UNIT 15 PARTICIPATORY COASTAL RESOURCE MANAGEMENT

Structure

15.1 INTRODUCTION

About 60% of the world's population lives within 60 km of the sea. Thus the social, economic and environmental significance of the boundary between the land and the ocean is widely recognized. The ecology of coastal lands and coastal waters provide numerous livelihood opportunities, encouraging concentrations of population and development activities in the coastal zone. Earlier concept of infinitely abundant aquatic resources, the infinite capacity of the ocean for dilution of waste products, and the unlimited productive capacity of coastal lands have been shown to be wrong by various examples of mishaps.

Over the last decade the management of coastal resource for their sustainable use has become a critically important issue for the South Asian region. Included among these resources are some of the most extensive mangrove areas in the Indian Ocean and also some of the world's least disturbed coral reefs. These coastal ecosystems have been subject to increasing exploitation particularly over the last 20 years. For example 1/5 of India population lives along the coast such pressures in the tropical coastal zone are not unique and the decline in status of coastal ecosystems worldwide, as a result of non-sustainable use, has become an issue of major international concern.

Recently, the global values of services obtained from coastal systems (defined as the benefits human populations derive from ecosystems) has been estimated at a total US$ 12 trillion per annum which is equivalent to the estimated combined value of the world's terrestrial and freshwater services. This factor is often given too little weight in policy decisions and for developing countries like those in South Asia, with large and increasing populations; the issue assumes even greater significance since it is the poorer members of society, which are forced to generate income from the coastal areas. It is these sites which are most accessible to the disadvantaged, and which offer

some prospect of support and livelihood though the adjacent land may be marginal and the inshore water bodies degraded as a result of over exploitation of resources.

In India livelihoods of many people in coastal areas are based upon the exploitation of both terrestrial and aquatic resources. However, expanding markets have driven such exploitation to extremes, where levels of investment create imbalance between alternative uses for the same resource. In such circumstances, the poor can be made poorer. Sustainable livelihoods for coastal communities are therefore dependent upon effective management of all interrelated activities in coastal areas to achieve sustainable use of both living and non-living resources, and equitable distribution of the arising benefits. In this unit, we will study major anthropogenic effects on the coastal zone in South Asia and the use of Integrated Coastal Management as a tool for sustainable development.

Objectives

After studying this unit you will be able to:

- appreciate the management of coastal resources for their sustainable development and its importance in South Asian region,
- explain the concept of integrated coastal management (ICM), with special reference to South Asia,
- describe various conservational strategies for mangroves in India, and
- describe history of exploitation of coastal habitats in South Asia and its common weaknesses.

15.2 DEFINING THE COASTAL ZONE

It is important to understand in depth the functions of the coastal resource systems and their characteristics for better appreciation and application of ICM. Before describing such characteristics we should first attempt to define the coastal zone. A coastal zone has been variously described. One possible definition [from the US Commission on Marine Science, Engineering & Resource] is "the coastal zone represents that part of the land affected by its proximity to the sea, and that part of the ocean affected by its proximity to the land".

A functional definition can be 'that space in which terrestrial environments influence marine environments and vice versa'. The international legal definition is 200 nautical mile limit from land over which coastal nations exert sovereignty (economic exclusive zone) and the scientific definition depends on the nature and scale of the processes that characterize the land ocean boundary. For most purposes the **coastal zone represents an area of transition where terrestrial and marine environments interact to form unique environmental conditions. The coastal zone embraces inshore waters, intertidal areas and extensive tracts of land.**

Much emphasis has been placed on defining the coastal zone for legal and administrative purposes, while the environmental processes, linking terrestrial and marine components of the coastal zone, are often ignored. A good example is the maintenance of hydrologic linkage between upland catchments and coastal wetlands, which are essential if wetlands are expected to function as feeding, nursery or spawning grounds for commercially valuable fish species.

India has a vast coastal stretch of about 7500 km (5700 km on mainland) on the West; the Arabian Sea washes the shores of Gujarat (Fig. 15.1), Maharasthtra, Goa, Karnataka and Kerala State.

- Seventh longest in the world
- 1/5 of the population live along the coast
- Gujarat has the longest coastline
- Three of our metropolitan cities are on the coast.

Fig. 15.1: Coral reef in Gulf of Kutch (Gujarat).
(Source: www.annauniv.edu/iom **)**

On the East, the Bay of Bengal washes the coast of Sunderbans in West Bengal, Orissa, Andhra Pradesh and Tamil Nadu states. The Southern promontory of Indian Peninsula is bathed by the Gulf of Mannar (Fig. 15.2) and India Ocean, along the coasts of Southern portion of Tamil Nadu (Fig. 15.3).

(a) **(b)**

Fig. 15.2: (a) Mangroves in Gulf of Manner (b) Algal vegetation in Gulf of Manner.
(Source: www.annauniv.edu/iom **)**

We should view the concept of the 'Coastal Zone' as a means of focusing attention on the emergence of an innovative framework for planning and management to help make wise and sustainable use of resources. For example, the management boundaries for dealing with lowland flooding will be different from those considered for coral mining. Thus management boundaries need to be issue and problem-based rather than be rigidly defined. Although the coastal zone is an interface between land and sea, the area of real concern is that region where human activities are interlinked with both land and marine environments. This area has been defined as the coastal resource system (Fig. 15.4).

Due to ecological significance of coral reefs and anthropogenic threats to this ecosystem, in India, four coral reef areas at Andaman and Nicobar Islands, Gulf of Mannar, Gulf of Kutchch and Lakshadweep Islands, have been identified for intetnsive conservation and management.

