure that solid waste is not mixed with wet garbage and the reasonable value from the waste keeps the interest of recyclers alive as the project advances and can become self sustainable.

Recyclers can be asked to belong to the project in the area and commit to take away the solid waste at regular intervals, compensating if possible those who help in accumulating and storing it for them.

The other approaches should include:

- Awareness creation among fishermen and other coastal stakeholders.
- Port management.
- Making it mandatory for the coastal industries/ports/jetties to maintain the beaches in the vicinity and keep them clean.
- Capacity Building should include human resources development through knowledge/skill up gradation, education, training and awareness.
- Assessment and monitoring of the floatable debris and beach and underwater clean up campaign in the coastal water and sea-floor debris, need to be taken up periodically to check the marine debris in the coastal waters, beaches and the seas.
- Above all, setting a pilot scale plastic recycling plant in the affected islands would be advantageous in curbing this problem effectively.

2.2.7 Plans for improvement of port reception facilities and services for garbage collection from the shipping and fishing industries

Besides Oil, Shipping is the source of another form of marine pollution. Every day around five million items of solid waste are reportedly thrown overboard from ships. This garbage drifts across the seas before ending up on coasts all over the world. Ship generated waste like ropes and fishing nets catch large amounts of fish and dolphins; and turtles are drowned by floating debris. The main reasons for this are:

- Waste reception facilities in ports are either lacking, too expensive, or cause delay.
- The current cost recovery system is not compliant with the "polluter pays" principle. The polluter at sea does not pay at all and the ship delivering its waste in port pays a bill.
- The current MARPOL-treaty sets waste discharge standards only. It does not force ships to actually deliver their waste to port.

The majority of waste from ships ends up in the sea, causing severe environmental and economic problems. The solution is to introduce:

- A mandatory obligation to discharge all ship-generated waste at port reception facilities;
- Control of ships in their next Port of call when a vessel is allowed to depart with waste on board;
- A fee system which provides an incentive for ships to deliver their waste at a reception facility and not to discharge at sea;
- Waste management planning in ports to ensure effective reception procedures and no undue delay for ships;
- Port Reception Facilities should be supported by the Respective National Governments. The new directive would provide an incentive for cleaner ships, cleaner harbours, cleaner shipyards and cleaner beaches.

Waste reception facilities can be provided at regional or site specific level. All reception facilities, regardless of size should be able to receive MARPOL 73/78 Annex V wastes (garbage) and Annex I wastes (waste oils and oily mixtures), besides being capable of handling any other wastes in the quantities that would normally be handled or discharged within that port or harbour. The planning and design processes should ensure that the facility has sufficient capacity to handle the peak load that would be imposed on the facility.

Specific design of waste reception facilities would be required for *Quarantine wastes, liquid wastes* (sewage or industrial) and *solid wastes.*

Incineration is an alternative and a preferred method of disposal of quarantined wastes. Therefore, full attention should be given to the use of the best available technology with suitable integrated air pollution control systems to obtain community and regulatory approval for such a method of disposal of wastes.

Where practical, pump-out facilities should be provided adjacent to fuel dispensing facilities. This would save time for the vessel operator as well as encourage the use of the pump-out facility.

Location of the waste containers should be accessible to both client and waste removal authorities. Receptacles for all types of wastes received at the facility should be available and clearly labelled and sign posted.

2.2.8 Development and improvement of waste management policies and systems

In the solid waste (including coastal and marine litter) management, the policy should be based on a number of elements, including in particular the following:

- The development of general awareness raising and sensitisation campaigns, around which specific thematic campaigns could be organised. The subjects to be approached are:
    - the explanation of the role of the natural vectors on the transport of waste (rains, winds);
    - the impacts of the solid waste on the fauna, the flora and the ecosystem;
    - the quantities and the categories of marine debris found on the coasts and in the sea;
    - the costs due by the dispersal of waste in the environment (cost of the cleanings, the loss of profit for the fishermen, the aesthetic degradation of the landscapes with tourist vocation);
    - urge consumers to avoid the multiplication of unnecessary packaging, objects with unique use development, and objects with short active life and long post-use duration promotion.
- Assessment of the current level of awareness of the target groups, and identification of their actual needs;
- Development of appropriate cost-effective communication and educational tools;
- The use of channels and media adapted to the target public and to each level of society;
- Proper long-term planning as a complement to the various programmes and reforms;
- Mobilisation of all the actors in civil society: public authorities at the national and local levels, NGOs, educators, etc;
- Assessment of the impact and effectiveness of the campaigns conducted;
- Encouraging and promoting initiatives for cleaning up the beaches, by NGOs.

At the National level the compliance of national regulations related to the problem of marine litter, obligations with respect to the GPA for Land-based Sources of Pollution and with section IX of Resolution A/RES/60/30 of the United Nations General Assembly should be evaluated and appropriate actions taken to strengthen them.

At the Regional level, the recommendations on marine litter contained in the Resolution A/RES/60/30 of the United Nations General Assembly and the results of the Global Programme of Action Meeting (Beijing 2006) should be considered for implementation though a regional policy on marine litter. A regional Working Group should be established to outline a regional policy on marine litter, which should be submitted for consideration to a High level Contracting Party for its analysis and approval.

2.2.9 Capacity building / human resource development

Joint programmes for training of personnel working in various government and other institutions to be developed with a view to facilitate experience sharing and develop transboundary programmes for creating a better understanding of respective national status of marine litter management. Capacities within education systems of respective countries to be created so that teachers as well as students are not merely made aware of marine litter issues but they can effectively participate in management of marine litter in the region. Appropriate measures should be taken to equip the institutions involved in marine pollution and solid/liquid waste management including municipal institutions adequately with modern management practices, human resource and equipment through national budgets or through donor funding or other innovative measures.

As a part of the Management Plan, appropriate training programmes should be implemented on a regular basis as a refresher course/training on the operation of the waste management system and the facility, as part of a formal training schedule and at the time of implementation of new procedures, covering a wide cross-section of personnel, including shore terminal and port/harbour personnel. Training of all designated enforcement officers dealing with the public on this issue would be required to help promote compliance and stewardship.

Assistance should be sought especially in relation to updating knowledge base with new developments from bodies such as United Nations Environment Programme (UNEP), the technical development services of IMO, environment protection authorities associations connected with maritime issues and other relevant government departments. In particular,

information should be sought on waste reception facilities in other ports and countries in the region. Shore personnel should be made aware of hazards related to certain types of vessels and cargoes.

Ships' agents and Organisations such as boat and fishing clubs should be made aware of the information about MARPOL 73/78 and its Annexes, not only by information sheets but also by familiarisation visits to reception facilities located elsewhere.

3. Implementation of specific projects for Marine Litter management in the South Asian Seas

The Action Plan proposed by Bangladesh, India, Sri Lanka and Maldives are in Annexure – 3 to 6. The Action Plan furnished by Bangladesh is rather general in nature, the action plans proposed by India and Sri Lanka address the marine litter issue in greater detail. The Maldivian Framework lists out issues relating to how waste is currently managed in Maldives and identifies their policy implications.

3.1 Integrated Marine Debris Management (IMDM) Programme

Integrated Marine Debris Management Programme is proposed for implementation in the SAS countries with the following components. In preparing this proposal, inputs from similar initiatives from Korea, Japan, China and Russia and the globally known Integrated Marine Area Management model were taken into consideration.

In the SAS Regional perspective, the large population along the coastal region, complexity involved in the management aspects of different agencies such as the Government Ministries/Departments/organisations, the local administration, NGOs, etc; lack of data on marine litter; diversity of marine litter due to site specific reasons such as tourism, fishing, vicinity of ports; and other related issues are considered for evolving a marine litter management programme.

Objectives

The major objectives of the IMDM Programme are to:

- Conduct marine debris survey in near shore and deep sea
- Support Technology development
- Develop Management tools
- Build capacity/skill and knowledge development
- Initiate Regional and National level awareness campaigns
- Restructure administrative/institutional and legal mechanisms
- Prevent and control marine debris through long-term monitoring.

Project components

Regional Working Group and National level Monitoring Committees

In each country of the SAS Region, a *National level Monitoring Committee* involving the Central and local Governments, National Research Laboratories, Academic institutions, Industries, NGOs and local community representatives has to be set up for marine litter monitoring and management. These Committees should have the mandate to formulate detailed work plans, review the implementation of the IMDM Programme, and provide necessary policy and advisory guidance to the Project implementing agencies and the concerned national Governments on effective marine litter management in the respective countries. A Project Directorate with supporting staff to be set up to coordinate these activities in each of the SAS countries.

At the Regional level, SACEP-SAS RSP should constitute a Working Group for the SAS, drawing Members from UNEP, IMO, GPA, IOC, GEF, World Bank, WWF, etc., and the respective National Focal Points to review and guide the implementation of marine litter activities in the region.

Survey of coastal and marine floating and sea-bed debris

Survey is the main component of IMDM Programme. In order to assess the quantity of marine debris in beach, near shore and deep sea a marine debris survey should be conducted at selected sites in all the five countries of the SAS Region, following uniform and standard methodologies adopted elsewhere, and by pooling the available resources in the Region.

The land based near-shore survey could be conducted along the shore by visual documentation of surface and buried debris as weight/volume and type of debris distribution.

The coastal and oceanographic research vessels with the respective countries should be effectively used in sighting the floating marine debris. This could be supplemented by the data acquired from aerial surveys as well as the satellite remote sensing – particularly the OceanSat launched by India and the other satellites especially of NOAA and others through proper agreement between the countries and the remote sensing organisations. The equipment required are GPS, Camera, hand tools for debris collection and segregation.

For realistic assessment and monitoring of the sea-floor debris, the survey equipment like Side Scan Sonar, echo-sounder with auxiliary tools like bottom trawl net, dredge, corer and underwater camera could be make use of by the coastal and ocean going research vessels. Divers are also to be engaged for sea bed survey. Large collection bins and rooms for storage are also required. The survey to include studies on the source/origin, quality and quantity of the debris, its distribution, dispersal and fate in the SAS Region, as well.

The survey can be carried out in a phased manner with initial emphasis on tourism related sites and other land-based activities, where majority of marine debris is generated which finds its way into the sea.

The marine debris survey has to include collection of data from Ports and Harbours, besides the sea-based survey. This will provide important information and the basic statistical data for making a budget and policy formulation.

The locations for field survey has to be chosen on the basis of the activities relating to tourism, fisheries, shipping, industrial, maritime and human settlement related activities, carried out along the coasts of the SAS countries.

The field survey has to include seasonal sampling spread over a period of 3 years (2008-2011) to get systematic data on marine debris, covering the

- Survey along the beach
    - Beach walk for survey and collection
    - Positioning device
    - Collection devices
    - Photographic documentation
    - Collection of data on source
- Shipboard survey of floating debris and debris settled on the sea bed
    - Study floating debris
    - Collection of floating debris
    - Deep-sea Bottom trawl equipment
    - Underwater camera system (1,000m water depth)
    - Side-scan sonar
    - Position-tracking device
- Identifying the source of marine debris.

The Scientists/Researchers in the National Institutes of Oceanography and other Ocean and Environmental Research Organisations/Institutes in the countries of the SAS Region, and the academia of the Universities/colleges could be engaged in these surveys.

The survey could be dovetailed with coastal and marine pollution monitoring programmes implemented in the SAS countries. For example in India the coastal marine debris survey could be included as a part of the ongoing Coastal and Ocean Monitoring and Prediction system (COMAPS) Project under which sampling is carried out from 82 sampling points covering the entire Indian coastline up to 25 km inside the sea from the coastline. In 13 hot spots, pollution is monitored covering four seasons in a year. Coastal and marine litter data collection could be incorporated in this programme from the year 2008 by suitably modifying the scope and content of the COMAPS programme. The project uses 2 dedicated Costal Research Vessels –Sagar Purvi and Sagar Paschimi covering the east and the west coast, respectively and fishing boats for near-shore sampling. In addition, the Ministry of Earth Sciences has two ocean going research vessels – Sagar Sampada and Sagar Kanya, besides two more new vessels Sagar Manjusha for deployment/retrieval of moored data buoys and Sagar Nidhi (which would be joining the research vessel fleet of MoES very soon) with a dynamic positioning system for ocean related technology development. The Coast Guard and Navy, the Marine Wing of the Geological Survey of India and National Institute of Oceanography have also oceanographic research and surveillance vessels. The Ports and Harbour authorities (particularly the major ports) and Shipping Corporation of India have also a good number of vessels. These vessels could be used for assessing both the floating and sea-floor debris survey and floating debris sightings, within the Indian EEZ and under bilateral programmes with the other SAS countries. The requisite underwater/acoustic instruments including side-scan sonar are also available with the National Institutes in India for sea-floor debris assessment and monitoring.

