Draft

National Action Plan

for

Protection of Marine Environment

from

Land – based Activities

Submitted to

South Asia Co-operative Environment Programme

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March 2000

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EXECUTIVE SUMMARY

India has a coastline of 7516 km with an Exclusive Economic Zone of 2.02 million sq.km. Out of its 940 million population, nearly 20% live in the coastal areas and atleast 22 million depend on the marine resources for their livelihood. The population below the poverty line along the coastal areas is estimated to be 64 million. The coastline is blessed with vast mangrove areas particularly along the east coast and coral reef in its islands as well as in the Gulf of Mannar and Gulf of Kachchh. The biodiversity of the coastal ecosystem is reported to be rich and support a variety of commercial fisheries. The major cities like Mumbai, Chennai and Calcutta and also fast growing cities like Surat, Cochin and Visakhapatnam are situated near/on the coast. Demographic pressure and rapid industrialisation have led to increased generation of wastes from domestic and industrial sources. The waste generated include solid waste, sewage sludge, and wastes from small, medium and large scale industries. The low income of majority of the coastal population and corresponding standard of living associated with the increasing degradation of land, coastal and marine environment is one of the biggest challenges to the Federal and State governments.

The land based activities along the coast of India include human settlements, industrial establishments and service sectors like Ports, transportation etc. Increasing pollution leads to generation of large amount of wastes. The estimated generation of sewage is 4747 MLD and nearly 80% are collected through sewerage systems. The sewerage systems include both underground systems and open canals. Except in the case of Mumbai where 290 MLD of waste is treated, the other volume of waste is disposed as raw sewage in the creeks, estuaries and directly into the coastal waters. As a result of disposal of raw sewage, the levels of dissolved oxygen is very low at few locations particularly in the creeks of Mumbai and close to the waste disposal points at Chennai, Veraval etc. Further, it has been noticed that close to the disposal points, the concentration of E.coli is as high as 2800×10^3.

The industrial facilities are located in large cities like Mumbai, Chennai and Calcutta and also in other places like Porbandar, Surat, Mangalore, Cochin, Cuddalore, Visakhapatnam and Paradeep. Major industries include chemical, steel, textile and fertiliser. Power plants are located in the Gulf of Kachchh, Mumbai,

Mangalore, Tuticorin and Chennai. These power plants release around 55000 cubic metre of warm water per day into the sea. The waste generated from industries particularly from the large industries are being treated before disposal. However, innumerable small and medium scale industries discharge their waste into the creeks and municipal sewerages. Due to release of untreated waste, contamination of sediments with heavy metals like mercury, cadmium and lead are reported particularly in the coastal sediments of Mumbai and in a few estuaries of Gujarat, Kerala, Tamil Nadu and Andhra. The other sources of marine pollution include tourism activities which include dumping of plastic waste by tourists on the beaches, ship breaking operations at Gujarat causing chronic oil pollution in the ambient waters etc. The riverine impacts causing non-point source of pollution is still to be investigated thoroughly and the quantity of waste disposed through the non-point sources are yet to be assessed. The agricultural sector uses nearly 75 kg per hectare of fertilisers which are mostly nitrogenous and phosphorous in nature. The impact of nitrogenous wastes results in eutrophication of lakes and fresh water zones of estuaries. Due to decreasing use of organochlorine pesticides, the residues of DDT, HCH in fishes are found to be low.

The physical alteration of the habitats is reported in the lagoons like Chilka and Pulicat along the east coast. Due to reduction in the fresh water flow into the lakes during the dry months the lagoon area decreases to 2 to 5 %. Due to heavy deposition of sand on the mouths of these lagoons, the entry of seawater is also restricted. As a result, the ecosystem are under stress with constant fluctuations in the biodivesity composition. The coastal developmental activities like construction of ports and harbours have also caused erosion of beaches which form habitats for molluscs and crustaceans. The changes in the river courses and alteration in the flow of water have changed the geomorphology of the mangroves as well as the backwaters which form the breeding and nursery grounds of commercially important fishes. The reduction in the water area in the Pichavaram mangroves has become a common phenomena in the recent years. Further, conversion of mangrove areas for shrimp culture in Sunderbans and Coringa have also led to reduction in the mangrove areas.

Despite priority for poverty alleviation programmes, the Government actions for control of land-based activities include, solid waste management through modern approaches; cleaning of rivers through programmes like National River Action Plan; promotion of adoption of Best Available Technology for treatment of wastes from

large scale industries and installation of Common Effluent Treatment Plants for small and medium scale industries etc. Schemes like exemption of customs duty for import of waste treatment plants, government. contribution in installation of Common Effluent Treatment Plants are also available to the industrial sector. The treatment of sewage demands enormous funds and due to paucity of funds, the government is planning to prioritise installation of sewage treatment plants, for which the international and bilateral assistances for funds and equipments are being sought. Practice of adoption of watershed approach for river basins is being encouraged to minimise downstream impacts on the coastal areas.

NATIONAL ACTION PLAN
for Implementation of Global Programme of Action for Protection of the Marine Environment from the Land-based Activities

BACKGROUND

India has a coastline of 7516 km. It has an Exclusive Economic Zone of 2.02 Million Sq. Km. Out of its 940 million population, nearly 20% live in the coastal areas. Many highly populated and industrialised cities like Bombay, Madras, Calcutta, Cochin, Visakhapatnam are located along/near the coastal areas. There are 12 major ports and a number of minor ports handling shipping to various degrees of intensity. The coastline of the mainland falls under the divisions of 9 States and two Union Territories. The coastline of islands of Andaman, Nicobar and Lakshadweep (Laccadives) group of islands constitute nearly 2,000 km.

The coastal sea is subjected to varied degree of environmental stress due to a variety of existing developmental activities and large-scale human settlements. Demographic pressure and rapid industrialisation has resulted into generation of a variety of wastes. These wastes both in solid and liquid form reach the marine environment either directly or indirectly through rivers and creeks, causing pollution in marine environment. Marine pollution in the coastal waters of seas around India is being caused primarily by the disposal of untreated domestic wastes. This is prominent in the seas off major metropolitan cities like Bombay, Cochin, Madras and Calcutta and also other prominent cities like Surat, Mangalore and Visakhapatnam. Considerable degradation of coastal environment and coastal habitats like lagoons, estuaries in a localised manner have been observed at most of the locations along the coastline of India.

The above scenario remains more or less same for most of the developing countries. Since these conditions have regional and global implications, the United Nations Environment Programme (UNEP) organised in 1995, an Inter-Governmental Conference for adoption of a **Global Programme of Action for Protection of the Marine Environment from Land-based Activities (GPA).** The objective of the action plan is to take actions at the National level to promote formulation of strategies and adoption of technologies which will minimise the adverse impact of land-based activities on the marine environment. As a follow-up of the GPA, a workshop on implementation of the GPA in the South Asian region comprising of India, Bangladesh, Nepal, Maldives,

Pakistan and Sri Lanka was organised in 1997 where in it was decided a National Action Plan to implement the GPA will be prepared by all the South Asian Nations indicating the assessment of the problem, priorities and management strategies to be adopted to implement the action plan. As a part of this need, the present National Action Plan for India has been prepared.

Coastal Areas of India and Land-based Activities

The coastal states of India constitute namely, Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamilnadu, Andhra Pradesh, Orissa and West Bengal which are governed by the State Governments. The Union Territories such as Andaman & Nicobar islands, Lakshadweep islands, Pondicherry, and Diu & Daman are governed by the Central Government even though the local Governments/Councils also play a vital role in their governance.

India has several critical habitats like mangroves, coral reefs, sea grass beds, turtle nursery grounds, wild life sanctuaries along its coastline. The land-based activities include waste disposal from municipalities, tourism, ship breaking, aquaculture, mining and developmental activities like ports, harbours, industries, power plants etc. The following text gives in detail the level of these activities and their impact on the coastal areas and their resources and the coastal population.

OBJECTIVES

The objective of the National Action Plan is to eliminate pollution deriving from land-based sources and activities, in particular to phase out inputs of the substances that are toxic. The specific objectives are

- Formulation of principles, approaches, measures, priorities and schedules for action
- Identification of national problems, evaluation and selection of strategies and measures
- Devising of specific programmes to address the priorities

A. IDENTIFICATION AND ASSESSMENT OF PROBLEMS

(a) Identification of Nature and Severity of Problems especially in Linked Sectors

i) Food Security and Poverty Alleviation

The land-based activities have a great deal of impact not only on the marine environment, but also on the socio-economics of the coastal population.

The coastal population living both in urban and rural areas consume rice and wheat as the staple food. The supporting dietary items include cereals, pulses, vegetables, meat, fish etc. While large part of the population derive the staple food from the land-based sources, nearly 60% of the coastal population are in the habit of consuming marine organisms like fish with a frequency of once or twice in a week. The average per capita consumption of the marine products among the coastal population is 50 gram per day.(Planning Commission, 1999)

Coastal Population, Decadal Growth and Literacy (as of 1991)

Name of State	No. of Coastal Districts	TotalPopulation (million)	Decadal Growth	Literacy Percentage
West Bengal	2	14.05	24.53	57.72
Orissa	4	15.01	19.50	48.55
Andhra Pradesh	9	28.65	23.82	45.11
Tamil Nadu	8	21.99	14.94	63.72
Kerala	10	23.69	13.98	90.59
Karnataka	2	33.90	20.69	55.98
Goa	2	1.16	15.96	76.96
Maharashtra	4	9.40	25.36	63.05
Gujarat	14	32.78	20.80	60.91
Pondicherry	1	0.80	30.60	74.91
Diu & Daman	1	0.10	28.43	73.58
Andaman & Nicobar	2	2.80	48.70	67.15
Lakshadweep	1	0.051	28.47	72.89
Total	60	184.381		

Large population and low wages, particularly among the lower income groups, makes India, in general, as one of the poor countries with 365 million of its population still remaining below the poverty line. The population of poor people is estimated to be 320 million in 1993-94. In case of coastal areas, the

population below the poverty line is estimated to be 64 million.(Planning Commission, 1999)

India produces 2.95 million tonnes of marine products every year with fish representing nearly 90% of the marine catches. The coastal fishermen with an estimated population of about 22 million consume by and large rice and wheat supported by small quantities of vegetables and cheaper variety of fish. The Government has introduced the Public Distribution System (PDS) with a focus on the urban and the rural poor. Under this system, basic items like rice and wheat are distributed to the poor population at subsidised rates. A special programme like Integrated Rural Development Programme (IRDP) is operational for the last 20 years. IRDP aims at providing self-employment to the rural poor through acquisition of productive assets or appropriate skills and facilitates generation of additional income on a sustained basis to enable them to cross the poverty line. Under this programme, 51 million families have been covered. The Government has incurred an expenditure of Rs.11,400 million during the year 1996-97. A review conducted on the effectiveness of the programme indicated that it has helped in generation of incremental income to the poor families, but in most cases, the incremental income has not been adequate to enable the beneficiaries to cross the poverty line on a sustained basis, mainly because of a low per family investment. However, a few percentages of population, who had the opportunity to generate a basic income of Rs.11,000 per year could cross the poverty line, due to incremental income derived by them through the IRDP programme. Analysis revealed that the major constraint in the implementation of IRDP has been sub-critical investments, which have adversely affected the Incremental Capital Output Ratio (ICOR) levels and thereby undermined the viability of the projects. A detailed review of the programme during the Eighth Five Year Plan (1992-97) helped the Government to refocus the programme to the literate unemployed youth below the poverty line in order to uplift their living standards by giving them subsidy.(Planning Commission, 1999)

Most of the India's coastal population live in the rural areas and the fishing sector, which is one of the major income generation sectors in the rural areas, is fast mechanising. A programme namely Training of Rural Youth for

Self-Employment, aiming to provide training to the rural youth in a variety of sectors like agriculture, fresh water fishing and marine fishing. The scheme is under implementation from the year 1993 and a quick review of the scheme conducted revealed that the response was mixed with a few sectors showing a sign of crossing the poverty line with better opportunities of employment using the training for them, which, of course, largely depending on the skill of the youth.

As a part of the poverty alleviation programme, a special scheme for Development of Women and Children in rural areas aiming at strengthening of the general component of IRDP was started in the year 1982-83. The main strategy adopted under this scheme is to facilitate access for power women to employment, skill upgradation, training credit and other support services so that the women as a group can take up income generating activities for supplementing their incomes. The scheme was found to be successful in the States of Andhra Pradesh, Kerala and Gujarat. It related to the empowerment of women in decision making on various social aspects that impeach on their daily life. The length of activities pursued by these groups are also fairly diversed. Some started mini banks and then reduced the dependence on money lenders. Other groups are managing lands taken on lease. A few groups found mini transport companies having acquired autos, light commercial vehicles etc. by bank lenders. The success of this scheme has been attributed to adult literacy among women and its culmination in the womens' movement and close involvement of NGOs. The Government is proposing to have an institutional mechanism for replicating the success of this programme through out the country. The other schemes like Jawahar Rozgar Yojana, Employment Assurance Scheme, Million Wells Scheme, National Social Assistance Programme etc. have also been launched with an aim of generation of additional gainful employment for unemployed and underemployed persons.(Planning Commission, 1999)

ii) Public Health

India was one of the pioneers in health service planning with a focus on primary health care. Improvement in the health status of the population has been one of the major thrust areas for the social development programmes of the

country. This was to be achieved through improving the access to and utilization of health, family welfare and nutrition services with special focus on under served and under privileged segment of population. Provision of safe drinking water and supplementary food to the school children was one of the major supportive schemes to the health schemes. The health programmes including the awareness programmes on diseases etc. helped in steep decline in the Crude Death Rate (CDR) from 25.1 in 1951 to 9.0 in 1996. Life expectancy rose from 32 years in 1947 to 61.1 years in 1991-96 with female life expectancy higher than the male. However, the morbidity due to common communicable and nutrition related diseases continue to be high.(Planning Commission, 1999) The Government has launched a special action plan for health, which envisages expansion and improvement of the health services to meet the increasing health care needs of the population, however, no specific targets have been set.

iii) Coastal and Marine Resources and Eco-system Health including Biological Diversity

India has an Exclusive Economic Zone (EEZ) of 2.02 million sq. km. with a coastline of 7500 km. The sea of Indian Coastline supports a wide range of marine flora and fauna. Its seabed is rich in minerals, oil and natural gas.

Living Resources

The coastal offshore environments support a wide variety of living resources such as algae, corals, seaweeds, shellfish, finfish and mammals. The brackish water areas along the Indian coastline, including marshes, backwaters, mangroves, intertidal and sub-tidal areas, measure about 1,416,300 ha. These areas act as feeding and nursery grounds for a variety of commercially important fish, prawn and crabs. They are also important for inland transportation and fishing.

Microbial Diversity

Bacteria and fungi are abundant in practically every habitat of the sea. Each habitat harbours unique assemblages of species. In addition to their importance in maintaining ecological balance in the ecosystem, microbial

biodiversity is used in many biotechnological applications. Organisms with novel and unique properties may be present in the marine environment. This potential has hardly been tapped.

Plankton

Due to enrichment of nutrients, the coastal waters show higher biomass of phytoplankton cells. Reports indicate a range of 37 to 11300 cells/ml. The zooplankton density also exhibits a wide range of population of 21.05 to 78046 Nos/m^3. While the phytoplankton is dominated by the diatoms, zooplankton is dominated by the copepods.

Seaweed

Over 630 species of marine algae have been reported from India. The annual production of seaweed is estimated at 70,000 tonnes (fresh weight). Maximum biodiversity of marine algae occurs in the Gulf of Kachchh and Mannar regions and the Lakshdweep and Andaman-Nicobar groups of islands.

Seagrass

Major seagrass meadows occur along the southeast coast off Tamil Nadu and in the lagoons of a few Lakshadweep Islands. Flora comprise 14 species of seagrass dominated by *Thalassia hemprichii* and *Cymodocea* species. The total standing crop is estimated at 7000-8000 metric tonnes. Over 100 species of marine algae have been observed in the beds of seagrass. Few economically important species of algae such as *Gracilaria edulia* could be cultivated in the seagrass beds on a large scale. A seagrass called *Enhalus acoroides* is now a threatened species.

Mangroves

Mangroves are an easily discernible transitional system found between terrestrial forests and life in the open sea. They are found along the islands, major deltas, estuaries and backwaters of the East Coast of India. They also exist along the oceanic island groups of the Andaman and Nicobar. The total

mangrove area of India is estimated at 681,976 ha. Gangetic Sunderbans (418,888 ha), Andaman Nicobar Islands (115,000 ha), Krishna, Kaveri and Godavari deltas and Mahanadi delta are some of the best mangrove areas in India.(Envis, 1997) Mangroves in the Andamans and Nicobar Islands are considered to be some of the most important in the world. The mangroves along the West Coast of India are dense, but they are scattered and comparatively small in area.

The mangrove ecosystem is rich in organic detritus and nourishes a wide variety of marine fauna. Crabs, mullets, mussels, oysters, fishfry and prawn seed are abundant here. There are about 45 mangrove species found along the Indian coast. These belong to the *Rhizophora, Avicennia, Bruguiera, Sonneratia, Canocarpus, Heretiera, zylocarpus, Ceriops*, and *Exoecaria* genera. Some of the common and economically important species include *Mugil cephalus, Hilsa ilisha, Lates calcarifer, Scylla seratta, Meretrix casta and Crassostrea grephoides.*

Mangroves are ideal spawning, breeding and nursery grounds for near-shore and estuarine organisms. They also serve as coastal stabilizers and shelter belt areas that protect the coasts and landward areas from erosion and cyclonic destruciton. The mangrove forests of India are also important from the point of view of wildlife preservation. Sunderbans is an important tiger habitat while the Mahanadi delta is a crocodile sanctuary.

Benthic Fauna

Benthic organisms form the food for demersal fishery resources such as shrimps and flat fish. Demersal fishery resources, mainly shrimp, provides a living for millions of fishermen along the Indian coast. The benthic communities sustain the demersal fishery resources in the food cycle of the sea. Benthic fauna largely consists of Plychaeta (62 %), crustacea (20 %) and molluscs(18%).

Coral Reefs

Coral reef formations are found in the Palk Bay, Gulf of Mannar, Gulf of Kachchh, Central West Coast of India, Lakshadweep atolls, and Andaman and

Nicobar Islands. Both the coral atoll and the fringing coral reefs are of immense importance. A few species of corals have recently been reported from the Malvan (Maharashtra) coast. Thirty-two genera from Minicoy Islands, 34 genera from Palk Bay and Gulf of Mannar, 25 genera from Andaman Islands, 9 genera from Lakshadweep and 3 genera from Nicobar Islands have also been recorded. 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. The Nicobar Islands have the greatest diversity with 42 genera and 9 sub-genera, followed by Lakshadweep islands (28 and 9), Andaman islands (25 and 8), Gulf of Mannar Islands (26 and 4) and Gulf of Kachchh islands (20 and 1). *Psammocora (Plesioseris)* and *P.Stephanaria* are found only in the Lakshadweep Islands. The record of diversity in Indian reefs is yet to be completed since extensive collections and detailed taxonomic studies have been undertaken on only a few islands reefs. (ENVIS, 1998)

Reef-associated Resources

Fish - The single most important living resource from the reefs edible fish. The reef areas yield 20 tonnes per sq km per year. The heavily fished coral-line shelves produce sustained harvests of about 5 tonnes per sq km per year. In Indian islands, fishing is mostly for sustenanace and local consumption. Hence the potential has not been exploited fully. This is obvious from a comparison of the present recorded yield of about 1 tonne per sq km per year, with the potential yield of 10-15 tonnes per sq km per year for reef areas.

Ornamental Fish - Ornamental fish from the reefs are of greater commercial value than the edible fish. In Indian islands, however, this still remains an untapped resource. Decrease of population of ornamental fish is noticed, due to decrease of coral reef coverage.

