

## Environmental Problems of the Coastal Zone in Sri Lanka

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### HISTORICAL PERSPECTIVE

#### The Pre-Colonial Era

Sri Lanka's coastal zone was practically free of any stress conditions imposed by human activity during pre-colonial times. The centres of civilisation were mostly inland and the coastal zone was considered a buffer against invasion from abroad, mainly from the Indian sub-continent. The island though strategically located in the East West sea-lanes existed on the basis of the self sustaining agricultural economy. Though its strategic location in the main East West sea-lane attracted to it seafarers from distant lands there was little or no interest in foreign trade. Travellers and traders from abroad though welcome did not make any meaningful impact on the lifestyles of the people. Hence their interest in the maritime areas was minimal. Whilst the coastal Zone was kept practically free of human interaction, during this period, nature was the primary change agent influencing the coastal zone. Nature itself imposed severe anomalies on the maintenance of the stability of the country's coastline. The South West Monsoon with its ocean fetch creates a wave climate that attacks the coast with great intensity and regularity and dissipates its energy along the South West and East Coasts. The North East Monsoon blows over the more limited fetch of the Bay of Bengal and accordingly attacks the coastline with much less intensity. Changes in the course of rivers, which are the predominant supply source to beaches in Sri Lanka, storm surges caused by cyclonic winds, and blocking of river outlets by the formation of sandbars and floods are all phenomena that cause changes in the

physical stability and productivity of the coastal zone.

These and other changes with a much longer periodic cycle such as subsidence, changes in sea level etc. have changed and shaped the size of the island over time. There is historical evidence of such changes that are visible even today. To quote a few examples, the Muthurajawela, presently a swamp below sea level, was once a thriving paddy field indicating a depression of this area relative to sea level. There is clear evidence of accretion and consequent building up of coastal beaches in Puttalam and Batticaloa whilst progressive erosion along the South West Coast has diminished the size of the coastal area along this seaboard.

These changes, however, went practically unnoticed as they were not in major centres of population. Land in these areas had hardly any value. Hence nature could be left to establish its own dynamic equilibrium without any interference by man.

#### The Colonial Era

The advent of the Western colonisers - the Portuguese in 1505, the Dutch in 1633 and the British in 1815 caused a profound change in man's attitude towards it. Coastal bastions were established to affirm their foothold on the country. Canals and roads were cut to establish communications between such bastions and trade assumed importance. The rich natural resources of the island attracted the attention of these invaders and the export of such resources to enrich their own economies necessitated the establishment of anchorages and harbours as well as access routes to the hinterland. The coastal zone provided the platform for such exploitation and underwent radical change. The indigenous population migrated from the traditional areas to the coastline to provide services to the new masters. Coastal lands suitable for the

cultivation of export crops such as cinnamon were utilised for that purpose. The insular culture of the island's population underwent radical change. Trade assumed increasing importance and consequently the coastal areas attracted those in search of opportunity. Population centres were established along the coast and more intensive exploitation of coastal resources to provide sustenance to such centres came into being. The opening of the coastal railways and highways accelerated this process. Hence man's presence began to exert pressure as a dynamic change agent on the coastal zone.

#### The Post Independence Period

The rise in the aspirations of people since the declaration of independence in 1948 attracted more people to the coastal cities. Opportunities in public administration, commerce and industry coupled with better opportunities in education were the catalysts in such migration towards the city. With this the population in the coastal zone increased and so did the utilisation of its resources. These in turn imposed stresses on the coastal environment. The adhoc nature of such development and the non-existence of a development planning and appraisal mechanism at a national level led to such development not having any consideration towards sustainable limits of depletion of the resource base. The industrialisation efforts of the late fifties the initiation of the drive towards exploiting the potential for beach based tourism of the mid sixties and the open economy policy of the late seventies imposed further strains on the coastal environment. Therefore both the constraints imposed by the nature as well as the development efforts to provide a better standard of living for the people, are the causative factors for the environmental problems of the coastal zone that we are faced with today.