In other countries of the SAS Region marine litter monitoring could be incorporated as a part of the ongoing marine pollution monitoring programmes using the existing facilities within their territorial waters and for floating and sea-floor debris outside the territorial waters, through bilateral/international collaborative programmes, with India or other neighbouring countries.

For studying the landing or accumulation of marine debris from other countries and passing ships along the coasts of the SAS countries, UNEP/SACEP could formulate and implement joint projects with International / Regional funding.

Research & Development

Academia and industry have to be encouraged to direct research to marine litter/debris. R&D activities should focus on collecting, collating and analysing baseline information on Marine Litter volume, distribution, composition, source identification and trend analysis; tracking experimentation of floating debris, experimental study of drifting and sinking of marine debris, impacts of marine litter, including plastic items and derelict and abandoned fishing gears, on the marine ecosystem, human health and on the economy of coastal areas and communities, and development of viable technology for treatment and recycling of marine litter. Research has to be conducted to determine whether economic incentives on cleaning litter and trash are effective in motivating behavioural changes of the people.

Study of economic impacts of marine litter

Economic information that tracks the costs associated with solid waste management activities, special cleanups and maintenance of beach areas, and costs associated with loss of recreational usage of coastal areas and lost commercial fishing nets and gear, damage to the vessels, the habitat destruction and its restoration etc., would be useful to government agencies dealing with solid waste, fisheries and marine litter issues. Research on the economic impacts of marine litter can assist in justifying the need for adequate resources to support management and educational efforts based on tourism and coastal management concerns.

An assessment of the economic impacts of marine litter, covering the above aspects, therefore, has to be made by involving the Government and Non-Government Agencies including the private sector, in the five countries of the SAS Region. This could be a part of the R&D efforts under the proposed IMDM Programme.

Technology for treatment and recycling of marine litter

R & D component for marine debris management has to be implemented with a major thrust on technology development for recycling and safe and environmentally friendly disposal of debris including medical wastes.

The R&D efforts are to be directed towards:

- Development of a barrier system for floating debris in rivers and estuaries,
- Development of recovery system for floating debris drained from rivers to coastal waters,
- Development of Multipurpose Marine Wastes Cleaning Systems for Shallow Waters
- Research alternative technologies for use in fishing gear and accessories
- Study of the Pyrolysis System Development for Oil Recovery from Waste Rope and Fishing Net,
- Design of a Downdraft Gasifiable Incinerator for Ocean Waste,
- Recycling of marine debris for Refuse Derived Fuel,
- Application of thermal extrusion system for the resource of waste polystyrene buoys,
- Waste Treatment technique for the Resources of Marine Debris.

These technologies developed with Government and private sector initiatives have to be taken to the Industry for pilot scale trials before dissemination in the field. Efforts have to be made to disseminate these technologies to the end users and to conduct training programmes through Local bodies and NGOs in the SAS Region. At selected sites these Recycling and eco-friendly technology demonstration and management Units could be set up under this project.

Assessment of MARPOL Annex V effectiveness - Better reception facilities and waste management

The MARPOL 73/78 Convention and its Annex V on garbage is the main international instrument to control marine litter pollution from shipping, including fishing vessels and leisure craft. Properly implemented and enforced by the Contracting Parties at the national level, the provisions of Annex V should result in a significant reduction (and eventual elimination) of the input of marine litter from these vessels/crafts.

Annex V of MARPOL 73/78 prohibits the disposal of plastic materials at sea and regulates the disposal of other garbage at sea. Under Annex V, garbage includes food and domestic and operational waste – excluding fresh fish – generated during normal vessel operations and liable to be disposed of continuously or periodically. Annex V also requires ports and terminals to provide garbage reception facilities for boats and ships.

No overall assessment of the general effectiveness of Annex V has been made in the SAS Region. Such an assessment should be made and used as a basis for further action, *e.g.*, for the possible designating of additional sea areas as Special Areas for the purpose of Annex V.

In the SAS Region, Annex V waste types do not seem to be managed properly onboard even in the larger vessels and in the fishing vessels and small leisure craft (where operational), there appears to be no facility to store and dispose of such wastes.

The fact that reception facilities for ship-generated waste, including solid waste and garbage, are lacking or insufficient in many harbours in the SAS Region is the major bottleneck in better implementation and enforcement of MARPOL Annex V. Thus, improvement of port reception facilities and better management of the waste delivered ashore is a potential and important area through which to address marine litter in the SAS Region countries.

In the SAS Region, to comply with the provisions of Annex V to MARPOL, a project aimed at ensuring a major reduction in marine pollution by upgrading the existing port reception facilities in some of the ports/harbours and provision of adequate waste reception facilities in the other ports and harbours, including fishery harbours, major fish landing centres, recreational ports and marinas (if any), needs to be taken up for implementation. This should be in addition to making it mandatory for all the ships, fishing vessels and recreational crafts visiting these ports to make use of the reception facilities provided for emptying ship-generated waste and cargo residues, by amending the National Maritime Laws.

The project should take up designing of the reception facilities for different types of garbage/litter as per MARPOL Annex V requirements in particular, frequency of use and emptying requirements, disposal methods to be used, environmental and amenity values of the area, and the access and security requirements. The facility standards and design must relate to the port/harbour characteristics. A waste management plan for each port, needs to be evolved and put in place, the implementation of which should be monitored by the National Governments through their nodal agencies, i.e., Ministry of Shipping and Ports.

This will require major investments in infrastructure (reception facilities) in ports/harbours, as well as in environmentally sound management of the waste once it has been delivered ashore. The funding requirements for this could come from IMO and the concerned Ministries in the respective National Governments and the Port Authorities.

Prevention of marine debris

The conservation measures would focus on minimising and mitigation of marine debris, with a mechanism for emergency response for recovery and maximisation of recycling with environmentally friendly treatment.

Fishing for Litter, which is coordinated by KIMO (Local Authorities International Environmental Organisation), is a unique marine litter project because it tackles litter at sea rather than on the shoreline and because it engages a sector (fishermen) which is not usually involved in preventing marine litter. The aim is not only to remove litter from the marine environment but also to change working practices within the fishing industry and improve waste management.

The basic idea is very simple; the project provides the fishermen with large hardwearing 1m³ bags, which they take to sea with them during their normal fishing activity. Any marine litter that accumulates in the nets during fishing is then placed in the bags and taken ashore for disposal on land. The fishermen participate on a voluntary basis although the project does pay for the bags and waste costs. Similar initiative in the SAS Region would help in tackling to some extent the marine litter problem.

The final phase is to control marine debris after detailed survey and technology development. Here there is a need for strict enforcement of the provisions/regulations contained under the international and national laws/acts/rules in force and for simultaneously educating the people on the importance of marine debris management.

Lead Project Implementing Agencies

The lead Project Implementing Agencies at the National level would be the Nodal Ministries of Environment, Shipping, Ports and Harbours, Fisheries, Earth Sciences, Tourism, Pollution Control Boards, Environmental Organisations, National Oceanographic Research Institutes, Coast Guard and Navy, Industries and NGOs in close coordination / linkage with UNEP-SACEP SAS RSP, GPA, IOC-UNESCO,IMO, etc.

3.2 Marine Debris Outreach Campaign in the SAS Region

Capacity Building through training, education, awareness and outreach

Capacity Building is a basic pre-requisite for monitoring, assessment and prevention of marine debris. This should include human resources development through education, training and awareness, as well as enhancement of institutional infrastructures through the provision of laboratory facilities and communication facility such as inter-net connectivity, with a view to updating information and knowledge on marine debris and its impact on marine ecosystem.

Lack of awareness has led to improper disposal of solid wastes, and associated problems such as non-aesthetic beaches, coastal degradation, and marine flora and fauna impoverishment. An outreach campaign and educational programme has become an essential requirement in marine litter management. This campaign would have the objective of informing stakeholders and local communities on environmental issues generally and about marine debris more specifically, educating them on proper waste management practices and discouraging dumping of debris items indiscriminately.

Objectives:

- Human Resource Development through training at all levels from policy planners to coastal community.
- Develop marine debris education materials including booklets, pamphlets, multimedia packages, etc.
- Encourage existing boards of education and teachers to distribute marine debris education materials; and
- Support extension services in the research / academic institutes / institutions.

Following is the proposed action plan to achieve these objectives. The entire programme has to be implemented over a five year duration starting from the year 2008 through 2013. UNEP-SACEP and Member Countries of SAS Region would be the lead implementing agencies.

- Upgrading or creating new facilities for training and extension;
- Conducting pilot training programmes in member countries at various levels of planners, policy makers, administrators, scientists, NGOs, voluntary organisations, school/college children/students, academics, private industries, and selected coastal communities.
- Conducting Trainers training in member countries;
- Establishing contact with stakeholders/heads of local communities, various trade associations in the communities, local body/council authorities, boards of education and teachers;
- Listing the types and most probable sources of marine debris that constitute the greatest hazards to the community and to living marine resources;
- Developing pamphlets, posters and stickers in English and in the local languages for distribution among coastal communities, marine recreational firms, other auxiliary services and NGOs;
- Distributing marine debris education materials to educators through presentation to teachers, conferences and seminars, organisation of students' excursions/exposure visits to relevant degraded environment for on-the-spot appreciation and organisation of essay competitions on the environment.

Coastal clean-up Operations in the SAS Region

Efforts have been made by at least three countries in the SAS Region to clean up the beaches. The most recent clean-ups done on voluntary basis achieved very little in terms of clean-up, but the awareness it has created among the people in keeping our coastline clean, is noteworthy. It is, therefore, proposed to start the clean-up exercise in all the five countries of the SAS Region targeting the youth, school children and college students, besides some active NGOs and public.

Objectives:

- Increase public awareness of marine debris problems;
- Use youth and school children who would be readily available for data collection and removal of debris items from the beaches;
- Get national committees, and regional committees to establish networks that would address the marine debris problem;

The proposed action plan would involve:

- Organising the youth and school children into groups for clean-ups of debris on beaches;
- Providing funding, logistics, and advice to the groups;
- Using both national/regional network committees to compile information on clean-ups and data findings in the form of a report;
- Widely circulating clean-up reports to local, regional and international organisations.

At the implementation stage, intense clean-up activities would be taken up every month at selected locations, besides organising a coastal clean up on the third week of September every year on the ICC Day. In this exercise, municipalities, NGOs, voluntary organisations, celebrities, public, youth, school and college children/students could be involved.

The partners to this programme are IOC, UNEP-SACEP – SAS RSP, Government Agencies concerned, including Navy and Coast Guard, NGOs, school children, college students, local public, media, etc.

Communication for information dissemination

A large chunk of the population is not aware of the relationship between their activities and the marine debris problem. Hence, there is a need to create awareness among all stakeholders on marine litter and its physical, biological, economic and environmental impacts.

Objectives:

- To promote collaborative efforts among the media network in facilitating marine debris/solid waste management activities;
- To establish a network of information exchange between the various NGOs;
- To establish information data bank on marine debris and solid waste.
- To initiate public awareness of the marine debris problem in the SAS region;

Action Plan to achieve the above objectives in the SAS Region include:

- Publication of a bi-annual newsletter on marine debris issues;
- Organising workshops, seminars and training programmes on marine debris problems and management for environmental journalists, which could lead into the Environmental Journalists Network;
- Promoting/conducting special events such as street plays, film shows, debates, quiz programmes, etc., besides special beach clean-up campaigns.

Implementation of the action plan would involve initiating the collection of marine debris related information gathered by institutions, programmes, projects and other Sub-Regional mechanisms and its periodic updating; developing a media campaign designed to increase awareness of the marine debris programmes; establishing Internet or e-mail bulletin board or compatible systems for the NGOs and journalist network; designing the format for collection, and periodic publishing of data on marine debris for the whole region; creating national solid waste database and linking it up with INTERNET (for access); and organising and conducting special events for awareness creation. The duration of this programme could be for 5 years during the years 2008 – 2013. UNEP-SACEP SAS RSP, IOC, and Respective National Governments could be the lead project implementing agencies.