Molluscs - Molluscs constitute an important source of calcium carbonate from the reefs. The reefs and coral shelves of the Indian islands, which cover an

area of 19,000 sq. km, can be expected to have a potential annual production of about 19 million tonnes of calcium carbonate. Commercial exploitation of corals at present is mainly for use as building blocks in the construction of roads and in lime and cement industries.

Fishery Resources

According to a recent assessment, the annual potential yield of marine fishery resources in the Indian Exclusive Economic Zone is 3.92 million tonnes, about 65 per cent of this potential is already being tapped. The annual catch as of 1997-98 is 2.95 MT at an estimated value of Rs.44,250 million. While resources upto a depth of 50 m are being fully exploited, resources available beyond this depth still offer scope for increasing the level of exploitation through the introduction of a judicious mix of resource-specific small and large fishing vessels. About 80 per cent of the present level of marine fish production comes from within a depth of 50 m and about 20 per cent from depths upto 200 m. Traditional and mechanized sectors contribute almost 98 percent of this production. The deep sea fishing sector contributes a mere 2 per cent of total production.(CSD Report 1996)

Out of the available potential of 1.4 mt in the offshore region it is estimated that only 1.13 mt is of commercial value. About 86 per cent of this potential is estimated to be of low commercial value, while only 14 per cent is of medium to high value. Even this could yield over Rs. 7200 million as foreign exchange through export.

Over the years commercial fisheries have primarily exploited high-priced shrimp, lobsters and certain finfish found in the coastal areas upto a depth of 50 m. This has resulted in a stagnation in the production of shrimp and reduction in the landings of certain species of finfish. Between 1985 and 1990, the annual production of penaeid prawns stagnated at 0.12 mt.

Concentration of efforts on shrimp fishery has resulted in large quantities of fish by-catch being discarded at sea or sold as trash fish. The by-catch being discarded at sea or sold as trash fish. The by-catch consists of low value fish and juveniles of valuable edible fish species. Studies undertaken by the Bay of

Bengal Programme (BOBP) have revealed that the discard from the fishing vessels operating in the east coast alone amounts to about 120,000 tonnes of by-catch on an average every year. At least 10-12 per cent of by-catch discarded is of sufficiently high value to be iced and sold in the retail markets. The remaining could be processed and used as feed.

Estimated Fishery Potential in the Indian EEZ

Region	0-50m depth	Beyond 50 m depth	Oceanic	Total
Northwest coast	866.7	567.0		1433.7
Southwest cost	565.5	357.3		922.8
Lower east coast	401.3	100.9		502.2
Upper eat coast	423.7	164.2		587.9
Andaman & Nicobar	22.5	139.0		161.5
Lakshadweep	-	63.0		63.0
Residual in 300-500 m depth	-	4.0		4.0
Total	2279.7	1395.4	246.0	3921.1

Non-living Resources

The continental margins and deep seas around India have many important non-living mineral deposits such as petroleum, terrigenous minerals like placer sands, and chemogenesis deposits like polymetallic noduls. The occurrence of phosphorites and hydrothermal activity (Hydrothermal sulphide &) has also been reported. Out of these only hydrocarbon deposits are being systematically explored and exploited and very limited information is available on other resources.

The detailed offshore Heavy Mineral investigation in the nearshore areas of Konkan coast, Maharashtra, covering 13 bays and an average of 436 sq km upto 20 m of water depth has indicated the presence of promising deposits of the mineral ilmenite (an ore for metal titanium). Concentrations of ilmenite range upto 64 per cent and ore benification studies have indicated that this ilmenite is

suitable for conversion into synthetic rutile. The inferred deposit of ilmenite is estimated to be 12.5 million tonnes to a thickness of 1 m of sand.

No systematic exploration has been carried out so far for phosphorites. However, some sporadic occurrence of phosphorites. However, some sporadic occurrence of phosphorites has been reported in surface sediments off the shelf of Quilon (upto 10 per cent) and in the sub-surface levels (1 m below in the marginal highs off the Goa (upto 32.5 per cent)coast. Occurrence of a few varieties of mineral deposits along the beaches and placer deposits in the seabed have been reported during surveys conducted by the Geological Survey of India.

The inner shelf area from Sonapurampeta to Puri contains appreciable quanitities of ilmenite, sillimanite, zircon, rutile and monazite. There is a heavy mineral concentration varying from 1.54 – 30. 85 wt. Percentage, dispersed over a 2000 sq km area. (About 630 sq km of inner shelf area off Gopalpur – Chatarpur – Malud shows a higher incidence of heavy minerals. The heavy mineral sands may contain about 17.29 mt of ilmenite, 6.8 million tonnes of sillimanite, 4.86 mt of garnet and 1.62 mt of zircon, rutile and monazite.)

A survey of an area of 1900 sq km of the inner continental shelf off Kalingapatnam – Sonapurapeta has revealed that the inner shelf sediments are predominantly sandy and extend upto 35-55 m isobath. Stretching over a maximum thickness of 3-4 m in 10-25 m isobath off Baruva – Bavanapadu, the heavy mineral content of the surface sediments varies from 0. 04 – 23.63 per cent. It has been estimated that there is about 6 mt of heavy minerals in Baruva – Kapasukuddi, 4 mt in Bavanapadu-Tattikonda, 3.6 mt in Kidsingi-Rattikonda and 3.7 mt in Maruvada-Kambalaraidupeta, of which garnet, ilmenite and sillimanite vary from 0.07 – 5.22 per cent, 0.13 – 11 per cent and 0.13 – 3.15 per cent respectively.

Lime mud deposits have been found in two sectors (south of Padimadaka over an area of 450 sq km, and north of Padimadaka in an area of about 200 sq. km) Lime mud is thicker and richer in the central part and tapers towards the periphery. Thickness of lime mud is 2.5 . It is fine grained, white to creamy in

colour and shows an association with corals, skeletal debris and ooids. It is found in water depths of 130 – 180 m. The lime mud contains 55 – 92 per cent calcium carbonate, 3.36 – 4 percent magnesium carbonate and 1.5 – 2 per cent acid in soluble form. About 3.12 mt of ilmenite and 0.68 mt of magnetite have been estimated from an approximate area of 8.45 sq km in the Kalbadevi Bay.

The offshore occurrence of heavy mineral sands off the Quilon-Varkala sector is of economic significance. Close grid sampling in Chavara and Varkala sectors of about 10 sq km in each area reveal that the heavy mineral content varies from 1 – 12 per cent in Varkala and 1 – 20 per cent in Chavara sector. The concentration of heavy minerals is greater in shallow waters decreasing downwards in the vibro-core samples. A reserve of about 1.41 mt of ilmenite, 0.117 mt of zircon, 0.113 mt of rutile and 0.517 mt of sillimanite in the above two small areas has been estimated. The reserve may increase in this sector, once the survey of the whole area is completed. The calcareous sands of Lakshadweep are of good quality and are low in silica, alumina and iron. The estimated reserve of calcareous sand in the lagoons down to 1 m from seabed is around 288 mt.

The Oil and Natural Gas Commission (ONGC) has established 3568.73 MMT geological reserves of oil and oil equivalent gas in offshore areas of which 1268.74 MMT are recoverable reserves. (CSD 1996)

The details on degradation of marine resources etc. are dealt under areas of concern.

iv) Economic and Social Benefits and Uses including Cultural Values

The coastal and marine areas bring enormous economic benefits through their resources like fisheries and usages like seafront for ports and harbours, beaches for tourism and other recreational activities. It has been estimated that the economic benefits arising out of marine living resources is Rs.44,250 million during 1996-97. The tourism sector earns a revenue of Rs.11,000 million. The coastal land areas have provided an excellent habitat for settlement of human and related activities. The rapid increase of industries along the coastal areas is

mainly due to the fact that the sea acts as a medium for receiving the waste disposed by the coastal industries. Most of the power plants, which have been set up in the recent years, located along the coastal areas, are mainly deriving benefit of obtaining the cooling water from the sea. The growth of the industries and associated infrastructure has provided employment opportunities to a large number of coastal population, which has enhanced their living standards.

Several cultural activities also take place along the coastal areas. The religious festivals conducted along the coastal areas, particularly by the temples, churches and mosques, facilitate the growth of religious tourism, which finds a place in India as a cultural promotion not only for the coastal population, but also for the people living in the far inland areas. The prominent places of religious tourism in India include Dwaraka (Gujarat), Mumbai (during the festival season), Goa, Malpey, Cochin, Trivandrum, Kanyakumari, Rameswaram, Tiruchendur, Velankanni, Nagapattinam, Machilipattinam, Puri, Saugar Island and Sunderbans. The growth of religious tourism also facilitates direct and indirect employment opportunities to the coastal population in all the areas. Noticeable increases in the living standards of the local people, even though they are not in large numbers, are common in the recent years.

(b) Contaminants

i) Sewage

The current estimated population of India (1998) is 940 million and nearly 20% of the population live within 40 km from the coastal sea. Mega Cities like Mumbai and Chennai and fast growing cities like Surat, Panjim, Mangalore, Cochin, Trivandrum, Pondicherry, Visakhapatnam and Puri are situated along the coastal areas. The inland cities like Calcutta is linked with the sea through a perennial river namely Hooghly (name of the river Ganga at its one of the deltaic areas). Cities like Mumbai, Chennai, Surat, Mangalore, Cochin, Visakhapatnam and Calcutta are heavily industrialised.

Constant increase of population and rapid industrialisation in the recent years have led to the generation of enormous wastes in the coastal cities and towns. These wastes, both domestic and industrial in nature, are directly

disposed off into the sea through creeks or through the rivers situated in these coastal cities and towns. A variety of contaminants ranging from putrified organic matter, pathogenic bacteria and heavy metals reach the marine environment from these sources. The details of these contaminants are given below:

Characteristics of a Typical Domestic Sewage mixed with Effluents From Small and Medium Scale Industries

Parameter	Mumbai µg/l
Dissolved Solids	1450000
Suspended Solids	245000
BOD	258000
Sulphate	75000
Nitrogen	35000
Phosphorus	6000
Chloride	587000
Manganese	507000
Iron	2529
Cobalt	30
Nickel	81
Copper	110
Zinc	251
Lead	11

It has been estimated that (as of 1991) the total amount of 4747 Million Litters per Day (MLD) waste water is generated in the major coastal cities and towns. It has been estimated that, out of 4747 MLD of waste water generated, only 4147 MLD is being collected through sewerage systems. Details of coastal cities and towns and quantity of waste water generated are given in **Annexure 1**

ii) Persistent Organic Pollutants (POPs)

The POPs like DDT are not being used in India to a large extent and only, in the case of outbreak of epidemics, DDT is being used. Survey conducted in

the past indicated the presence of DDT and HCH at very low levels (parts per billion) in muscles of marine fishes.

iii) Radioactive Substances

Although power generation is mostly thermal in India, nuclear power is also being generated from the nuclear power plants located in the coastal areas at Tarapur and Kalpakkam. So far, no serious harm has been reported from these sources. Radioactive wastes from nuclear power plants are normally disposed off according to international regulations. However, their heat generation poses several problems. Nuclear power plants normally release 50 per cent of their generated heat to the coastal marine environment through outlet water. Localised damage to ambient flora and fauna appears to be unavoidable.

iv) Heavy Metals

Heavy metals like copper, nickel, cadmium, lead, iron, manganese and mercury arise mainly from the industrialised wastes. Chemical characteristics of wastes arising from the industries and industrial estates are given **Annexure 2**. These wastes reach the marine environment directly through pipelines, creeks or through the sewerage systems.

v) Oils (Hydrocarbons)

The major source of oil from the land-based activities is due to the disposal of oil and allied substances from the chemical industries and the refineries. Oil pollution is a chronic problem in ports and harbours.

vi) Nutrients

The nutrients like aluminium, nitrite, nitrate, phosphate and silicate originate from domestic, industrial and agricultural sources. There is a little evidence of entrophication in the coastal waters.

vii) Sediment Mobilization

Sediment, particularly the suspended sediment, is one of the major sources of substratum for Mangroves along the coast of India. These sediments

originating from rivers also contribute to the nutrient budget of estuaries and coastal waters. The sediment load from the rivers, through estuaries, contributes to the stabilization of coastline in the form of beach building. The contribution of sediments by the rivers situated along the West Coast of India varies with those of the rivers along the East Coast. While the rivers of South Gujarat coast contribute large quantity of sediments during the monsoon months, their contribution during the next monsoon months is quite low. The Hooghly river which has perennial water supply brings sediment to the tune of 20×16^6 tonnes per year. The Characteristics of sediments from the Hooghly estuary could be traced up to northern part of Andaman islands.

India has 8 major coastal lagoons, of which Chilka, Pulicat and Vembanadu are the most prominent lakes. The Chilka is the largest and is spread over an area of 1100 sq. km. It has been declared as a Ramsar site. The heavy siltration, contributed by the surrounding rivers has led to decrease in the lake area. Such silting is also noticed in other lakes like Pulikat, Vembanadu and Nizampatanam. The excess input of nutrients to the lake has led to luxurious growth of macro plants. Growth of such plants has been shifting the eco system from faunal to floral categories.

viii) Litter

The major source of litter along the Indian Coastline is solid waste being dumped by the coastal population, particularly those who are living close to the beaches. The ships and other crafts, which are passing through the Indian waters, also dispose off the solid waste into the sea. Recently, the ship breaking activities prevailing in Alang (Gujarat Coast) also contribute to the dumping of solid waste like rubber and wooden materials to the adjoining sea.

(c) Physical Alteration, including Habitat Modification

The coastal habitats in India mainly include mangroves, lagoons and estuaries, besides, backwaters and associated eco system like mud flats. This habitats are greatly influenced by land based activities like discharge of sediments, wastes from domestic and industries as well as cutting of trees in the mangroves areas for fuel and fodder.

Prominent alteration of the habitats has been noticed in the lagoons, estuaries and backwaters and little alteration in mangrove areas. The physical alteration of other habitats is mainly due to reclamation of land for human activities like human settlement, construction of industries etc. Developmental activities like construction of ports and harbors are also contributing to the alteration of nearby coastal habitats. The disturbances of coastal process due to construction of breakwater in the ports have led to severe accretion of beach sand on the mouth of estuaries resulting in accumulation of land based waste in these water bodies. Several examples exist along the East and West Coast of India. The prominent one is being Cooum river mouth close to the Chennai port. It is found that the mouth area has been accreting to the extend of 1.5 m per year during the non-monsoon seasons. About 50 years ago, the Cooum River had considerable freshwater and estuarine biodiversity. As the river is filled up with domestic sewage and sledges, it does not have any living organisms. Even during the flooding season, there has been found to be very low recovery of biodiversity.

Large scale exploitation of corals by cement industries in Gulf of Kachchh and Mannar has totally affect the coral reef areas. The damming effects in the upper reaches of the rivers have changed the coast of many rivers, decrease the water flow and sand accumulation at the mouth as completely transferred the eco system from estuarine through fresh water with very low biodiversity due to accumulation of land based waste discharged in the rivers by town and cities locating along the sides of these rivers.

(d) Sources of Degradation

i) Point Sources (Coastal and Upstream)

a) Waste Water Treatment Facilities

The waste water treatment facilities are available with large industries located along the coastal areas of the countries. The treatment of domestic waste is prevalent to some extend only in Mumbai. The details on generation of sewage along the coastline of the country is given in **Annexure 1.** Release of

raw sewage into the coastal waters by the Municipalities and Corporations have suitably deteriorated seawater quality with nil to low levels of dissolved oxygen and high levels of bacteria around the disposal points. For example Thane, Basein, Mahim and Veservacri off Mumbai where large quantity of raw sewage is disposed, the oxygen level during the low tide period is found to be nil to 2 mg/l. Similarly in the sewage disposal point of Raipuram in Chennai and at similar locations in Surat, Mangalore, Vizag, E.coli counts were as high as 2800 x 10^3. It has been found that the dissolved oxygen level and the pathogenic bacteria improve towards offshore. The population of marine organisms both Pelagic and Benthic is found to be very low in and around sewage disposal points. Due to the presence of oxygen levels above 5 mg/l beyond the disposal points, no deterioration of water quality has been found and sea believed to assimilate all the organic pollutants arising from the sewerage.

b) Industrial Facilities

A variety of industries like chemical, pharmaceutical, steel, automobile, textile etc. are situated along the coastlines of India. The state wise details of large and medium industries located along the Indian coastline are given in **Annexure 2.**

The primary causes of industrial pollution are as follows:

- Prevalence of outdated, inefficient technologies which generate large amount of waste
- Large unplanned industrial conglomerations which have been encroached upon and severely pollute their environs.
- The absence of ecological zoning and industrial siting norms.
- Existence of large number of small scale industries which escape land use and environmental regulations.
- Lack of resources for implementing pollution control programmes.
- Poor enforcement of pollution control laws.
- Industrial wastes account for 25% of waste water and over 50% of the pollution load.
- Storage and dumping of solid and hazardous wastes.

Investigations revealed that nearly 90% of the major industries treat the effluents. The major concern is innumerable number of small and medium scale industries, which discharge their effluents either in the backwaters, creeks etc. or in the municipal sewerage. It has been found that the mixture of sewage and effluents from small and medium scale industries have led to very high concentration of zinc and mercury in the sediments of Thane Creek (Mumbai). Industrial discharges from the other cities and towns have not revealed high concentration of toxic metals like cadmium, arsenic and mercury. However, high levels of other metals like lead, zinc and manganese were observed. Toxicity of marine organisms due to accumulation of heavy metals in sediments is uncommon along the Indian coastlines except from the fauna collected from Thane and Mahim Creeks of Mumbai, wherein the polycheatres showed high concentration of lead and mercury. Very low population of benthic organisms has been noticed in 5 sq.km area close to these creeks. A prominent source of acidic effluents from an industry located at Trivandrum of South east coastline also caused declining of Marine organisms in the 2 sq. km area in the sea.

c) Power Plants

The power plants along the coastal areas are located in Gulf of Kutch (Gujarat), Mumbai (Maharashtra), Mangalore (Karnataka) and Tuticorin and Chennai (Tamil Nadu). These power plants draw enormous quantity of sea water for cooling purposes and discharge these waters in the coastal wastes with an elevated temperature of around 5°C than the ambient water. For example, the intake volume of sea water in case of North Chennai Terminal Power Plant is around 55000 m^3. While the fly ash resulting from burning of coal is dumped as a landfill in the new power plants at Chennai, the old power plants in Chennai disposes into the sea, after mixing it with sea water. The concentration of suspended matter exceeds as much as 35000 ppm in the slurry. Localised impact of flora and fauna in the discharge area has been noticed.

d) Military Installations

There are no military installations along the coastal areas, which generate pollutants and disposes them into the sea.

e) Recreational/Tourism Facilities

The coastal tourism in India in the form of beach tourism and resorts is popular only along a few stretches of the coast. These locations include Goa, Kerala and a few parts of Maharashtra and Tamil Nadu. The tourism activities along the coastline of India are mostly in the form of day tourists visiting to beaches. These tourists, mostly in Mumbai, Goa, Malpay, Cochin, Trivandrum, Kanyakumari, Rameswaram, Chennai, Visakhapatnam, Puri and Dhiga, utilise the beaches for short-term recreational purposes (2 to 3 hours in a day), due to prevalent of hot humid conditions during the day. In view of the presence of large number of people in the beach during these limited hours, disposal of solid wastes, which are mostly paper products and sometimes polythene bags, is evident. It has been noticed that during several occasions, these polythene bags, which are non bio-degradable, are carried into the sea by the winds.

Due to the location of religious places at a few locations along the coastal areas, localised degradation of sea water occur because of improper sanitation facilities. High counts of pathogenic bacteria are also evident during the occasions.

f) Construction Works (Ports, Harbours etc.)

Along the Indian Coastline of 5500 km in the main land, there are 12 major ports and a large number of minor ports facilitating handling of large number of materials and products, ranging from sophisticated electronic goods upto oil. The total volume of crude oil, cargo handled in all the 9 major ports during the year 1996-97 is estimated to be 51 MT. These port activities contribute to the chronic oil pollution due to operational discharge of waste, mostly by medium and small ships of less than 150 GRT, where installation of oil-water separator is not mandatory. The garbage and human waste disposal by these small and medium scale vessels, which do not have treatment facilities, also poses problem of organic pollution.