## ENVIRONMENTAL PROBLEMS

The environmental problems of Sri Lanka's coastal zone can be summarised as follows:

- a. Coastal erosion.
- b. Effects of sand bar formation across river and lagoon outlets.
- c. Construction of maritime structures such as river outfall training schemes, salt water exclusion schemes and harbours etc. without due regard to effect on adjacent coastline.
- d. Construction of buildings and other structures without due regard to the dynamics of coastal behaviour.
- e. Coral mining.
- f. Sand mining.
- g. Breaking of the reef to provide navigation channels and anchorages.
- h. Discharge of industrial effluents.
- i. Oil slicks caused by spillage during refuelling of mechanised fishing craft in anchorages and fishery harbours.
- j. Discharges from ships as a result of pumping out ballast and bilge water.
- k. Discharge of sewage and waste water into coastal waters.
- l. Clearing of coastal vegetation.
- m. Filling of mangrove areas and coastal wetlands.
- n. Dredging in rivers and estuaries.
- o. Overfishing of certain species of fish (lobsters, crabs, prawns etc.) and collection of exotic fish for aquaria.

p. Dynamiting and use of explosives for fishing.

q. Siltation of lagoons.

The magnitude, intensity and geographical spread of these problems follow.

### Coastal Erosion

Sri Lanka has a coastline of 1600 km and of this nearly a third (approximately 500 km.) is subjected to varying degrees of coastal erosion. The causes or intensity of erosion varies from site to site. However, the major cause is lack of sand supply for the formation of wide beaches which are the best form of defence against the ravages of the sea. The predominant source of supply for such formation of beaches in Sri Lanka is the network of rivers. However, the development of upland areas, regulatory works on rivers for flood control, power, water supply and irrigation have reduced the volume of sand transported to the coast by the river system. It is doubtful if this source was ever adequate to maintain shore stability. Man's interaction has further aggravated this situation. At present the South West and West coasts of Sri Lanka are subjected to heavy erosion varying from average annual rates of 1 to 7 m per year. Erosion has reduced the available area of land and the high population density and the multiplicity of human activities in these areas have been compressed into narrow and fragile ribbons of land that can no longer sustain them without giving rise to serious use-conflicts. The protective measures undertaken such as the construction of revetments and groynes have essentially been defensive in nature and managed barely to hold the diminishing frontiers. It is estimated that a sum of Rs. 60 million has been spent on work associated with coastal conservation in the last decade.

One of the defects in the strategy adopted for coastal protection in the past was the inadequacy of

predesign investigations. Several examples of costly construction that has not helped in protecting the coast could be seen today. Some of the revetments have been built without adequate filter material or foundations. Hence it has now become necessary to maintain them at great cost. If these structures had been properly designed a large volume of money spent at present in maintenance could have been saved. Another strategy is that implementation of schemes of work for coastal protection was initiated only during an emergency, such as at times when transport networks, public buildings or private property were directly threatened. Such piecemeal solutions have increasingly been found to be ineffective. Whilst coast protection structures have been built by Government as far back as 1938 a proper organisational framework for tackling this national problem was not available until 1978. In 1978, the Coast Conservation Department was set up with a mandate to carry out coastal engineering research, coastal zone management and the implementation of schemes of work for coastal protection.

The coastal erosion problem has now assumed serious proportions, especially on the South West and West coasts. Along stretches of the South West coast the arterial highway as well as the railway is in existence today purely because of the presence of coast protection structures. Traditionally used techniques are now proving to be increasingly less cost-effective. The inadequacy of coastal land to meet the demands of coast based industry also make the continued use of these techniques unacceptable. An "area-concept" for the implementation of coast protection schemes has to be considered to meet today's needs. The need to plan out such schemes on a pro-active basis instead of the defensive approach adopted so far would necessitate heavy outlays in capital expenditure for implementation of beach replenishment schemes. The imple-

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mentation of such large scale schemes in environmentally sensitive areas such as Hikkaduwa will have to be planned with great care.

Such engineering solutions will have to be backed up with regulatory/management approaches in order to prevent the aggravation of the erosion problem through human activities.