Organising a Network of NGOs

National active NGOs dealing with coastal/environmental management in the SAS Region are a few and have little contact among themselves except some local initiatives where they are invited. Conscious of this situation, there is a need to organise the NGOs which have interest in organising and conducting coastal clean ups and awareness campaigns on marine litter and its adverse impacts into a network.

Objectives:

- Initiate and reinforce relation between NGOs in the sector;
- Establish focal points for activities in each country of the SAS Region and institutional partners (bilateral and international);
- Collaborate with the implementation of activities related to programmes dealing with Marine Debris/Solid Waste Management and Coastal Management.

To achieve the above objectives a Workshop could be organised to examine and validate the status of the network; a consultative meeting of the network could be held to adopt the text and put in place detailed action plans for effective utilisation of the services of the NGOs in marine litter management and mitigation. The Partner institutions in this activity spread over three years (2008-2011) could be IOC/UNESCO, UNEP, UNDP, WORLD BANK, GEF and National Governments.

4. Enhancement of national legal and administrative instruments; and national institutional arrangements

4.1 National legal and administrative instruments

There are no exclusive legal mechanisms/framework, institutional framework and policies for marine litter management, but whatever mechanisms and framework are in place are all umbrella framework for environmental protection and management, in the SAS Region, as highlighted in Part-1 “Review of Marine Litter in the SAS Region”. However, a summary of the legal mechanisms is furnished below.

Bangladesh has more then 200 rules and regulations on Environment. The National Programme of Action (NPA) for Protection of the Coastal and Marine Environment from the Land based Source of Pollution for Bangladesh, does not specify the proposed action or strategy for management of marine litter. For the specific purpose of conservation of nature and protection of environment and Environmental Conservation Act (ECA) of 1995, Environmental Conservation Rules (ECR) of 1997 and the Environmental Court Act, 2000 have been enacted. Bangladesh has signed the Basel Convention under which transportation of hazardous wastes and their disposal between countries is prohibited. To tackle the environmental pressures created by solid waste disposal, ship breaking and lube oil discharge at sea, the Bangladesh Government uses the provisions of the Environmental Conservation Act and Regulations.

In ***India*** the main source of maritime law, besides domestic law, has been international conventions to which India is a signatory. India is yet to ratify the International Convention relating to Intervention on the High Seas in case of Pollution Casualties, 1969. The International Convention for the Prevention of Pollution from Ships, 1973 (ICPPS) was ratified by India in 1986. The disposal of ship-based wastes is regulated by the Merchant Shipping Act, 1958 and by the adoption of MARPOL 73/78. Standards for discharging effluents are listed in the Environment (Protection) Act (EPA) 1986. The Recycled Plastics Manufacture and Usage Rules, 1999; and Municipal Solid Wastes (Management and Handling) Rules, 2000; are some of the rules framed under EPA, 1986, with an aim to providing environmental protection and are relevant to the coastal environment.

The Coastal Regulation Zone (CRZ) Notification issued in 1991 under the EPA, 1986 aims at protecting and improving the quality of the coastal environment. A Coastal Aquaculture Authority (CAA) of India was constituted in 2005 under the Coastal Aquaculture Authority Act for regulating and developing sustainable coastal aquaculture. Water (Prevention and Control of Pollution) Act, 1974, includes tidal waters, unlike some other countries and is applicable up to 5 km into the sea. National Oil Spill Disaster Contingency Plan formulated under Coast Guard Act in 1996, lays down action to be taken to combat oil spills in the EEZ of India.

Some of the other international conventions on environment ratified by India which are closely associated with marine debris are

- International Convention on Civil Liability for Oil Pollution Damage, 1969.
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972, (London Convention).
- Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora, 1973.
- International Convention for the Safety of Life at Sea, 1974.
- Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, Vienna.
- Basel Convention on Trans-boundary Movement of Hazardous Substances 1992.
- Sustainable Development of Small Islands, etc.

In the ***Maldives***, the Environmental Protection and Preservation Act of Maldives (Act 4/93) contains important provisions on environmental advice, environmental policy formulation, biodiversity conservation, environmental impact assessment, waste disposal and hazardous wastes. Maldives is party to the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal. The Environment Protection and Preservation Act of the Maldives (Law 4/93), provides a statutory framework enabling the control and regulation of the transboundary movement of hazardous waste controlled under the Basel Convention in the Maldives.

The Second National Environment Action Plan (NEAP) of Maldives adopted in 1999 addresses the pressing environmental challenges, which identifies the need to take an integrated approach to the management of the environment including the coastal and marine ecosystems and to work towards the goal of sustainable development. Seventh National Development Plan and Third Environment Action Plan (2008 – 2013) identify the national strategy for solid waste management. The government is expected to endorse these plans in the near future.

In ***Pakistan***, presently, there is no legislation specifically covering litter in marine and coastal regions. However, Pakistan is a signatory to a number of conventions, protocols and international treaties on environment and related issues, which include:

- MARPOL
- Convention on Trade of Endangered Species (CITES)
- Convention on Biological Diversity (CBD)
- Kyoto Protocol
- The Pakistan Fisheries Ordinance, etc.

In ***Sri Lanka***, the Coast Conservation Act and its Coastal Zone Management Plan have the mandate to monitor, control/reduce/prevent dumping of litter in the coastal zone. Further, Marine Pollution Prevention Authority (MPPA) Act also stipulates provisions for preventing dumping activities in marine environment. Section 4 of MPPA Act prohibits dumping of oil or any other pollutants into Sri Lankan waters.

Relevant International conventions ratified by Sri Lanka include:

- MARPOL 73/78.
- London Convention 1972.
- UNEP Regional Seas Programme
- UNEP GPA: The Global Programme of Action for the Protection of the Marine Environment from Land-based Activities
- Basel Convention.

There is, therefore, a need to:

- Evaluate the existing legislation, regulations and enforcement practices that deal with marine pollution and strengthen them or enact new legislation/regulation – a *Marine Litter Act* – exclusively for marine litter management in each of the five countries of the SAS Region.
- Establish and/or enhance government sponsored "litter patrols" in coordination/collaboration with municipal and other national authorities and establish the infrastructure for compliance.
- Expand ratification and promote effective implementation of MARPOL Annex V by the SAS Regional countries.

4.2 National institutional arrangements

There are a number of Government Ministries/Departments and Organisations, having the mandate for addressing the marine pollution and protection of coastal environment related issues in general, but not specific to marine debris, as highlighted in Part-1 "Review of Marine Litter in the SAS Region".

Institutional structures/mechanism would be reviewed so as to bring about institutional integration both horizontally and vertically. Institutions would be authorised and empowered at all levels to perform in consonance with the mandate of the strategy and relevant legislation and policies for marine litter management. Information, education and communication programmes for developing capacities for decision making at all levels as well as capacities to implement specific programme elements at each level would be structured and implemented. In order to achieve these objectives, institutional development would be through a legislative process. Wherever necessary, programmes would be structured jointly to facilitate capacity development, through regional cooperation and information and experience sharing within the sub-region.

In all institutional arrangements, representatives of the stakeholders to be given adequate representation and appropriate roles. The SAS countries would, therefore, in all their institutional mechanisms ensure that stakeholders, including those from the civil society, community and the private sector, are appropriately encouraged to participate in decision making process, in risk assessment procedures and during the preparation of the integrated coastal zone management projects, besides assigning them appropriate roles based on their comparative advantage.

A close coordination/linkage among concerned Ministries and organisations would be established to address the issue of management of marine litter in the Region, which is presently lacking. This would be accomplished by setting up Inter-Ministerial Monitoring Committees at the National Level and a Working Group at the Regional Level coordinated by SACEP/SAS RSP.

5. Potential regional and international partners

UNEP/GPA, IMO, FAO, IOC/UNESCO, WWF, World Bank, GEF, Regional Seas Conventions and Action Plans and other concerned global, regional and national organisations as well as the respective national governments, private/public industries/organisations, NGOs should all play an important role in a coordinated manner to address the marine litter issues in the SAS Region, given their varied and unique expertise and knowledge on different aspects of marine litter.

6. Potential funding sources (including Government)

All the countries of the SAS Region are developing countries, where resources are scarce and virtually there is no technology for marine litter management and abatement. Implementation of the Regional Programme for the Integrated Management of Marine Litter in the SAS would require funds from different sources. To make the programme of marine litter management in this region more meaningful, there is a need for funding from donor countries and organisations, including shipping industry besides technical assistance/cooperation, particularly for establishing port reception facilities, landfills, fisheries, etc., which are high cost initiatives.

Actions at national level should rely mainly on local funding. Investments to broaden the coverage of garbage collection and its disposal in sanitary landfills and managed dumps should come from commercial/development banks in each country or in the region. Likewise, the required investments to make Annex V of MARPOL 73/78 operational (*e.g.*, garbage reception facilities in ports) could come from port operators and from already established funding mechanisms in the countries. Funds for research would require support from national research funds, even though it would be necessary to complement these

activities in cooperation with research centres and universities interested in the issue, as well as from international cooperation agencies. Actions for public awareness and communication would require multiple sources of support, including sponsorships (*e.g*., port authorities, government institutions, NGOs and companies linked to the issue).

Actions at regional level would require support from various sources. Part of the actions should be funded with contributions made by the governments within the framework of the SAS Region. It is required to ensure support schemes within the framework of the Global Programme of Action for the Protection of the Marine Environment from Land- based Activities and the Regional Seas Programme of the United Nations Environment Programme (UNEP). It would also be necessary to establish cooperation agreements with other countries and international organisations (*e.g*., Ocean Conservancy/IMO/World Bank), which may be interested in investing in the solution to the problem. For several elements of the regional programme funding support could be sought from GEF, mainly through medium sized projects. It would also be convenient to establish sponsored financial schemes from companies with regional presence linked to the issue (*e.g*., food and drinks companies). Funds could be focused on information and diffusion actions, applied research and promotion of recycling.

IMO is ready to co-operate with international organisations such as UNEP, FAO, regional centres, individual countries and shipping industry, if need be, to reduce and eventually, eliminate ship-generated garbage worldwide. For high cost initiatives (port reception facilities, landfills, fisheries, etc.), approach should be made to the World Bank, Asian Development Bank, Global Environment Facility (GEF) and other International Financing Institutions in order to obtain financial support for relevant regional and national efforts.

SACEP/SAS Regional Seas Programme through negotiations with these donors should arrange technical and financial support for implementing the various programmes identified for marine litter management in the Region. The National Governments in the SAS Region should incorporate marine litter management programmes under their plan/development schemes for which funds could be provided in their country budget, besides making it mandatory for the industries (including shipping, food, beverages, plastic, etc) and companies to contribute both in terms of financial and technological support for controlling the solid waste discharge/dumping along the coastline and in the sea.

7. Way Forward

In the two day SACEP/SAS Marine Litter Workshop held at Colombo, Sri Lanka on 20-21st August 2007, it was decided that the future strategy and action plan for marine litter management in the countries of the SAS Region should take in to consideration the needs of the National Governments. In line with this decision, it was resolved that a Marine Litter Task Force will be established with a minimum of two nominees from each country – an expert and a country focal point- and /or an environmental NGO. The SACEP will be the coordinator for this task force. The Task Force on constitution will review the final Marine Litter assessment report and the framework document, the priority action identified by the national governments and come out with future strategies and action plan for each country of the region, based on their needs. The budgetary requirements will be worked out on the basis of the decisions taken in/outcome of the proposed meeting of the Task Force that will be constituted by SACEP/UNEP.

8. Conclusion

With an overarching aim of marine litter mitigation through source management in the SAS, the region should aim at reaching the following goals:

- Reducing land-based waste and litter through application at national and regional levels, the Integrated Solid Waste Management (ISWM) focusing on river litter and coastal litter management based on the Three 'Rs' Approach of Reducing, Re-using and Recycling waste in the SAS region.
- Reducing sea- sourced litter through, *inter alia*, the development and use of adequate port reception facilities for garbage from ships.
- Establishment of a sustainable indicator-based Marine Litter monitoring mechanism both at regional and national level, including regional monitoring of vessels and platforms.
- Improved regional and national inter-sectoral coordination on Marine Litter related activities.
- Influencing people's waste generation and disposal behaviour in the short to medium term and waste generation and culture in the long term.
- Development of sustainable and environmentally friendly tourism, fisheries and coastal activities in the region.