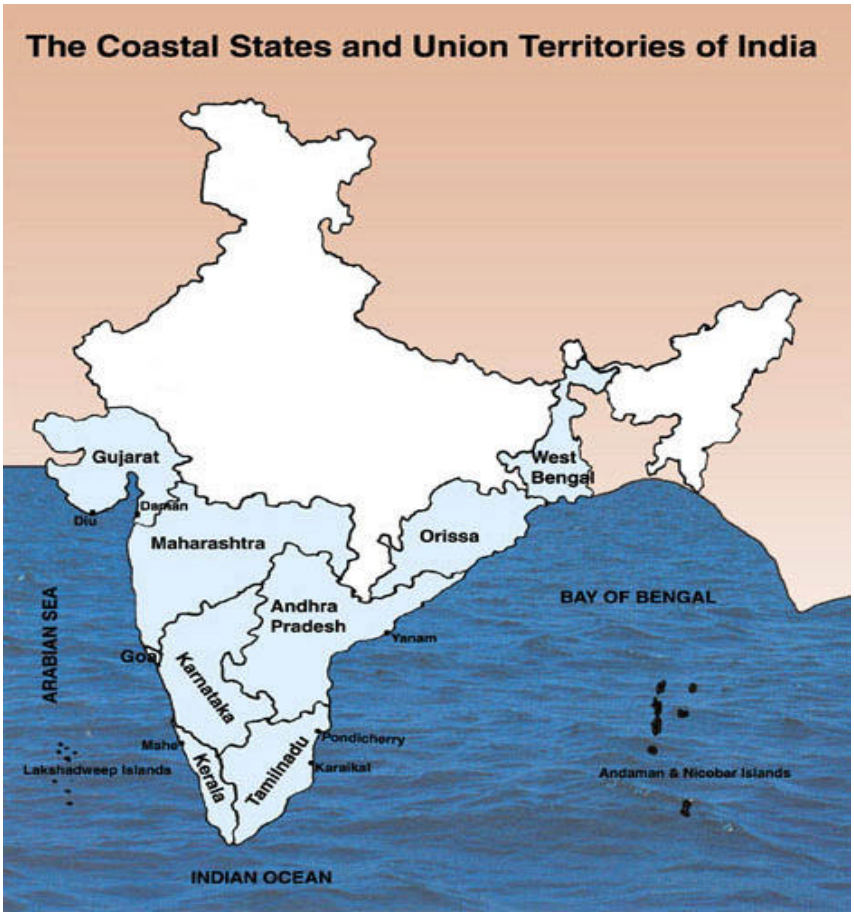

Fig. 15.3: Coastal Zones of India
(Source: http://www.cpreec.org/04_articles/the_coastal_ecosystem/the_coastal_ecosystem.html)

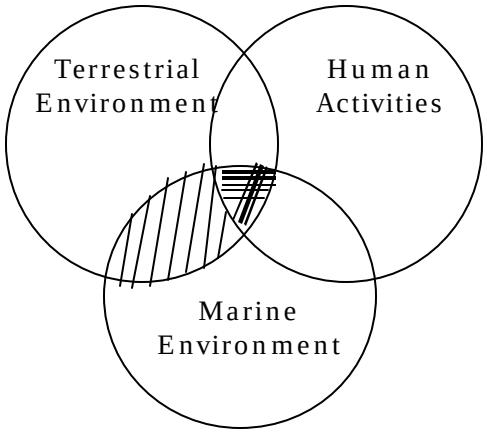

Fig. 15.4: Relationship between the coastal zone and the coastal resource system (after Chua 1993)

Coastal zone

Coastal resource system

15.2.1 Characteristics of Coastal Zones

Costal zones have the following characteristics:

i) They may have a wide variety of diverse habitats and ecosystems (e.g. estuaries, coral reefs, seagrass beds, mangrove swamps (Fig. 15.5), creeks, lagoons, bays)

Fig 15.5: Mangrove swamps

ii) These ecosystems have key inbuilt features, which are described as 'functions' when regarded in the context of a coastal resource system. For wetlands these might include primary and secondary production, which sustain the flora and fauna; storage of sediments and organic carbon, which may enhance productivity; linkages between ecosystems, which are essential to the maintenance of food chains, migration routes, and increased production.

For coral reefs (Fig. 15.6) these 'functions' would include high primary productivity and high rates of carbon fixation ultimately leading to significant reef accretion; and biological and physical erosion leading to the generation of calcareous sediments.

Fig 15.6: Coral reef area in Gulf of Mannar
(**Source:** www.annauniv.edu/iom)

iii) In turn these 'functions' generate 'goods' (e.g. fish, oil, gas, and minerals) and 'services' (e.g. natural defense against storms and tidal waves, recreation and transportation). Such 'goods' and 'services' have an economic value while some can be traded using market mechanisms but others or equal value do not lend themselves to such straightforward evaluation. Good examples are the valuation of a coral habitat damaged as a result of ship grounding or valued pastimes such as swimming, boating, recreational fishing or simply gazing at the ocean.

For mangroves, consideration has been given to these resources that are not marketed and also to the valuation of 'goods' and services' that might be used some distance from the actual ecosystem in question. Box 1 in Table 15.1 represent the products derived from a mangrove that have a recognized market value while Boxes 2, 3, and 4 represent 'goods' and 'services' that are generally excluded from analyses of the value of mangroves when decisions are taken to develop alternative uses (e.g. conversion to shrimp ponds). Table 15.1 also indicates 'goods' and 'services' which are located on and off site.

Table 15.1: Valuation of 'goods' and 'services' from a mangrove ecosystem (after Hamilton and Snedaker 1984).