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Beaches are important environmental units and must be preserved. Other than providing a defence against the erosive potential of waves and currents they act as run-off regulators, provide an important habitat in the life cycle of some species of marine life, and have great aesthetic and recreational value. Erosion and consequent land loss in most parts of Sri Lanka's densely populated coastline necessitates relocation of roads, dwelling units, public utilities etc. They displace fishing activities such as beach seine operations and reduce the productivity of the coastal waters. In certain coastal areas such coast erosion has caused serious pollution problems as a result of the destruction of sewage and waste disposal units. It could of course be argued that if adequate buffer zones were delineated some of this damage would have been avoided. The delineation of wide enough buffer zones in areas that have already been put to high density use, however, is an extremely costly exercise and in areas that are subjected to heavy rates of erosion there just isn't sufficient coastal land to delineate wide enough buffers. Hence a rational balance of management and coastal protection measures have to be evolved to counteract this problem.

#### **Effects of Sand Bar Formation Across River and Lagoon Outlets**

The causes of sand bar formation across lagoon and river outlets differ from site to site. However, these causes could be generalised as (a) insufficient flow (b) low tidal range (c) insufficient gradient of

bed (d) non-optimal outlet size (e) waves and (f) currents. The formation of seasonal sand bars across the mouths of streams, rivers and lagoons is a common phenomenon in Sri Lanka. The effects of such closure affects the productivity of the estuary by decreasing salinity levels, siltation, concentration of pollutants beyond acceptable levels and insufficient

flushing and exchange. It also causes upstream flooding and prevents navigational access to and from the sea. The decrease in the productivity of the lagoons and estuaries are associated with this problem. In cases where the water in such estuarine areas are used for agriculture and irrigation the opening of such outlets by artificial means also causes the salinity

levels to increase thereby preventing its use for such purposes and also increasing the salinity level of agricultural lands rendering them unsuitable for cultivation. An example of a productive lagoon that has through the process of time become a dead lake is Mundel on the West coast. The permanent closure of its outlet through natural processes of bar formation and consequent stagnation has caused its death. Serious pollution and

siltation problems and consequently reduced productivity in the Batticaloa lagoon, which was one of the most productive lagoons is also associated with the formation of sand bars at its outlet.

Estuaries are considered the most biologically productive areas on earth. They serve as nestling areas, migration routes and wintering areas for migrating water fowl and wading bird species. They are

a spawning and nursery habitat for fish.

### **Construction of Maritime Structures**

The construction of river outfall training works, fishery harbours, coastal protection works and commercial ports are a necessity. However, if they are not carefully planned, especially as to the effects such structures would have on the

adjacent reaches of coastline, they could cause serious environmental problems. Numerous examples of such problems could be seen on almost all parts of Sri Lanka's coastline. Gerritsen and Amarasinghe in a paper presented at the Coastal Engineering Conference in 1976 commented as follows:

"By far the largest contribution to problems of erosion and sedimentation of the island's shoreline has been made by the *interference by man with the natural processes that occur in the coastal zone*. Such activity in Sri Lanka has consisted of (a) the legal and illegal mining of sand and coral from the coastal zone, the latter usually by the destruction of reefs (b) construction of training works at outlets of rivers and streams for drainage purposes without adequate consideration of the consequences to the adjacent coastline (c) construction of fishery harbours to meet demands of national priorities without adequate investigation and study and (d) the construction of emergency protective works against sea erosion, such as groynes and sea walls, to satisfy pressures resulting from density of human habitation in the coastal zone and which in the long term have adverse consequences on adjacent coastal areas."

The construction of a long groyne on the South bank to stabilise the outlet of the Panadura river is a case in point. The intention was to train the waters to keep the outlet always open by means of tidal flushing to drain the waters of the Bolgoda Lake and prevent flooding of adjacent paddy lands. A subsidiary objective was to provide access for fishing boats into the river for mooring. Whilst the objective of the project was achieved, the construction of the groyne had caused serious erosion problems in the area North of the river. The entire coastline from Panadura

to Ratmalana has been subjected to heavy erosion due to the interruption of littoral supply by the groyne acting as a barrier. Numerous houses have been washed off and the beaches of Egodaunya and Lunawa have been completely wiped out. The main coastal railway in this section exists today due to the protective measures that have been undertaken. Most of the beach seine operations in this area have been stopped due to the loss of the beach areas necessary to sustain such operations.