"Waste, given creative conversion, can become Wealth". A famous quote from Emerson, a Scientist said*, "What is a Weed? A plant whose virtues have not been discovered".* Similarly if we have the genius in us, we can understand the usefulness of some of the litter/trash which can be transformed into riches. Our aim therefore, should be to convert coastal/ marine litter into wealth, through recycling and reuse of these litter, and *"Keep our seas clean".*

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Annexure –1

SACEP/SAS

DEVELOPMENT OF A REGIONAL MARINE LITTER ACTIVITY IN THE SOUTH ASIAN SEAS

QUESTIONNAIRE TO BE USED BY THE NATIONAL CONSULTANTS FOR EVALUATION AND ASSESSMENT OF MARINE DEBRIS/LITTER IN THE SAS REGION

Name of the Country:

Name of the Consultant:

Occupation:

Organisation & address:

Country: **City/Town:**

Telephone (Business) **Residence**

Mobile **Fax**

e-mail address:

1. Preamble

1.1 State of Marine and Coastal Environment in your country, including the issue of marine debris/litter and compare it with the global status.

2. Current status of marine debris in your country

2.1 What are the sources (both land based and ocean-based – shore-line & recreational activities, smoking related activities, medical/personal hygiene wastes, ocean/water way activities, dumping activities) of marine litter (input on debris from vessels, coastal litter, floating litter, seabed litter) in your country? Give in detail the various sources and the types/composition, quantity and distribution of litter, factors controlling litter distribution in space and time, litter dynamics, etc., in your coastal and marine waters, along with the methods adopted for collecting information on marine litter.

An inventory of the types of marine litter (their quantity and distribution) should include:

- Plastics (fragments, sheets, bags, containers)
- Polystyrene (cups, packaging, buoys)
- Rubber (gloves, boots, tyre)
- Wood (construction timbers, pellets, plywood, fragments of both)
- Metals (drink cans, oil drums, aerosol containers, scrap)
- Sanitary or sewage related debris (tampons, diapers, condoms, faeces)
- Paper and cardboard
- Cloth (clothing, furnishings, shoes)
- Glass (bottles, light bulbs)
- Pottery/Ceramic
- Monofilament fishing line
- Waxed milk carton
- Fruit peel
- Cigarettes, cigarette fibre, lighters, cigar tips, and other tobacco related packaging/wrappers
- Used batteries,
- Building materials, etc.

The sources should include:

- Sewage treatment works (STWs)
- Combined sewer overflows (CSOs)
- Other industrial discharges

- Urban runoff
- Shipping including garbage from ships
- Oil rigs
- Ministry of Defence munitions
- Dereliction (piers, wrecks, etc)
- Agricultural waste
- Fishing industry including gear from fishing vessels
- Aquaculture
- Municipal waste
- Recreational & leisure usage
- Marine mining
- Harbours

2.2 Identify the Government bodies and other agencies including local governments, who have a mandate for addressing marine litter; NGOs, conservancy and other civic groups working with projects or programmes that address marine litter issues.

2.3 What are the social, physical, biological and economic ramifications of marine debris?

3. Current initiatives to manage marine litter/debris in your country.

3.1 Are there any national, sub-regional or regional projects and programmes for the management of marine litter? If yes, please list and make a brief assessment/review.

3.2 Are there marine litter management activities/practices in your country including beach cleanups, participation in International Coastal Cleanup Day, solid waste handling, collection, transport, disposal; waste avoidance, reduction, reuse/recycling, treatment, etc? If so, give a brief account of such activities. (Give information on activities and groups/stakeholders involved in waste management, clean-up activity, description and location of monitoring activities, frequency of sampling, constraints, if any, in sound waste handling, strengths and weaknesses in current marine litter management programme, etc., along with the lessens learnt).

3.3 Has any assessment of the economic loss due to marine litter problem, been done in your country?

3.4 Outline briefly any evidence of the negative impact of marine debris including lost and abandoned fishing gear on marine and coastal ecosystems e.g. costs of beach cleanup exercises, damage to ecosystems, entanglement of marine animals - marine mammals, birds, turtles, fish , etc., tourism, human/public health and safety. Is "Ghost Fishing" an important problem for your country?

3.5 Are there any legal mechanisms, legal and institutional frameworks, and policies in your country for monitoring, controlling/reducing/preventing dumping of litter in the marine and coastal regime? If so give details of such Acts, Rules, compliance with International and National Conventions/Instruments, Acts, Codes, Rules, etc; description and functions of the institutions involved in marine litter management; and policies.

3.6 What are the gaps and needs in coverage of marine litter management?

4. Suggested approaches/strategic framework for marine litter management.

4.1 What in your opinion are the priority thematic areas, activities and possible approaches, which could be included in a regional project on marine litter management in the South Asian Seas Region in general and your country in particular? [This should include proposals for national/regional monitoring and assessment programmes, comprising development of appropriate methodologies to assess the quantities, composition, distribution and trends of marine litter, the actions needed to reduce the impact of marine litter with a suggested framework comprising strategic approach to be adopted in developing solutions to the problems, potential regional and international partners, a list of operational activities, a costed programme of work, recommended source of funding, etc.]

The input should also include the following aspects:

- Programme of enhancement of national legal and administrative instruments; national programmes and initiatives; and national institutional arrangements;
- Programme of implementation of national monitoring programmes including suggested methodologies;
- Development of national strategies on integrated management of marine litter (including guidelines for the wise management of marine and coastal litter);
- Recommended programmes of co-operation with the civil society (private sector, NGOs and the scientific community). Programmes to develop partnerships, voluntary agreements and cooperation with major

stakeholders (e.g., shipping industry, tourism industry, fisheries, manufacturers of plastics, waste managers/services, Coast Guard, Navy, Pollution Control Boards, local authorities, municipalities and communities, NGOs and general public);

- Outlines for development of campaigns and /or permanent services for the cleaning and collecting of solid wastes that pollute coastal and marine areas;
- Demonstrations through awareness-raising campaigns in selected destinations and with selected stakeholders;
- Outlines for development of 'responsible citizenship' guidelines for different sectors and target audiences, in particular: children and students, tourists, municipal authorities and local communities, shipping companies, ship and smaller vessels crews; commercial and recreation fishing vessels, and other identified target groups;
- Outlines for development of professional sectoral guidelines for the wise management of marine litter (e.g., tourism, boating, diving, cruise lines, fisheries, coastal construction);
- Outlines for Plans for the improvement of port reception facilities and services for garbage collection from the shipping and fishing industries;
- Outlines for Development and improvement of waste management policies and systems;
- Outlines for capacity building/human resource development at various levels for marine litter monitoring and management;
- Identification of specific projects and approaches to potential funding sources (including Government) for various components and activities of the Marine Litter Activity in the South Asian Seas; and
- Development of strategies, approaches and specific projects for funding high cost initiatives (such as port reception facilities, landfills, fisheries, etc.).

5. Summary assessment/Conclusion

6. References/literature cited

Annexures

Note:

The information should be supported by qualitative and quantitative data as much as possible, along with suitable illustrations, maps, photographs, etc. The information should be drawn from all pertinent sources, desk-top study and interviews with key parties such as administering government authorities, harbour users, waste management contractors, fishing and marine related companies, local community, tourism sector, waste treatment or disposal authorities, indigenous groups, etc).

Annexure-2

Sources and quantum of Marine litter collected in India between 16th Sept. and 18th Oct. 2006

Sl. No.	Date	Place	No. of people participated	No. of Students participated	Approx weight of marine litter collected (kg)	Probable Source*
GUJARAT						
1.	18-10-06	Nararabet	47		350	4 / 12 / 10 / 13
2.	18-10-06	Okha (Khadir Temple Beach)	150		150	4 / 12 / 13
3.	27-09-06	Chowpathy Beach, Porbander	1200		1500	4 / 12 / 13
4.	18-09-06	Hover port / Jakhau village, Jakhau	26		200	4 / 5 / 10 / 12 / 13 / 15
5.		Alang, Gulf of Cambay			59940	**Data taken from research article****
6.		Sosiya, Gulf of Cambay			36780	
GOA						
7.	2-10-06	Vasco-da-Gama (Bina beach)	250		1590	4 / 12 / 13
MUMBAI						
8.	16-09-06	Sassoon Dock	20		13	15
9.	16-09-06	Katalwadi Anjenvel, Dabhol, Maharashtra	60		300	3 / 4 / 5 / 14 / 15
10.	14-10-06	Mumbai (Girgaon, Juhu, Dadar beach)	2000	600	2062	4 / 12 / 13
11.		Juhu Beach			20000	**Data obtained from Mumbai Municipal Corporation-Mumbai**
12.		Versova Beach			7500	
13.		Dadar-Mahim Beach			20000	
14.		Girgaum Beach			10000	
15.		Coastal Areas adjoining Versova Jetty			5000	
16.		Marve, Aksa, Madh, Danapani, Erangal and Silver Beach			8000	
17.		Gorai			1500	
DAMAN						
18.	22-09-06	Daman	700		1900	4 / 10 / 12 / 13
KARNATAKA						
19.	15-10-06	Dakshina Kannada, New Mangalore	2000		5400	4 / 10 / 12 / 13
KERALA						
20.	16-09-06	Cochin	3000		5500	2 / 4 / 5 / 10 / 11 / 12
21.	16-09-06	Thiruvananthapuram	30		200	4 / 10 / 12 / 13
22.	16-09-06	Fort Kochi Beach	185		2350	4 / 10 / 12 /13
23.	16-09-06	Hama beach, Kovalam	13		13	13
24.	16-09-06	Samudya beach, Kovalam	35		150	10 / 13
25.	16-09-06	Light House beach, Kovalam	7		30	13
26.	16-09-06	Calicut	60		600	12 / 13
TAMIL NADU						
27.	16-09-06	Manavalakuridi (village beach), Kanyakumari	155		200	4 /10 / 12
28.	16-09-06	Ganapathipuram (village beach), Kanyakumari	222		1050	4 / 10 / 12
29.	16-09-06	Kallukootam, Kanyakumari	85		200	4 / 10 / 12
30.	16-09-06	Mandaikadu beach,	90		150	4 / 10 / 12

Sl. No.	Date	Place	No. of people participated	No. of Students participated	Approx weight of marine litter collected (kg)	Probable Source*
		Kanyakumari				
31.	16-09-06	Puthalam, Kanyakumari	85		300	4 / 10 / 12
32.	16-09-06	Tuticorin (Harbour beach)	247		2023	4 / 10 / 12 / 13
33.	16-09-06	Tirunelveli District	43	5	60	3 / 5 / 9 / 10 / 13
34.	16-09-06	Tuticorin District	93	4	985	4 / 10 / 12 / 15
35.	16-09-06	Ramanathapuram District	35		1121	10 / 13 / 15
36.	16-09-06	Mandapam beach	110		3000	4 / 10 / 12 / 15
37.	16-09-06	Manadad, Thiruchendur	17		90	5 / 10 / 13
38.	16-09-06	Alanthali, Thiruchendur	26	4	28	4 / 5 / 10 / 13
39.	16-09-06	Kayalpatinam, Thiruchendur	12		72	4 / 5 / 9 / 10 / 13
40.	16-09-06	Chinna Erwadi	35		1121	10 / 13 / 15
41.	16-09-06	Ekkiarkuppam, Marakanam, Villupuram	452		3060	4 / 10 / 12
42.	16-09-06	Kaipanikuppam, Marakanam Villupuram	155		1600	4 / 10 / 12
43.	16-09-06	Chinamudaliar-chavadi Kuppam, Villupuram	458		4670	4 / 10 / 12
44.	16-09-06	Nadukuppam, Villupuram	440		2900	4 / 10 / 12
45.	16-09-06	Periamudaliar chavadi Beach, Villupuram	10		460	4 / 10 / 12
46.	16-09-06	Sodhanaikuppam, Villupuram	75		250	4 / 10 / 12
47.	16-09-06	Thanthirayan kuppam, Villupuram	8		145	4 / 10 / 12
48.	16-09-06	Panaiyurkuppam, Villupuram	145		1900	4 / 10 / 12
49.	16-09-06	Cuddalore Silver Beach	800		5675	4 / 10 / 12 / 13
50.	16-06-06	Nagapattinam	650	600	4850	4 / 10 / 12 / 13
51.	18-09-06	Parangipettai	18	12	114.5	4 / 10 / 12
52.	18-09-06	Mudasal odai landings	18	18	44	10 / 12 / 15
53.	18-09-06	Samiyarpettai and Madavapallam	50	50	500	2 / 4 / 9 / 10 / 12 / 15
54.	18-09-06	Vellar estuary	9	9	143	15
55.	18-09-06	Reddiyarpettai	10	10	46.5	4 / 10 / 12
56.	18-09-06	Ammankoil	15	12	4	4 / 10 / 12
57.	18-09-06	Madavappallam	6	6	55.6	4 / 10 / 12
58.	18-09-06	Pudupettai	21	19	65	4 / 10 / 12
59.	18-09-06	Chinnoor	14	12	45	4 / 10 / 12
60.	23-09-06	Nainarkuppam Beach	55	25	328.00	4 / 9 / 10 / 13 / 15
61.	23-09-06	Panaiyur Beach	72	42	189.00	4 / 5 / 9 / 10 / 13
62.	23-09-06	Injambakkam Beach	150	150	63.50	5 / 10 / 12 / 15
63.	16-09-06	Thiruvanmiyur Beach	150	150	430.00	4 / 5 / 10 / 12 / 13
64.	16-09-06	Besant Nagar Beach	250	200	247.10	4 / 5 / 10 / 12 / 13
65.	16-09-06	Marina Beach	3000		19504.00	4 / 5 / 12 / 13
66.	16-09-06	Chennai Port Trust (CPT)	300		1650	4 / 5 / 10 / 12 / 15
67.	16-09-06	Royapuram Fishing Harbour (CPT)	200		2320	4 / 5 / 10 / 12 / 13 / 15
68.	16-09-06	Royapuram Fishing Harbour, Chennai	50	10	1218.00	4 / 5 / 8 / 10 / 12 / 13 / 15