Valuation of goods and services	**Location of 'goods' and 'services'**	
	On-site	**Off-site**
Marketed	**Box 1.** Usually included in an economic analysis (e.g. poles, charcoal, woodchips, mangrove crabs)	**Box 2.** May be included (e.g. fish or shellfish caught in adjacent waters)
Non-marketed	**Box 3.** Seldom included (e.g. medicinal uses of mangrove, domestic fuel wood, food in times of famine, nursery area for juvenile fish, feeding ground for estuarine fish and shrimp, viewing and studying wildlife)	**Box 4.** Usually ignored (e.g. nutrient flows to estuaries, buffer to storm damage)

iv) There is a direct link between environmental 'functions' and the generation of 'goods', which may be used by more than one form of human activity (e.g. coral rock for building and for lime production). As in a factory the system will not continue to produce products unless attention is paid to the amount and quantity of inputs required to maintain productivity and functional integrity of the system.

v) In the coastal zone where there is competition between various stakeholders, for land and sea uses which often result in severe conflicts and destruction of the integrity of the resources system.

vi) Activities in the costal zone of many states make a significant contribution to the GDP of national economies. For example in Sri Lanka the coastal zone occupies 24% of the country's land area yet it contributes 40% of the nation's GDP, with 50% of the population living there. Many coastal communities in South Asia depend upon the oil and shipping industry, coastal tourism, fisheries and primary industries.

vii) The coastal zone has a high concentration of human settlements and is the preferred site for urbanization. Most of the major cities of South Asian countries are situated on the coast. Many countries like India are currently experiencing significant population expansion, e.g. in Chennai, Mumbai and Kolkata.

viii) The coastal zone will be a focus for future development in the next 50 years as coastal populations expand and countries extend their shipping, industrial and trade bases (Fig. 15.7), while maximizing their tourism potential. Such developments will lead to increased social and environmental conflicts, which will require the implementation of integrated management planning.

Fig 15.7: Fishing harbour in Coastal Karnataka.

15.2.2 Coastal Zones in India

The coastal ecosystems (Fig. 15.8) are now highly disturbed and very much threatened, encountering problems like pollution, siltation, and erosion, flooding saltwater intrusion, storm surges and other activities due to ever expanding human settlements. Under the Environment (Protection) Act, 1986, the Coastal Regulation Zone Notification was issued in 1991. Through this notification, the Government of India directed the coastal States to prepare Coastal Zone Management Plans with High Tide Line 500m-regulation line, other boundaries, etc for approval of the Ministry of Environment and Forests (MoEF). By the said notification, the coastal areas were classified into four categories. i.e. CRZ - I,CRZ - II, CRZ - III, CRZ - IV. The ecologically sensitive areas and areas of extraordinary natural beauty are included under CRZ - I, where no activity is allowed. The coastal stretches of urban and developed areas are categorized under CRZ - II. In this category, buildings are permitted on the landward side of the existing structures. The areas, which do not come under CRZ - I and II are included in CRZ - III where no construction is permitted up to 200 m from the high tide line. The Lakshadweep, Andaman and Nicobar Islands and small islands are categorized in CRZ - IV. To implement the CRZ notification, we need to identify the Ecologically Important Areas (EIA).

The identified and designated EIA's will be declared as no-development zones. Management plans for these areas will be prepared by scientific institutions and approved by the NCZMA. The approved plan should be implemented by the concerned State/UT Authorities. Such a management strategy will ensure the sustainable development and management of coastal environment.

In the next section let us examine Integrated Coastal Management in theory and practice. Countries included in the South Asian regional seas Pakistan, Bangladesh, India, Sri Lanka, the Maldives, and the British Indian Ocean Territory (BIOT- the Chagos Archipelago). Apart from all having coastlines which are bathed by the Indian ocean, these countries also share the problems of increasing population pressures and resultant increasing demands on the coastal zone, at a level which is almost unprecedented elsewhere in the world. For example in India the population had reached one billion mark with 25% of this number living along the coast; in Bangladesh population numbers are projected to reach 145 million by 2000 with 80% of these inhabiting coastal areas. These problems are further aggravated by the fact that coastal populations in South Asia include some of the poorest members of the community – artisan fishermen, the landless and nomadic pastoralists.

The term integrated coastal management (ICM) is used to describe a continuous and dynamic process that unites government and the community, science and management, sectoral and public interests in preparing and implementing an integrated plan for the protection and development of coastal systems and resources (after GESAMP 1996).

Fig. 15.8: Coastal ecosystem and its components
(Source: http://www.cpreec.org/04_articles/the_coastal_ecosystem/the_coastal_ecosystem.html)

The coastal zone becomes a focus for settlement by poor people because of the accessibility of the coast and its aquatic resources and the lot is not improved by non-sustainable use of resources. Population increases and the attraction of the coast for settlement by the poorest members of the community represent considerable challenges to the countries of South Asia and also to the sustainable exploitation of resources in the coastal zone. Some of these challenges may be met, by an **integrated management approach** to the use of coastal resource. Conventional sectoral management is not effective in addressing the complex management issues of the coastal zone. These issues are **cross-sectoral** in nature with the activity of one sector often adversely affecting the development of the others.

15.3 ESSENTIAL ELEMENTS OF INTEGRATED COASTAL MANAGEMENT

Integrated Coastal Management (ICM) is a framework, which involves comprehensive assessment, setting of objectives, planning and management of coastal systems and resources, while taking into account traditional, cultural, and historical perspectives and conflicting interests and uses. It is an interactive and evolutionary process for achieving sustainable development and implementing a continuous management capability that can respond to changing conditions. ICM includes the following:

- Integration of programmes and plans for economic development, environmental quality management and land use.
- Integration of programs for sectors such as food production (including agriculture and fishing), energy, transportation, water resources, waste disposal and tourism.
- Integration of all the tasks of coastal management from planning through to implementation, operation and maintenance, monitoring and evaluation performed continuously over time.

- Integration of responsibilities for various tasks of management among levels of government - local, state/provincial, regional, national, international and between the public and private sectors.
- Integration of available resources for management (i.e. personnel, funds, materials, equipment).
- Integration among disciplines (e.g. geomorphology, geochemistry, marine biology, economics, engineering, political sciences and law).

As you will realize the essential elements of integrated coastal management are **integration** and **co-ordination**. Any policy and management action, which has been designed to address coastal development conflicts, must be founded on a sound understanding of natural processes and ways in which these may be disturbed (i) on political socio cultural and economic conditions (ii) on present and future demands (iii) social costs involved. The management of the coastal resources system has been likened to a cube consisting of three mutually supporting dimensions. These are **processes, issues** and **actions** and each forms an axis of the cube (Fig. 15.9). The three dimensions are closely intertwined and to consider only one may lead to collapse of the whole management system. This approach to integrated coastal management follows closely that adopted for the countries of South East Asia.

