TIDAL AREAS OF SRI LANKA[1]

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ABSTRACT

Sri Lanka is an island in the Indian Ocean of 65519sqkm land area and 103 river basins. Highest annual precipitation is 5500mm in the central highlands. The wet zone is demarcated by 2000mm isohyet covering southwestern and central regions. Nearly 2/3 area of the country is dry and the annual precipitation lies between 1100-2000mm. The northeast, north central, northwestern and southeastern areas are in the dry zone. It supported 3000 years of agricultural civilization continuously. 1200km long coastal zone supports nearly 33% of the population about six million. Wet zone areas are increasingly getting populated due to prevailing conditions in Sri Lanka. The coastal zone is a tidal area.

Wet zone population increased from 1300AD due to international impacts and spice trade. Tidal zones always had paddy cultivation in the periphery of lagoons. Mangroves dominated in the coastal wetlands.

Negombo Lagoon, Koggala Lake and Madampe Lake are large water bodies formed due to faults of the region. The basin has a high precipitation of 2200mm and rice farms are cultivated for a longer period. Low humic gley soils are suitable for paddy and not suitable for any other crop. But the brackish water of the lake is harmful to paddy. Tidal flows take up saline water up to 0.6m and salinity barriers are constructed across the canals to control the high tides. Irrigation Department maintained these barriers. The lagoon bed is possessing (beru) carbonic compounds but life is not flourishing in that layer. Lagoon water supports predators such as prawns and crabs. Prawns come from the sea and again go back to sea for reproduction. Hence a passage to the sea is open. Sand bars always block this passage, which is due to accretion. Irrigation department is cutting sand bar for a longer time but later groynes were laid to clear the passage. Sand budget has a balance in rivers and beaches. Presently sand mining in rivers in excessive quantities has reduced the beach formation. The accretion is on the southern side of the groynes in the western beach. It is on the western side of the groynes of the southern beach.

Ben River basin has a large area of tidal action. Water transport in the 19th century used the up tides for the boating up to Hattaka. Down tides are used to reach the coastline at Bentara. These boat ways are now limited to marshy areas only. Motor transport is used elsewhere. Railway and highway are laid across the mouth of the lagoon preferably on the suitable rock base. Many mangroves are now cut for land clearing and buildings were erected. Tourism is the main reason for the wanton destruction of mangroves. Regosol soils in the coastal region are suitable for coconut plants.

Lagoons in the dry zone were developed for prawn ponds. Artificial ponds were constructed along the periphery and brackish water was pumped into it. Effluent was released back to the lagoon. This changed the biodiversity of the salt marshes.

Tidal swamps are under environmental degradation due to industrial pollution. This is aggravated due to the ignorance of farmers as many fields are abandoned. Environmental management is necessary to preserve link between the sea and control excessive pollution. Industries, houses, roads, reclamation work and recreation activities destroy the natural habitats of salt marshes and reduce lagoon area. Commercialization of lands needs national awareness. Case studies are interesting for future plans. Coastal engineers criticize groynes.

1 INTRODUCTION

Sri Lanka's economic and coastal management challenges are clearly set out in the published Coastal 2000: Recommendations for a Resource Management Strategy for Sri Lanka's coastal region. The identified basic facts are,

1 There are more people per square kilometer in the coastal region than in the rest of the country-people who want to achieve a better quality of life (good health, a way to support their family, education, a healthful environment), and who in turn put additional demands on the coastal eco system

2 The traditional coastal resource base cannot support the number of people already utilizing these resources for agriculture, fisheries, industry and tourism, and there are indications that the resource base itself is getting poorer.

The potential economic developments that can provide jobs for this growing population either depend on a healthy natural eco system for their success and sustainability-for example tourism, aquaculture or expanded fisheries – or have the potential –as with industrial estates, ports, energy facilities-of further degrading this resource base if improperly sited, constructed or operated.

Hence the challenges of coastal eco system management and of economic development are inextricably intertwined. The basic problem that coastal management programs should be attempting to address is that of altering current patterns in the utilization of coastal ecosystems, which are reducing the capacity of these eco systems to produce wealth and sustain human quality of life over the long –term. To put it another way in classic economic terms, the economic "rent" that can be obtained from coastal ecosystems to benefit people is being reduced. We are living off capital rather than the interest that such capital can produce.

2 COASTAL MANAGEMENT AND DEVELOPMENT

2.1 Coastal Management

Tidal areas are divided into coastal zone and upstream areas. First we must define coastal management, which has several definitions There are that are of concern: (a) coastal zone management, which typically means managing or regulating all that occurs in a defined narrow strip -300 meters-at the land sea interface; (b) Coastal resources management –managing renewable and non renewable resources such as coral reefs, mangroves, fish etc., either separately or in an integrated fashion; and (c) coastal area or eco system management, where one considers a geographic area or eco system and tries to chart a course for its over all sustainable development. In Sri Lanka as else where, all three are essential to economic development.