The fishery harbour at Beruwela is also a case in point. The harbour was built without adequate design studies and consequential erosion in the area North of the harbour has been extremely heavy. For a stretch of several miles the main Colombo/Galle road has been threatened. All beaches in this area have been threatened. All beaches in this area have been completely eroded. The expenditure on coast protection to save the road has been extremely heavy and continues to date. In addition, the harbour has silted up defeating the very objective of its construction. Productive beach seine operations had been traditionally conducted in the area north of the harbour. Today, these operations have completely stopped due to the non-existence of a beach to support such activity.

Perhaps the most dramatic example of a maritime structure causing environmental damage is the construction of a breakwater at Wellamankara, North of Negombo as a part of a project to build a fishery harbour along this straight portion of coastline. The project was never completed. The existence of this breakwater constructed at a cost of rupees one million caused such severe erosion problems in areas North of the breakwater that an entire fishing village was destroyed. Serious note of this problem had to be taken when new masonry houses provided to the fishing families came to be threatened through progressive erosion

of this shoreline. The position was reversed only by the removal of this breakwater at a cost exceeding what was spent on building it. Today this coastal stretch is gradually being stabilised by the restoration of the littoral supply as a result of the removal of the breakwater. There are further examples of such environmental damage caused by ill-planned maritime construction too numerous to quote here. However, a new phenomenon, that is a recent addition to the list of ill-planned structures, is the construction of vertical or steeply faced sea walls too close to the waterline by owners of tourist hotels that have themselves been constructed too close to the shore. Such constructions are the direct cause of diminishing beaches in Hikkaduwa and Negombo.

The adverse consequences arising from the construction of maritime structures have been primarily caused by the absence of an environmental impact assessment mechanism in the past. If such assessment procedures were implemented it would have been possible to mitigate adverse impacts by incorporating suitable measures into the cost of these projects. Some projects that had failed may not have been implemented if such procedures were followed. The acceptance of impact assessment procedures as a part of project formulation in recent times augurs well for the future.

### **Construction of Buildings and Structures within the Dynamic Zone**

As mentioned in the preceding section coast-fronted land was not considered in the past as having much value. People tended to build away from the sea front in order to avoid the corrosive effects of sea spray. Sri Lanka did not have a tradition of beach use for recreational purposes. The minimal value assigned to sea fronted land in the past is even visible today in the presence of a large number of public and private burial grounds

adjacent to the coast. These properties have today assumed high value mainly because of the demand for sea fronted land for purposes associated with beach fronted tourism development. The major type of dwelling units constructed on the sea front, in the past, were fishermen's huts. These were temporary in nature and could easily be relocated in case of land retreat caused by erosion. However, with the tourism boom of the mid-sixties larger building complexes came to be constructed along the sea front. In the construction of these complexes the only criterion considered in the past was the proximity to the beach. No buffer zones were delineated and large complexes came to be built on basically unstable land. With progressive erosion such buildings were threatened. Due to the high capital investment associated with such building the only alternative, available to the owners of such property was to build sea defence works. Many examples of such structures can be seen along the coastlines of Negombo, Hikkaduwa and Beruwela. Some of these structures have caused the disappearance of the thin stretches of beach that was available and some of these defence works are now acting as littoral barriers further aggravating the problem. In the case of some of these hotels, the waste water and sewage disposal structures have collapsed causing acute pollution problems. Since 1978, however, the Coast Conservation Department in collaboration with the Ceylon Tourist Board and the Urban Development Authority has implemented a scheme of delineating a setback zone for such construction.

There are also examples of bridges and highways being built across unstable areas. These have had to be protected at great cost when they were later threatened by coastal erosion. Construction of buildings, roads etc. within the dynamic zone increases run-off and affects valuable coastal resources, such as coral reefs, quite

apart from necessitating the construction of additional structures for their protection and consequent environmental problems.

### Coral Mining

Coral mining is one of the most serious environmental problems within our coastal zone. This has been a traditional activity in which a significant percentage of the population in Hikkaduwa, Peraliya and Seenigama areas are dependant on for their livelihood. The damage caused to the reef in these areas had destroyed it to a great extent. Coral based lime is in demand for the following uses:

- a. As a soil ameliorant to reduce acidity in agricultural lands.
- b. As a building material.
- c. As a chemical in certain industrial processes.

The mining of the coral reef has the following environmental consequences:

- a. Ecocide of reefs.
- b. Depletion of marine life.
- c. Coastal erosion.