The coastal structures like brackish water, which form part of the ports, cause erosion and accretion of coastal areas. This is prominent along the East

Coast, where littoral drift is very strong. The obstruction of littoral drift by breakwaters causes accretion on the southern side and erosion on its northern side. It has been estimated that, due to construction of brackwater for Chennai Port, there is an annual accretion of 1.5 m of sand in the Southern part, while there is an erosion at a rate of 1.7 m per year in the Northern part. The ports, which are situated close to the river mouths, particularly Paradeep along the Orissa Coast results in accretion in the deltaic area resulting into the poor exchange of sea water in the Mahanadhi estuary.

Reclamation of coastal areas particularly the sea areas for human settlement is common along Maharashtra and Kerala. This has led to destabilisation of coast in the form of erosion in the impact areas leading to loss of several hectares of land and also a huge expenditure for remedial measures to prevent the erosion.

g) Coastal Mining

The beaches of Kerala, Orissa and Tamil Nadu are rich in minerals. The concentration of heavy minerals is found to occur between Quilon and Varkala sector of Kerala Coast. A reserve of about 1.41 Million Tonne (MT) of Ilmenite, 0.117 MT of Zircon, 0.113 MT of Rutile and 0.517 MT of Sillimanite. The mining of heavy minerals along the beaches is common along these locations. Mining of Zircon etc. is also being done along Tamil Nadu and Orissal Coasts. The mining in sub-surface areas of sea is yet to be initiated in India. Mining of beach sand has not resulted in any adverse impact, as the sand is redumped in beached after extraction of minerals.

The mining of iron ores in the upper reaches also play a vital role in the water quality characteristics of coastal areas of Goa. The mine rejects setting in the bottom are reported to affect clams etc.

h) Research Centres

The academic and R&D institutions are located throughout the coastline of India with the activities by and large confined within the institutions. Collection of biological specimen by university students along the coastline of the country

particularly in the bio-sphere reserve of Gulf of Mannar are found to deplete the bio-diversity.

i) Aquaculture

The aquaculture activities in the form of shrimp farm is predominant along the coast of Andhra Pradesh, Tamil Nadu, Orissa and West Bengal. Shrimp farming is also being done at lesser scale in Kerala and Gujarat. It has been estimated that 100,000 hectares of coastal land areas is being used for aquaculture. The major impact of aquaculture has been found to contaminate aquafers due to seepage of brackish water from the salt farms, which affect the nearby agricultural fields also. Predominant changes in the land use pattern from agriculture to aquaculture is also reported in Andhra Pradesh and Tamil Nadu. The changes in the land use pattern and ground water contamination have caused several socio-economic implications, which made the shrimp farming as one of the most unpopular industry in India.

j) Habitat Modification

Under the previous section, modification on the degradation of the wetlands like Chilka lake, due to land-based impacts like sedimentation, reclamation etc., have been spelt out. It has been estimated that the size of the lake has been diminishing by about 1.5 sq km per year since 1925 due to annual siltration process and reclamation. The estimated quantity of silt discharge alone is 13 m tonnes per year. The satellite imagery shows that an area of about 46 sq. km has been silted up. Due to such changes, the floral and faunal characteristics of the lake have undergone considerable changes with loss of several species of flora and fauna. A table given in **Annexure 3** indicates the present status of flora and fauna in Chilka lake.

k) Introduction of Invasive Species

There are no reliable reports indicating introduction of alliance species in Indian Waters, except introduction of a virus, which caused white spot disease in prawn farms, particularly in the farms, which adopt the method of some intensive and unintensive farming. The virus is reported to have come from the imported seeds.

ii) Non Point Sources

a. Urban Run- off

31% of the Indian population (estimated to be 291 million as on 1997) are living in the urban areas. It has been projected that the population will increase with a figure of 289 million in 2001 and around 605 to 618 million during 2021 – 2025. There would be about 14 major cities in the country in 2001 as against 21 in 1991. A large parts of civic communities, particularly water supply, sanitation and sewerage are managed with the assets that have outlived the operational efficiency. The lack of comprehensive urban planning in the past to promote regular upgradation and renewal has resulted in a large backlog of civic communities like collection and treatment of solid and liquid waste generated by the urban population. The quantity of waste water generated by the urban societies in the form of sewage is estimated to be 3560 ml/d. The wastewater reaches into the coastal waters through rivers and numerous creeks. The waste water contains large amount purified organic matter with BOD value of more than 89 in places like Mumbai and Chennai. The high amount input of organic matter through these rivers and creeks have resulted in low oxygenated sea water close to the drain area. Nil dissolved oxygen values have been reported even up to 500 m of coastal waters and other water bodies. Concentration of chemical constituents of a non-point source like Cooum river in Chennai is given in **Annexure 4.**

b. Agricultural and Horticultural Run-off

India is basically an agricultural country with rice, wheat and cereals as the prominent crops in the interior as well as coastal areas. The agricultural sector consumes nearly 80% of the water generated through rivers and underground sources. Run-off from agricultural and horticultural fields mainly reaches the adjoining rivers and backwaters. It has been reported that the quantity of fertilizer used is about 75 kg/ha.(Planning Commission, 1999) Large quantity of fertilizers which are mostly nitrogenic and phosphoric in nature is being used in agriculture. The resultant chemicals from the agriculture are nitrate and phosphate, which mostly cause eutrophication of rivers and nearby coastal areas. The report of eutrophication of coastal waters due to agriculture is only at

very few locations like Hooghly, Mahanadi, Subernarekha, Krishna and Godavari delta.

In the agriculture and horticulture, a variety of pesticides are being used. Most of the pesticides belong to phosphorus, carbonate and synthetic pyrethroid group. The consumption of pesticides in India is 0.45 kg per hectare, which is far less compared to developed countries like Italy, which consumes 13.3 kg per hectare. The organo-chlorine pesticides like DDT, HCH are not being used in agriculture and they are restricted to public health only. Concentration of these organo-chlorines were found to be at PPb levels in riverine and estuarine fishes.

c. Forestry Run-off

The run-off from forest area is not distinguishable from riverine run-off, as most of the forest run-off drain into minor and major rivers. These rivers by and large pass through the coastal towns and cities. The impact of urban run-off is already discussed in the previous section.

d. Mining Waste Run-off

Mining of ores and resulted disposal of mine rejects are common in the rivers of Goa and Bihar. In case of Goa, it has been estimated that 30 - 45 MT mine rejects reach the coastal waters through major rivers like Mandovi and Zuari.

e. Construction Run-off

The run-off from construction activities in the land areas of Indian coast is known distinguishable as their meager in quantity and generally mixes with the urban and rural sewerage systems.

f. Landfills and Hazardous Waste Sites

There are notified landfill areas for disposal of solid wastes. However, at many locations, monsoonal ponds (accumilation of water in low level areas during rainy seasons) are used as landfills to dispose domestic wastes due to lack of drains. The hazardous wastes are handled as per the Hazardous Waste

(Management and Handling Rules) 1989. These sits are normally when petroleum products are being stored before their transhipment.

g. Erosion as a result of Physical Modification of Coastal Beaches

In the previous section of construction works, the impact of construction breakwater as a part of the port developmental activities, causing erosion has been described. In addition to the breakwater, coastal protection structures have also resulted in erosion of beaches. It has been reported that, out of 590 km of coastline of Kerala, nearly 470 km is covered with seawalls with an aim to prevent erosion of beaches. Due to ill-designing of seawalls, severe erosion of beaches has been reported, leading to modification of geomorphology of beaches. Such a feature is also common in parts of Karnataka, Tamil Nadu and West Bengal.

iii) Atmospheric Deposition

a. Transportation

The transport sector, which is composed of mostly large size vehicles like trucks, buses, cars and motorcycles, contribute to the pollutants like suspended matter, carbon monoxide, sulphur dioxide and petroleum hydrocarbons. It has been found that the metro cities like Delhi, Mumbai, Calcutta, Chennai and smaller cities like Cochin and Kanpur show high levels of suspended matters as well as sulphur dioxide. The carbon monoxide levels also remain high in metro cities like Delhi, Mumbai and Calcutta. Several health complaints like Tranquility are again reported in cities like Delhi. Compared to the inland cities, the coastal cities like Chennai have very low levels of atmospheric suspended matter, carbon monoxide and sulphur dioxide.

b. Power Plants and Industrial Facilities

The atmospheric pollution caused by power plants and industrial locations are restricted to suspended matter, sulphur monoxide and nitrogen monoxide. The values of these pollutants remain quite high around the industrial locations, particularly in areas where the dispersion rate over the atmosphere is very less. This is evident in coastal cities like Visakhapatnam, where the emissions by steel

and fertilizer plants, which are located within the city limits, remain suspended in the atmosphere over the city.

c. *Incinerators*

The atmospheric pollution caused due to the incineration of solid waste etc., is highly localised and is mostly restricted to open burning of solid waste collected from the domestic sources.

d. *Agricultural Operations*

Consumption of pesticides in India is estimated to be 0.45 kg per hectare. These pesticides are in liquid formulation and are sprayed using mechanical sprayers. Since mostly organic solvents are used in the pesticides formulation, the fraction of pesticides in the vapour component remains less. Very low levels of pesticides have been have been detected in the atmosphere adjoining to agricultural fields.

(e) *Areas of Concern*

i) Critical Habitats

In India the following areas have been identified as critical habitats due to presence of either Mangroves, Coral Reefs, rare/endangered species or due to uniqueness of the rain bio-diversity.

Gujarat

1. The Rann of Kutch (Okha, Mitapur and areas of breeding grounds of Flamingos)
2. Gulf of Kutch (Mangroves, coral reefs)
3. Piram - Gulf of Khambat (coral reefs)
4. Porbandur - Sutrapada (Breedi grounds)
5. Veraval

Maharashtra

6. Ratnagiri and Shirgao creek
7. Vijaya Durg
8. Aschra
9. Malvan

Goa

10. Chorao
11. St. George Islands

Karnataka

12. Kundapur
13. 7 Islands off Karwar

Kerala

14. Islands of Cochin backwaters
15. Asthamudi lake (coastal Lagoon)

Tamil Nadu

16. Entire Gulf of Mannar
17. Palk Bay (Mandapam to Point Calimere)
18. Pitchavaram

Andhra Pradesh

19. Pulicat lake
20. Nizampatnam
21. Ellichitadibba
22. Sacromanto island
23. Coringa

Orissa

24. Chilka lake
25. Mahanadi estuary (Hukitola, Jambu island)
26. Bhitarakanika

West Bengal

27. Lothian island
28. Sunderbans (Biosphere reserve areas)

29. Lakshadweep islands

Andaman & Nicobar islands

30. Great Nicobar (Biosphere reserve areas)
31. Car Nicobar
32. Wandoor national park and other notified areas

The details of distribution of mangroves, coral reefs and other special ecosystems are given under the Chapter Marine Resources. The current status of these habitats are given below:

Mangroves: Mangroves in India have suffered from various biotic problems such as reclamation and deforestation. The biotic problems like extreme climates resulting in cyclones and floods also pose a danger to mangroves. The Gangetic Sunderbans, Cochin backwaters, Bombay region and Gulf of Kachchh are examples of indiscriminate exploitation, reclamation and pollution. Mangrove forests have been converted into aquaculture farms and reclaimed areas for construction of causeways and roads. The effect of insecticides and pesticies like Dimacron, Nuvan and Nuvacron was also found to be harmful to these plants although at a slow rate.(ICMAM-GIS, 1999)

Coral Reefs: It has been observed that dead as well as live coral beds are exploited for the carbide industry and for white cement. Large scale exploitation of corals have been reported from the Gulf of Kutch and Gulf of Mannar. Reports indicate an annual degradation of 10 - 20% of coral area against rejuvenation of 2 - 5% area. Development of Tuticorin harbour and associated industrial activities as well as oil pollution, has resulted in large scale destruction of coral reefs around the islands of Tuticorin. Andaman-Nicobar fringing reefs and Lakshadweep coral atolls are comparatively free from such problems. The recent data of Minocy and Kavaratti atolls and Great Nicobar Island indicate that there is a definite effect of oil pollution on corals of these areas. *Acanthester plancii*, a reef dwelling echinoderm, which feeds extensively on corals, is also responsible for destroying the corals in these two major groups of islands. (ICMAM-GIS, 1999)

Sea-grass: The Sea-grass eco system is prevalent in the Gulf of Mannar, Lakshadweep and in few areas of Gulf of Kachchh. Due to human intervention and land reclamation, which is common in Gulf of Kachchh and Gulf of Mannar, the area of distribution of sea-grass is fast declining. Due to less disturbance by human, the sea-grass eco system of Lakshadweep is more or less preserved. The endangered species like Dugong which were occurring in Gulf of Kachchh and Gulf of Mannar have become rare in Gulf of Kachchh and

they are very few in number at present in Gulf of Mannar. Dugongs have not been reported so far in Lakshadweep islands. (ICMAM-GIS, 1999)

Turtle Breeding: An area nearly 35 - 40 km long stretch of coast extending from Maipura river mouth upto Hansa river mouth, known as Gahirmata, in Orissa form habitat of Olive Ridley Turtles. 0.3 - 0.6 million turtles nest along the beaches of this area. The turtle population is found to decrease during certain years due to unknown reasons. The turtles also get caught in the trawl nets operated for prawn fisheries along the Orissa Coast. The estimated population which are affected by the trawling is less than 2%.e Illegal catching for commercial purposes is also responsible for their decrease.(ICMAM-GIS, 1999)

Coastal Lagoons: In the previous section on coastal lagoons, the status of these lagoons particularly that of Chilka has been explained. Sedimentation, over exploitation of resources, formation of bar at the mouth of the lagoons leading to poor inflow of seawater are the common problems of the 8 coastal lagoons. Conversion of these eco-systems from marine to brackishwater is also common.

ii) **Habitats of Endangered Species**

Nearly 8 species of marine mammals, 5 speices of marine turtles, 1 species of hemichordata, 3 species of cephalochordata, 6 species of echinoderms, 2 species of Xiphosurans (Meristoma), 15 species of molluscs, 10 species of crab and 1 species each of Echiuroid and Brachipod are endanged.

There are certain commercially threatened marine finfish due to indiscriminate fishing are the whale sharks *Rhiniodon typus*, marine catfish of the genera *Tachysurus* and *Osteogeneousus,* the white fish *Lactarius lactarius*, the flat head *Platycephalus maculipinna,* the threadfins *Polynemus indicus (Dara)* and *P. heptadactylus*, and sciaenids *Pseudoscianena diacanthus (Ghol)* and *Otolithoides brunneus (koth),* the perch *Pomadasys hasta* and the eel *Muraenosox.*

The notable endangered species, which are of great concern are the Horse Shoe Crabs and Dugongs. 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. The habitats of Dugongs in Gulf of Mannar particularly the sea-grass eco-system are fast diminishing due to human intervention.

iii) Ecosystem Components including Spawning, Nursery and Adult Areas

Spawning and breeding of commercially important fishes occur all along the coastal areas of the country. Rich fishing grounds are noticed all along the coast of India, especially in the South West coast of India. Rich grounds of prawns are noticed along Kerala, Gujarat, Gulf of Mannar, Vishakhapatnam and Ganjam Districts of Orissa Coast. Juvenile fishing in nursery areas like estuaries and mangroves has been noticed all along the East Coast, which results in reduction of recruitment to the marine fishery.

iv) Shorelines

India has a shoreline of 7500 km and the mainland has 5500 km coastline. Significant changes in the geomorphology of shorelines found to occur more prominently along the coast of Karnataka, Kerala, Tamilnadu and West Bengal. These shoreline changes are due to alteration of coastal process by manmade structures like breakwaters and shoreline protection structures. The declining of sediment supplied from the rivers due to reduction in the river flow also contributes to shore line changes in Andhra Pradesh.

v) Coastal Watersheds

In India, the watersheds are located in the mountain areas and they form as rivers. The descriptions on coastal lagoons, estuaries, mangroves etc. given in the previous sections, give in detail the nature of concern in these areas. Water from watersheds released during monsoon causes flooding in rivers and, as a result, the sand-bar at the mouth get removed. Stagnant and polluted surface river water and the polluted sediments are washed to the sea. Such a flushing phenomena helps in disposal of land-based wastes into the sea.

Marginal reduction of coastal water quality is evident for 1 or 2 months or till the time sand-bar is formed at the river mouth.

vi) Estuaries and their Drainage Basins

In India a combined river length of 45,000 km comprising 113 major and a large number of rivers form estuaries and backwaters. The health and the biological diversity of the Indian estuaries system are degraded through manmade activities like dumping of untreated sewage and industrial waste. Degradation of water quality and decrease of biodiversity is reported in the Tapi, Adyar, Krishna and Hooghly Estuaries. The estuarine system recovers during the monsoon months as described in the previous para.

vii) Specially Protected Marine and Coastal Areas

In India, specially protected areas have been declared under the Wild Life Protection Act. National Marine Parks, Bio-sphere Reserves and Wild Life Sanctuaries occur all along the coastal areas of the country. The 21 islands of Gulf of Mannar have been declared as bio-sphere reserves. A part of Gulf of Kachchh, Perumal Reef Wandoor have been declared as National Parks. Several wild life habitats like Rann of Kachchh, Malvan, Vembanadu, Point Calimere , Nizampatanam, Gahirmatha and Sunderbans occur along the coastal areas. While the status of bio-diversity in the bio-sphere reserve and National Park areas is showing a sign of decline in the recent years, the population of migrant birds etc. is showing a year-to-year varieties.

viii) Small Islands

India has three major groups of islands namely Andaman, Nicobar and Lakshadweep. While Andaman Island is Volcanic of origin, Nicobar and Lakshadweep Islands are corals in origin. Coral Islands are also found along the Gulf of Mannar area. The islands of Karwar, Gulf of Kachchh, Gulf of Kambat, Cochin, Vishagapatnam, Orissa and West Bengal coast exhibit unique biodiversity. Except the islands close to the main land, the other islands in Andaman, Nicobar and Lakshadweep groups are by and large remain undisturbed. The islands close to the main land particularly in Gulf of Mannar

and Gulf of Kutch are facing human intervention and signs of serious decline of biodiversity.

Conclusion

The impact of land-based activities on the critical habitats is mostly restricted to human intervention like over-exploitation of natural resources and increase of sedimentation in case of lagoons and corals. The impact of pollution is far less compared to other factors.

B. ESTABLISHMENT OF PRIORITIES

In order to attain the sustainable development of coastal resources and sustainance of economic growth incorporating the social and health concerns of the local population, the following areas could be identified as priority areas of action:

i) Disposal of Solid Waste

It has been estimated that the coastal population generates 500 g of solid waste in the form of paper, vegetable remains etc. The total solid waste generated is estimated to be 17000 Million Tonnes per Day. Only 60% of the solid waste is disposed off in the collection facilities maintained by the municipalities and the corporations. The remaining wastes are disposed off in the form of localised landfills, which degenerate and becomes a health hazard. Since solid waste is responsible for the proliferation of disease prone bacteria and virus, priority should be accorded for systematic collection of solid waste and their safe disposal.

ii) Sewage

An amount of 4747 MLD of waste water is being generated from the domestic sources. Only about 75%, is being collected through urban and semi-urban sewerage systems and the rest particularly in the suburban and rural areas are disposed off in the open drains. Since open drains provide a medium for growth of harmful bacteria, priority should be accorded for proper collection of sewage.