Much of what coastal programs do can be characterized as coastal zone management. This is expressed as trying to bring order to the development process, avoiding site selection and construction mistakes, directing development away from critical ecological or high hazard areas, minimizing adverse environmental impacts of development and reducing foreseeable use conflicts. This is classic coastal zone management. It is both pragmatic and conceptually simple. It also makes good an obvious economic sense.

2.2 History

In Sri Lanka expressions of avoidable mistakes are well known. How much better off we could be today if the British had built the Colombo-Galle road and the coastal railway 100 meters further inland? The enormous expenditures that have recently been made in shoreline structures to protect this important infrastructure are testament to the economic costs of such simple miscalculations. Electrical transmission and distribution network and the telecommunication link network also found its base along the same road. A super highway is now planned to link Colombo and Matara along a new route about 15 km interior from the coastline. This highway is planned to reduce the bulk of traffic presently undertaken by the Galle Road.

In 1796 when the British regiment captured Colombo and Galle fortresses this road was in existence. A road was running right round the island and it was the only free route, which communicated with Arab and Indian traders. The Dutch controlled coastal provinces and the common trade items were collected along the rivers. Boats were in use than carts. Coastal settlers were foreign due to continuous migration and emigration took place before 1800. They wanted a good road for their free communication. The central kingdom eliminated all the routes due to foreign invasion. Armed guards controlled key entrance points and the tax officers maintained custom offices in the coastal side. This basic operation resulted in linking high grounds along the coastal belt at suitable locations of estuaries. Water drainage courses were subjected to tides from the sea. At the same time floods gather and drain to the sea during rainy season. Timber bridges were constructed across the river.

2.3 Human Activity

Southwest coastal area had a line of mountains, which had sloping sides to the lagoons on one side and it paved the way to restrict the shifting the road to interior due to its base rock formation. These estuaries functioned as flood buffer zones. The adjoining area was developed for paddy cultivation. Mangroves developed along the low-lying marshy lands. Clean water was visible during fair weather. Turbidity was visible during floods. Fishing was continued in the coastal zone using big nets. About 50 men pulled this big net. They stand on the beach and pull the two ends gradually so that it coincides at one point. The set back area is defined to allow this operation without any obstruction. Coconut trees and houses shall not be with in this set back area. It was recorded that the beach is encroaching private owned lands. The net fishing operation continues for one season from October to April where the sea is calm and the sand is collecting towards the coast. This beach collection is eroded in the rough season from April to September due to monsoon winds. The tourist season also ends due to rough winds. If a coral rock is available as in Hikkaduwa it acts as a pool. But fishing net operation is not possible due to the rock. Pooled areas are safe for bathing as the under currents are not dragging the swimmers into the deep sea as in open area. The under sea currents are capable in dragging the bodies in to the deep sea and take away about 10 kilometers. The dead bodies are landed to locations about five to sixty km north of the dragging point. Skilled swimmers are also found drowned as the under currents are not allowing to breathe from the initial upright position. One boy found unconscious and not dead after five days and floated nearly 120kms and landed near Negombo.

The open currents are visible to the beach users. Surface currents very rarely caused a death. Investors deploy fishing boats. Fishermen hire a boat and sail to deep sea to catch fish by nets. Their experience and the favorable weather confirm the safe return with a good catch. Bad weather takes them away from the prominent area and finally land in India or Africa. Indian coast guards arrest many fishermen for the encroachment of national fishing area. Motorboats are now in use as against the wind driven

boats. Sea wind is used to drive into the deep sea. Then anchor in the sea in the night and fish until the sea breeze begins at 4 a.m. Then the anchor is lifted. The boat is sailed towards the land. Landing points are necessary to unload the fish catch and tie the boats for safe vacation period. Harbors are developed by tradition. Fishermen are not developing any harbor but insist on governing bodies to do so. The shore is a source of income to the local authority. It is auctioned for the season for the highest bidder. The prospective bidder earns the income by allowing fishing in traditional manner. When season is over boats and nets are nicely packed and kept in near shore huts for the reuse after six months.

Many fishermen move to east coast in the rough season. But this traditional move is now not possible due to the civil war. Disabled fishermen refuse to go to sea but used to lagoon fishing. Lagoon fishing is continued through out the year but it has limits in the drought season. The drought reduces the fish growth and diseases spread due to various reasons. The estuaries are the breeding grounds for some fish varieties. Prawns breed in sea but migrate to lagoons for maturity and again go back to the sea for mating. This cycle continues using brackish water and nutrients in the lagoons. If the lagoon is separated from the sea by a sand bar this natural growth of prawns is disturbed. It also happens due to loss of mangroves.