Reefs are all extremely productive eco-systems. It has been estimated in 1977 that 7000 tons of coral was mined in the Hikkaduwa area. Current estimates are that a volume in excess of 10,000 tons is mined annually from the reef and beach. The spread of this activity to the Batticaloa district was controlled in the late seventies by a rigorous implementation of the law. Action is now planned for a similar exercise on the South West coast. The devastation that has been caused by coral mining is well known and needs no further elucidation here.

### Sand Mining

Whilst coral mining has received much public comment and debate, the effects of sand mining has not received the attention it deserves. Traditionally sand has been regarded as a free resource and the only value assigned to it has been the cost of mining. Mining of beach and river sand especially in the lower reaches of rivers has now assumed critical proportions. The activity is spread right along our coastline and is most intensive in the areas close to big towns. Sand is a fast dwindling resource and the day is not too far when we would have to look for alternative off-shore sources. Sand mining in the Kelani river is rapidly beginning to exceed the total bed-load transport. The establishment of several 'ready-mix concrete' plants along the river bank in recent times will further increase extraction levels and the stability of the river course as well as the coastline north of Colombo is threatened.

The removal of large volumes of sand from beaches disturb their equilibrium. Low sand dunes that exist along the coastline in the Uswetakeiyawa area have been heavily mined and the stability of the entire area is threatened. The environmental consequences of such unrestricted mining of sand could very well lead to disastrous consequences. Regulations have recently been brought into force under the Coast Conservation Act. Location and exploitation of alternative sources is a matter of urgent national priority.

### Breaking of the Reef to provide for Navigation

Along a considerable portion of Sri Lanka's coastline coastal reefs (coral or sandstone) provide a natural protection against the erosive forces of the sea. In most areas the shape and stability of the shoreline has been to a large extent determined by their presence. Since the introduction of mechanised craft navigation channels have been provided by blasting passages through such reefs. In the case of

coral reefs such blasting has caused considerable damage. Coral reefs are extremely sensitive and such blasting destroys a much larger area than the section actually blasted. In the case of sandstone reef the opening up of channels causes less damage. However, it is not possible to avoid consequential damage to the coastline in the vicinity as a much larger percentage of the wave energy is expended on the shore face itself. This in turn would cause increased turbidity which would affect marine life in the area. Whilst fishery harbours have been provided, their usage is still not very popular amongst individual fishermen. As a consequence the demand for provision of anchorages in close proximity to their houses is great. This demand results in navigation channels being blasted through the reef at several places in close proximity to each other. When several such gaps are made over a limited length of reef the erosive action of waves would with time cause the reef to disintegrate, gradually destroying the whole reef. The opening of such passages would also cause changes in the current circulation patterns thereby affecting stability as well as the environment of such coastal waters.

#### Discharge of Industrial Effluents

Discharge of industrial effluents into river systems or coastal waters is not as widespread in Sri Lanka as it is in developed countries. Hence it has not assumed critical proportions in Sri Lanka's coastal zone. However, an example of widespread environmental damage caused as a result of the discharge of industrial effluents is the paper mill factory in Valachchenai. The discharge of effluents from the mill which uses paddy straw as raw material has caused severe pollution of the Pothuweli channel and areas of the main lagoon adjacent to it. Grave concern has been expressed that if the position is not reversed the entire lagoon will be devoid of life forms. The lagoon had prior to the establishment of the paper mill sustained a fishing population

of approximately 1200 persons. The catch from the lagoon included significant quantities of prawns, crabs, catfish, milkfish etc. The accumulation of fibrous residue and sludge is gradually silting up the lagoon and the level of dissolved oxygen is presently considered to be below the minimum requirements for fish life. The siltation of the lagoon and consequent reduction in discharge levels has made the adjacent areas earlier used for paddy cultivation ill-drained and marshy. The soil itself has become dark and paddy cultivation has been abandoned.

Factory units producing asbestos, leather goods, galvanised sheets, confectionary and chemicals; and workshops; sawmills and textile mills about the Bolgoda Lake and Lunawa lagoon systems. Discharges from these industrial units has significantly reduced the productivity of the entire system. A similar problem has been encountered in the Kelani estuary with two large scale fish kills reported in the last two years.