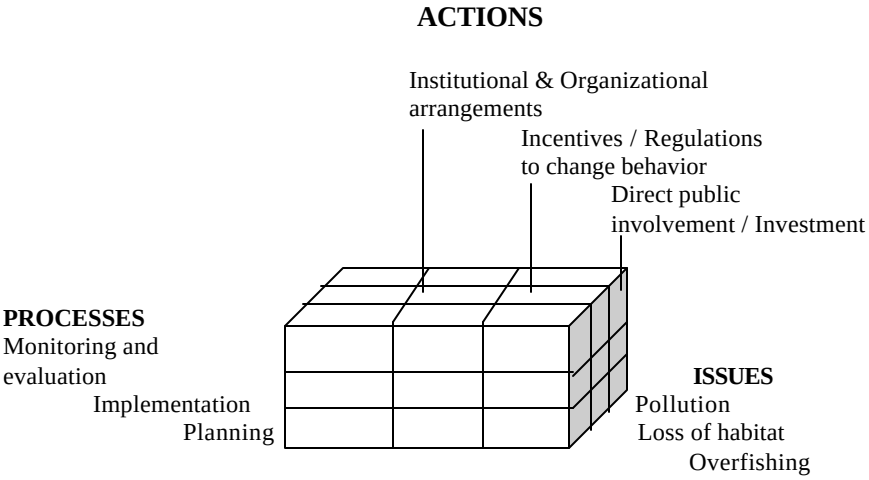

Fig. 15.9: A coastal area management system (after Chua 1993)

Management **processes** identify and analyze management issues and develop the necessary policy and management options. In this model management processes consist of four essential sequential components, namely **planning, implementation** , **monitoring** and **evaluation**. The planning component constitutes the basic layer of the cube. The management **issues** embrace the conflicts resulting from resource exploitation (e.g. over fishing, coral mining) and use (habitat loss, pollution) and it forms a second dimension to the cube. Management **actions** constitute the third dimension and include direct public investment (e.g. restocking, fisheries enhancement, education and public awareness): incentives and regulation, which might change behaviour (e.g. permits, quotas, rights, monitoring and enforcement). Unlike sectoral management, which is represented by only one sector of the cube (e.g. over fishing), the spell-over effects of one form of development on all others can be addressed in this integrated approach.

15.3.1 Management Processes

The management processes consist of integrated planning, implementation, monitoring and evaluation:

- Integrated planning involves inception, research and analysis, programme formulation, adoption and execution. While the detail and level of planning may

vary according to the conditions at the site and the experience of the planning team, the fundamental steps are essentially the same. They are:

i) Establishing a multidisciplinary planning team to provide a framework for the management programme, initiate the planning process and identify the key participating agencies. Core staff might include a coastal management expert, a regional planner, a resource economist, an ecologist, a sociologist and an environmental engineer. Obviously the composition of the team will vary depending on the type of project in hand or the management challenge.

ii) Adopting a planning process, this should take no longer than 1-2 year to execute. In principle the planning process involves the evaluation of secondary data and also any formal targeted research with a view to the production of a strategic management plan and an area profile. The actual planned life of the project should be between 5-10 years to permit the development of skilled human resources, plans and other measures needed to allow the project to be self-sustaining beyond the limit of donor funding and technical support. **Clear goals should be apparent and acceptable to all participants**.

iii) Collection of research data will include secondary information but may also involve instigation of focused research needed for a specific coastal management programme. The research will be multidisciplinary in character and should include attempts to evaluate the 'assimilative capacity' of a system/ecosystem, resource evaluation, and legislation as appropriate. Assimilative capacity can be defined as 'the ability of a receiving system or ecosystem to cope with levels of waste discharges or human activity without suffering any significant effects.'

- Implementation requires funds and human resources and primarily depends upon project design and the capability of the implementing agencies.

- Monitoring is an important component of the management process and should be incorporated at an early stage of the programme. The aims of monitoring are to see how the projects are progressing; to explore opportunities that could be developed and to assess the impacts and the lessons learned.

- Evaluation is critical since it enables corrective action to be taken where management plans are not producing the desired results. As a result of evaluation changes in plans, management strategies may be initiated and mistakes corrected at an early stage of the management process. In this way integrated coastal management becomes iterative with scope for learning from mistakes made early in the management programme.

Because the planning, implementation and monitoring and evaluation are sequential they can be depicted as a cycle, often described as the policy cycle (Fig. 15.10).

The most difficult transition occurs between planning and implementation. Each cycle of the policy process for a coastal management programme can be considered a generation. The procedures adopted in many mature coastal management programmes are substantially redesigned in subsequent generations as a result of earlier experiences and such exercises have been termed 'adaptive management'. In this way constructive use is made of lessons learned from successes and failures in the management process.