3 EROSION AND CONTINENTAL SHELF

Sri Lanka has a sedimentary rock formation, which can resist sea erosion due to wave action. The northern part has limestone bed-rock, which is soluble and breaks due to sea waves. The islands presently withstand the erosion but the weaker material has already left its neighborhood to form the strait. Coral islands formed under the sea level had now emerged up due to land rise. Sea level drop is another possibility. Transported soil is available in some areas over the limestone.

In the south gneiss rocks resist the wave action and the present coastline has carved from a high land mass. From time to time sea level change is recorded. Nearly three miles of shallow shelf is the result of wind driven waves. Hikkaduwa area has lost more than one square mile in the recent past. The only stable area was identified as a sacred shrine at Sinigama. The beach eroded coconut lands and lost lands were compensated to residents by providing new residential areas. Coral rock was survived in the lost land bed. This provides stability against further erosion.

The growth of coral provides pure calcium carbonate, which is used for plastering. The colorful corals attracted tourists and breaking of it was prohibited. How ever the chemicals in seawater kill part of corals. This is the result of urbanization in the coastal area. Estuaries develop limestone under the ground due to deposition. This was extracted and sold for building construction. The continental shelf is widening in the southwest coastal belt by erosion and the sediments gather along northwest coast. The sediment budget is strengthened by the sand and silt brought by river flow. Agriculture in the river basins continuously supplies silt to the coastal belt. The large dams in the Kelani basin trap the sediment load in the reservoirs. Sand bars are formed along the southern coast blocking the estuary sea confluence. Sand bars are periodically cut and remove to facilitate the drainage of storm water in the estuary basin. Sand mining in rivers during the past 15 years has reduced the natural budget and it has caused the riverbank erosion and reduced water table, which allowed salinity intrusion in to estuaries.

River sand is best suitable for cement mortar than coastal sand, which is finer. Thus much of the riverbeds in the Matara to Chillaw region in the southwest coast are affected. Hence regulations are laid to control the extraction from rivers using permits during restricted days in the week. The bridges, dams and flood bunds are under a threat due to bank erosion. As traditional brick making was expensive it is difficult to control sand mining from rivers in the near future. The natural making and breaking of seacoast is likely to disturb due to sand mining. Employment due to traditional lime industry in Akurala is reduced by legal action but it continues.

4 SEA LEVEL RISE AND SALINITY INTRUSION

Global warming is well documented in Sri Lanka and it was observed that the daily mean temperature of the coastal areas has risen by one degree C during the past sixty years.

Jungles of 20% of the country area were converted into agricultural lands, which increased the day and night temperature difference in this period. The reduction of trees in the coastal zone increases the salinity intrusion. Revetments along the coast prevent spilling of seawater at improved locations. Aquaculture projects in Puttalam District went beyond the target planned and encroached Mundel Lake area completely. It brings fresh water lands, which had coconut trees into salinity forever. It is necessary to promote mangroves to reduce salinity effects. Biodiversity of the lake is affected due to nutrients and effluents released from prawn ponds. Coastal engineers oppose erection of groynes, revetments and salinity gates as it affects the beauty. Changes in the high and low tides coupled with sediment deposition in the lagoons are leading factors of cropping and aquaculture.

5 RELEASE OF EFFLUENT

5.1 Effluent Release

New industries are releasing the effluent to the sea as the final dumping ground. Quality standards are given before the commencement under EIA procedure. Sewerage effluent is pumped under ground to sufficient distance so that the near shore is not affected. The proposed coal power plant can have an effect on water quality. Dwellers damage the seashore by various means but the hotel projects are maintaining the necessary quality. Hotels built close to the sea are to be demolished as the set back limit is 50 meters.

Coast Conservation Department controls the release of effluents by issuing permits. The most dangerous hazard is landing through the newly installed industries, which receives state security under the name of investment. The next is due to the increase of dwellers along the coast. Increase of roof area reduces the use of nutrients brought by the rain. How ever the river basins have to be more protected from industries as it provides drinking water. Beira Lake in Colombo is already polluted by sewage. Flood bunds and reclamation work increases local pollution. Very nice beaches are seen in Kalpitiya and in the East. Floating parcels of carbonic matter provide occasional dirtying of beaches. Lakes possess more reddish floating matter due to iron soil drains from upstream basin. Greenish floating belt is due to plankton growth using nitrates and phosphates from drainage water.