Sl. No.	Date	Place	No. of people participated	No. of Students participated	Approx weight of marine litter collected (kg)	Probable Source*
69.	16-09-06	Ennore Port, Chennai	23		23.7	4 / 5 / 10 / 12 / 15
70.	16-09-06	Kasimedu	30	10	226	3 / 9 / 12
71.	16-09-06	Sozhanganallur	145	50	1928.50	4 / 9 / 10 / 12 / 13
PUDHUCHERRY						
72.	16-09-06	Beach Road	300	151	5525.00	4 / 12 / 13
73.	16-09-06	Kalapet Beach	255	57	2600.00	4 / 12 / 13
74.	16-09-06	Periya Kalapet	77	57	267	3 / 9 / 10 / 12 / 13
75.	16-09-06	Kurusukuppam Beach	260	68	1800.00	4 / 10 / 12 / 13
76.	16-09-06	Nallanadu Beach	110	59	1125.00	4 / 10 / 12 / 13
77.	16-09-06	Narambai Beach	120	60	1325.00	4 / 10 / 12 / 13
78.	16-09-06	Solai Nagar Beach	224	4	2350.00	4 / 10 / 12 / 13
79.	16-09-06	Vambakeerapalayam Beach	121	5	3280.00	4 / 10 / 12 / 13
80.	16-09-06	Veerampattinam Beach	160	4	1250.00	4 / 10 / 12 / 13
ANDHRA PRADESH						
81.	18-09-06	Guntur District	200	150	297.00	7 / 9 / 10 / 11 / 13 / 14 / 15
82.	16-09-06	Kakinada Beach	150		1205.00	13
83.	16-10-06	Visakhapatnam (R K beach submarine area)	199		745	4 / 5 / 7 / 12 / 13 / 15
84.	16-10-06	Visakhapatnam (R K beach submarine area)	230		814	4 / 5 / 7 / 12 / 13 / 15
85.	16-10-06	Visakhapatnam (R K beach Gokul park area) – 1	189		700	4 / 5 / 12 / 13 / 15
86.	16-10-06	Visakhapatnam (R K beach Gokul park area) – 2	195		814	4 / 5 / 12 / 13 / 15
ORISSA						
87.	16-10-06	Paradip (Light house area)	50		210	4 / 12 / 13 / 15
88.	16-10-06	Paradip (Mahanadi mouth area)	100		430	4 / 5 / 12 / 13
89.	16-10-06	Chandipur, Paradip	150		200	4 / 12 / 13
90.	16-10-06	Paradip Beach	200		1000	4 / 12 / 13
91.	16-09-06	Gopalpur & Baliground Beach	700		2600	4 / 12 / 13
WEST BENGAL						
92.	16-09-06	Kolkata	500		3500	4 / 9 / 10 / 12 / 13
93.	16-10-06	Haldia (Marine drive)	500		4550	4 / 12 / 13
94.	16-10-06	Haldia (Diamond Harbour)	80		76	4 / 5 / 10 / 12 / 15
ANDAMAN & NICOBAR ISLANDS						
95.	16-09-06	Andaman & Nicobar Islands	3000		8750	2 / 4 / 5 / 8 / 10 / 12 / 13 / 15
96.	16-09-06	Corbyns cove, Port Blair	349		890	4 / 12 / 13
97.	16-09-06	Campbell Bay	155		1160	4 / 8 / 12 / 13 / 15
98.	16-09-06	Lakshman beach, Campbell Bay	50		1800	4 / 8 / 12 / 13
99.	16-09-06	Butter beach, Hut Bay	65		250	4 / 12 / 13
100.	16-09-06	Durgapur resort, Hut Bay	56		102	4 / 12 / 13
101.	16-09-06	Durgapur aerial Bay, Hut Bay	20		33	4 / 8 / 12 / 13
102.	16-09-06	Aerial Beach, Hut Bay	20		75	4 / 12 / 13
103.	18-09-06	Kavaratti beach, Lakshadweep	30	8	1757	4 / 12 / 13
		TOTAL	**27632**	**2621**	**307563.4**	

***** - Numbering done as follows:

S. No	Source of Sewage
1.	Sewage Treatment Works (STWs)
2.	Combined Sewer Overflows (CSOs)
3.	Other industrial discharges
4.	Urban runoff
5.	Shipping including garbage from ships
6.	Oil rigs
7.	Ministry of Defence munitions
8.	Dereliction (piers, wrecks, etc)
9.	Agricultural waste
10.	Fishing industry including gear from fishing vessels
11.	Aquaculture
12.	Municipal waste
13.	Recreational & leisure usage
14.	Marine mining
15.	Harbours/Ports, fish landing centres

*** Srinivasa Reddy, M., V.G. Sravan Kumar, H. V. Joshi, P.K. Ghosh (2003) Quantification and classification of ship scraping waste at Alang-Sosiya, India. Marine Pollution Bulletin 46, 1609 – 1614.*

Action Plan Proposed by Bangladesh

(Extracted from Bangladesh Country Report - 2007)

A number of strategies and measures were identified to address the existing land-based pollution activities. The following measures may reduce the risk of marine environment through both point and non-point sources.

Strategy 1. Proper management of waste (including agro-chemicals and pesticides, solid waste and sewage)

In the coastal and marine areas of Bangladesh waste including agrochemicals and pesticides, solid waste, and sewage contributing a lot in polluting the environment. Proper management of the waste is needed to minimize and ultimately reduce the pollution. **Implementation Period:** 5 years. **Tentative budget**

Scoping and designing: 25,000 US$

Implementation: 1.5 million US $

Strategy 2. Proper management of industrial waste

Industrial waste (including ship breaking) is a major concern in the coastal and marine areas of Bangladesh. Proper management of those industries is needed to reduce the pollution from industrial sources. **Implementation Period:** 7 years. **Tentative budget:**

Scoping and designing: 25,000 US$

Implementation: 5 million US $

Strategy 3. Increase coastal afforestation

Coastal ecosystems are highly dynamic in nature and deforestation in the coastal areas increases livelihood vulnerability (IUCN 2004). To protect the coastal and marine ecosystem for ensuring the sustainable environment as well as livelihood improvement, large scale degraded coastal and marine ecosystem and afforestation/reforestation is a must. Realizing the paramount importance of protecting coastal and marine ecosystem, Government, Intergovernmental Agency (IUCN) as well as several Non Governmental Organizations has taken afforestation/restoration programme in different coast areas. The Forest Department of the government of Bangladesh is the pioneer in coastal afforestation in the world and has been raising mangrove plantations in the coast since 1960. However, these efforts are not sufficient. These programmes need to be scaled up immediately as well as successful models need to be replicated throughout the coastal areas of Bangladesh. Land use of newly accreted Charlands should be forestry and this must be a legal binding for all agencies concerned in land use in the coastal areas.

The creation of vegetative cover under a 'shelter-belt' concept, especially those areas that remain exposed to natural calamities. Presence of a Green belt greatly decreases the vulnerability of coastal zones to tsunami, cyclone and tidal surges.

Strategy 4. Capacity Building (Training, awareness, research and monitoring)

At the national level, coordinating bodies and research facilities should be strengthened for systematic observation of marine pollution, environmental impact assessment and development of control recommendations. At the local level, Government, Non Governmental Organizations, Intergovernmental Agency, should come forward and mobilize communities so that they will be inclined to adapt techniques and activities that are sustainable. Training and Awareness Programmes aimed at particular focus groups should be promoted. Implementation Period: 5 years. **Tentative budget:**

Scoping and designing: 25,000 US$

Implementation: 2.5 million US $

Strategy 5. Assessment of environmental flow requirement and salinity Intrusion

The Pilot study of the Environmental Flow Assessment of the Bakkhali River Rubber Dam in the Cox's Bazaar area can be replicated to assess the impacts of increasing salinity in the coastal regions. Certain species can be selected as indicator species for the environmental flow assessment and the trade off of flow between the salinity levels and abundance of species can be determined. **Implementation Period:** 5 years. **Tentative budget:**

Scoping and designing: 25,000 US$

Implementation: 2.5 million US $

Strategy 6. Establishment of Central Data Base Directory and Information System

Perhaps the greatest barrier towards the development of coastal-based management projects is the unavailability or inaccessibility of useful data. Before proceeding with preventive mitigation measure, existing environment of individual sectors like ship scrapping and shrimp culture and the extent of environmental damage caused by the sectors should be assessed. A web enable database management system should be developed for proper management of the resources and fulfil the future demand. Collection of data and information should be stored in a centralized system that enables to store, modify, and extract information for users. The directory will consist of the following:

- Land-use zoning maps indicating the types and uses of land in the coastal areas with aim to assist in future land use planning process.
- A directory of all industries in the coastal area indicating the location, type, and other sets of parameter to assess their impact on the coastal ecosystems
- Environmental directory indicating the ecosystem conditions, species abundance etc. in the coastal areas

Implementation Period: 2 years. **Tentative budget:**

Scoping and designing: 25,000 US$

Implementation: 1 million US $

Strategy 7. Ensure preparedness for the adaptation to natural disasters

The occurrence of flood, tidal surges, cyclones, earthquake and most recently tsunami in the coastal areas of Bangladesh has increased the need for the development of proper adaptation measures against these natural disasters. Moreover, the coastal areas of Bangladesh are highly vulnerable to the future impacts of climate change which will not only cause an increase in sea level leading to enhanced salt water intrusion but will also aggravate the frequency and magnitude of natural disasters that already plague the coastlines of Bangladesh.

Implementation Period: 5 years. **Tentative budget:**

Scoping and designing: 100,000 US$

Implementation: 10 million US $

Summary assessment/Conclusion

Reducing marine debris means reducing the amount of waste generated on land and disposing of it properly. Recycling can significantly reduce the amounts of litter reaching marine and coastal waters. Volunteer coastal cleanups and public education efforts can also

Also we need to provide resources to educate the public on the impact of marine debris and guidance for how to eliminate it and to support for the development of studies to address the impact of marine debris. Organizing and sponsoring cleanup efforts and International Coastal Cleanups experiences will provide guidance for the implementation of regulations addressing marine debris.

Whether directly or indirectly, many of our land-based activities ultimately impacting and adversely affecting the sea. Reusing and recycling efforts have helped, but a great deal more can be done. It can be part of the solution.

We want to take utmost priority to clean up our ocean form litter/debris. In this respect, we need technical & financial assistance from donor agencies for project formulation and implementation.

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Action Plan Proposed by India

(Extracted from India Country Report – Venkatesan, 2007)

Taking inputs from the international exercises elsewhere, particularly in the Mediterranean sea involving a number of countries and individual country's initiatives particularly by Korea, China and Japan, the under mentioned work plan is envisaged for the SAS Region in general and Indian seas in particular.