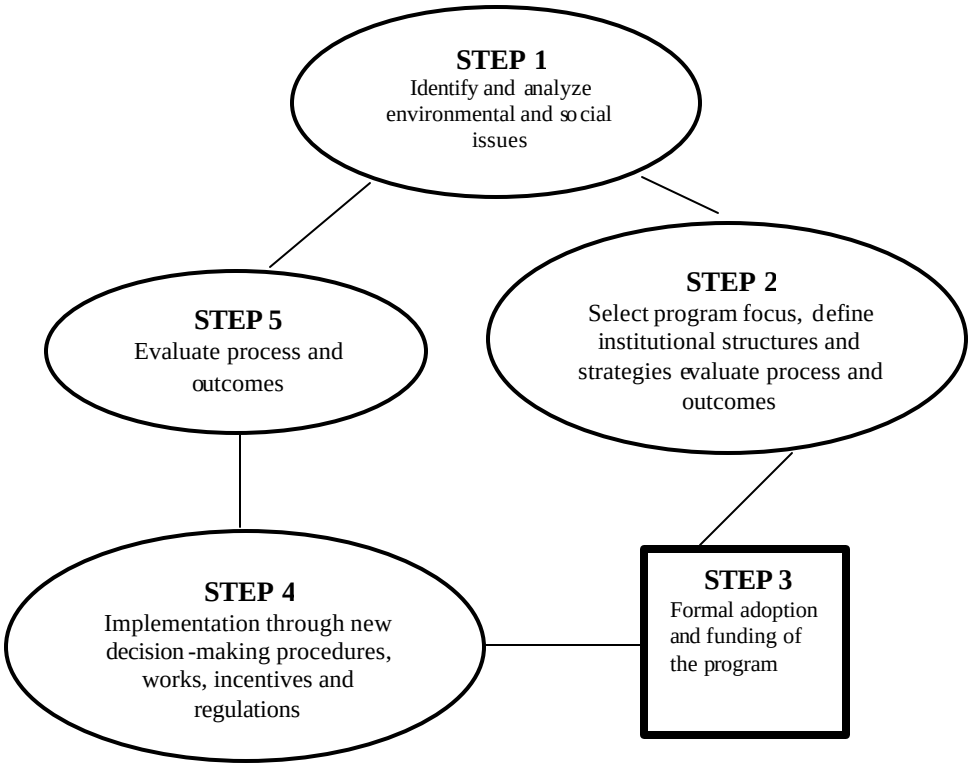

Fig. 15.10: Steps in the evolution of generation of a coastal management programme (Oslen 1993).

15.3.2 Management Issues

Management issues include resource use (over fishing, tourism potential, destruction of habitats etc.); environmental quality (population, coastal erosion) and institutional concerns (conflicts in legislation, intersectoral conflicts, ineffective law enforcement etc.). While depicted in the cube model as individual issues, many clearly overlap and serve usefully at this point to highlight another aspect of coastal management that of multiple use of costal environments.

At the heart of this concept lies a recurrent problem in coastal management described as a sectoral approach to resource use. This approach favours a single purpose and exclusive use of land and water resources. However shared coastal systems generate a wide variety of 'goods' and 'services'. It has been argued that we should be looking for an optimal mix of uses that generates the greatest economic benefit to society. That optimal mix is hard to achieve and demands an effective and integrated coastal management policy if resource conflict is not to occur. In Sri Lanka coastal lagoon areas are frequent sites, which suffer from multiple resource conflict (fishing, mining and tourism). In India dredging is done in many atolls in Lakshadweep and one beautiful underwater garden of the atolls is totally depleted. Such locations have been considered under the heading of special area management sites where collaborative management plans have been set up to resolve conflicts. It is clear from a large number of case histories that the diverse range of 'goods' and 'services' cannot be managed adequately through private ownership or control by sectoral agencies.

15.3.3 Management Actions

Management actions provide the most important dimension of a coastal management programme since they involve the application of measures directed towards achieving the desired changes e.g. maintaining the functional integrity of the ecosystem, improving water quality and changing human behaviour. They include:

- International and organizational arrangements, which clarify legal rights and obligations, strengthening enforcement capability and undertaking monitoring and evaluation.
- Incentives and regulations to change human behaviour which might involve establishment of subsidies, fishing permits or quotas, taxes, fishing and mining bans, regulations of vessels and fishing activities.
- Direct public involvement which would involve investment by a government into increasing public awareness, conducting appropriate research, providing basic infrastructure (e.g. waste disposal systems) and technical assistance where needed.

Box 15.1: Regional policies and action frame work of South Asia

A regional meeting for countries in South Asia was held in November 1985 in the Maldives. A major output of this meeting was to identify options for a regional policy and action framework which are as follows:

- Promotion of research and monitoring, and exchange and sharing of data and information among member States.
- Promotion of methods and practice for the management of human activities that safeguard environmental quality and utilize resources rationally and on a sustainable basis.
- Assessment and evaluation of causes, magnitude and consequences of environmental degradation.

At the regional meeting, country delegates recognized four major anthropogenic influences affecting the coastal zone in South Asia. These were:

- sedimentation (from dredging, land derived run off and land reclamation);
- marine resource exploitation (sand, coral, mangrove, fisheries);
- pollution; and
- tourism.

The relative significance of each factor varies from country to country as shown in Table 15.2

Table 15.2: Major anthropogenic influences (listed in order of importance) in the coastal zone of South Asian countries: as agreed at the 1995 ICRI meeting.

Sri Lanka	Maldives	India	Bangladesh	Pakistan
1.Sedimentation (land development and mangrove clearance)	1. Marine resource exploitation	1. Sedimentation (Poor land practice)	1. Marine resource exploitation	1. Marine resource exploitation
2. Marine resource exploitation	2. Sedimentation (from dredging)	2. Marine resource exploitation	2. Sedimentation (Mangrove clearance)	2. Pollution
3. Pollution	3. Tourism	3. Pollution	3. Pollution	3. Sedimentation (Mangrove clearance)
4. Tourism	4. Pollution	4. Tourism	4. Tourism	

SAQ 1

i) List the anthropogenic influences on coastal zone of India according to your thinking. Do you think tourism is degrading our coastal area? Explain.
ii) Why cannot management of Coastal Area alone bring sustainable development?
iii) Define ICM, why has it become an important tool for sustainable development.

15.4 THEORY INTO PRACTICE: KAVERI BASIN ECO-SYSTEM DEVELOPMENT: PROBLEMS AND TASKS AHEAD·

River systems are interwoven with human civilization - this being particularly so in India. In fact, river banks have been considered to be the cradle of major civilizations in the world. For instance, about the Ganga, Jawaharlal Nehru wrote:

"The story of the Ganga from her source to the sea, from old times to new, is the story of India's civilization and culture"..... "The Ganges is the river of India, beloved of her people, round which are intertwined her racial memories, her hopes and fears, her songs of triumph, her victories and her defeats. She is a symbol of India's age-old culture and civilization, ever-changing, ever-flowing and yet ever the same Ganges."