5.2 Salvinia

Salvinia is a floating asexual bush growth due to excessive nutrients. Rich salvinia growth is fully controlled using a weevil if nitrogen content is about 3% in the leaves. This method was introduced by CISIR and it cleared the water bodies in three days using this imported weevil from South America. The method of introduction was to cut a square meter size patch of salvinia and replace that with a same size portion cut from a tank with the living weevil colony on salvinia. The new buds of salvinia formed on the new water body develop the starting point and the weevil continues the eating procedure until it vanishes. If the nitrogen content is less it is not fully successful. Green water bodies of salvinia controlled by this method need frequent care as these will again catch salvinia. The danger of salvinia is loss of water and prevention of sunlight reaching bottom of water body. Only selected fish is thriving under salvinia. Boat travel and human use of the water body is restricted as the plants occupy nearly half a meter. Reptiles live under the bush and myco-bacteria grow in water. This is not the case of eutrophication as the dissolved oxygen is maintained at good level. Lotus growth from the bottom of a freshwater tank has more transpiration.

Salt marshes of arid areas possess more thorny plants and provide breeding grounds for crabs and birds. Tides bring necessary nutrients while making surface drainage up and down on the sandy beaches.

6 GROYNES AND REVETMENTS

People express opposition to the formation of groynes generally but it is better than revetments to form some type of beach. Northern line of the beach is getting less sand due the obstruction caused by Thoduwawa groynes. Groynes are laid to clean the passage of estuaries from sand bars as in Kathaluwa, Mahamodera, Thoduwawa, Hikkaduwa, and Dewata by Irrigation Department. Sand bars are cut five times of the year and that sand is allowed to remove. Galle harbor is dredged near the jetties. Revetments along the heavily eroded sections were systematically laid under the program in Moratuwa, Bentara and Beruwala. Some places the revetment level was higher than the road. Tourism has low attraction in such areas. It was seen in recent years that the erosion in free areas are worse.

7 DEVELOPMENT OF HARBOURS

This is the most important development industry, which can bring employment to people. Small ports are suitable for fisheries improvement through motorboats. Major harbors may attract the ships traveling across Indian Ocean. Galle, Colombo, Hambanthota and Trincomalee are natural harbors, which can be improved to international requirements to accommodate all the modern techniques. This needs improvement to jetties, new breakwaters and connected road network for industrial development. However degradation of social values are very serious as it was noticed through the contraband passed through various entry points. The social unrest, growth of narcotics trade, induction of low quality literature, increased crime rate are features of present day exchange activities. Investors are responsible for the development but they usually practice harmful activities purely for the gain in profits. As a developing country the imposed conditions on the investor is not mandatory. Investors are ready to get profits by items like ship breaking which is harmful to the environment. Employment opportunities are needed due to growth of population.

8 PADDY CULTIVATION

Koggala Lake, Madu Ganga, Negombo Lake and many upstream tidal areas of rivers are earlier trained for paddy cultivation. Economically high income is recorded by paddy up to 1980. Salinity intrusion was controlled using wooden gates operated at the time of the high tides. Drainage gates are opened in normal hours. Salinity wedge rising with high tides damages paddy tracts. Many paddy tracts are abandoned due to losses. Irrigation Department maintained these projects. Reeds grow in saline soils and farmers prefer to cultivate it.

Bolgoda Lake area is now used by so many industrialists. Moratuwa is a furniture making populace city. Timber dust is gradually

polluting Panadura Moratuwa River draining from Bolgoda Lake but still some fishermen catch fish in protected areas of the riverbed.
Great lakes in the eastern coast are very good fishing grounds and pollution is least affected this part of the country due to civil war.

9 DRINKING WATER SUPPLY

Coastal areas are supporting nearly half of the population and the Kelani, Kalu, Gin, Nilwala and other rivers are presently using water in the tidal areas of rivers. During low base flows salinity enters the intakes and it becomes a problem to solve in future. Freshwater reservoirs are proposed using rubber dams in rivers. Upstream reservoirs are proposed but some villages are inundated. Salinity barriers are proposed as another method. Tidal flows are to be reduced by this weir laid across the low riverbed. But tidal flow jumps over the weir.

10 CONCLUSIONS

Coastal zone management needs proper physical planning to protect the ecosystems. Tourism, ports development, local industries, population distribution, water quality management, internal security and above all the peace among people are main features of a coastal zone management in Sri Lanka. These are the unending challenges we face in a coastal country.

Industrial pollution due to promoted zones is creating a new threat leading to pollution of tidal areas. Ports development increased the facility to fishermen to land the boats and keep it anchored. Small motorboats are now used for fishing but safe anchor places are less in number.

Mangroves are cut for various uses but reforestation is necessary for the reduction in salinity intrusion resulting in sea level rise. Trees can bring down the water level through transpiration.

New ports are planned for Oluwil and Hambanthota to serve international ships in future. Sand collections fill the constructed harbours and it needs a high cost of maintenance.
Water transport activities of rivers using tides are limited to marshy areas and it is not economical.

Salinity barriers are now planned to construct near the mouth of major rivers as it is a continuing nuisance during low flows for water supply projects.

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