At present, the treatment of raw sewage is lacking in coastal and towns and cities. No proposal, except for Mumbai, exists for treatment/disposal of sewage. Priority should be accorded for treatment of sewage.

iii) Industrial Waste from Small and Medium Scale Industries

In India, innumerable number of small and medium scale industries are present in several coastal cities and towns. These industries dispose the waste either in open drains or in sewerages. Priority should be accorded for segregation of these wastes from the sewerage systems and their treatment before disposal.

iv) Manmade Activities

Upland activities like deforestation, damming and diversion of water for irrigation and manmade structures in the coastal areas are some of the manmade activities that have impact on coastal habitats like mangroves, estuaries, lagoons and beaches. Priority should be accorded to have an integrated approach to tackle these problems, especially adopting the concept of Integrated Coastal Zone Management (ICZM). Preparation of ICZM plans to deal with coastal and sea-related issues should be accorded priority.

v) Degradation of Habitats

The disposal of solid and liquid waste in the rivers and the creeks, which reach the specialised eco-systems like coastal lagoons, estuaries and mangroves, cause severe degradation of water quality in these areas, leading to declining of bio-diversity and consequent loss of resources. It is necessary to accord priority to preserve these habitats through adoption of integrated approaches with active peoples participation.

vi) Declining of Natural Resources

In India, the marine resources like fisheries, coral reefs and non-living resources like beach minerals are being exploited without realising the long-term non-sustainability of these resources. Some of these resources, even though over-exploited, the growing food needs of human is the major cause of depletion

of fishery related sources. Adoption of destruction methods of fishing like juvenile fishing using lower mesh size nets is also contributing to the non-replenishment of renewable resources. Awareness programmes and resource conservation and augmentation programmes should be accorded priority in the programmes designed for preservation and conservation of natural resources.

The coral reefs close to the mainland are under great threat, due to indiscriminate exploitation by human for commercial uses. While the commercial sector is keen on utilizing the low cost materials like corals for production of lime, the malnutrition and the unemployment among the coastal fishermen drives them to engage themselves in the mining of coral reefs as contract labours. Priority should be accorded for alternative source of employment to the dependant population in all programmes relating to integrated management of coral reefs.

The above section does not deal with viable strategies, actions and solutions to the problems identified and their impacts assessed in the previous section. They are dealt in the separate heading under Section D.

C. SETTING MANAGEMENT OBJECTIVES FOR PRIORITY PROBLEMS

The management objectives to address environment related problems both on the coastal land and marine environment are basically from the formulations of policies and implementing the policies through programmes and legislation. The current status of policies, programmes and legislation in addressing the problems and the objectives proposed are given below:

i) Solid Waste Management

The solid waste collection facilities are proposed to be increased, in order to facilitate proper collection of solid waste generated from the domestic sources. Since India uses mostly manual methods for collection and mechanical methods for transport, the existing manpower for collection and the vehicles for transport, which have been found to be far inadequate, are needed to be expanded. Since the Government based operation is not found to yield expected results, changes in the Government Policy to switch over from the public to the private sector for

the solid waste collection and safe disposal is being thought of. In cities like Mumbai, the practice of engaging the private sector in solid waste collection and disposal has given encouraged results. Therefore, the objective would be adoption of an efficient method of collection and disposal of solid waste.

ii) **Sewage**

Even though the Government based legislation prescribes the disposal standards for sewage generated through the municipal sources, all the coastal Municipalities and Corporations have violated these standards, due to non-installation of treatment plants. Recently, water quality criteria for several uses of seawater has also been notified. Paucity of funds and clubbing of fund allocation to water supply and drainage, which makes most of the expenditure to be incurred on water supply instead of sewage disposal, are found to be one of the main reasons for non-treatment of sewage. Only in the case of cities like Mumbai, a massive scheme for disposal of sewage, with the financial assistance from the World Bank, has been formulated. The scheme envisages treatment of sewage at four locations and the disposal in the coastal waters and direct disposal of untreated sewage through deep sea outfalls at three locations in massive underwater tunnels as marine outfalls have already been constructed and the scheme is at the final stage of completion. Similar schemes should be launched for all the coastal cities and Municipalities with an objective of treatment of all domestic sewage by the year 2025.

The private sectors have found the sewage treatment on behalf of the Municipalities and Corporations and found to be non-attractive sectors, as they experience difficulties in collection of revenue, fee etc. A suitable intensive scheme to attract the private sector has to be formulated by changing the Government Policies on treatment of waste by the private sector. Where needed, new policies have to be enacted to attract funding from the multilateral donors for treatment of sewage.

The waste disposal through non-point sources like rivers etc. are being dealt under the programme National River Conservation Plan (NRCP). The Ganga Action Plan is already operational for treatment of waste arising from the river Ganga and its tribunal. The scheme has been partially successful and

proposed to be replicated for other rivers under the NRCP. Under the NRCP, 46 towns and 18 rivers of 10 states namely Andhra Pradesh, Bihar, Gujarat, Karnataka, Maharashtra, Madhya Pradesh, Orissa, Punjab, Rajastan and Tamil Nadu are proposed to be covered. The cost of the plan is Rs.7721 million and the scheme is expected to be completed by March 2005. On completion, the water quality of these rivers will be improved and the BOD levels will be kept within the 3 mg per litter level or less.

The rivers, which are highly polluted compared to the coastal waters, significantly contribute the organic load to the coastal waters. The percentage of NRCP coverage of rivers is far inadequate compared to the total volume of sewage carried out by the Indian rivers. The objective should be the expansion of programme to all the non-point sources i.e. including for creeks and drains.

iii) Industrial Waste

While large industries treat their waste as per the prescribed standards with little violations, major issue regarding the industrial waste is disposal of untreated waste by small and medium scale industries in rivers, creeks and municipal drains.

The present scheme of having CETPs have not been found to be successful in a few states, mainly because of the pre-treatment before the final treatment of wastes in CETPs was found to be far inadequate to meet the technological requirements. This problem is being studied for identifying a suitable solution.

iv) Agricultural Waste

The Government has already formulated necessary legislation for ban of use of bio-accumulation insecticides like DDT in the agriculture. Introduction of new pesticides has been regulated through necessary legislation. The environmental awareness campaigns are being launched to deal with excessive uses of pesticides.

v) Vehicular Pollution

Poor quality of fuel and non-maintenance of aging vehicles are some of the main sources of pollution from vehicles. The Government has enacted standards for all categories of petrol and diesel vehicles, which will be made strict from 01.04.2000. Unleaded petrol has already been introduced in four metropolitan cities. It is likely to be expanded to several cities in future. The Government is considering enacting an appropriate policy for incorporation of pollution concerns in the manufacturing stage of the vehicles itself.

D. IDENTIFICATION, EVALUATION AND SELECTION OF STRATEGIES AND MEASURES

a) Specific Measures and Incentives

i) Measures to prevent Sustainable Uses of Coastal and Marine Resources and Prevent Degradation

The Government of India has enacted environmental legislation like Environment Protection Act and framed guidelines for promotion of adoption of environmentally friendly techniques and practices for treatment of waste and disposal. Environmental Impact Assessment of all industrial projects and Environmental Management Plans have been made compulsory. An environmental audit in the form of environmental statements has to be submitted mandatorily by all the polluting units. Physical incentives like 100% depreciation, exemption of payment of customs duty for installation of pollution control/monitoring equipment and for shifting of polluting industries from congested areas to be given. An award for clean industries has been constituted to encourage firms for maintaining high level of compliance with the Environmental Standards and Guidelines.

The recent initiatives taken by the Ministries of Env & Forests

An Industrial Pollution Project (1995-2001) with the assistance of World Bank has been launched with the following objectives:

Regarding & Policies for Control of Pollution including

i) to strengthen the capabilities in the States of Rajasthan, Madhya Pradesh, Karnataka and Andhra Pradesh

ii) to facilitate priority investment to prevent pollution from industrial sources by encouraging use of clean technologies, waste minimisation and resource recovery

iii) to provide technical assistance for adoption of modern tools of information and management.

This component supports programmes of strengthening of State Pollution Control Boards in Rajasthan, Madhya Pradesh, Karnataka and Andhra Pradesh training programmes, acquisition of equipment and laboratory facilities.

The strategies adopted with respect to small and medium scale industries are as follows:

i) A scheme for setting up of Common Effluent Treatment Plants in cluster of small scale industrial units has been taken up. About 60 CETPs have been approved which are at various stages of construction.

ii) To promote pollution prevention in small and medium scale industries, the Government has initiated the following project:

- Project on establishment and running of Waste Minimisation Circles in clusters of small scale industries. Under this scheme, so far 15 waste minimisation circles in sectors of electroplating, pulp and paper, tannery, textiles - dyeing and printing, hotels, hosiery, etc. have been established in various parts of the country. About 300 waste minimisation measures have been identified by the circle members so far, majority of them have already been implemented. These measures have resulted in reduction of pollution load to the extent of 15 to 30%. In addition, savings to the tune of Rs.150 lakhs is expected per annum.

- Waste minimisation and demonstration studies in sectors of electroplating, dye and dye intermediates and edible oil industries have been taken up. A general guideline manual from Wastes-to-Profits and sector-specific manuals on waste minimisation in respect of pulp and paper based on agricultural residues and pesticide formulations have been brought out through NPC.

- A National Cleaner Production Centre at National Productivity Council has been set up with the assistance of UNIDO. Under this project, capacity building and awareness creation in the area of cleaner production in small and medium scale industries has been taken up.

While the new industries have been adopting the above practices and also maintaining a fairly acceptable level of disposal standards both for emissions and waste water, the problem continues with large sized old industries, which use conventional techniques, leading to emission of high levels of air pollution and discharge of chemicals. Recently, such industries, particularly using soda ash industries, have been identified and all of then given deadlines for change of technology mercury cells to chloride-alkali cells. All the industries have now shifted to chloride-alkali technology. Similarly, other chemical, fertilizer and pharmaceutical industries are being advised to adopt cleaner technologies or shift them from congested areas. Despite several economic constraints, the Government has already initiated for use of low ash coals in most of the thermal power plants, even though such coal has to be imported from outside India, as the coal produced in India has high levels of ash. Excise duty exemptions on utilisation of fly ash, phospho gypsum etc. are provided. The State Pollution Control Boards have been providing them with information relating to advanced technologies, which are environmentally friendly.

Even though efforts are being made for switching over of environmentally safe technologies, many industries, due to involvement of high level of capital investment, are still unable to switch over the technology. The Government has also been requesting in International Forums for providing cleaner technologies to

India and to the developing nations in non-commercial terms from the developed countries. Unless a global strategy with the involvement of UN Organizations for transfer of environmentally friendly technologies from the developed nations to the developing nations under non-commercial terms occur, it would be far difficult for many developing countries, including India, to switch over to environmentally friendly technologies.

All the new industries have been advised to adopt waste minimisation and recycling practices, particularly to avoid discharge of liquid waste into the environment, including the coastal waters. Some of the marine based industries use water, recycle them instead of disposing them into sea.

ii) Industrial Zoning Atlas

In order to facilitate comparability between the land and the sea use, the Government has already notified water quality criteria for different uses of sea water. The details of these criteria for different uses are given in **Annexure 5.** In order to achieve the designated use of sea water along the coastal area of India, a detailed Industrial Zoning Atlas is being prepared with the financial assistance from the World Bank. The Industrial Zoning Atlas is being prepared by the Central Pollution Control Board with due consideration of location of critical habitats and areas of high mixing. Incorporation of zoning atlas in the ICZM plans is necessary.

iii) Rehabilitation of Critical Habitats

A long-term programme for preparation of Integrated Coastal and Marine Area Management Plans to achieve the sustainable growth of the coastal areas and their resources with due emphasis for protection of critical habitats and, where possible, rehabilitation of degraded habitats has been taken up by the Ministry of Environment & Forests and the Department of Ocean Development. Several Capacity Building Measures like training of personnel is being taken up under this programme.

Strategies like treatment of sewage at least upto the secondary level using Best Available Technology is necessary. A massive scheme with at least 50% contribution by the Government of India and 50% through external assistance

need to be formulated and be implemented in a phased manner. The list of coastal cities and towns identified for this purpose is given in **Annexure 1.**

Present incentives to the industries for adoption of cleaner technologies, waste minimisation etc. have to be extended to commercial institutions in the form of exemption from taxes or other benefits, for adoption of urban/rural areas to install waste treatment plants or meeting the recurring expenditure of their operation. Several examples already exist, where some of the industries adopt nearby areas to increase the greenery with activities like plantation and maintenance of public parks etc.

iv) Institutional Mechanisms

India has well-structured institutional mechanism to deal with pollution like existence of Central Pollution Control Board with State Level Pollution Boards in all the States. These Pollution Control Boards are assigned with the responsibility of prevention, control and regulation of pollution along the coastal areas. In order to provide a total coverage to coastal land environment and to minimise the degradation of marine environment, due to land based activities, Coastal Zone Management Authorities in all the States have been constituted. As these Boards and Authorities do not have adequate trained manpower to handle various actions for Integrated Management of Coastal and Marine Areas, a long-term programme to these coastal states through dedicated training is necessary. The Department of Ocean Development is already in the process of establishing training facilities for Development of Integrated Coastal and Marine Area Management Plans. There are National Institutions like Indian Institute of Technology, National Environmental and Engineering Institute etc., which conduct training courses on cleaner technologies with the help of Ministry of Environment & Forests etc. Further, under National Productivity Council, a Cell, namely, Cleaner Production Technology, is also established. The Confederation of Indian Industries also regularly issue bulletins and notices to all the industries about the availability of cleaner production technologies. Even though the individual efforts have created knowledge on the existence of cleaner production technologies, lack of a dedicated group under anyone of the above organisations for documenting and

introducing cleaner production technologies is felt to be more appropriate to face the challenge of pollution that may arise in the immediate and long future.

v) *Financial Mechanisms*

Since the solid waste and sewage being the major source of contaminant and little treatment of sewage is being done at present, priority has to be accorded for sewage treatment. Cost of treatment of sewage by various techniques is given in **Annexure 6**. It is estimated that treatment of sewage of 3560 MLD generated by the cities and towns (as listed in Annexure 6), would cost Rs.110,000 million (US $ 2500 Million) for capital items and Rs.183 million/MLD/year as the recurring cost. In the case of small and medium scale industries for establishment of subsidies, an estimated annual financial requirement is Rs.1000 million (US $ 22.7 million).

The financial requirements have to be met in a phased manner with 50% from Government sources and 50% through external grants/loans.

In a nutshell, the strategy to face the land-based activities include:

i) Treatment of domestic sewage arising from coastal cities and towns in a phased manner with 50% financial contribution by the Government of India and the rest from the external sources

ii) Intensification of introduction of cleaner production technologies in all critical categories of industries and in others, which generate large volume of pollutants

iii) Adoption of no waste technology and waste minimisation techniques, including recycling of waste for all future projects

iv) Adoption of the concept of Integrated Coastal Zone Management to deal with the upstream effects and land-based activities that have impact on the coastal and marine areas and resources

v) Dedicated group within an existing organization to provide information relating to eco-friendly technologies, best environmental practices etc.

vi) Incentives to commercial institutions, who adopt urban/rural areas/ segments for promoting cleanliness in the environment in terms of bearing the cost for waste removal and the treatment.

vii) Strong public participation in management strategies

E. CRITERIA FOR EVALUATING THE EFFECTIVENESS OF STRATEGIES AND MEASURES

One of the excellent mechanisms for checking the effectiveness of the strategies is periodical, monitoring and review of all Environmental Management Plans prepared by the industries, ports etc. and also checking of their compliance through Environmental Audit Procedures. The Ministry of Environment & Forests has already taken up this task through establishment of Regional Centre of Excellence under the Ministry. Since these set-ups are under-staffed and need training on different types of techniques and technologies used in the industrial and domestic sector, a massive programme to upgrade these centres is essential. Formulation of a long-term scheme for this purpose is essential.

i) Monitoring

One of the means to check the effectiveness of environmental practices adopted by Municipalities and Industries is a Long-term Monitoring Programme with the help of the ambient air and water quality criteria. A Long-term River Monitoring Programme is being undertaken by the Central Pollution Control Board with the help of the State Pollution Control Boards and a Marine Pollution Monitoring Programme undertaken by the Department of Ocean Development have yielded considerable results in understanding the status of pollution in Indian environment. While River Monitoring Programme has been fully institutionalised, it is necessary to institutionalise the Coastal Water Monitoring Programme, as the programme is being implemented on a five year plan basis. The State Pollution Control Boards to strengthened to undertake the task of Coastal Water Quality Monitoring.

ii) Economic Costs and Benefits

The advantage of maintaining the good water and air qualities not only benefits the population which derive the resource environment for their livelihood but also the users of environment. For example, achievement of sea water quality through adoption of Environmental Standards and Guidelines by Municipalities and Industries will facilitate augmentation of living resources like fish etc. This will benefit thousands of fishermen, who derive their livelihood from near shore fishing. Further, the aquaculture industries, which draw water from underground sources due to the fact that the quality of sea water is not acceptable for culture of fish, shrimps etc., will save enormous energy cost, which is spent on pumping of underground water. This will greatly benefit the energy sector, which is already under low production. The cleanliness of sea water near cities and towns, due to adoption of environmentally friendly technologies, will result in good sea water quality and prevent degradation of beaches, which will promote growth of day tourism of along the coastal areas of the country.

By the above means of adopting environmentally friendly techniques and guidelines issued by the Government, the target of achieving the upliftment of living standards of the coastal population below the poverty line would be realised within the targeted period of 2020.

F. PROGRAMME SUPPORT ELEMENTS

(a) Organizational Arrangements to Co-ordinate among Sectors and Sectoral Institutions

For the successful implementation of the objectives of the management strategies and other measures, which effectively deal with the degradation arising from land based activities, an efficient organizational arrangement to coordinate among sectors and sectoral institutions is essential. At present in India, the Ministry of Environment and Forest which deal with the land based sources of Marine Pollution; Ministry of Industries, Petroleum and Natural Gas dealing with coastal industries and refineries respectively; Ministry of Surface and Transport dealing with shipping and ports and Harbours; Ministry of Animal

Husbandry dealing with fisheries; and Department of Ocean Development dealing with conservation of marine environment based on scientific principles and tools, need to be effectively coordinated to achieve the goal of the Action Plan. Since the separate institutional body for coordination would add to existing number of institutions, for the purpose of the implementation of the Action Plan, the Central Pollution Control Board, which has a major Advisory Body to the Govt. of India be strengthened to deal with the management strategies and programmes as suggested in the present Action Plan.

(b) Legal and Enforcement Mechanism

The present Environment Protection Act which forms as an important Act for all environmental activities. It has adequate provisions to deal with the environmental legislation arising out of land based activities. However, it focus on oceans in terms of standards seems to be inadequate compared to the needs. Recently, it has notified ambient seawater quality criteria for different uses of seawater. However, a comprehensive legislation to deal exclusively marine environment or at least to provide guidance in deal with issues relating to marine environment is lacking at present. Necessary rules need to be framed to deal effectively the land-based impacts on the Marine Environment and its resources.

At present Enforcement Agencies suffer due to lack of adequate manpower and facilities to enforce the environmental legislations, guidance etc., which results in unchecking of large violations of environmental standards both by industries and municipalities. It is necessary that these Pollution Control Boards are sufficiently strengthened in terms of infrastructure and manpower.

(c) Financial Mechanism

Large scale environmental degradation occur due to dumping of solid and liquid wastes chiefly from the domestic sources. The civic bodies like Municipalities and Corporations which are ill-funded even for day-to-day activities need to be adequate manpower and provided with required funds for collection and treatment of wastes. Large scale funding by multilateral donor agencies and

well-wishing countries is necessary to deal with the gigantic problem of sewage treatment.

(d) Means of Identifying and Pursuing Research and Monitoring Requirements

The self-reliance and suitability of waste treatment technologies to Indian conditions can be achieved through in-house R&D in Indian institutions. It is necessary to increase R&D efforts in this direction. Further, present incentive to industries on R&D to develop new technologies should be augmented.

The effective mechanism to check pollution and other degradation is a Long-term Monitoring Programme that compliance of rules and regulations by industries and municipalities. Since conventional manual-based monitoring methods are laborious in nature, technology to facilitate automatic monitoring of environmental parameters with less human involvement is essential. Since automation in monitoring programmes has to fulfil the legal needs and conditions, an exclusive special research programme has to be launched to develop these techniques.