Besides fulfilling the prime needs for life processes, rivers have been used for domestic, agricultural, fisheries, industrial, recreational, aesthetic, navigational and power generation purposes. Our progress in the agricultural sector is, to a great extent, attributed to the presence of an irrigation system involving a chain of rivers, canals and channels in the country. The irrigation systems have been very vital for our agriculture from times immemorial.

In our country there are five major river systems – the Ganga, the Brahmaputra, the Indus, the East Coast and the West Coast river systems – covering a length of over hundred thousand kilometers. Kaveri is an important river of the East Coast river system, nearly 850 km long. Originating from Brahmagiri Hills on the Western Ghats at an elevation of about 1,340 metres above the sea level, it is the largest river south of Krishna. The important tributaries of Kaveri are the Harangi, the Shimsha, the Arkawathi, the Lakshmana Lirtha, the Kabini and the Suvarnavati in Karnataka, and the Bhavani, the Noyil and the Amaravati in Tamil Nadu. Its main catchment is located in Karnataka and is fed by South-East monsoon. It covers a drainage area of nearly 67,785 square kilometers. Of this, an area of 40,663 sq km is subjected to South-West monsoon while the rest is under the influence of the North-East monsoon. The annual rainfall in the basin varies from less than 60 cm over North-Western part of Amaravati sub-basin to more than 600 cm in the source region of the Kaveri river.

The Kaveri basin area in Karnataka is 41.2 percent, in Tamil Nadu 55.5 percent and the Kerala 3.3 percent. The annual flow in the main Kaveri river at Chunchanakatte (about 48 km upstream of Krishnarajasagar dam) is 2.91 thousand Mm^3 (102.7 TMC; average for 58 years). Forty percent of flow occurs in July, followed by 30 per cent in August; September brings about 11 percent and October about 6 percent. The flow in June is slightly less than nine percent. The contribution of the remaining seven months, November to May, taken together, is less than five percent of the annual flow, while the five months June-October account for 95.4 percent. Essentially, therefore, it is a monsoon river.

Surface water resources are rather scarce in Penninsular India and have to be supplemented with ground water. According to the UNDP study done in Tamil Nadu

· Keynote Address delivered at the Inauguration of the Workshop on Kaveri Basin Eco-development organized at Kodaikanal by the Madras Science Foundation, January 10, 1985 by Dr. T.N. Khoshoo.

region of Kaveri basin, the total replenishable ground water that can be made use of in the delta amounts to about 3,650 million cubic metres per year. This water which is reported to be of good quality, can be utilized for drinking purposes by nearby towns and also to feed water supply channels.

No estimates of ground water potential are available for Kaveri basin in Karnataka region. Detailed hydrogeological and geophysical studies in the region should be undertaken to exploit the hidden water resources.

Kaveri system is one of the best regulated and fully exploited river basins. It is an excellent example of stored system of river as against the perennial alluvial rivers of northern India (Kulandaiswamy, 1985). Rice bowl of Kaveri delta is chiefly located in the districts of Thanjavur and Tiruchirapalli.

Kaveri is interwoven in the cultural life of Karnataka and Tamil Nadu where the river is associated with Agastya Muni. The two island towns of Srirangapatinam and Srirangam are famous pilgrim centres. Besides, there are a large number of temples in Thanjavur and Tiruchi districts. The river system was navigable during the early Cholas who established their capital at Woriyoor on the banks of the river near Tiruchi. Many famous schools of philosophy, music, dance, crafts, etc. have flourished on the banks of Kaveri in many hamlets.

Impact of Riverine Ecology

With rapid industrialization and urbanization in the country in the post-independence era, a large number of dams and barrages were built for irrigation, flood control, navigation and power generation. Dams, rivers and barrages act as physical barriers to migration of fish, tending to prevent their access to the usual breeding, rearing and feeding grounds. Consequently, substantial morpho-ecological changes occur in the original riverine ecology both above and below the dam site. Kaveri cannot possibly be an exception to this.

It is now established that construction of dams modifies the physical natural of soil in the vicinity. The prevalence of "knock-knee" deformity or "genu-valgum" among adults and children in some districts of Andhra Pradesh and Tamil Nadu is attributed aetiologically to excess fluoride concentration in water after construction of dams in the region.

Other changes include turbidity and siltation in the man-made reservoirs, leading thereby to the imbalance in the population of aquatic flora and fauna with direct impact on food chain. Considerable reduction in water flow due to artificial barriers also affects ecology, rendering large areas of land unproductive. Sizeable chunks of land that become inhabitable after getting inundated, force the population to rehabilitate itself elsewhere often at State expense. Large reservoirs and the irrigation channels also affect the local climate.

Like all other rivers in the country, Kaveri too has been subjected to the onslaught of the negative impacts of industrialization and urbanization. A number of dams, reservoirs and "anicuts" (man-made impoundments of water) have been built on Kaveri to utilize almost 95 percent of its water for agriculture and hydroelectric power generation. Construction of huge masonry structures like Krishnarajasagar Dam (44,827 million cft capacity) and Mettur Dam (83,500 million cft capacity), the latter being one of the world's largest, are responsible for progressive growth of this region. The entire Kaveri system, together with its delta and mangrove regions is subjected to intense land and water use and other man-made influences.

Industrial Discharge

Our rivers are particularly vulnerable to an indiscriminate discharge of industrial effluents. Mass mortality of fish fauna is often reported from different parts of the

country. The old industries located on river banks continue to discharge effluents affecting water quality. The pollution load is very heavy in rivers passing through industrialized belts of the country. Effluents from pulp and paper mills, synthetic rubber factories and chemical factories and fly ash from coal washeries cause extensive pollution in some of our rivers. Some of the industrial effluents include dangerous carcinogens such as arsenic, nickel, asbestos and vinyl chloride. Again, Kaveri cannot be an exception of such a situation.