Proposed Work Plan for marine litter management in India

The marine debris management is a multidisciplinary process that unites levels of government and the community, science and management, sectoral and public interests in preparing and implementing a programme for the protection and the sustainable development of coastal resources and environment. The overall goal of this work plan should be

- to improve the quality of life of the communities that depend on coastal resources,
- to provide for needed development (particularly coastal dependent development),
- to maintain the biological diversity and productivity of coastal ecosystems in order to achieve and maintain desired functional and/or quality levels of coastal systems,
- to reduce the costs associated with coastal hazards to acceptable levels.

Indian model should have national and regional programme involving other neighbouring countries. The national programme should involve all the relevant agencies in Central and State Government levels, Industry, NGOs and private partners.

Identification of specific projects and approaches to potential funding sources (including Government) for various components and activities of the Marine Litter Activity in the South Asian Seas; and International projects

Integrated Marine Debris Management (IMDM) - India

Integrated Marine Debris Management is proposed with following components. In preparing this proposal inputs from similar initiatives from Korea, Japan, China and Russia were taken into consideration. Also the globally known Integrated Marine Area Management model is also studied.

In the Indian perspective, the large population along the coastal region, complexity involved in the management aspects of different agencies such as the central, state and the local administration, NGOs, etc; lack of data on marine litter; diversity of marine litter due to site specific reasons such as tourism, fishing, vicinity of ports; should be taken into account for evolving a marine litter management programme.

According to a report published in The Hindu dated 18 March 2007, global waste management practices such as source segregation, composting use of biodegradable products and the need for governments to provide monetary incentives for ecologically sustainable practices at the individual and community levels, are the need of the hour.

The Project – IMDM

The project envisaged is a national project on Integrated Marine Debris Management (IMDM) with following objectives

- to initiate a National level awareness campaign
- to conduct Marine debris survey in near shore and deep sea
- to formulate Integrated management strategy
- to support Technology development
- to develop Management tools
- to build capacity/skill and knowledge development
- to consider administrative issues
- to monitor marine debris on a long-term basis

Project components

IMDM should concentrate on practical solution to marine debris by formulating the marine conservation policy with respect to marine debris.

Survey is: the main components of IMDM. In order to assess the quantity of marine debris in beach, near shore and deep sea a marine debris survey should be conducted at selected sites.

R & D component for marine debris management is required to be initiated with a major thrust on technology development for disposal of debris collected. In particular latest technology should be made available for safe and environmentally friendly disposal method of marine debris. Further, when dealing with medical waste disposal special care should be taken.

The Conservation Policy should focus on minimizing and mitigation of marine debris, with a mechanism for timely response for recovery, maximization of recycling with environmentally friendly treatment. The administration has to support the mitigation measures, education, and monitoring,

Field Survey: The survey can be carried out in a phased manner with initial emphasis on tourism related sites where majority of marine debris is generated and finding way into the sea. There is a great demand for practical strategy to control the input from marine vessels and land-based activities in order to assess their potential impact on marine environments and fishery resources, and to remove the accumulated litters on the seabed.

Ports: The marine debris survey should include collection of data from Ports and Harbours. This is important information that would provide the basic statistical data for making a budget and policy formation.

The Survey method should be simple and cost-Effective. The land based near shore survey can be conducted along the shore by visual documentation of surface and buried debris as weight/volume and type of debris distribution. Divers are to be engaged for sea bed survey.

Equipment The equipment required is GPS, Camera, and hand tools for debris collection and segregation. The survey equipment like Side Scan Sonar, echo sounder with Auxiliary tools like Bottom trawl net, Dredge, Corer and underwater camera are required. The large collection bins and rooms for storage are also required.

Locations: From the International coastal clean up campaign conducted in September 2006, the suggested locations where this project can be initiated are

1. Gulf of Kutch - Ship traffic, fisheries
2. Alang - Ship breaking yard
3. Daman - Tourism, fisheries
4. Veraval - Fisheries
5. Mumbai - Anthropogenic effect, Industry, tourism, ship traffic
6. Mangalore - Fisheries, ship traffic
7. Kochi - Anthropogenic effect, tourism, fisheries, industry
8. Kanyakumari - Tourism, fisheries, international ship traffic
9. Minicoy - International ship traffic, fisheries
10. Tuticorin - Ship traffic, Industry, fisheries
11. Chennai - Ship traffic, Industry, anthropogenic effect
12. Kakinada - Fisheries, Industry
13. Vishakapatnam - Ship traffic, fisheries, Industry
14. Paradip - Ship traffic, fisheries
15. Haldia - Ship traffic
16. Kolkata - Ship traffic, fisheries, anthropogenic effect,
17. Port Blair - Ship traffic, human settlement
18. Great Nicobar - International ship traffic

The Project cost estimation:

Indian coast is about 7500 km long with 9 states and 3 union territories and 3 major three island groups. Hence survey can be taken up in few selected places including major cities like Chennai, Mumbai and Kolkata.

Project should be conducted in phases to identify different sources of marine debris and amount of debris along the coast and on the sea bed.

1. Formation of working groups involving various agencies
2. Field survey
3. Technology for treatment and recycling
4, Prevention of marine debris

1. Formation of working group

The Indian Government should constitute a Working Group involving Central and State Governments with the support of Industry and NGOs. These working groups should formulate detailed work plan for this programme in 6 months period. A Project Directorate with supporting staff should be recruited to coordinate these activities. They can also be involved with other international programmes like GEF etc.

The cost for manpower is projected as part of field survey. Here the cost component is for arranging meetings with Government officials and expenditure towards formation of working group, travel expenses and Project Directorate, Preparation of visual and written document showing detrimental effect of marine debris and importance of marine debris management

Cost for formation of working group/ Project Directorate 50000 USD

2. Field Survey

The field survey would include seasonal sampling spread over a period of 3 years to get systematic data on marine debris, covering the

2.1 Survey along the beach

2.2 Survey of floating debris and debris settled on the sea bed, and

2.3 Identifying the source of marine debris

2.1 Survey along the beach

- Beach walk for survey and collection
- Positioning device
- Collection devices
- Photographic documentation
- Collection of data on source

2.2 Survey of floating debris and on the sea bed

- Study floating debris
- Collection of floating debris
- Deep-sea Bottom trawl equipment
- Underwater camera system (1,000m water depth)
- Position-tracking device

Cost estimation for field survey:

Sl No	Description	Cost USD
1	Vessel hiring charges boats/research ships **1. Beach** Travel expenses to different beaches along the coast, Collection and transpiration of debris, Collection of supporting data from local people, source of debris, social impact of debris, seasonal variation etc., Appoint local NGOs to get systematic data per location 3 visits per year totalling to 9 visits @ 20000 USD per location per year for 3 years per location amounts to 60000 USD For 18 locations **1080000 USD** **2. Near shore** Sampling per site : Boat # 500 USD per day for 45 days per year and for 3 years estimated to be 67500 USD and for 18 sites amounts to 18 x 67500 = 1215000 USD Transportation, port charges etc., 50000 USD **Total 12650000 USD** **3. Deep sea** 45 days cruises one each for east and west coast per year for 3 years totally 6 cruises are required Vessel hiring charges @ 10000 USD per day for 45 days and for 2 voyages (east and west coast) – 90 days (45x2x10000) Cost of vessel hiring charges 900000 USD per year and for 3 years 2700000 USD Transportation, Port charges, fuel and water charges 300000 USD **Total 3000000 USD**	16730000

2	**Ports and Harbours** *Data to be collected on daily basis with support of Port authorities* Cost for per year per site Installation of disposable bins, arrangement for collection of debris from ships, transportation to recycling / dump yard 30000USD Periodic collection of fish waste, broken nets and unusable fishing gears from Fishing harbours 50000USD Underwater survey to assess debris in Port waters 10000USD Provide training on marine litter management to fishers 10000USD Subtotal 100000 USD **For 18 locations for 3 years 5400000USD**	5400000
3	Arrangement of local tours, meetings workshops seminars local transport and related expenses	200000
4	Incidental expenses	250000
5	Salaries (Please work out details and incorporate the budget – present projection for 3 years appears to be very much on the lower side) Manpower @ Project head 1; Senior scientific officer 3, consultant 1, field staff – 20, Research students – 15, Administrative staff 8	300000
6	Expense towards Documentation and photography, workshops, awareness campaign etc	100000
7	Diving charges 20000 USD per location for 18 locations 360000 USD	360000
8	Consumables trash bags, gloves, safety and protective gears etc.,	160000
	Grand total	23600000
	Grand Total	**23.6mUSD**

Total cost for this survey for 3 years amounts to 23.6 million USD

3. R&D - Technology for treatment and recycling

As part of this programme appropriate technology for recycling and eco-friendly disposal of marine debris should be taken up and management of these debris has to be initiated.

This technology can be divided into three stages

Phase I

Development of Base Technologies – this should be viable to Indian conditions. R&D Projects to be initiated through Govt and Private agencies.

Phase II

Practical Technologies - should be easily adoptable and cost effective. The technology developed in Phase I can be taken to Industry for pilot scale trials before dissemination in the field.

Phase III

Popularization of Developed Technologies – efforts should be made to disseminate these Technologies and to conduct training programmes through Local bodies and NGOs. The Self Help Group movement which is very popular in southern coastal states can be used. At selected sites these Recycling and eco-friendly technology demonstration and management Units can be set up under this project.

The scope of work for R & D, therefore, can be in the following areas:

- Pre-treatment system
- Waste fishing net and Polystyrene Buoys Recycling System
- Marine Debris Incinerator
- On-board Combined Treatment System
- Waste FRP vessel Treatment System

Considering the technology involved and scope of work and diversity of marine debris along the Indian coast the estimation is arrived at

	Million USD
Special incinerator for medical waste	0.50
Site specific technology to suit Indian conditions and Low cost and maintenance free technology preferred	0.50
Plastic recycling units @ 20000 USD x 18 units	0.36
Development of proto type models	1.25
Indigenous models	
Procurement of safe disposal systems	0.39
Total cost for Technology for treatment and recycling	**3.00**

4. Prevention of marine debris

The final phase is to control marine debris after detailed survey and technology development. Here the Indian Government should enforce strict regulations and simultaneously educate the people on the importance of marine debris management.

Also this includes accumulation of marine debris from other countries and passing ships. South Asian Seas programme can formulate joint projects with neighbouring countries with International / Regional funding.

The scope of work includes

- Management tools & administrative issues
- Legislation
- Carry out several site experiments in rivers, and channels leading to sea
- Mitigation Strategy
- Education & Campaign
- International Coastal Clean-up Activities

	Cost US$ in million)
Expenditure on formation of legislation, arrangement of meetings, travel, related expenses	1.00
Awareness campaign at sites involving local Self Help Groups, NGOs and local elected bodies like Panchayats	1.00
Advertisement through media and newspaper	0.50
Preparation of teaching materials, student competition	0.75
National seminar	0.50
Printing of books and reading materials, video on marine debris	0.25
To organdie International coastal clean up day	3.00
Total	**7.00**

The cost for prevention of marine debris 7 million USD

To sum up

The programme on Integrated Marine Debris Management (IMDM) – India is estimated as given below to conduct this study at 18 locations for 3 years

		million USD
1.	Formation of working group/ Project Directorate	0.05
2.	Survey for 3 years	23.60
3.	Technology for treatment and recycling-	3.00
4	Prevention of marine debris could be approximately	7.00
	Total cost of the project	**33.65**

5. Summary assessment/Conclusion

The basic statistical data for distribution of marine litters seems to be the first exercise to be initiated. The approach of the integrated management system is very important in dealing with the problem of marine debris. Technology development should place emphasis on the practical needs and must keep pace with management tools and administrative issues.

The suggested directions for managing the marine litter in the Indian seas in particular are the following:

- Specification of mass pollution sources by carrying out monitoring research in marine regime in seawater areas and coastal zones;
- Creation of databases on the sunk sea objects for creation of databases on the sunk sea objects for this region;
- Estimation of pollution at the demersal and the bottom of the sea in the areas of intensive fishing:
- Ecological education
- Strict enforcement of Regulations
- Periodic assessment of debris
- Sustained interest by Government agencies
- Study flow of funds for the project
- International efforts

The programme on marine debris management on a long term basis has to be evolved with Government - People participation in a more cohesive and systematic manner after studying the results collected from the sample study conducted at selected sites.