(e) Contingency Planning

Contingency Planning is required for establishments that generate and dispose toxic wastes. Since these are generated largely by medium and large scale industries, Environmental Impact Assessment of the project, followed by Effective Environmental Management Plan comprising of contingent measures, in the event of accidents etc. are essential. Mechanisms be evolved for their periodical checking of their effectiveness.

(f) Human Resources Development and Education

The authorities involved in the formulation of management programmes and their implementation need to have adequate knowledge in all environmental friendly techniques and technologies, which are highly suitable to local conditions. Regular exposure programmes need to be arranged for these personnel. The curriculum in Engineering Institutions dealing with environmental

aspects needs to be constantly updated to build knowledge on the latest environmentally friendly technologies. Since the concept of no waste and waste minimizing technology is fast gripping the developed nations, adequate interactions with the countries which develop and use these technologies through bilateral training programme is essential.

(g) Public Participation

Awareness on Pollution and citizens' responsibility to deal with the pollution problems are the fundamental needs for successful implementation of the action plan. With the Involvement of Educational Institutions and NGOs widespread awareness programmes on the negative impacts of pollution, habitat degradation etc. are required. It has been found that, in the Phillippines, empowerment of local people in the management of the critical habitats like coral reefs have yielded positive results on protection of these eco-systems. Necessary policy amendment to this effect is also needed in India.

TABLE 1
WASTEWATER & SOLID WASTE GENERATION, COLLECTION & DISPOSAL IN METRO OF INDIA

Sl. No.	Name of Metro City	Population	Volume of Waste Water Generated (mld)	Volume of Waste water Collected (mld)	Solid Waste Generated (mt/d)
1	Bombay	12288519	2228.10	2210.00	5355
2	Calcutta	9643211	1383.80	1074.90	3692
3	Kochi	670009	75.00	45.00	347
4	Madras	4752974	276.00	257.00	3124
5	Surat	1498817	140.00	112.00	900
6	Vadodara	1031346	120.00	105.00	400
7	Visakapatnam	752037	68.00	55.00	300
	Total	**30636913**	**4290.90**	**3858.90**	**14118**

Source : Central Pollution Control Board, 1997

TABLE 2

WASTEWATER & SOLID WASTE GENERATION, COLLECTION & DISPOSAL IN CLASS – I COASTAL CITIES OF INDIA (MLD)

Sl. No.		Name of State	Name of Town	Population	Volume of Waste water Generated (mld)	Volume of Waste Water Collected (mld)	Percentage Sewerage	Solid waste Generated (mt/d)	Solid Waste Collected (mt/d)
1	Coastal	Andhra Pradesh	Chirala	80861	6.80	5.10	75	28	28
2			Ongole	100836	4.60	3.40	75	29	29
3			Vizianagarm	160359	6.20	4.60	75	20	20
4		Gujarat	Bhavnagar	402338	38.00	32.30	85	120	120
5			Valsad	57909	8.20	6.00	75	15	15
6			Jamnagar	341637	45.00	33.80	75	150	150
7			Bhuj	102176	8.40	6.30	75	20	20
8			Navsari	126089	22.00	16.50	75	28	28
9			Porbandar	116671	11.30	8.50	75	12	12
10		Karnataka	Udipi	78094	7.20	5.40	75	8	8
11		Kerala	Cherthala	132883	14.90	NA	NA	26	26
12			Thiruvananthapuram	524006	80.00	60.00	75	350	350
13			Kanhanagod	57165	3.60	1.80	50	6	6
14			Alappuzha	174666	8.80	6.60	75	40	40
15			Trissur	74604	16.00	12.00	75	60	60
16			Kottayam	63155	6.40	4.80	75	10	10
17			Kozhikode	419831	19.20	14.40	75	113	113
18			Kannur	463962	22.30	11.00	50	170	170
19			Kollam	139852	17.60	13.20	75	28	28
20			Guruvayoor	118632	13.30	NA	NA	32	32
21		Maharashtra	Bhivandi	379070	42.00	31.50	75	85.04	85.04
22		Orissa	Puri	125199	13.60	10.20	75	24	24
23		Tamil Nadu	Cuddalore	144561	3.50	NA	NA	36	36
24			Nagercoil	190084	11.80	NA	NA	52	52
25			Tuticorin	199854	1.20	0.60	50	55	55
26		Pondichery	Pondichery	8419084	24.00	NA	NA	60	60
		Total		**13193578**	**455.9**	**288**	**1510**	**1577.04**	**1577.04**

Source : Central Pollution Control Board, 1988

TABLE 3

WASTE WATER & SOLID WASTE GENERATION, COLLECTION & DISPOSAL IN CLASS – II COASTAL CITIES OF INDIA (MLD)

Sl. No.	Name of State	Name of Town	Population	Volume of waste water generated (mld)	Volume of Waste Water Collected (mld)	Percentage Sewerage
1	Andaman	Port Blair	74955	4.94	3.46	70
2	Andhra Pradesh	Anakapalle	84356	2.54	1.91	75
3		Srikakulam	88883	6.32	4.74	75
4	Goa	Margoa	58951	4.72	4.01	85
5		Marmugoa	83367	6.67	5.34	80
6		Panaji	53382	4.27	3.84	90
7	Gujarat	Billimora	51039	3.68	2.39	65
8		Mahuva	59912	6.56	4.92	75
9	Karnataka	Karwar	51022	8.80	4.40	50
10	Kerala	Kasaragod	50126	0.35	0.18	50
11	Kerala	Kayamkulam	67151	3.70	1.85	50
12		Kodugallur	31159	3.20	1.28	40
13		Payyannur	64032	0.10	0.05	50
14		Ponnani	51770	1.00	0.50	50
15	Maharashtra	Ratnagiri	56529	4.00	1.00	25
16		Vasai	39741	1.60	0.64	40
	Total		**966375**	**62.45**	**40.51**	**970**

Source : Central Pollution Control Board- 1988

Annexure 2

TABLE 4
INDUSTRIES AND INDUSTRIAL COMPLEXES LOCATED ALONG THE COASTAL AREAS

State	No. of Coastal Industries/Complexes
West Bengal	10 major industries
Orissa	3 major industries
Tamil Nadu	17 major industries
Pondicherry	4 major industries
Kerala	20 major industries
Karnataka	3 major industries
Maharashtra	20 industrial complexes
Gujarat	15 industrial and 2 industrial complexes

Source : 1. Central and State Pollution Control Boards

2. Central Pollution Control Board, 1996

TABLE 5
STATE-WISE LOCATION OF MEDIUM AND LARGE SCALE INDUSTRIES

Sl. No.	Coastal	Name of State	Name of Town	Name of Industry	Whether Small, Medium or Large Scale	Manufac-ture of Chemi-cals	Volume of Waste Water generated (per day/ month/year)
1.	Coastal	Gujarat	Vapi	Atul Products Ltd.	Large	Chemicals	13600 m^3/d
2.	"	Gujarat	Vapi	Cyanamide India Ltd.	Large	Pesticide Pharmaceutic als	1650 m^3/d
3.	"	Gujarat	Vapi	Asha Nitrocellulose P. Ltd.	Medium	Chemicals	300 m^3/d
4.	"	Gujarat	Vapi	Atik Industries Ltd.	Medium	Dyes	300 m^3/d
5.	"	Gujarat	Vapi	Cibatul Ltd.	Large	Chemicals & Pharmaceutic als	1950 m^3/d
6.	"	Gujarat	Vapi	Damosha Chemicals Ltd.	Medium	Chemicals	45 m^3/d
7.	"	Gujarat	Sutrapara	Gujarat Heavy Chemicals Ltd.	Large	Soda-Ash	80080 m^3/d
8.	"	Gujarat	Mithapur	Tata Chemicals	Large	Soda-Ash	1000 m^3/d 00
9.	"	Gujarat	Dhrangadhra	DCW Ltd.	Large	Chemicals	m^3/d 3360
10.	"	Gujarat	Porbandar	Saurashtra Chemicals	Large	Soda Ash	6200 m^3/d 0
11.	"	Gujarat	Varaval	Indian Rayon Chemicals	Large	Textiles	m^3/d 8250
12.	"	Gujarat	Kodinar	Bhileshwar Khand Udyog Sahakari Mandali	Large	Sugar Mill	1900 m^3/d
13.	"	Gujarat	Olpad	Cyanamide and Chemicals	Medium	Chemicals	45 m^3/d
14.	"	Gujarat	Hazira	Gujrat Electricity Board	Large	Power Plant	3600 m^3/d
15.	"	Gujarat	Hazira	Adarsh Chemicals & Fertiliser Ltd.	Large	Chemicals	526 m^3/d
16.	"	Gujarat	Hazira	Jayant paper Mills	Large	Paper Mill	930 m^3/d
17.	"	Gujarat	Hazira	Navin Fluoride	Large	Chemicals	4700 m^3/d
18.	"	Gujarat	Hazira	The Baroda Rayon Corporation Ltd	Large	Textiles	21600 m^3/d
19.	"	Gujarat	Hazira	Essar Gujarat Ltd.	Large	Iron & Steel	1957 m^3/d
20.	"	Gujarat		Essar Process Plant	Large	Power Plant	11700 m^3/d
21.	"	Gujarat		Reliance Industries Ltd.	Large	Petrochemica ls	1527 m^3/d
22.	"	Gujarat		National Thermal Power Corporation Ltd.	Large	Power Plant	31110 m^3/d
23.	"	Gujarat		Heavy water project	Large	Heavy Water	1080 m^3/d
24.	"	Gujarat	Hazira	ONGC	Large	Petrochemica ls	4000 m^3/d
25.	"	Gujarat	Vadodara	Krishak Bharati Co-operative Ltd.	Large	Fertiliser	1700 m^3/d
26.	"	Gujarat	Vadodara	Gujarat State Electricity Board	Large	Power Plant	53 m^3/d
27.	"	Gujarat	Vapi	Rogman Glues & Chemicals	Large	Chemicals	5000 m^3/d

Source : Gujarat Pollution Control Board 1999

Sl. No.	Coastal	Name of State	Name of Town	Name of Industry	Whether Small, Medium or Large Scale	Manufac-ture of Chemi-cals	Volume of Waste Water generated (per day/ month/year)
28.	"	Gujarat	Hazira	GIDC Estates Vapi	Cluster	Cluster-chemicals Dyes, Pulp & Papers	32,000 m^3/d
29.	"	Gujarat	Sachim	GIDC Estate Pandesara	Cluster	Cluster Chemicals Textiles Dyes	35000 m^3/d
30.	"	Gujarat	Vadodara	GIDC Estate Sachin	Cluster	Cluster – Textiles Chemicals Dyes	15000 m^3/d
31.	"	Gujarat		GIDC Effluent channel project	Cluster	Cluster Petrochem, Fertilisers	80000 m^3/d
32.	"	Gujarat	Ankaleshwar	GIDC Estate Nandesari	Cluster	Cluster Chemicals, Dyes, Drugs	2500 m^3/d
33.	"	Gujarat	Baruch	GIDC Estate Ankleshwar	Cluster	Cluster Chemicals Pharmaceutic als Pesticide Textiles, Pulp & Papers	30000 m^3/d
34.	"	Gujarat	Bhavnagar	GIDC Estate Panoli	Cluster	Cluster Chemicals Pharmaceutic als,Pesticide Textiles & Paper	3000 m^3/d
35.	"	Gujarat	Kandla	Exeal Industries	Medium	Pesticides	220 m^3/d
36.	"	Gujarat		Indian Farmer Fertiliser company	Medium	Fertilisers	100 m^3/d
37.	"	Maharashtra	Mumbai	Indian Aluminium Company Ltd.	Large	Metallurgical	400 m^3 /d
38.	"	Maharashtra	Mumbai	Mukund Ltd.	Large	Enginnering	1080 m^3 /d
39.	"			Raymond Wollen Mills Ltd.	Large	Textiles	4100 m^3 /d
40.	"	Maharashtra	Mumbai	Colour Chem Ltd.	Large	Dye	4000 m^3 /d
41.	"	Maharashtra	Mumbai	Laxmi Board & Paper Mills Ltd.	Large	Paper	1500 m^3 /d
42.	"	Maharashtra	Mumbai	Bayer India Ltd.	Large	Pharmaceutic als	2200 m^3 /d
43.	"	Maharashtra	Mumbai	Caprihane India Ltd.	Medium	Chemicals	17 m^3 /d
44.	"	Maharashtra	Mumbai	Cadbury India Ltd.	Medium	Food	800 m^3 /d
45.	"	Maharashtra	Mumbai	Hindustan Breweries & Bottling Ltd.	Medium	Brewery	400 m^3 /d
46.	"	Maharashtra	Mumbai	Duphar Interfran Ltd.	Medium	Pharmaceutic als	115 m^3 /d
47.	"	Maharashtra	Mumbai	Boehringer Mannheim India Ltd.	Large	Pharmaceutic als	400 m^3 /d
48.	"	Maharashtra	Mumbai	Bharat Gears Ltd.	Large	Automobile	3 m^3 /d
49.	"	Maharashtra	Mumbai	Sandoz (India) Ltd.	Large	Pharmaceuiti cals	1200 m^3 /d
50.	"	Maharashtra	Mumbai	Goodlass Nerolac Paints	Large	Dyes & Pigments	1035 m^3 /d

Source : Maharashtra State Pollution Control Board, 1999

Sl. No.	Coastal	Name of State	Name of Town	Name of Industry	Whether Small, Medium or Large Scale	Manufac-ture of Chemi-cals	Volume of Waste Water generated (per day/ month/year)
51.	"	Maharashtra	Mumbai	Indofil Chemicals Company	Large	Chemicals	120 m^3 /d
52.	"	Maharashtra	Mumbai	Roche Products Ltd.	Large	Pharmaceutic als	460 m^3 /d
53.	"	Maharashtra	Mumbai	Voltas Ltd.	Large	Engineering	22.5 m^3 /d
54.	"	Maharashtra	Mumbai	Asian Cables & Industries	Large	Engineering	172 m^3 /d
55.	"	Maharashtra	Mumbai	N.R.B. Bearing	Medium	Engineering	8 m^3 /d
56.	"	Maharashtra	Mumbai	Glaxo India	Large	Pharmaceutic las	285 m^3 /d
57.	"	Maharashtra	Mumbai	Devidayal Electronics & Wire	Large	Engineering	30 m^3 /d
58.	"	Maharashtra	Mumbai	Voltas Ltd.	Large	Engineering	444 m^3 /d
59.	"	Maharashtra	Mumbai	B.R.T.Ltd.	Medium	Engineering	70 m^3 /d
60.	"	Maharashtra	Mumbai	Inarco Ltd.	Medium	Textiles	52 m^3 /d
61.	"	Maharashtra	Mumbai	Crimplon Yarns	Small	Textiles	36 m^3 /d
62.	"	Maharashtra	Mumbai	Blue Star	Medium	Engineering	28 m^3 /d
63.	"	Maharashtra	Mumbai	Garware Paints	Medium	Paints	35 m^3 /d
64.	"	Maharashtra	Mumbai	Uni Deritend Precision Casting	Medium	Metallurgical	30 m^3 /d
65.	"	Maharashtra	Mumbai	Romon & Demm	Medium	Engineering	115 m^3 /d
66.	"	Maharashtra	Mumbai	Teksons Ltd.	Medium	Engineering	80 m^3 /d
67.	"	Maharashtra	Mumbai	Catalyst (India) Ltd.	Medium	Chemicals	14 m^3 /d
68.	"	Maharashtra	Mumbai	Rallis (India) Ltd.	Medium	Pesticide	20.5 m^3 /d
69.	"	Maharashtra	Mumbai	H.R.Jhonsons (India) Ltd.	Large	Ceramics	162.5 m^3 /d
70.	"	Maharashtra	Mumbai	Firth (India) Steel Co.Ltd.	Medium	Engineering	42.2 m^3 /d
71.	"	Maharashtra	Mumbai	National Standard Dunncan Ltd.	Medium	Engineering	325 m^3 /d
72.	"	Maharashtra	Mumbai	Industrial Solvents & Chemicals P. Ltd.	Medium	Chemicals	25 m^3 /d
73.	"	Maharashtra	Mumbai	Roptacoss Brett & Co.Ltd.	Medium	Food	170 m^3 /d
74.	"	Maharashtra	Mumbai	Hawkins Cookers Ltd.	Medium	Engineering	64 m^3 /d
75.	"	Maharashtra	Mumbai	F.G.P. Ltd.	Large	Fibre Glass	95 m^3 /d
76.	"	Maharashtra	Mumbai	S.M.Dye Chem Ltd.	Medium	Agro-Chemicals	8 m^3 /d
77.	"	Maharashtra	Mumbai	Brodma (India) Ltd.	Medium	Engineering	28.7 m^3 /d
78.	"	Maharashtra	Mumbai	Morarjee Goculdas spg&wvg co.ltd.	Large	Cotton & Synthetic Fibre	1400 m^3 /d
79.	"	Maharashtra	Mumbai	Glaxo (india) Ltd.	Large	Pharmaceutic als	548 m^3 /d
80.	"	Maharashtra	Mumbai	The Mafatlal Fine Spg&Wvg	Large	Textiles	442 m^3 /d
81.	"	Maharashtra	Mumbai	Sree Kamal Dying, Bleaching & Printing works	Large	Textiles	120 m^3 /d

Source : Maharashtra Pollution Control Board - 1999

Sl. No.	Coastal	Name of State	Name of Town	Name of Industry	Whether Small, Medium or Large Scale	Manufac-ture of Chemi-cals	Volume of Waste Water generated (per day/ month/year)
82.	"	Maharashtra	Mumbai	The Simplex Mills Co.Ltd.	Large	Textiles	544 m^3 /d
83.	"	Maharashtra	Mumbai	The Mafatlal Fine Spg & manufacturing Co. Ltd.	Large	Textiles	70 m^3 /d
84.	"	Maharashtra	Mumbai	The Dawn Mills	Large	Textiles	469.5 m^3 /d
85.	"	Maharashtra	Mumbai	Boots Pharmaceuticals	Large	Pharmaceutic als	205 m^3 /d
86.	"	Maharashtra	Mumbai	Ahmed Mills	Large	Vegetable oil	170 m^3 /d
87.	"	Maharashtra	Mumbai	Victoria Mills Ltd.	Large	Textiles	1270 m^3 /d
88.	"	Maharashtra	Mumbai	Parimal Spg. & Wvg Mills Ltd.	Large	Textiles	1000 m^3 /d
89.	"	Maharashtra	Mumbai	Crompton Greaves Ltd.	Large	Engineering	36 m^3 /d
90.	"	Maharashtra	Mumbai	New ERA Fabrics Ltd.	Large	Textiles	145 m^3 /d
91.	"	Maharashtra	Mumbai	Jalan Dye Bleaching Mills	Large	Textiles	930 m^3 /d
92.	"	Maharashtra	Mumbai	Beauty Art Dyers & Cleaners	Large	Textiles	118 m^3 /d
93.	"	Maharashtra	Mumbai	Bombay Union Dyeing Mill	Large	Textiles	65 m^3 /d
94.	"	Maharashtra	Mumbai	Jivan Silk Mill	Large	Textiles	77 m^3 /d
95.	"	Maharashtra	Mumbai	New Haven Steel Ball Corp. Pvt. Ltd.	Large	Engineering	49 m^3 /d
96.	"	Maharashtra	Mumbai	Bharat Radiators Ltd.	Large	Engineering	24.5 m^3 /d
97.	"	Maharashtra	Mumbai	Kamani Oil Mills	Large	Edible Oil	65 m^3 /d
98.	"	Maharashtra	Mumbai	The Bharat Silk Mill	Large	Textiles	44 m^3 /d
99.	"	Maharashtra	Mumbai	Malhotra Silk Mill	Large	Textiles	84 m^3 /d
100.	"	Maharashtra	Mumbai	KMA Ltd.	Large	Metallurgical	160 m^3 /d
101.	"	Maharashtra	Mumbai	Bharat Bijay Velvet & Silk Mill Ltd.	Medium	Textiles	237 m^3 /d
102.	"	Maharashtra	Mumbai	Crown Processors	Large	Textiles	62.4 m^3 /d
103.	"	Maharashtra	Mumbai	Apollo Textile Mills	Large	Textiles	255 m^3 /d
104.	"	Maharashtra	Mumbai	India United Mills No.1	Large	Textiles	300 m^3 /d
105.	"	Maharashtra	Mumbai	Bharat Textile Mills	Large	Textiles	40 m^3 /d
106.	"	Maharashtra	Mumbai	Bombay Tyres international Ltd.	Large	Automobile	360 m^3 /d
107.	"	Maharashtra	Mumbai	The Standard Batteris Ltd.	Large	Lead Storage Cells	220 m^3 /d
108.	"	Maharashtra	Mumbai	Orkay Silk Mills Ltd.	Large	Textiles	58 m^3 /d
109.	"	Maharashtra	Mumbai	Vijoy Synthetic Prints	Large	Textiles	198 m^3 /d
110.	"	Maharashtra	Mumbai	Larsan & Toubro Ltd.	Large	Engineering	1710 m^3 /d
111.	"	Maharashtra	Mumbai	Industrial perfumes Ltd.	Large	General	70 m^3 /d
112.	"	Maharashtra	Mumbai	Britannia Industries Ltd.	Large	Food	125 m^3 /d