Synthetic pesticides and fertilizers used extensively in modern agriculture are washed out to rivers and tributaries. Direct access of such highly toxic chemicals into the water is not only hazardous for pisciculture but also from public health point of view. Concern has been expressed about the occurrence of pesticides and phosphate fertilizers in Kaveri waters in recent years. The problem is very serious when seen in the context of use of synthetic fertilizers and pesticides in the Karnataka and Tamil Nadu regions.

Following types of industries are located in and around Kaveri basin:

a) Chemicals
b) Plastics
c) Dyestuff Units
d) Solvent Extraction Units
e) Paper Mills
f) Aluminium
g) Sugar
h) Distilleries
i) Textile Mills
j) Cement
k) Leather Tanneries
l) Dairy and Allied Industries

There appears to be no bacteriological contamination except for the occasional presence of the faecal coliforms which were found upto 16,000 as the most probable number per hundred millilitres. The total coliform is also of the same magnitude indicating presence of the coliforms of faecal origin only.

Information on communicable diseases like malaria, cholera, typhoid, dysentry, etc. is nearly 15-20 years old and needs to be reviewed. It would, however, be worthwhile to see latest records of Ministry of Health to have an idea about the current situation.

No status report on pollution of Karnataka region is available but needs to be compiled at the earliest.

Afforestation Programmes

Any serious attempt to undertake improvement and preservation of Kaveri Basin should take into account the afforestation programmes. There has been a sharp reduction in forest cover around Hosnagar in Shimoga district in Karnataka after Linganamakki Project. The dense forest which existed in these areas in 1934 has been drastically reduced (Meher Homji, 1985). Similarly, after construction of railway tracks linking Hassan and Sakleshpur, forests have been cut. All these areas, according to the investigations have shown a tendency towards diminishing rainfall.

As is evident from the studies, the environs of Bhavani river (an important tributary of Kaveri Basin) have undergone perceptible changes with regard to land use. Forests have been converted into agricultural land and industrial sites. Without any significant change in rainfall in Bhavani watersheds of Kattery and Coonoor, the peak floods during monsoon have increased alarmingly, obviously due to a reduction in forest

cover (Chinnamani, 1985). The population has suffered immensely because of indiscriminate felling of trees.
It is well known that deforestation leads to runoff rainwater which does not sink in soil, leading to unpredictable stream flow as also to soil erosion and consequent sedimentation of streams and water bodies. On the other hand, afforestation helps in holding rain water and downward percolation and recharging of underground aquafers. Therefore, the best strategy to guarantee water in perpetuity in Kaveri Basin is to have a massive afforestation programme.

Presence of luxurious mangrove forests near Coleroon and Muthupet and adjoining estuaries and lagoons contribute significantly to high primary biological production. The estuarine transport of chemical wastes, trace elements and nutrients and organic compounds and heterotrophic process need a careful study.

The mangrove vegetation of Pichavaram, South Arcot District at northern extremity of the Kaveri delta, needs special care. Although the area is highly populated, 1400 ha mangrove vegetation in this area is well preserved. This should be continued at all cost (Meher Homji, 1985).

Some information is also available on the disappearance of wildlife from Kaveri Basin in the past century. Higher mammals like nilgai and cheeta can no longer be seen in this area. The wolf, wild fox and tiger have been reduced in number (Sukumar, 1985).

The Central Board for Prevention and Control of Water Pollution under the Department of Environment has published two comprehensive volumes on Yamuna and Ganga Basins giving all the relevant information as also detailed inventory of pollution sources of the respective basins. In the years to come, such studies would be extended to all the 14 river basins which collectively account for more than 83 percent of the land mass, 85 percent of surface runoff and 80 percent of the population of the country. The whole exercise on Ganga Basin has been summarized in the form of six maps in a calendar (1984 – 85) on Ganga issued by the Central Board. The calendar summarizes information on:

a) Physiography of ground water and stream flow
b) Soil types and climate
c) Land use and fertilizer consumption
d) Irrigation and pesticide consumption
e) Pollution generating potentials and generated load
f) Abstraction and stream classification, the designated use like:

    i) Drinking water without conventional treatment but after disinfection
    ii) Outdoor bathing
    iii) Drinking water source with conventional treatment followed by disinfection
    iv) Propagation of wildlife and fisheries, and
    v) Irrigation, industrial cooling and controlled waste disposal.

Our integrated eco-development programmes already initiated in the Himalayas, Western Ghats and Ganga Basin would now be extended to the Eastern Ghats and Kaveri Basin shortly. Department of Environment has also prepared a report on Nilgiri Biosphere Reserve. Discussions have been held with the concerned States to finalize concrete action on this Biosphere Reserve. Once initiated, it would cover a large stretch of Kaveri Basin.

The Central Board for the Prevention and Control of Water Pollution which is an associated organization with TERI has established a country-wide network of about 120 monitoring stations which monitor the water quality in respect of 19 parameters. Fourteen major inter-state rivers of the country are thus monitored to assess the pollution problems. In respect of these rivers, zoning and classification has been completed by the Board. As far as possible, Department of Environment will provide

laboratory and other infrastructural facilities for water quality monitoring of Kaveri Basin.

What the Ganga is to the North, the Kaveri is to the South. Kaveri has been worshipped as a family deity by Coorgs. The purity of its water, therefore, has to be maintained. It is from this point of view that workshop on Kaveri Basin revised the following issues for consideration of the participations:

a) Water resource management in the river basin with special reference to water budgeting for various uses, leading to classification of the river for designated uses.
b) Detailed exploration of flora and fauna of the region particularly the identification of pollution indicators and population studies on threatened species.
c) Ecological functioning of the entire Kaveri system and of its self-purification mechanism involving constant recycling of organic compounds, transport of metals by river water into estuary and their uptake by microbes.
d) Pollution control of industrial effluents and agricultural chemicals runoff.
e) The role of Kaveri river in maintaining the biogeochemical cycle of carbon.
f) Prevention and reclamation of saline and alkaline soils due to combination of drainage and successive surface irrigation.
g) Protection of river banks through biological and engineering methods.
h) Programme of extensive afforestation and soil conservation with the help and the support of voluntary agencies and public at large.
i) Problems of salinity ingress and micronutrients depletion in the estuarine area.
j) The cultural impact of river on the people living in adjoining areas.