Maldives - Suggested approaches/strategic framework for marine litter management

(Excerpts)

This section outlines the issues relating to how waste is currently managed in Maldives and identifies their policy implications.

Incorporation of waste management principles

By implication the strategies and initiatives incorporate the key waste management principles that are accepted around the world. These principles should be explicitly incorporated into the policy. This will provide an effective framework that can guide all decision-making about waste. The proposed principles are as follows:

Polluter pays

In the Maldives, the application of the principle of polluter pays involves establishing a fee collection system that represents the true costs of waste management. Under this principle there is also the concept of 'extended producer responsibility' where the producer of a product is encouraged to bear the responsibility and financial cost (partly or fully) to handle the waste related to a product. In Maldives, extended producer responsibility would apply to local producers and possibly to importers of products.

Funding

The solid waste system is not yet fully funded and the sources of funding need to be identified. The government has recently decided to provide recurrent funding for the ERC's budget and to support some projects. Whilst some government revenue is raised for waste-related matters, this revenue is not necessarily dedicated to the formation or maintenance of the waste management infrastructure. Consequently, the government is reliant on donor and corporate support to contribute to the funding. These issues suggest a need to establish a separate fund for waste management that can capture revenue from government, donors and industry to finance-

- PSP soft loans to assist their investment in plant and equipment;
- purchase of equipment for lease to the private sector;
- a bottle return system;
- awareness raising programs;
- promotion of cleaner production and technologies; and
- scholarships for individuals pursuing advanced studies in waste management.

Institutional Responsibility for the infrastructure

At present it is unclear who should own and be responsible for the ongoing management and upkeep of the waste management infrastructure. Choice of the entity should depend on which has the greatest trust amongst the island community as the entity will probably need to manage or oversight the finances of the system on the island. The choice of entity should also be consistent with the recent reforms in government. Private sector participation can, for example, involve privatization of Thilafushi and the Municipality could assume management responsibility for the site and for the collection systems. Responsibility for special wastes (such as medical, ship and hazardous wastes) should reflect the national character of the systems that need to be introduced. This implies that the Central Government should assume this role.

Waste management in the other islands

At present there are only minor waste collection services throughout the islands and householders are generally required to carry their waste to disposal sites, which often results in dumping and open air burning of waste. Systematic and comprehensive waste collection systems should be enabled in all islands to avoid dumping. As every island situation is different, there should be flexibility about the type of waste collection system used to meet the size and needs of the populations on the islands.

Waste Management by Resorts

Maldives currently hosts approximately 90 tourist resorts and more are planned for construction. Most of the resorts have well organized central waste collection and handling systems. The law requires most wastes to be incinerated on site in small-scale onsite incinerators. The incinerators are, however, not optimal and in some resorts incineration of waste gives rise to smoke and odours. Although resorts are authorized to remove processed recyclable wastes and other non-combustible and non-putrescible residual wastes for disposal off the island, in practice mixed solid wastes are often back loaded on resort service dhonis and disposed of at Thilafushi. The current situation in the resorts indicates a need to reconsider their waste management.

Private Sector Participation (PSP)

Although private sector participation has the capacity to introduce additional investment to the waste management system and provide essential services, it is not well developed in Maldives. For PSP to be effective, an environment must be created that allows for financially viable businesses that are capable of investing in their own futures and in sound environmental practices and technologies.

Willingness to pay

The *Report on the Willingness to Pay for Waste Management in Baa Atoll* (2006) shows that, although 73% find that the development of a RWMF is very important, they are not willing to pay for the costs of operating IWMCs (90%) or for the transport of waste to the RWMF (35%). The issue can be addressed by incorporating the equity principle. Finally, the issue relates to creating a billing and payment system that maximizes payments. This can be addressed by introducing a billing system that people have confidence in.

Waste Management Plans

At present, islands are encouraged to develop waste management plans (according to prescribed guidelines), which identify what wastes they have to manage and how they intend to manage them. Plans could, however, be applied in a more comprehensive fashion to include other locations and enterprises etc. They can be created as a multi-layered interlocking framework. For example, a national plan can describe the entire national waste system and regional, atoll, island, enterprise plans etc., can link into it as consistent descending layers to describe the management of waste in each of these areas. Special wastes (such as medical or hazardous wastes) can also have their own plans that link into the framework. This requires identifying who must prepare the plans and what should be included in them.

Legislation

The current regulatory framework for waste management is contained in the Environment Protection and Management Act (1993) (MEEW), the Regulation on Protection of the Environment in Tourism and Related Activities (Ministry of Tourism), the Regulation on Handling of Waste (Ministry of Construction and Public Works), the Regulation on Conduct of Workshops, Service Centres for Vehicles and Carpentry (Male Municipality), and the Regulation on the Conduct of Clinics (Ministry of Health). The Environmental Law (1993) is in the process of review and a guideline for the safe handling, transport, storage and disposal of hazardous substances, fuels and oil associated with the generation and supply of electricity, and for the operation of landfills are being prepared.

These laws apply waste management standards inconsistently between industries. This is an issue for resorts, which have expressed concern that the waste management standards applying to them should also be mirrored in the island communities. The laws are also silent on many critical aspects of waste management (such as who is responsible for waste disposal and incorporating the MARPOL and Basel international standards), and do not apply modern principles for waste management (such as the waste management hierarchy and the ‘polluter pays’ principle).

Administrative framework

The administrative framework for waste management is spread across 5 different government agencies. This creates the risk of policy and enforcement inconsistencies as well as costly administrative duplication. It also creates communication and co-ordination problems both within and between Ministries, besides creating a potential conflict of roles. Best practice waste administration involves locating all waste regulatory functions and responsibilities in one government agency. Bringing together these responsibilities also creates opportunities to introduce a trained inspectorate.

RWMF Environmental and financial viability

With the exception of the Thilafushi site, there are no established Regional Waste Management Facilities (RWMF). There are, however, some regional landfill sites that serve as waste disposal centres at Hithadhoo and Kulhudhuffushi. These 3 facilities do not dispose of waste in a manner that protects the environment; leachates are not managed properly and the open air burning causes dangerous air pollution. The facilities demonstrate the need to establish financially and environmentally sustainable final disposal methods. They also underscore the need for such facilities and future RWMFs to be financially viable and capable of investing in their own growth, equipment and technology.

South Regional Waste Management Facility (Hithadhoo, Addu Atoll)

A private company operates this site. Rudimentary separation is undertaken on site to remove PET, recyclable metals and glass from the general waste stream at the disposal site. The company has insufficient vehicles and equipment to enable an optimal operation of the site. The financial viability of business at the facility is marginal

North Regional waste management facility (Kulhudhuffushi, South Thialdhunmathi Atoll)

The situation at the Kulhudhuffushi landfill site is very similar to that at the Hithadhoo landfill. A private company operates the site. It does not collect a gate fee from people bringing their waste to the landfill. Problems concerning competition and difficulties in raising adequate fees also exist.

Management of waste by industry/business

Industry waste is not well managed in Maldives. Heavy building and construction wastes are also costly for the Male Municipality to transport and this is currently done for free. Similarly, wastes from offices, shops and other private sector enterprises are disposed of for free. The principle of 'polluter pays' should therefore apply to make those industries pay for the actual cost of the disposal of their wastes and a system to accommodate their wastes this needs to be introduced. Some businesses have introduced innovative 'extended producer responsibility' waste management programs that can act as good examples to others. Of particular note is MIFCO's extended producer responsibility program to support the return of its empty cans. It recognises that producers and suppliers are also polluters and that they should contribute towards the cost of disposal (polluter pays principle).

Final waste disposal

On islands, the traditional disposal methods of dumping waste in the ocean or forests no longer works because the nature and quantities of wastes generated on the islands have changed. Managing organic wastes by either composting/mulching or burning on the islands is also advocated, although these are not always well-accepted practices on the islands. The waste management hierarchy requires wastes to be prevented from being generated or the amount to be reduced or re-used. Recovery and recycling of valuable material within the waste is given next priority, especially since it is a way to de-couple the relationship between economic growth and the generation of waste. The least desired option is land filling. The disposal of wastes by either landfill or open air burning is therefore not optimal.

Management of special wastes

Hazardous waste

The most prominent types of hazardous wastes identified in Maldives are - used engine oil, solvents, paint, boat coatings. Worn-out lead batteries are generally collected and sold for recycling. Hazardous wastes are often managed in the same way as all other wastes, creating environmental harm. The quantities and types of hazardous waste in Maldives have not been assessed and no adequate reception and handling facilities for such wastes have been established.

Ship waste

Maldives is signatory to the MARPOL Convention that requires the Government to establish mandatory reception facilities at harbours. Such a reception facility must be capable of receiving the wastes produced on vessels, including hazardous waste. These facilities do not presently exist in Maldives.

Waste Electric and Electronic Equipment (WEEE)

WEEE represents a relatively new type of hazardous waste (such as worn out refrigerators, computers etc) and is increasing in volume in Maldives. This waste component is usually disposed of in landfills although some of these wastes can be recycled and other parts should be treated as hazardous waste. This issue needs to be addressed in Maldives.

Medical waste

The Ministry of Health is developing a policy for the management of clinical/health waste that implements a waste management system that is parallel to the normal solid waste management system. Some waste will be sterilised and the remainder will be treated by dedicated incinerators. Six high temperature incinerators are planned, of which 2 are already installed at large hospitals and the remaining 4 are scheduled for introduction this year. Wastes from health care facilities will be transported to these incinerators for disposal.

Waste Transport

Transporting waste by boat is expensive and distances are often substantial. Good waste segregation and disposal of organic wastes on the islands and the planned construction of RWMFs will reduce the waste transport distances and costs. There is, however, strong evidence that waste is currently often dumped into the sea during transport. These issues indicate that environmental standards should be introduced to regulate the transport of waste, supported by strong sanctions.

Environmental and waste awareness

The segregation of waste by householders is done inconsistently across the islands. Segregation practices can be improved by awareness programmes and by the introduction of the polluter pays principle.

Specific programmes to boost good waste management practices are currently being (and are planned to be) delivered. There is a need for ongoing, strong, flexible awareness programmes for proper waste separation, waste minimization and composting/mulching by householders. Information sharing about effective waste practices and strategies between islands and atolls are also necessary.

Incentives and penalties

Effective penalties for blatant breaches of legislated standards should be introduced. This involves considering what penalties will have a deterrent effect on illegal activities, such as littering, dumping, and conducting unlicensed activities. There also needs to be a strong enforcement system to support the legislative standards. Similarly, rewarding good waste management should be recognised and rewarded, such as the current 'Cleanest Island Competition'. Rewards can also be implemented to encourage clean up the islands and waters of Maldives, for example by introducing a system where a small financial reward is offered for the return of PET bottles.

Conclusion

In surveying the current status of the waste management regime in the Maldives a number of key issues of concern have been observed. These key issues of concern comprise some barriers for further improvement of the waste management system, some issues which are recognized but have for many reasons not been properly dealt with and some issues previously not considered at all.

As next step in the development of an improved and more consolidated waste management regime is the preparation of a national waste management policy, it is of paramount importance that these key issues – and the resolution and overcome of them – are adequately incorporated, treated and dealt with in the future policy.

It is a general conclusion that the current waste management regime causes pollution of the environment and public health risks. This situation is worsening and, if left unchecked may threaten the country's economy, which is intrinsically linked to the tourist and fishing industries Further, tackling these growing waste management problems in the Maldives is fundamental to the promotion of achieving sustainable development.

Positively, a number of studies and consultancies have been undertaken in recent years. As mentioned these studies have focused on waste management issues within specific areas such as Malé, atolls or individual islands rather than looking at the national picture. They have not proposed a comprehensive role for the government and they have also tended to focus on 'end of pipe' solutions, addressing waste disposal rather than waste prevention and minimization. Therefore, the Maldivian government has recognized the need to address the waste management issues in a more integrated and comprehensive fashion through introduction of a future integrated national solid waste management policy (NSWMP).

Generally speaking such a policy should:

- Address existing barriers within the waste management sector;
- Define an adequate future infrastructure for waste collection, handling and disposal;
- Clarify roles and responsibilities and allocates priority tasks;
- Define a legislative framework for its implementation; and
- Incorporate the private sector in waste services.