Source : Maharashtra Pollution Control Board - 1999

Sl. No.	Coastal	Name of State	Name of Town	Name of Industry	Whether Small, Medium or Large Scale	Manufac-ture of Chemi-cals	Volume of Waste Water generated (per day/ month/year)
113.	"	Maharashtra	Mumbai	Shree Madhusudan Mills	Large	Textiles	50 m^3 /d
114.	"	Maharashtra	Mumbai	New Hind Textile Mills	Large	Textiles	372 m^3 /d
115.	"	Maharashtra	Mumbai	India United Mills Dye Works	Medium	Textiles	979 m^3 /d
116.	"	Maharashtra	Mumbai	Digvijay Textile Mills	Large	Textiles	600 m^3 /d
117.	"	Maharashtra	Mumbai	Bombay Dying & Manufacturing Co.Ltd.	Large	Textiles	3700 m^3 /d
118.	"	Maharashtra	Mumbai	IVP Ltd.	Large	Edible & Non-edible oil	190 m^3 /d
119.	"	Maharashtra	Mumbai	Paragon Textile Mills	Medium	Textiles	420 m^3 /d
120.	"	Maharashtra	Mumbai	The Ruby Mills Ltd.	Large	Textiles	525 m^3 /d
121.	"	Maharashtra	Mumbai	Morarjee Goculdas Spg & Wvg Co.	Medium	Textiles	769 m^3 /d
122.	"	Maharashtra	Mumbai	Sree Ram Mills Ltd.	Large	Textiles	1400 m^3 /d
123.	"	Maharashtra	Mumbai	Doulatram Dyeing & Bleaching Mills	Large	Textiles	158 m^3 /d
124.	"	Maharashtra	Mumbai	Parke Davis (India) Ltd.	Large	Pharmaceutic als	600 m^3 /d
125.	"	Maharashtra	Mumbai	Tata Mills	Large	Textiles	1150 m^3 /d
126.	"	Maharashtra	Mumbai	Gemini Dyeing & Printing Mills	Medium	Textiles	20 m^3 /d
127.	"	Maharashtra	Mumbai	The Hindustan Spg&Wvg Mills Ltd.	Large	Textiles	119 m^3 /d
128.	"	Maharashtra	Mumbai	Roche products Ltd.	Medium	Pharmaceutic als	50 m^3 /d
129.	"	Maharashtra	Mumbai	Khatau Makanji Spg&Wvg. Co. Ltd.	Large	Textiles	1695 m^3 /d
130.	"	Maharashtra	Mumbai	Khatau Makanji Spg&Wvg. Co. Ltd.	Large	Textiles	917 m^3 /d
131.	"	Maharashtra	Mumbai	Rallies (India) Ltd.	Large	Pharmaceutic als	51 m^3 /d
132.	"	Maharashtra	Mumbai	Parle Beverages Ltd.	Large	Brewery	910 m^3 /d
133.	"	Maharashtra	Mumbai	Mahindra & Mahindra Ltd.	Large	Automonbiles	450 m^3 /d
134.	"	Maharashtra	Mumbai	Cable Corporation (India) Ltd.	Large	Engineering	140 m^3 /d
135.	"	Maharashtra	Mumbai	Grauer & Weil (India) Ltd.	Large	Metallurgical	21 m^3 /d
136.	"	Maharashtra	Mumbai	Unichem Lab	Large	Pharmaceutic als	140 m^3 /d
137.	"	Maharashtra	Mumbai	German Remedies Ltd.	Large	Pharmaceutic als	203 m^3 /d
138.	"	Maharashtra	Mumbai	Centaur Hotel	Large	Food	195 m^3 /d
139.	"	Maharashtra	Mumbai	Godfrey Phillips (India) Ltd.	Large	Tobacco	37.2 m^3 /d
140.	"	Maharashtra	Mumbai	Nirlon Ltd.	Large	Synthetic	386 m^3 /d

Source : Maharashtra Pollution Control Board - 1999

Sl. No.	Coastal	Name of State	Name of Town	Name of Industry	Whether Small, Medium or Large Scale	Manufac-ture of Chemi-cals	Volume of Waste Water generated (per day/ month/year)
141.	"	Maharashtra	Mumbai	Parle Products Ltd.	Large	Food	70 m^3 /d
142.	"	Maharashtra	Mumbai	Mahindra & Mahindra	Large	Automobile	235 m^3 /d
143.	"	Maharashtra	Mumbai	Special Steels Ltd.	Large	Metallurgical	850 m^3 /d
144.	"	Maharashtra	Mumbai	Golden Chemicals	Large	Metallurgical	100 m^3 /d
145.	"	Maharashtra	Mumbai	Camlin Ltd.	Medium	General	76 m^3 /d
146.	"	Maharashtra	Mumbai	Borosil Glass works	Medium	General	15 m^3 /d
147.	"	Maharashtra	Mumbai	Excel Industries	Medium	Chemical	92 m^3 /d
148.	"	Maharashtra	Mumbai	Rashtriya Metal Industries Ltd.	Medium	Metallurgical	12 m^3 /d
149.	"	Maharashtra	Mumbai	Encee Dyeing & Printing works	Medium	Textiles	145 m^3 /d
150.	"	Maharashtra	Mumbai	Rajendra Mechanical (India) Ltd.	Medium	Engineering	23 m^3 /d
151.	"	Maharashtra	Mumbai	Poly Chem Ltd.	Medium	Textiles	12 m^3 /d
152.	"	Maharashtra	Mumbai	Indian Plastic Ltd.	Medium	Chemicals	33 m^3 /d
153.	"	Maharashtra	Mumbai	Ramada Inn Palm Grove Hotel	Medium	Food	54 m^3 /d
154.	"	Maharashtra	Mumbai	Excel (India) Ltd.	Medium	Chemicals	19 m^3 /d
155.	"	Maharashtra	Mumbai	IPCA lab.Ltd.	Medium	Pharmaceutic als	22 m^3 /d
156.	"	Maharashtra	Mumbai	F.D.C.Ltd.	Medium	Pharmaceutic als	85 m^3 /d
157.	"	Maharashtra	Mumbai	Permanent Magnets Ltd.	Medium	General	16 m^3 /d
158.	"	Maharashtra	Mumbai	Hixon & Padaji Ltd.	Medium	Chemicals	167 m^3 /d
159.	"	Maharashtra	Mumbai	Pedilite Industries Ltd.	Medium	Chemicals	36 m^3 /d
160.	"	Maharashtra	Mumbai	Nocil Ltd.	Large	Chemicals	7920 m^3 /d
161.	"	Maharashtra	Mumbai	Jaysnth Ltd.	Large	Dye	637 m^3 /d
162.	"	Maharashtra	Mumbai	Herdilia Unimers	Large	Chemicals	1655 m^3 /d
163.	"	Maharashtra	Mumbai	Herdilia Chemical Ltd.	Large	Chemicals	1124 m^3 /d
164.	"	Maharashtra	Mumbai	Phillips (India) Ltd.	Large	Engineering	1600 m^3 /d
165.	"	Maharashtra	Mumbai	Pfizer Ltd.	Large	Pharmaceutic als	710 m^3 /d
166.	"	Maharashtra	Mumbai	Bharat Pulvarising Mills	Large	Pesticides	47.5 m^3 /d
167.	"	Maharashtra	Mumbai	Balmer Lawrie & Co. Ltd.	Large	Engineering	4 m^3 /d
168.	"	Maharashtra	Mumbai	B.A.R.C.	Large	Radio active substances	101 m^3 /d
169.	"	Maharashtra	Mumbai	Lubrizol India	Large	Petrochemica ls	670 m^3 /d
170.	"	Maharashtra	Mumbai	United Carbon	Large	Petrochemica ls	120 m^3 /d
171.	"	Maharashtra	Mumbai	Siemens	Large	Engineering	560 m^3 /d
172.	"	Maharashtra	Mumbai	Standard Alkali	Large	Clor-alikali	1 150 m^3 /d
173.	"	Maharashtra	Mumbai	Terene Fibre Pvt. Ltd.	Large	Synthetic fibre	1 650 m^3 /d
174.	"	Maharashtra	Mumbai	I.P.C.L.	Large	Chemicals	1 025 m^3 /d
175.	"	Maharashtra	Mumbai	Allana Cold Storage	Medium	Food	166 m^3 /d
176.	"	Maharashtra	Mumbai	Shivaji Roller Flour Mill	Medium	Food	4 m^3 /d

Source : Maharashtra Pollution Control Board - 1999

Sl. No.	Coastal	Name of State	Name of Town	Name of Industry	Whether Small, Medium or Large Scale	Manufac-ture of Chemi-cals	Volume of Waste Water generated (per day/ month/year)
177.	"	Maharashtra	Mumbai	Herdilia Polymer	Medium	Petrochemica ls	708 m^3 /d
178.	"	Maharashtra	Mumbai	G.L.Rexrotle Industry Ltd.	Medium	Engineering	7 m^3 /d
179.	"	Maharashtra	Mumbai	Indo Pharma	Medium	Pharmaceutic als	75 m^3 /d
180.	"	Maharashtra	Mumbai	Premier Synthetic Processor	Medium	Textiles	308 m^3 /d
181.	"	Maharashtra	Mumbai	Roussel (India) Ltd.	Medium	Pharmaceutic als	600 m^3 /d
182.	"	Maharashtra	Mumbai	Rallis (India) Ltd.	Medium	Pesticides	35 m^3 /d
183.	"	Maharashtra	Mumbai	Reliance Silicon Ltd.	Medium	Chemicals	17 m^3 /d
184.	"	Maharashtra	Mumbai	New Reshma Dying	Medium	Textiles	81 m^3 /d
185.	"	Maharashtra	Mumbai	Poly Olefine (India) Ltd.	Medium	Chemicals	2020 m^3 /d
186.	"	Maharashtra	Mumbai	Associated Breweries & Distilleries	Medium	Breweries	498 m^3 /d
187.	"	Maharashtra	Mumbai	BASF Ltd.	Medium	Agro-chemicals	600 m^3 /d
188.	"	Maharashtra	Mumbai	Unique Chemicals	Medium	Chemicals	65 m^3 /d
189.	"	Maharashtra	Mumbai	Bharat Bijlee Ltd.	Medium	Engineering	200 m^3 /d
190.	"	Maharashtra	Mumbai	Savita Chemicals Ltd.	Medium	Petochemical s	50 m^3 /d
191.	"	Maharashtra	Mumbai	Star Chemicals	Medium	Chemicals	102 m^3 /d
192.	"	Maharashtra	Mumbai	Taida Trading & Industries Ltd.	Medium	Paper	92 m^3 /d
193.	"	Maharashtra	Mumbai	Mafco Ltd.	Medium	Food Processing	18 m^3 /d
194.	"	Maharashtra	Mumbai	Eldher pharmaceutical	Medium	Pharmaceutic als	38 m^3 /d
195.	"	Maharashtra	Mumbai	Electrolytic Manganese Ltd.	Medium	Chemicals	580 m^3 /d
196.	"	Maharashtra	Mumbai	Corn products pvt. Ltd.	Medium	Food	93 m^3 /d
197.	"	Maharashtra	Mumbai	Hico Ltd.	Medium	Chemical	365 m^3 /d
198.	"	Maharashtra	Mumbai	ICI speciality chemicals	Medium	Chemicals	310 m^3 /d
199.	"	Maharashtra	Mumbai	Mazado Dye Chem Ltd.	Medium	Pigments	256 m^3 /d
200.	"	Maharashtra	Mumbai	Proctor & Gamble	Medium	Pharmaceutic als	360 m^3 /d
201.	"	Maharashtra	Vengaurla	Usha ispat Ltd.	Large	Ore processing	189 m^3 /d
202.	"	Maharashtra	Ratnagiri	Naik Ice & Cold Storage	Small	Shrimp processing	72 m^3 /d
203.	"	Maharashtra	Ratnagiri	Finolege Pipes Ltd.	Large	Chemicals	3108 m^3 /d
204.	Ulhas creek	Maharashtra State	Badlapur	MIDC	MIDC	--	7000 m^3/d
205.	Ulhas creek	Maharashtra State	Ambernath	MIDC	MIDC	--	6000 m^3/d
206.	Ulhas creek	Maharashtra State	Shahad	Century	LSI	--	25500 m^3/d
207.	Ulhas creek	Maharashtra State	Ambernath	DMCC	LSI	--	555 m^3/d

Source : Maharashtra Pollution Control Board - 1999

Sl. No.	Coastal	Name of State	Name of Town	Name of Industry	Whether Small, Medium or Large Scale	Manufac-ture of Chemi-cals	Volume of Waste Water generated (per day/ month/year)
208.	Ulhas creek	Maharashtra State	Ambernath	OFA	LSI	--	2400 m^3/d
209.	Ulhas creek	Maharashtra State	Ambernath	MTP	LSI	--	925 m^3/d
210.	Ulhas creek	Maharashtra State	Kalyan	M/s.National Rayon Co. Ltd.	Large	Textiles	94,300 m^3
211.	Ulhas creek	Maharashtra State	Kalyan	M/s.Century Chemicals Ltd.	Large	Chemicals	00.400 m^3
212.	Ulhas creek	Maharashtra State	Kalyan	M/s.Gharda Chemicals	Large	Chemicals	00.150 m^3
213.	Ulhas creek	Maharashtra State	Kalyan	M/s.Hard Castle Ltd.	Large	--	00.010 m^3
214.	Ulhas creek	Maharashtra State	Kalyan	M/s.National peroxide Ltd.	Large	Chemicals	00.065 m^3
215.	Arabian sea through creek	Maharashtra State	MIDC Roha area	MIDC Area	Large-12 Medium-24 Small-07		14.341 MLD
216.	Arabian sea through Bankot creek	Maharashtra State	MIDC Mhad area	MIDC area	Large-19 Medium-34 Small-105		12.225 MLD
217.	Creek	Maharashtra State	Nagothane	M/s.IPCL	Large	Petrochemicals	22400 MLD
218.	Creek	Maharashtra State	Nagothane	M/s.Supreme Petrochem	Large	Petrochemicals	325 MLD
219.	Arabian sea	Maharashtra State	Alibag	M/s.RCF	Large		42210 MLD
220.	-	Maharashtra State	Usar-Alibag	M/s.Hindustan Petroleum Corp.Ltd.	Large	Petroleum	5.0 MLD
221.	-	Maharashtra State	Usar Alibag	M/s.GAIL	Large	--	275 MLD
222.	Amba	Maharashtra State	Pali	M/s.Sunshield Chemicals	Large	Chemicals	15 MLD
223.	Amba	Maharashtra State	Pali	M/s.Schenectdy Specialist	Large	--	30.0 MLD
224.		Maharashtra State	Sukeli Nagothane	M/s.Jindal drilling	Large	Engineering	325 MLD
225.		Maharashtra State		M/s.Maharashtra Seamless	Large	--	23 MLD
226.		Maharashtra State		M/s.Mahalaxmi Seamless	Large	--	24 MLD
227.	Arabian Sea	Maharashtra State	Salav-Murud	M/s.Vikram Ispat	Large	--	2064 MLD
228.	Panvel creek	Maharashtra State	MIDC Taleja	-	Small, Medium, Large		About 10 mld
229.	Uran creek	Maharashtra	Uran	M/s.ONGC Ltd.	Large	Oil & gas	168000M3
230.	Uran creek	Maharashtra	Uran	M/s.Skol Breweries Ltd.	Large	Breweries	1000 M3
231.	Uran creek	Maharashtra	Uran	M/s.Burns Philip India Ltd.	Large		460 M3
232.	Uran creek	Maharashtra	Uran	M/s.MSEB	Medium	Electrical	480M3

Source : Maharashtra Pollution Control Board - 1999

Sl. No.	Coastal	Name of State	Name of Town	Name of Industry	Whether Small, Medium or Large Scale	Manufac-ture of Chemi-cals	Volume of Waste Water generated (per day/ month/year)
233.	Coastal	Goa	Marmagoa	Zuari Industries	Large		9024m/day
234.	"	Goa	Corlim	Ciba Geigy Ltd.	Large	Pharmaceutic als	2000m/day
235.	"	Goa	Ponda	E-Merck India Ltd.	Medium	Chemcals	3m/day
236.	"	Goa	Vasco	Indian Oil Corporation	Large	Petroleum	500m for 9-10 days in a month
237.	"	Goa	Vasco	Hindustan Petroleum Corp.Ltd.	Large	Petroleum	200m/month
238.	Coastal	Karnataka	Mangalore	Mangalore Chemicals & Fertilisers Ltd.	Large	Chemicals/ Fertilizers	1040 m^3/d
239.	"	Karnataka	Mangalore	Kudremukh Iron Ore Co. Ltd.	Large	Iron Ore	40000 m^3/d
240.	"	Karnataka	Karwar	T.M.C.		Chemicals	2064m^3/d
241.	"	Karnataka	Bhatkal	TMC.		Chemicals	640 m^3/d
242.	"	Karnataka	Honnavar	TMC.		Chemicals	180 m^3/d
243.		Karnataka	Kunta	TMC.		Chemicals	432 m^3/d
244.	"	Karnataka	Karwar	Ballarpur Industries Ltd.	Large	Chemicals	1500 m^3/d
245.	"	Kerala	Udhyogamandal Area	Travancore-Cochin Chemicals	Large	Chemicals	4480 m^3/d
246.	"	Kerala	Udhyogamandal Area	Fertiliser & Chemical travancore Ltd.	Large	Fertilizer	37600 m^3/d
247.	"	Kerala	Udhyogamandal Area	Indian Rare Earths Ltd.	Large	Chemicals	3000 m^3/d
248.	"	Kerala	Udhyogamandal Area	Hindustan Insecticides Ltd.	Large	Pesticides	920 m^3/d
249.	"	Kerala	Udhyogamandal Area	The Fertiliser & Chemicals Ltd.	Large	Petro Chemicals	5040 m^3/d
250.	"	Kerala	Ambalamugal Area	The Fertilizer and Chemicals Travancore Ltd.	Large	Fertilizer	32400 m^3/d
251.	"	Kerala	Ambalamugal Area	Cochin Refineries ltd.	Large	Petro Chemicals	5080 m^3/d
252.	"	Kerala	Ambalamugal Area	Hindustan Organic Chemicals	Large	Petro Chemicals	1800 m^3/d
253.	"	Kerala	Kochi Area	Bharat Petroleum Corporation	Large	Petroleum (Storage)	0.3 m^3/d
254.	"	Kerala	Kochi Area	Hindustan Petroleum Corporation	Large	Petroleum (Storage)	400 m^3/d
255.	"	Kerala	Kochi Area	The Tata Oil Mills Co. Ltd.	Large	Chemicals	12657 m^3/d
256.	"	Kerala	Allapuzha	Mc Dowells Co. Ltd.	Large	Distillery	270 m^3/d
257.	"	Kerala	Allapuzha	Kerala State Drug & Pharmaceuticals Ltd.	Large	Pharmaceutic als	120 m^3/d
258.	"	Kerala	Chavara	The Aluminium Industries Ltd.	Medium	Metallurgical	111 m^3/d
259.	"	Kerala	Chavara	Kings Marine products	Medium	Fish Processing	8 m^3/d
260.	"	Kerala	Chavara	Poyilakkada Fisheries Ltd.	Medium	Fish Processing	22 m^3/d
261.	"	Kerala	Chavara	Indian Rare Earth Ltd.	Large	Chemicals	750 m^3/d