Pollution of rivers, streams, canals, lagoons and coastal waters as a result of coconut based industries (brown fibre, white fibre, desiccated coconut and distilleries) as well as from rubber based industries should be further studied. Whilst these have not assumed critical proportions the potential for widespread environmental damage exists.

#### Oil Slicks

Oil slicks from mechanised fishing craft anchored in nearby anchorages and in the fishery harbour as well as from glass-bottomed boats have been cited as causative factors in the reduction in the quality of the famous coral reef at Hikkaduwa. A recent environmental study has also revealed that ditches, marshes, lagoons and the sea in the West and South West coastal zone are polluted by the presence of oil. Oil slicks even in low concentration cause widespread

destruction to aquatic life forms. Oil slicks in marine waters are also caused by land based sources as a result of storm water run-off which collects slippages, and from discharge from industrial processes. Whilst industrial causes may not attract much attention the cumulative effect could and does prove an environmental problem within the coastal zone of Sri Lanka.

#### Discharge from Ships

Sri Lanka is located in close proximity to the main East-West shipping lanes. Such traffic concentrates into a funnel off Dondra Head making a landfall on the Dondra Head light house. The absence of a coast guard or patrolling service has made it possible for passing ships to empty their bilge holds or for tankers to pump out ballast water off the coast of the country, even though such activities are banned by international regulations and local law. The discharges finally end up polluting the beaches in the form of tar-balls. The slicks on their way in, could also cause damage to marine life and if settling on a reef during low tide could kill reef organisms.

The heavy concentration of shipping traffic also poses the hazard of accidental spills. Even though general cargo vessels have gone aground and wrecked in our coastal waters no perceivable damage has occurred in the form of oil spills. But the hazard of an accidental spill is always there. Recently Sri Lanka became a member of the International Oil Pollution Compensation Fund which will entertain claims arising from pollution damage caused by ships carrying oil. However, for claims to be successful, identity of the vessel, date, place and specific details of the incident are required. These are almost impossible to get in the case of passing vessels in the absence of a coast guard or regular patrols.

## Discharge of Sewage and Waste Water

This is perhaps the largest source of pollution in our coastal waters as well as in estuaries and lagoons. Outlets which dump raw untreated sewage into the near-shore coastal waters are still present even in the capital city. These are, however, being replaced by ocean outfalls. Faecal pollution is a common problem on our beaches. An inspection of any stretch of populated coastline in Sri Lanka would reveal the presence of drains and canals that discharge untreated sewage and waste water to the coastal zone. The effects of faecal pollution cause reduction in species diversity and size of individual species. A major hazard is the contamination of prawns and other commercial shellfish by human pathogens.

Another source of such pollution is the heavy concentration of touristic facilities in the more popular coastal resorts. Numerous examples can be found of even large tourist hotels emitting waste water into beaches and coastal waters. These pose a major hazard in areas where coral reefs are present. There are a large number of hotels that have located their waste water and sewage pits on the beach. In some cases these structures have collapsed due to erosion and caused heavy pollution damage to adjacent areas. Centralised treatment plants to serve the needs of such complexes would go a long way in mitigating this problem.

## Clearing of Coastal Vegetation

Clearing of coastal vegetation is a problem of some magnitude in Sri Lanka. In urban areas such clearing occurs as a result of construction activity and in rural areas coastal vegetation is cleared for firewood. The vegetation in the coastal zone performs an important function in regulating the climate of the areas and run-off. Such increased run-off can destroy coral reefs and dependent life forms

as well as cause excessive siltation. Increased run-off could also bring increased loads of pollutants in the coastal waters. Vegetation also helps in stabilising coastal land forms and reducing erosion. In the East coast the demand for firewood had resulted in even mangrove areas being denuded. The seasonal timing of the rate of fresh water discharge to the coastal basin governs the salinity and circulation which in turn affects the productivity, stability and the overall carrying capacity of the coastal eco-system. The natural seasonal flow rate is generally optimum for plants and animals as they have synchronised their life cycle to such seasonality. Denudation of coastal vegetation and increased run-off may hence radically alter the natural rhythm for critical life functions such as breeding, feeding and migration and thereby reduce the productivity of the coastal areas.