The following key issues are identified as being the major existing problems in delivering efficient waste management services within the Maldives

1. The lack of clear roles and responsibilities, leadership and co-ordination within the Maldivian authorities at all levels.
2. Insufficient institutional capacity and financial resources within key government agencies and within lower the lower level of authorities resulting in inability to execute fully its mandated responsibilities.
3. Weak and inconsistent regulatory framework that fails to set the appropriate standards and responsibilities for waste management.
4. Weak and scarce control and enforcement even for the existing regulatory framework.
5. The lack of implementing the requirements of waste related international conventions to which Maldives is a party, i.e. the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, the Vienna Convention and the MARPOL Convention (endorsing the regulations relating to the prevention and control of oil, bulk noxious liquid substances and garbage from ships).
6. Lack of waste data collection and monitoring and thereby lost opportunities to manage the waste development setting and monitoring e.g. goals for the degree of recycling.
7. Low public awareness of good waste management, resulting in low levels of compliance from the public, and uncertainty about available options and best practices.

8. The lack of adequate investment in waste management infrastructure and equipment within the inhabited atolls and islands.
9. Inadequate investment in the waste infrastructure is intensified by an absence of appropriate cost recovery mechanisms throughout the sector.
10. Lack of economic tools and incentives to manage public behaviour within waste management.
11. The limited involvement of the private sector in service delivery resulting in lost opportunities to improve efficiency and reduce costs.
12. Lack of economic incentives and support to the private sector to involved themselves within the waste management service sector.
13. No consolidated and transparent tendering system and process when involving the private sector in waste management services.

Ultimately, a NSWMP will need to provide mechanisms to manage waste from the point of generation through to its final disposal. This is often referred to as the 'cradle to grave' concept. This allows for a more effective, integrated approach to material and resource efficiency.

The following policy objectives are therefore recommended as the basis for the future framework of sustainable solid waste management in the Maldives:

- To reduce the impact of waste disposal activities on human health and environment through establishing economically viable and environmentally sustainable integrated waste collection, transfer and disposal systems focusing on waste reduction, recycling and reuse taking account the best available technology not involving excessive costs
- To promote sustainable waste management through encouragement to move up the hierarchy of waste management options (waste hierarchy);
- To ensure that self sufficiency in waste disposal is established;
- To ensure that the development of waste services is based on market mechanisms and cantered on the use of price mechanisms as a means of achieving cost-effective and economically efficient outcomes. This recognizes that waste management should be sensitive to commercial competition and that the prices of the various waste management options should reflect as far as practicable the costs of any environmental damage associated with waste (cost recovery principle);
- The costs of the various management options should fall as far as possible on those responsible for the creation of the waste (polluter-pays-principle);
- The treatment and disposal of waste should be carried out close to the point of waste production; and
- To ensure consistency with national policies and legislation and international standards.

The following policy strategies are recommended to provide support to the objectives recommended above:

- A regulatory strategy that establishes and enforces the specific obligations relating to the management of waste;
- A data-led strategy, where reliable information on the sources, types and volumes of waste produced, as well as the proportion of re-used, recycled or disposed is collected and used to assist policy formulation and review (waste data collection);
- A target strategy, where targets on waste minimization and recycling are set and their achievements are measured and evaluated;
- A promotion strategy that employs education and publicity to promote waste minimization and recovery and good environmental management practices;
- A re-sourcing strategy through the establishment of a National Waste Management Fund;
- A deterrence strategy by the introduction of a landfill tax on possible re-useable materials or recyclables to promote re-use and recycling; and
- A centralization strategy where policy and planning is managed by one department .

A NSWMP should be evaluated and revised, and new targets for waste minimization and waste recovery established every 5 years.

Annexure-6

Action Plan proposed by Sri Lanka

(Extracted from Sri Lanka National Report – Sureshkumar, 2007)

Since only few pieces of information are available on the amount and type of marine litter in the waters of Sri Lanka, the actual scale of the problem has not been investigated yet in a comprehensive and systematic manner. Therefore, the main activities within the marine litter project are aiming at gathering sufficient information to:

- assess the main sources of marine litter, scale of the problem, including amounts and types of marine litter in Coastal and offshore waters of Sri Lanka, its environmental effects and other negative effects;

Marine litter might be detected and monitored by:

- ❖ remote sensing using satellites photographs or aircraft;
- ❖ sampling at sea from ships using neuston nets, or;
- ❖ collection and measurement when washed ashore.

Although a comprehensive control mechanism is absent in Marine litter issue in the country, the issue is recognised as a concern within relevant state agencies. It has not received priority in any of the environmental action plans in the recent past as issues involved in marine litter issues are not brought out properly mainly due to lack of comprehensive data on the issue. Thus, so far marine litter issue has gained importance with coast and marine agencies as a beach litter problem only. Thus, efforts were focused on to beach cleanup programmes only and some extent to control pollutants mainly waste oil entering into environment.

Further issue of beach litter is found to be a serious problem to tourist establishments and beach users. It is also evident that several environmental organisations and non-governmental organisations are concerned about the issues and implanting programmes to address the issues in small way.

Legal powers to combat marine litter problem need to be strengthened for effective management of the issue. In this regard legal enactments and other available regulatory and management mechanisms should be revised to include relevant requirements to address the issue in future.

Further regional and international cooperation should be obtained to tackle the issues in the country. Also research and surveys required to be initiated to assess the extent of the problem.

In order to have an effective mechanism to combat marine litter issue in the country require recognition as an important issue or priority issue in the first hand. Concerned institutions apart from public attractive programmes such as beach cleanup etc., should pursue remedial actions to main root causes. In this regard, several steps could be taken by concern agencies.

h. During revision of respective enactments, marine litter issue could be included. The MPA Act is being revised at present.

i. Future Coastal Zone Management plan to address the coastal or beach litter management issues.

j. Develop a strong cooperative mechanism between major stake holders to combat marine litter issue through establishment of a Steering Committee.

k. Develop state – private partnership programmes and to involve other stake holders such as non governmental organisations, community based organisations, fishermen societies etc.

l. Different angles of marine litter issues to be addressed differently with connected stakeholders including their participation. Litter problem in Fishery harbours to be tackled through active participation of Ceylon Fishery Harbour Corporation (CHFC) and litter problem in tourist areas to be tackled through Ceylon Tourist Board and hotels / reports concerned.

m. Combating beach litter issue through regular programmes involving local authorities and communities.

n. Public awareness programmes to be conducted. Presently island wide coverage is not received by any of the beach cleaning programmes.

ACRONYMS

ADB	Asian Development Bank
As	Arsenic
BCS	Balochistan Conservation Strategy
BEACH Act	Beaches Environmental Assessment and Coastal Health Act
BFDC	Bangladesh Fisheries Development Corporation
BFRI	Bangladesh Fisheries Research Institute
BOBLME	Bay of Bengal Large Marine Ecosystem
BOD	Biological Oxygen Demand
CAA	Coastal Aquaculture Authority of India
CBD	UN Convention on Biological Diversity
CCD	Coast Conservation Department
Cd	Cadmium
CEA	Central Environmental Authority
CEP	Caribbean Environment Programme
CEP	Caspian Environment Programme
CITES	Convention on Trade of Endangered Species
CLC	Convention on Civil Liability for Oil Pollution Damage
CMCH	Chittagong Medical Collage Hospital
Co	Cobalt
COMAPS	Coastal Ocean Monitoring and Prediction System
CPCB	Central Pollution Control Board
Cr	Chromium
CRMP	Coastal Resources Management Project
CRZ	Coastal Regulation Zone
CSD	Commission on Sustainable Development of the UN
CSO	Combined sewer overflow
Cu	Copper
CZM	Coastal Zone Management
DCC	Dhaka City Corporation
DDT	Dichlorodiphenyltrichloroethane
DOD	Department of Ocean Development
DOE	Department of Environment
ECA	Environmental Conservation Act
ECR	Environmental Conservation Rules
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EPA	Environment (Protection) Act
EPA	Environment Protection Agency
EPZ	Export Processing Zones
ESCAP	Economic and Social Commission for Asia and the Pacific
EU	European Union
FACE	Forum of Adayar Civic Exnora
FAO	United Nations Food and Agriculture Organisation
FEPA	Federal Environmental Protection Agency
GBM system	Ganga, Brahmaputra and Meghna System
GCMRN	Global Coral Reef Monitoring Network
GDP	Gross Domestic Product
GEF	Global Environment Facility
GEO	Global Environment Outlook
GESAMP	Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (IMO/FAO/UNESCO-IOC/WMO/WHO/IAEA/UN/UNEP).
GIWA	Global International Waters Assessment
GNP	Gross National Product
GOOS	Global Ocean Observing System
GPA	Global Programme of Action for the Protection of the Marine Environment from Land-based Activities
HDPE	High density Poly-ethylene
HELCOM	Helsinki Commission/The Baltic Marine Environment Protection Commission
HELMEPA	Hellenic Marine Environment Protection Association
Hg	Mercury
HTL	High Tide Line
IAEA	International Atomic Energy Agency
ICAM	Integrated Coastal Area Management

ICARM	Integrated Coastal Area and River Basin Management
ICC	International Coastal Cleanup
ICPPS	International Convention for the Prevention of Pollution from Ships, 1973
ICMAM	Integrated Coastal and Marine Area Management
ICP	Indian Council for Plastic Environment
ICPE	Indian Centre for Plastics in the Environment
ICRI	The International Coral Reef Initiative
ICZM	Integrated Coastal Zone Management
IGBP	International Geosphere-Biosphere Programme
IMO	International Maritime Organisation
INC	Intergovernmental Negotiating Committee
IOC	Intergovernmental Oceanographic Commission
IP	Industrial Parks
ISBA	International Sea Bed Authority
IUCN	The World Conservation Union
JICA	Japan International Co-operation Agency
LBS	Land-Based Sources
LC	London Convention
MAP	Mediterranean Action Plan
MARPOL	Convention International Convention for the Prevention of Pollution by Ships
MEPC	Marine Environment Protection Committee (IMO)
MFRA	*Marine Fishing Regulation Act*
MLD	Million Litres per Day
MOEF	Ministry of Environment & Forests
MoES	Ministry of Earth Sciences
MPA	Marine Protected Area
MPCB	Marine Pollution Control Board
MPPA	Marine Pollution Prevention Authority
MPPRCA	Marine Plastic Pollution Research and Control Act
MPRSA	Marine Protection, Research, and Sanctuaries Act
MRL	Maximum Residue Levels
MSW	Municipal Solid Waste
NAP	National Action Plan
NARA	National Aquatic Resources Research and Development Agency
NEA	National Environmental Act
NEAP	National Environmental Action Plan
NGO	Non-governmental Organisation
Ni	Nickel
NIO	National Institute of Oceanography
NMDMP	National Marine Debris Monitoring Program
NOAA	National Oceanic and Atmospheric Administration
NOWPAP	Northwest Pacific Action Plan
NPA	National Programme of Action
OECD	Organisation for Economic Cooperation and Development
OHC	Oil Hydrocarbons
OPRC	Convention on Oil Pollution Preparedness, Response, and Co-operation
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
PADH	Physical alteration and destruction of habitats
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PCB	Polychlorinated biphenyl
PET	Polyethylene Terephthalate
PHC	Petroleum Hydrocarbons
POPs	Persistent Organic Pollutants
PTS	Persistent Toxic Substances
RAMSAR	Convention on Wetlands of International Importance, especially as Waterfowl Habitat
ROPME Sea Area	Regional Organisation for the Protection of the Marine Environment of the sea area Surrounded by Bahrain, I.R. Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and the UAE
RPA	Regional Programme of Action
RSA	ROPME Sea Area
SACEP	South Asia Cooperative Environment Programme
SAS	South Asian Seas
SIDS	Small Island Developing States
SOE	State of the Environment
SPA	Shore Protection Act

SPCB	State Pollution Control Boards
SPM	Single Point Mooring
SSS	Side Scan Sonar
TBT	tributyltin
TDA	Transboundary Diagnostic Analysis
TDS	Total Dissolved Solids
UK	United Kingdom
UN	United Nations
UNCED	UN Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNICPOLOS	United Nations Consultative Process on the Law of the Sea
USA	United States of America
USDA/NRCS	US Department of Agriculture/Natural Resources
US-EPA	United States Environmental Protection Agency
UTs	Union Territories
WCR	Wider Caribbean Region
WHO	World Health Organisation
WIO	Western Indian Ocean
WMO	World Maritime Organisation
WTO	World Trade Organisation
WWF	Worldwide Fund for Nature
Zn	Zinc

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