Source : Goa, Karnataka and Kera Pollution Control Board - 1999

Sl. No.	Coastal	Name of State	Name of Town	Name of Industry	Whether Small, Medium or Large Scale	Manufac-ture of Chemi-cals	Volume of Waste Water generated (per day/ month/year)
262.	"	Kerala	Trivandrum	Travancore Titanium Products	Large	Chemicals	8236 m^3/d
263.	"	Kerala	Trivandrum	English India Clays Ltd.	Medium	Rare Earth	700 m^3/d
264.	"	Kerala	Quilon	Kerala Minerals & Metals Ltd.	Large	Chemicals	200 m^3/d
265.	"	Kerala	Quilon	Trivandrum Regional Co-operative Milk producer's Union Ltd.	Medium	Dairy	205 m^3/d
266.	"	Kerala	Kozhikodu	The Tata Oil mills	Medium	Soap	58.5 m^3/d
267.	"	Kerala	Kozhikodu	Grasim Industries Ltd.	Large	Paper Mills	37000 m^3/d
268.	"	Kerala	Kozhikodu	Uniroyal marine products ltd.	Medium	Fish Processing	50 m^3/d
269.	"	Kerala	Kozhikodu	Poyilakada Fisheries Ltd.	Medium	Shrimp Processing	15 m^3/d
270.	"	Kerala	Kozhikodu	The Commonwealth weaving factory	Medium	Textiles (Handloom)	58.6 m^3/d
271.	"	Tamil Nadu	Tuticorin	Madras Refineries Ltd.	Large	Refineries	150 m^3 /d
272.	"	Tamil Nadu	Tuticorin	AV Aqua Farm Ltd.	Medium	Aqua Culture	5700 m^3 /d
273.	"	Tamil Nadu	Tuticorin	Minota Aqua Tech Ltd.	Medium		150000 m^3 /d
274.	"	Tamil Nadu	Tuticorin	TAC Ltd.	Large	Chemicals	1800 m^3 /d
275.	"	Tamil Nadu	Tuticorin	TTPS	Large	Thermal Power	50000 m^3 /d
276.	"	Tamil Nadu	Tuticorin	Coats India Ltd.	Large	Spinning Mills	141 m^3 /d
277.	Coastal	Tamil Nadu	Tuticorin	SPIC Ltd.	Large	Fertilizers	6500 m^3 /d
278.	Coastal	Tamil Nadu	Tuticorin	King International Aqua Marine Exports Ltd.	Medium	Aqua Culture	90000 m^3 /d
279.	Coastal	Tamil Nadu	Tuticorin	DCW Ltd.	Large	Caustic Soda	1800 m^3 /d
280.	Coastal	Tamil Nadu	Tuticorin	Femina Prawn culture P.Ltd.	Medium		100 m^3 /d
281.	Coastal	Tamil Nadu	Tuticorin	Lean Aqua culture	Small		400 m^3 /d
282.	Coastal	Tamil Nadu	Tuticorin	Sri Ram Prawn culture Unit	Small		100 m^3 /d
283.	Coastal	Tamil Nadu	Tuticorin	SSK Aqua Farm	Small		300 m^3 /d
284.	Coastal	Tamil Nadu	Tuticorin	KMK Karpaga Prawn culture	Small		200 m^3 /d
285.	Coastal	Tamil Nadu	Tuticorin	Amulya Sea Foods	Small		8 m^3 /d
286.	Coastal	Tamil Nadu	Sayalkudi	Jagannath Aqua Culture P. Ltd.	Medium		57.5 m^3 /d
287.	Coastal	Tamil Nadu	Ramanathapuram	Baby Marine Eastern Exports Ltd.	Medium		50.5 m^3 /d
288.	Coastal	Tamil Nadu	Tuticorin	George Maijo	Small		16 m^3 /d
289.	Coastal	Tamil Nadu	Tuticorin	Premier Marine Product	Small		25.5 m^3 /d
290.	Coastal	Tamil Nadu	Vachipuli	Poyilakada Fisheries	Small		44 m^3 /d
291.				Oceanic products	Small		14 m^3 /d

Source : Kerala and Tamil Nadu Pollution Control Board - 1999

Sl. No.	Coastal	Name of State	Name of Town	Name of Industry	Whether Small, Medium or Large Scale	Manufac-ture of Chemi-cals	Volume of Waste Water generated (per day/ month/year)
292.	Coastal	Tamil Nadu	Vallinokkam	Tamil Nadu Magnesium and Marine Chemicals	Large	Chemicals	1025 m^3 /d
293.	Coastal	Tamil Nadu	Pudupattinam	Vairum Aquaculture P.Ltd.	Medium		30.6 m^3 /d
294.	Coastal	Tamil Nadu	Mahabalipuram	Amusement and Picnic Resorts P. Ltd.	Medium	Food allied	20 m^3 /d
295.	Coastal	Tamil Nadu	Mahabalipuram	Gem Holiday Resorts Ltd.	Small		201 m^3 /d
296.	Coastal	Tamil Nadu	Mahabalipuram	Fisherman's cove	Medium	Food - allied	45 m^3 /d
297.	Coastal	Tamil Nadu	Kalpakkam	Madras Atomic Power Station	Medium	Chemicals	75 m^3 /d
298.	Coastal	Tamil Nadu	Palavakkam	VGP Golden Beach Resorts Ltd.	Medium	Food	180 m^3 /d
299.	Coastal	Tamil Nadu	Palavakkam	MAC Industries	Small		301.5 m^3 /d
300.	Coastal	Tamil Nadu	Cuddalore	CALAC P. Ltd.	Medium	Chemicals	2 m^3 /d
301.	Coastal	Tamil Nadu	Cuddalore	TANFAC Industries	Medium	Chemicals	1110 m^3 /d
302.	Coastal	Tamil Nadu	Cuddalore	Pentasia Chemicals Ltd.	Large	Chemicals	260 m^3 /d
303.	Coastal	Tamil Nadu	Cuddalore	Loyal Super Fabrics Ltd.	Medium	Textiles	100 m^3 /d
304.	Coastal	Tamil Nadu	Manali	Indian Rare Earth Ltd.	Large	Rare Earths	1650 m^3 /d
305.	Coastal	Tamil Nadu	Manali	EID Parry (India) Ltd.	Large	Fertilizers	1492 m^3 /d
306.	Coastal	Tamil Nadu	Manali	Ennore Thermal Power Station	Large	Thermal Power	34000 m^3 /d
307.	Coastal	Tamil Nadu	Manali	ICI (India) Ltd.	Large	Pharmaceutic als	233 m^3 /d
308.	Coastal	Tamil Nadu	Manali	ICI (India) Ltd.	Large	Agrochemical s	936 m^3 /d
309.	Coastal	Tamil Nadu	Ennore	Ennore Foundries Ltd.	Large	Foundary	525 m^3 /d
310.	Coastal	Tamil Nadu	Ennore	Ashok Leyland Ltd.	Large	Engineering	850 m^3 /d
311.	Coastal	Tamil Nadu	Ennore	The Enfield India Ltd.	Large	Engineering	130 m^3 /d
312.	Coastal	Tamil Nadu	Ennore	National Carbon Co. Ltd.	Large	Lead	95 m^3 /d
313.	Coastal	Tamil Nadu	Ennore	Madras Fertilizers Ltd.	Large	Fertilizers	4495 m^3 /d
314.	Coastal	Tamil Nadu	Ennore	Tamil Nadu Petro Products Ltd.	Large	Chemicals	1170 m^3 /d
315.	Coastal	Tamil Nadu	Ennore	UB Petro products	Large	Chemicals	4505 m^3 /d
316.	Coastal	Tamil Nadu	Ennore	Manali Petrochemicals Ltd.	Large	Petrochemica ls	3515 m^3 /d
317.	Coastal	Tamil Nadu	Ennore	Madras Refineries Ltd.	Large	Fertilizers	8650 m^3 /d
318.	"	Tamil Nadu	Ennore	KID Parry (I) Limited	Large (Misc.)	Chemicals	120 kl/m
319.	"	Tamil Nadu	Ennore	Kothari Industrial Corporation Ltd.	Large	Fertilizer	10 Kl/m
320.	"	Tamil Nadu	Ennore	Ennore Chemicals & Fertilizers Ltd.	Small	Chemical	-
321.	"	Tamil Nadu	Ennore	Viedeocon Power (proposed 9/99)	Large	Thermal Power	2780000 kl/m

Source : Tamil Nadu Pollution Control Board - 1999

Sl. No.	Coastal	Name of State	Name of Town	Name of Industry	Whether Small, Medium or Large Scale	Manufac-ture of Chemi-cals	Volume of Waste Water generated (per day/ month/year)
322.	"	Tamil Nadu	Ponneri Taluk	G.V.K. Generation Ltd.	Large	Power generating	132000 kl/m
323.	"	Tamil Nadu	Ponneri Taluk	Van Omeran MAC Tank Terminals Ltd.	Large (Misc.)		-
324.	"	Tamil Nadu	Thiruvottiyur	M.R.F. Ltd.	Large	Rubber	1440 kl/m
325.	"	Tamil Nadu	Thiruvottiyur	Thangam Metal Rolling Mills	Small (Misc.)	Steels	-
326.	"	Tamil Nadu	Thiruvottiyur	Bharat Steel Industries	Small (Misc.)	Steels	-
327.	"	Tamil Nadu	Thiruvottiyur	Naitonal Chlorides	Small	Chemical	5.0 kl/m
328.	"	Tamil Nadu	Ernavoor	Eswaran Sons Engineers Ltd	Small (Misc.)	Chemicals	25 kl/m
329.	"	Tamil Nadu	Ennore	Kothari Industrial Corporation Ltd	Large	Fertilizer	10 kl/m
330.	"	Tamil Nadu	Thiruvottiyur	Bharath Pulverizing Mills Ltd.	Small	Pesticides	-
331.	"	Tamil Nadu	Thiruvottiyur	Gopal Chettiar Steel Rolling Mills	Small (Misc)	Steel	-
332.	"	Tamil Nadu	Thiruvottiyur	Bharat Metals Alloy (P) Ltd.	Small (Misc.)	Alloys	-
333.	"	Tamil Nadu	Thiruvotriyur	Sri Rama Machinery Corporation Ltd.	Medium (Misc.)	Engineering	S-2 KLD TE - Nil
334.	"	Tamil Nadu	Thiruvotriyur	Ennore Steel Enterprises Ltd.	Medium	Steel	1.18 kl/m
335.	"	Tamil Nadu	Thiruvotriyur	Chenitherm Plants Ltd.	Small (Misc.)	..	-
336.	"	Tamil Nadu	Thiruvottiyur	Himachal Pradesh Horticultural Product Marketing & Processing Corporation Ltd.	Medium (Misc.)	Agro Food	60 kl/m
337.	"	Tamil Nadu	Ennore	Trisakthi Energy (P) Ltd.	Medium (Misc.)	Thermal Power	1876800 kl/m
338.	"	Tamil Nadu	Thiruvotriyur	Eveready Industries	Private	Batteries	375 kl/m
339.	"	Tamil Nadu	Thiruvottiyur	Royal Enfield Motors Ltd.	Large	Engineering	2250 kl/m
340.	"	Tamil Nadu	Ennore	E.I.D. Parry Ltd.	Large	Multi Effect Distillation Plant	239040 kl/m
341.	"	Tamil Nadu	Ennore	E.I.D. Parry Ltd.	Large	Chemial (Sulphuric Acid Plant	-
342.	"	Tamil Nadu	Thiruvotriyur	Carborundum Universal Ltd.	Medium (Misc.)	Chemicals	525 KLD
343.	"	Tamil Nadu	Chengai District	North Madras Thermal Power Station	Large	Power Plant	S-1200 KLD TE - 55800 KLD
344.	"	Tamil Nadu	Chennai	Deccan Overseas	Small		9.5 KLD
345.	"	Tamil Nadu	Chennai	Standard Batteries	Medium	Batteries	S-15 TE 16/KLD
346.	"	Tamil Nadu	Chennai	Slaughter House	Small	Food	1.5 KLD
347.	"	Tamil Nadu	Chennai	ABI Service Centre	Medium	Automobiles	2 KLD
348.	"	Tamil Nadu	Chennai	IOCL	Medium	Drum Plant	S-2 TE-0.1

Source : Tamil Nadu Pollution Control Board - 1999

Sl. No.	Coastal	Name of State	Name of Town	Name of Industry	Whether Small, Medium or Large Scale	Manufac-ture of Chemi-cals	Volume of Waste Water generated (per day/ month/year)
349.	"	Tamil Nadu	Chennai	India Pistons Huzur Garden	Large		S-450 TE-120
350.	"	Tamil Nadu	Chennai	TAFE	Large	Steel	S-92 TE-31
351.	"	Tamil Nadu	Chennai	Simpson & Co	Medium	Steeel	S-12 TE-1.2
352.	"	Tamil Nadu	Chennai	Addision Paints & Chemicals	Medium	Chemicals & Paints	S-22.5 TE-2
353.	"	Tamil Nadu	Chennai	Standard Service	Medium	Automobiles	1 KLD
354.	"	Tamil Nadu	Chennai	SlaughterHouse	Small	Food	50 KLD
355.	"	Tamil Nadu	Chennai	ICF (Shell Division)	Large	Steel	S-225 TE-30
356.	"	Tamil Nadu	Chennai	Southern Railway Loco Works	Large	Locomotives	S-160 TE-2
357.	"	Tamil Nadu	Chennai	Madhuram Dyers	Small	Dyes	4 KLD
358.	"	Tamil Nadu	Cuddalore	Asian Paints (I) Ltd	Large	Paints	S – 35 Te – 200
359.	"	Tamil Nadu	Cuddalore	Maruthi Synthetics & Pharmaceuticals (P) Ltd.	Medium	Pharmaceutic als	1 KLD
360.	"	Tamilnadu	Cuddalore	Maruthi Laboratories ltd.	Small	Chemicals	5 KLD
361.	"	Tamil Nadu	Cuddalore	Kumar Chemical Corporation	Small	Chemicals	0.2 KLD
362.	"	Tamil Nadu	Thiruvottiyur	Zeneca ICI Agro Chemicals Ltd.	Large	Agro Chemicals	-
363.	"	Tamil Nadu	Cuddalore	Square-D-Bio Tech Ltd.	Large	Agro Food	S-9 TE-1012
364.	"	Tamil Nadu	Cuddalore	Tamilnad Pigments P Ltd.	Small		12 KLD
365.	"	Tamil Nadu	Cuddalore	Tantech Agrochemicals Ltd.	Large	Agrochemical	8.5 KLD
366.	"	Tamil Nadu	Cuddalore	Ominicast Precision Products (P) Ltd.	Medium	Ceramic	S-4 TE – 3.5
367.	"	Tamil Nadu	Cuddalore	Nova Roofings and Pipes Ltd	Medium	Steel/Plastics	45 KLD
368.	"	Tamil Nadu	Cuddalore	Vijay Phosphates and (Madras) Chemicals Pvt. Ltd	small	Chemicals	0.18 KLD
369.	"	Tamil Nadu	Cuddalore	Sri Lakshmi Cellolose Products (P) Ltd.	Medium	Food	85 KLD
370.	"	Tamil Nadu	Cuddalore	Loyal Super Fabrics Ltd.	Medium	Textiles	S-10 TE – 400 KLD
371.	"	Tamil Nadu	Cuddalore	Shasun Chemicals & Drugs Ltd.	Large	Chemicals	51 KLD
372.	"	Tamil Nadu	Cuddalore	Morgan Industries Ltd.	Large	PVC	S-13 TE- 4 KLD
373.	"	Tamil Nadu	Cuddalore	GJB Chemicals Worls P Ltd.	Medium	Chemicals	S-2 TE-1

Source : Tamil Nadu Pollution Control Board - 1999

Sl. No.	Coastal	Name of State	Name of Town	Name of Industry	Whether Small, Medium or Large Scale	Manufac-ture of Chemi-cals	Volume of Waste Water generated (per day/ month/year)
374.	"	Tamil Nadu	Cuddalore	Victory Chemicals P Ltd	Medium	Chemicals	S-2 TE-2
375.	"	Tamil Nadu	Cuddalore	JK Pharmachem Ltd.	Large	Pharmaceutic als	2420 KLD
376.	"	Tamil Nadu	Cuddalore	Spic Pharmaceuticals Division	Large	Pharmaceutic als	3650 KLD
377.	"	Tamil Nadu	Cuddalore	Amjin Agro Exports Ltd.	Medium	Agro products	-
378.	"	Tamil Nadu	Cuddalroe	Sudhakar Chemicals Ltd.	Medium	Chemicals	S-1 TE-4.15
379.	"	Tamil Nadu	Cuddalore	Morgan Acid and Chemicals (P) Ltd.	Medium	Chemicals	S-9 TE-Nil
380.	"	Tamil Nadu	Cuddalore	Rallis India Ltd.	Medium	Fine Chemicals	S-5 TE - 32
381.	"	Tamil Nadu	Cuddalore	Tagros Chemicals India Ltd.	Medium	Chemicals	S-7 TE-15
382.	"	Tamil Nadu	Cuddalore	Maruti Industrial Carboibydrates Ltd	Medium	Food	S-7 TE-8
383.	"	Tamil Nadu	Cuddalore	SPIC Pharmaceuticals Division (Bulk Drugs)	Medium	Phar	18 KLD
384.	"	Tamil Nadu	Cuddalore	Pentafour Products Ltd.	Large	Chemicals	S-3 TE-33
385.	"	Tamil Nadu	Cuddalore	Vanavil Dyes and Chemicals Ltd.	Large	Dyes and Chemical	400 KLD
386.	"	Tamil Nadu	Cuddalore	Bayar Sanmar Ltd	Large		S-20 TE – 75
387.	"	Tamil Nadu	Cuddalore	EIF Atochem Peroxies India Ltd.	Large	Chemicals	S-5 TE-85
388.	"	Tamil Nadu	Cuddalore	Pioneer Miyagi Chemicals (P) Ltd	Medium	Chemicals	S-3 TE-1200
389.	"	Tamil Nadu	Cuddalore	EID Parry (I) Ltd.	Large	Chemicals	275 KLD
390.	"	Tamil Nadu	Vedaranyan	Chemplast Sanmar Ltd.	Medium	Chemicals	S – 0.4 TE - 660
391.	Coastal	Pondicherry	Pondicherry	Pondicherry Papers Ltd.	Medium	Paper	9000 KLD
392.	"	Pondicherry	Pondicherry	Pondicherry Distilleries Ltd.	Medium	Distilleries	1600 KLD
393.	"	Pondicherry	Pondicherry	Chemfab Alcalis Ltd.	Large	Chlor-alcali	50 KLD
394.	"	Pondicherry	Pondicherry	Shasun Drugs	Medium	Pharmaceutic als	60 KLD
395.	"	Andhra Pradesh	Visakhapatnam	HPCL	Large	Petrochemica ls	33500m/d
396.	"	Andhra Pradesh	Visakhapatnam	Hindustan Zinc Ltd.	Large	Chemicals	4000m/d
397.	"	Andhra Pradesh	Visakhapatnam	Naval Dockyard	Medium	Shipping	1 50 lt/d
398.	"	Andhra Pradesh	Visakhapatnam	Visakhapatnam Port Trust	Medium	Shipping	-
399.	"	Andhra Pradesh	Visakhapatnam	Visakhapatnam Steel Plant	Large	Steel	9 120m/d
400.	"	Andhra Pradesh	Visakhapatnam	M/s.Hindustan Shipyard Ltd	Large	Shipping	-
401.	"	Andhra Pradesh	Visakhapatnam	The Andhra petro Chemical Ltd	Large	Petrochemica ls	3 524m/d