## Filling of Mangrove Areas and Coastal Wetlands

Mangrove areas and coastal wetlands serve as essential habitats, food producers, energy storage units, water purifiers, run-off retainers and salt traps, and shore stabilisers. If such areas are filled indiscriminately they could greatly reduce the productivity of coastal areas. The filling of such salt marshes and lowlands would greatly reduce the capacity of the coastal zone to absorb pollutants before they reach coastal waters and estuaries. Such areas also provide important breeding and rearing grounds for valued species.

Research has shown that large marsh acreages are associated with higher productivity of the fish resource. Most edible species spend part of their lives in such wetlands. Such wetlands and marshes also perform a valuable damping function reducing the effects of storm surges.

In Sri Lanka an increasing acreage of coastal wetlands are being filled to provide necessary

land for human settlements. Most of the clear areas available for building are such wetlands. Very often no assessments are made of the function these wetlands play in the health of the coastal environment. The value of such lands are not well recognised and such areas tend to be treated as waste land. Compatible alternative uses of higher economic potential such as aquaculture are a distinct possibility and deserve much more attention than they have received upto now.

## Dredging in River Estuaries

Dredging in rivers has been primarily undertaken to provide fill material and to reduce flood damage. Consequences of excessive removal of sand from rivers have been dealt with elsewhere in this paper. In view of the strict relationship that exists between the stability of our shoreline and the sand transported by river it is necessary that the impacts of such dredging are pre-evaluated. The biological effects of turbidity and siltation resulting from dredging needs to be carefully considered. Well planned dredging operations can produce beneficial results.

Re-suspension of bottom material by dredging operations may result in increasing the fertility of water bodies through the release of nutrients as well as release of embedded toxicants to the water column. They may also bring fine silts into suspension causing excessive turbidity. All these factors must be taken into account in the dredging of estuaries in order to mitigate or obviate consequential environmental damage.

## Overfishing and Collection of Exotic Fish

Overfishing of certain species such as lobsters, crabs and prawns have occurred in our coastal water bodies. Maximum sustainable yields are not precisely known, but at least in the case of species mentioned above it has been reported

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that catches as well as individual species are dwindling.

Excessive collection of exotic species are also feared to be causing the near extinction of certain rare species. In the collection of reef fish any over-exploitation of the rarer species may remove important links in the food web and ultimately lead to the destruction of the reef eco-system. There has been considerable interest in declaring certain areas as marine preserves. It appears that declaration of such sanctuaries is essential to maintain the diversity of stocks.

### **Dynamiting and Use of Explosives for Fishing**

This destructive mode of fishing though banned by law is carried out in most fishing grounds. Several detections have been made in Trincomalee and other areas in recent times. The use of such destructive methods unless checked could lay waste vast areas of once productive waters. This problem has been receiving increasing attention in recent times and a stricter enforcement is expected.

### **Siltation of Lagoons**

Siltation has become a serious problem affecting the productivity of most of our lagoons. Clearing peripheral areas of vegetation, closure of outlets, erosion of watersheds and deposits by increased run-off have been the causes. Siltation alters the physical and chemical characteristics of lagoons. Fine sediments may form a thin surface ooze which gives poor inland oxygen circulation and leads to excessive oxygen reduction both within the sediments and in the overlaying waters. High quantities of sediment could also increase water temperatures causing the habitat to become unfit for species that cannot tolerate such temperature differences. Siltation problems are affecting economically important lagoons such as Valachchenai and Negombo.

### **CONCLUSION**

The foregoing has focussed on environmental problems of the coast zone. However, a bare statement of the problems will not serve a purpose unless we also investigate what attempts are being made to find solutions to such problems. The passing of special legislation for coast conservation and the establishment of the Coast Conservation Department with a specific mandate for the conservation of the coastal zone are important indicators of the attempt at solving such problems. The Coast Conservation Act makes mandatory provision for the preparation of a Coastal Zone Management Plan before October 1986. It also institutes an advisory council con-

sisting of all agencies involved with activities within the coastal zone as a mechanism for better coordination and inter-agency consultations. The establishment of the Central Environmental Authority, the National Mangrove Committee, the work on evolving a National Environmental Conservation strategy indicates a growing concern for preserving and where possible improving the environment of the island. The Coastal Zone Management Plan once completed will provide strategies, and guidelines for managing the coastal environment. All these measures give one hope that environmental problems of our coast zone will be mitigated before they reach irreversible proportions.