Source : Tamil Nadu, Pondicherry and Andhra Pradesh Pollution Control Board - 1999

Sl. No.	Coastal	Name of State	Name of Town	Name of Industry	Whether Small, Medium or Large Scale	Manufac-ture of Chemi-cals	Volume of Waste Water generated (per day/ month/year)
402.	"	Andhra Pradesh	Nellore district, Sullurpet	M/s.Asian Perosider Ltd.	Large	Petrochemica ls	147m/d
403.	"	Andhra Pradesh	Varakavi pudi (V) Nellore District	M/s.The Water base Ltd.	Large	Aqua Culture	310m/d
404.	"	Andhra Pradesh	G.N.T.Road Nellore Dist	M/s.Indo National Ltd.	Large	--	37kl/d
405.	"	Andhra Pradesh	Singaraya konda Prakasam Dist	M/s.Pearl Distillaries Ltd.	Large	Distillaries	655kl/d
406.	"	Andhra Pradesh	Gudipallipadu (V) Nellore District	M/s.Circar paper Mills Ltd.	Large	Paper	4525 kl/d
407.	"	Andhra Pradesh	Tiplipalem(v)	M/s.Balaji Biotech Ltd.	Large	Food	33kl/d
408.	"	Andhra Pradesh	Chirala Prakasam district	M/s.ITC (I LTD Division)	Large	Chemicals	78m/d
409.	"	Andhra Pradesh	- do –	M/s.Coromandel Agro productions Ltd.	Medium	Agro Products	109kl/d
410.	"	Andhra Pradesh	Ulavalapadu Prakasam Dist	M/s.Premier Tobacco papers Ltd.	Medium	Tobacco	15kl/d
411.	"	Andhra Pradesh	Nellore	M/s.Indo Matshushita Carbon tada	Large	Chemical	30kl/d
412.	"	Andhra Pradesh	Eluru	M/s.Mohiddin Thumby and Co.	-	--	35kl/d
413.	"	Andhra Pradesh	Bhimadole	M/s.west godavari Co.op Sugars ltd	-	Sugar	200 kl/d
414.	"	Andhra Pradesh	Uyyur, Krishna Dist	M/s.KCP Ltd.(Distillary)	-	Distillary	384 kl/d
415.	"	Andhra Pradesh	- do -	M/s.KCP Ltd.(Sugars)	-	Sugar	1360kl/d
416.	"	Andhra Pradesh	Bommuluru	Guardian papers Ltd	-	Paper	5000 kl/d
417.	"	Andhra Pradesh	Kodurupadu, krishna Dist	Hanumanth kali var prasad babu chemicals	-	Chemicals	250 kl/d
418.	"	Andhra Pradesh	Bagulapadu Krishna dist	Raja Rajeswari paper Mills Ltd.	-	Paper	800 kl/d
419.	"	Andhra Pradesh	Serinarasannap alem Krishna dist	Sri Kanakadurga paper Mills Private ltd.	-	Paper	17kl/d
420.	"	Andhra Pradesh	R.R.Pet, Eluru	Mohiddin Thumby	-	--	35 kl/d
421.	"	Andhra Pradesh	Serinarasannap alem Krishna Dist	Hanuman Co-op sugars	-	Sugar	300 kl./d
422.	"	Orissa	Chilka	Paradip phosphate	Large	Chemicals	960 m^3 /d
423.	"	Orissa	Puri	East Coast Brewery	Medium	Breweries	150 m^3 /d
424.	"	Orissa	Gopalpur	Jayshree Chemicals	Medium	Chemicals	30 m^3 /d
425.	"	Orissa	Gopalpur	Indian Rare Earths Ltd.	Large	Rare Earths	

Source : Andhra Pradesh and Orissa Pollution Control Board - 1999

Sl. No.	Coastal	Name of State	Name of Town	Name of Industry	Whether Small, Medium or Large Scale	Manufac-ture of Chemi-cals	Volume of Waste Water generated (per day/ month/year)
426.	"	West Bengal	Haldia	Shaw Wallace & Co. Ltd.	Large	Pesticides	50 m^3 /d
427.	"	West Bengal	Parganas (N)	Hindustan Lever Ltd.,	Large	Vegetable Oil and Vanaspathi	5.807 MLD
428.	"	West Bengal	Calcutta	Hindustan Lever Ltd.,	Large	Soaps & Detergents	0.36 MLD
429.	"	West Bengal	Haldia	Consolidate Fibres & Chemicals Ltd.	Large	Synthetic Fibres	2303 m^3 /d
430.	"	West Bengal	Haldia	Haldia Dock Complex	Large		650 m^3 /d
431.	"	West Bengal	Parganas (N)	Exide Industries Ltd.	Medium	Lead Acid Battery Mfg. Unit	0.064 MLD
432.	"	West Bengal	Parganas (N)	Hindusthan Heavy Chemicals Ltd.	Large	Sulphuric acid, Caustic, HCl Mfg	0.215 MLD
433.	Coastal	West Bengal	Parganas (N)	Jayashree Chemicals & Fertilisers	Medium	Sulphuric Acid, Sodium Silica fluoride silica phosphate etc.	0.232 MLD
434.	Coastal	West Bengal	Nadia	United Breweries Ltd	Medium	Fertilizer	
435.	Coastal	West Bengal	Nadia	Supreme Paper Mills		Pulping & Paper Mfg.	1.266 MLD
436.	Coastal	West Bengal	Nadia	Jensen & Nicholsen India Ltd.		Paint Industry	0.000494 MLD
437.	Coastal	West Bengal	Nadia	Ramswarup Industrial Corporation		G.I. Wire Mfg.	0.0056 MLD
438.	Coastal	West Bengal	Calcutta	Eastern Distillery Ltd.		Distillery	0.25 MLD
439.	Coastal	West Bengal	Parganas (S)	IFB Agro Industries Ltd		Distillery	0.25
440.	Coastal	West Bengal	Calcutta	Black Diamond Beverage Ltd.		Soft Drinks Mfg.	0.4 MLD
441.	Coastal	West Bengal	Parganas (S)	Bata India Ltd.	Large	Shoe Mfg.	0.615 MLD
442.	Coastal	West Bengal	Calcutta	Kesoram Industries & Cotton Mills Garden Reach.		Cotton Textile Industry	0.665 MLD
443.	Coastal	West Bengal	Calcutta	Stone India Ltd.,		Engineering Unit	0.002 MLD
444.	"	West Bengal	Calcutta	GEC, AEI Works		Engineering Unit	0.02 MLD
445.	"	West Bengal	Calcutta	ESAB India Ltd		Engineering Unit	0.02 MLD
446.	"	West Bengal	Calcutta	ELMI		Electrical	0.158 MLD
447.	"	West Bengal	Calcutta	Rasoi Ltd.		Vanaspati Mfg	0.085 MLD
448.	"	West Bengal	Calcutta	Gun & Shelf Factory		Ordnance Factory	2.443 MLD
449.	"	West Bengal	Hooghly	Phosphate Co. Ltd.,		Fertiliser	0.23 MLD
450.	"	West Bengal	Hooghly	Dunlop India Ltd.		Rubber	9.0559 MLD
451.	"	West Bengal	Hooghly	Nalco Chemicals		Chemical	0.5545 MLD

Source : West Bengal Pollution Control Board - 1999

Sl. No.	Coastal	Name of State	Name of Town	Name of Industry	Whether Small, Medium or Large Scale	Manufac-ture of Chemi-cals	Volume of Waste Water generated (per day/ month/year)
452.	"	West Bengal	Parganas (N)	Infar (India) Ltd.	Large	Steroid Bulk Drug Mfg	0.5545 MLD
453.	"	West Bengal	Hooghly	ITC Ltd.		Pulp & Paper	19 MLD
454.	"	West Bengal	Hooghly	Kesoram Rayon		Chemical	19. 3 MLD
455.	"	West Bengal	Hooghly	Black Diamond Beverages Ltd.		Bottling Plant	-
456.	"	West Bengal	Hooghly	ICI India Ltd.		Chemical	-
457.	"	West Bengal	Hooglhly	Kusum Products Ltd.		Vanaspati	0.91 MLD
458.	"	West Bengal	Howrah	Asiatic Oxygen & Acetylene		Chemical	0.03375 MLD
459.	"	West Bengal	Howrah	Berger Paints India Ltd.		Paints	0.0582 MLD
460.	"	West Bengal	Howrah	Shalimar Paints Ltd.		Paints	0.042 MLD
461.	"	West Bengal	Howrah	Seth chemical Works (P) Ltd.		Dye	0.052 MLD
462.	"	West Bengal	Hooglhly	Hindustan Motors Ltd.		Engineering Industry	11.08 MLD
463.	"	West Bengal	Hoogly	Waldies Ltd.		Lead	0.12 MLD
464.	"	West Bengal	Nadia	Nicco Corporation Ltd.		Large Jelly filled	0.006 MLD
465.	"	West Bengal	Nadia	Aromate Pvt. Ltd.		Chemical Mfg.	0.00075 MLD
466.	"	West Bengal	Nadia	Alchrome Chemcial Industries		Small Chemical	0.004 MLD
467.	"	West Bengal	Parganas (N)	B & M Chemical Ltd.		Chemical Mfg.	0.0008 MLD
468.	"	West Bengal	Nadia	Nicco Corporation Ltd.	Large	Steel Wire Mfg. Unit	0.036 MLD
469.	"	West Bengal	Parganas (N)	Rifle Factory	Large	Rifle Mfg.	4.85 MLD
470.	"	West Bengal	Parganas (N)	Reliance Jute Mills	Large	Jute Industry	0.43 MLD
471.	"	West Bengal	Parganas (N)	Metal & Steel Factory		Heavy Metal & Steel Mfg.	9.031 MLD
472.	"	West Bengal	Midnapore	Hindusthan Fertiliser Corporation		Fertiliser & Chemical	-
473.	"	West Bengal		IOC Ltd.	Large	Oil Refinery	13800 m^3 /d
474.	"	West Bengal		Chloride Industries	Large	Lead - Battery	402 m^3 /d
475.	"	West Bengal		H.F.C.Ltd. (main plant not operating since 1987)	Large	Fertilizer	3400 m^3 /d
476.	"	West Bengal		Standard Pharmaceuticals Ltd.		Phasrmaceuti cal industry	-
477.		West Bengal		C & W Workshop, Eastern Railway, Liluach, Howrah		Engineering Industreis	25.68

Source : West Bengal Pollution Control Board - 1999

TABLE 6
CHEMICAL CHARACTERISTICS OF INDUSTRIES/ESTATES LOCATED IN A COASTAL AREA

	Name of the Spot:-MIDC Sump-Mahad							
Sl.No	Parameter							
		11/3/98	4/4/98	15/5/98	17/6/98	13/7/98	19/8/98	27/11/98	29/12/98
1	PH	7.4	6.3	6.6	6.5	7.9	6.9	3.4	1.0
2	Turbidity NTU	ND Coloured	ND Coloured	ND Coloured	-	-	ND Coloured	-	-
3	Dissolved Oxygen	Nil	Nil	Nil	Nil	Nil	Nil	Nil	-
4	Conductivity ms/m	6560.0	10800.0	7840.0	-	-	4040.0	-	-
5	B.O.D. 5 days 20^0 C	269.0	364.0	500.0	1050.0	210.0	920.0	600.0	150.0
6	C.O.D	1480.0	2920.0	1520.0	2944.0	576.0	1800.0	2000.0	808.0
7	Suspended solids	379.0	392.0	411.0	180.0	210.0	1110.0	310.0	ND
8	Hardness	1410.0	1940.0	1390.0	ND	618.0	1080.0	-	-
9	Calcium	500.0	640.0	452.0	ND	216.0	384.0	-	-
10	Magnesium	39.2	83.0	63.5	ND	-	29.4	-	-
11	Total Alkalinity	530.0	800.0	388.0	Nil	124.0	384.0	-	-
12	Chloride	920.0	1470.0	1380.0	1400.0	-	922.0	1270.0	-
13	Nitrate	4.28	4.41	3.79	-	-	4.79	-	-
14	Sulphate	2013.15	3907.8	1873.1	600.0	80.0	675.97	150.4	4700.0
15	Phosphate	2.05	1.93	0.66	-	-	0.24	-	-
16	T.K. Nitrogen	N.A	N.A	N.A	-	-	250.8	-	-
17	Sodium	880.0	1760.0	1160.0	-		450.0	-	-
18	Bacteriology MPN/100ml	-	-	-	-	-	-	-	-
19	Plate Count/ml	-	--	-	-	-	-	-	-
20	MPNCT	-	-	-	-	-	-	-	-
21	Oil & grease	-	-	-	8.2	10.2		8.0	Nil
22	% Free Ammonia Alkalinity							-	Nil
23	TDS				2960.0	1889.0		5320.0	-

Source : Maharashtra Pollution Control Board - 1999

TABLE 7
CHEMICAL CHARACTERISTICS OF THE CHILKA LAGOON

Physio – Chemical Properties

Temperature (^{0}C)
- Surface water : 17.5 – 32.0

Salinity (ppt)
- Range : Traces – 36.0

PH
- Range : 7.6 – 10.0

Dissolved oxygen (mg/litre) : 1.3 – 13.4

Transparency (Secchi disc depth in m.) : Minimum – 0.32, Maximum – 1.

Nutrients (mg/litre)
- Nitrate : Traces – 0.19
- Phosphate : Traces – 0.18
- Slicate : 0.10 – 0.60

Trace elements (ppm)
- Copper : 0.02 – 0.04
- Zinc : 0.025 – 0.19
- Iron : 0.12 – 0.32

Sediments

Carbonate contents (%) : 1.6 – 3.8

Trace metals (ppm) in sediments
- Copper : 5 – 66 (37)*
- Nickel : 150 – 270 (195)*
- Chromium : 30 – 270 (188)*
- Lead : 72 – 122 (91)*

Phytoplankton

Phytoplankton density
- Mishra et al. (1998) : $2.10^3 – 3.10^6$
- Panigraphy (1985) : cells/litre (appx.)

Relative species Abundance (%)
- Diatoms : 70%
- Blue – green algae : 25%
- Dinoflagellates : 3%
- Green algae : 2%

Phytoplankton pigment (mg/m^3)
- Total Chlorophyll : ND – 67.05
- Chlorophyll a : ND – 13.38
- Chlorophyll b : ND – 18.60
- Chlorophyll c : ND – 59.03

Primary productivity : 7-70 mg $c/m^3/h$

Zooplankton and secondary productivity

- Plankton volume(ml/l) : 0.03 – 0.27
- Faunistic composition : 170 species (26 groups)

Relative abundance of dominant groups (%)
- Copepoda : 43.0 – 70.0
- Veligers : 5.0 – 30.0
- Nauplii : 16.0 – 18.0
- Protozoans : 7
- Rotifers : 4
- Polychaetes : 2
- Mysids : 1.5
- Biomass (gm/m) : 0.32 – 3.30

Macrophytes

Dominant species : Potamogeton pectinatus, Halophila ovata, Najas gramineae, N.falcioulata, Rupia maritima, Eichornia crassipes, Scirpus articulatus, Gracilaria verrucosa

Area covered by Macrophytes (km^2) : 1973 – 20, 1977 – 60, 1982 – 100, 1985 – 200, 1991 – 440

Zoobenthos

Total no. of species : 62

Dominant groups : Foraminifera, Nematoda, Polychaeta, Copepoda, Ostracoda, Isopoda, Amphipoda, Gastropoda, Bivalvia

Biomass (gm/m^2) : Northern sector – 11.1, Central sector - 18.3, Outer channel area – 13.8, Southern Sector - 11.1

Average annual Production (gm/m^2) : 13.5 – 16.5

Fisheries

Fish catch (tonnes) 1986 – 87 to 1991 – 92 : Min – 4185.0, Max – 8815.7, Avg. – 6034.2

Rate of fish Production (kg/ha) : 65 – 122

Faunistic composition : Icthyofauna – 166 species, Prawns - 21 species, Crabs - 5 species

Birds & Mammals

No of Species of birds : 151 (26 families), Migratory – 96, Resident – 55

Mammals : Dolphin (*Coryphaena sp.*), Sea cow (*Dugong dugong*)

Source : CSD 1996

TABLE 8
CHEMICAL CHARACTERISTICS OF COOUM RIVER WATER

Sl. No.	Parameter	Station (Arumbakkam)
1	Temperature (^{0}C)	25
2	PH	7.21
3	EC (μ S/cm)	1082
4	Total solids (mg/l)	680
5	Non-filterable solids (mg/l)	500
6	Total hardness (mg/l)	276
7	Chloride (mg/l)	319
8	Ammonia (mg/l)	11
9	Dissolved Oxygen (ml/l)	0.015
10	BCOD (ml/l)	66
11	Alkalinity as $CaCo_3$	
	a. Bicarbonat (mg/l)	213
	b. Carbonate (mg/l)	0.36
12	CO_2 acidity (mg/l)	18
13	Fluoride (mg/l)	0.281
14	Sulphat (mg/l)	22

Source : Centre for Water Resources, Anna University, Chennai

Annexure 6

COST FOR TREATMENT OF 3560 MILLION LITRES OF SEWAGE GENERATED PER DAY

Sl. No.	Method	Capital Cost (Rs. in million)	Recurring cost MLD / year (Rs. in million)
1.	USAB	10555	0.05
2.	Activated Sludge	11392	0.005
3.	Trickling Filters	11036	0.075
4.	Oxidation pond	2492	0.050

Source : National Research Development Council

Note : This does not include cost of land, for installation of treatment plant, which varies from area to area.

References

1. Central Pollution Control Board, 1988 – Status of water supply and wastewater collection, treatment and disposal in Class II Towns – 1988. Control of Urban Pollution series. CUPS/31/1988-90

   Central Pollution Control Board, 1997 – Status of water supply and wastewater generation, collection, treatment and disposal in metrocities (1994-95). Control of Urban Pollution series. CUPS/42/1997 – 98

2. CSD, 1996 – India country report to Commision on Sustainable Development. Ministry of External Affairs

3. Envis.1997 – Mangroves of India. State of the art report (1987 – 1996). Environmental Information System Centre. Annamalai University

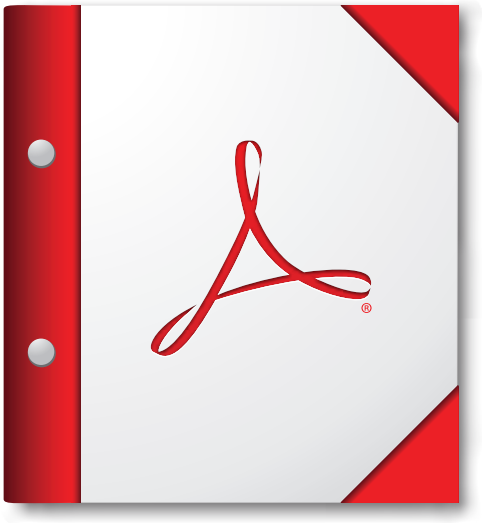
4. Envis 1998 – Coral Reefs in India. State of art report. Environmental Information System Centre, Annamalai University.

5. Planning Commission, 1999 – Ninth Five Year Plan (1997 – 2002)

6. Department of Ocean Development – Coastal and Ocean Monitoring Prediction Systems (1992 – 99)

7. ICMAM – GIS, 1999 – Draft Final Reports of Critical Habitat Information System for Mangroves, Coral Reefs etc.

8. Inputs from Central Pollution Control Board, New Delhi and State Pollution Control Boards of Gujarat, Maharashtra, Goa, Kerala, Karnataka, Tamil Nadu, Pondicherry, Andhra Pradesh, Orissa and West Bengal.



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