In the ultimate analysis, the only guarantee for a river system to flow in perpetuity is to have the catchment area in a healthy condition. This alone would ensure water conservation in an effective manner. A good river is essentially a living and a self-purifying system. It can continue to remain so, if the extent and nature of onslaught of pollution is not heavy and continuous. A river can be kept in a healthy condition by monitoring the extent and nature of pollution on a continuous basis and by taking corresponding mitigative measures wherever and whenever needed.

15.5 CONSERVATION STRATEGIES FOR MANGROVES IN INDIA*

India has a total area of 4,871 km2 under mangroves. About 57% are found along the east coast (Bay of Bengal), 23% on the west coast (Arabian sea) and the remaining 20% on the Bay Islands (Andaman & Nicobar Islands in Bay of Bengal).

There are three major types of coastal settings on which mangroves in India exist and they are (i) deltaic, (ii) backwater-estuarine and (iii) insular categories. The deltaic mangroves occur along the east coast (Bay of Bengal) where the mighty rivers (Ganga, Brahmaputra, Mahanadhi, Krishna, Godavari and Cauvery) make the deltas. These deltas have nutrient rich alluvial soil and hence the mangroves are luxuriant. The backwater-estuarine type of mangroves that exists in the west coast (Arabina sea) is characterized by typical funnel-shaped estuaries of major rivers (Indus, Narmada, Tapti with delta formation is almost absent) or backwaters, creeks, and neritic inlets. The insular mangroves are present in the Bay Islands, where many tidal estuaries, small rivers, neritic islets, and lagoons support a rich mangrove flora.

15.5.1 Floral and Faunal Resources

Mangrove species have been counted as the plant species that exist within the limit of saline tidal water flow and unstable muddy substrates. According to the given definition, the mangroves in India comprise of 69 species excluding slat-marshes and other associate species, under 42 genera and 27 families) are present on the east coast; 37 species (25 genera and 16 families) on the west coast and 44 species (28 genera

under 20 families) on the Bay Islands. The East coast has 91% of mangrove species west coast has 53% (Fig 15.11).

Fig. 15.11: Mangrove vegetation.

There are a total of 53 species of prawns/shrimps in Indian mangroves, of which 53 (68%) in the east coast and 22 (42%) in the west coast. There are 91 crab species in Indian mangroves of which 67 (74%) in the east coast and 13 (14%) in the west coast. Similarly, there are higher numbers of molluscan and fin-fish species along the east coast than on the west coast.

15.5.2 Conservation Status of Floral and Faunal Species

Conservation status of mangrove species

Mangrove ecosystem as a whole is in vulnerable condition. Hence, all the components of the ecosystem need to be conserved critically. It is necessary to prioritize the rare, endemic and endangered species for immediate conservation measures. Extensive field study reveals that 20 mangrove species are either rare or endemic species (Fig. 15.12).

Fig 15.12: Mangrove vegetation in Kerala coast.

More widely distributed species like *Aegiceras corniculatum, Acanthus ilicifolius, Avicennia marina, A. officinalis, Excoecaria agallocha,* have great ecological amplitude and a remarkable ability of vegetative regeneration. Due to high productive values in fuel energy, timber, fodder, boat and house building materials, tannin, paper pulp and in other sustainable life supports, some common mangrove species of *Avicennia, Excoecaria,Bruguiera* and *Rhizophora* (Fig. 15.13) may come under the threatened category with the increasing human pressure and if regular regeneration programme through afforestation are not taken up immediately, they may decline in the near future. India has been taking efforts to save the biodiversity components of the vulner able ecosystem .

Fig. 15.13: Special types of roots are found in mangrove vegetation.

15.5.3 Threats to Mangroves

The mangroves in India experience several threat factors in different maritime states of our country. Three problems are very common in most of the mangrove ecosystems and they are: (1) over-exploitation of fishery resources, hampering regeneration of mangrove seedlings and unnecessary cutting of trees, (2) damage of trees for firewood, cattle feed, rehabilit ation, reclamation and conversion activities, and (3) lack of peoples' awareness and participation in conservation activities. The most significant threat is of human pressure on mangrove-resources for forestry and fishery products. Hence, the Ministry of Environment and Forests has given increasing attention for sustainable management of the mangrove resources, with the local peoples' participation.

15.5.4 Remedial Measures

Remedial measures for the important issues that are related to mangrove conservation and management are given here-under.

- To all the local communities to cultivate the fast growing mangrove species like *Avicennia* in degraded areas.
- To provide alternate sources of timber (like *Casuarina*).
- To implement silviculture strategies like practicing the crop rotaion once in 15 years in alternate strips (60 m wide at an angle of 45º to the waterways), and regeneration naturally by using seeds of nearby mangrove trees.

Cattle grazing

There is a heavy grazing by cattle especially on seeds and seedlings during monsoon that result in poor regeneration of mangroves.

- To ban on entry of cattle during monsoon.
- To provide alternate source of fodder.
- To encourage the people to cultivate fodder species through inter-cropping with *Casuarina.*
- To implement Dairy Development scheme for the local communities.
- To develop bio-fencing using toxic mangrove species like *Excoecaria agallocha.*

Unsustainable fishing practices

- To prevent mechanized raft operations in shallow waters of mangroves.
- To allow the fishing nets with > 20 mm mesh size that prevents the catch of juvenile fishes.
- To ban fishing activities during the critical stage of fish breeding (premonsoon & summer) thereby allowing development of juvenile fishes.

Lack of people's participation

People who dwell in and around mangrove habitats are careless of mangrove resources, due to lack of awareness or to not involving them in conservation processes.

- To create awareness of mangroves about the conservation of mangroves.
- To involve the local people particularly womenfolk in planning and implementation of management action plans.
- To cease fire-arms from license holders for preventing poaching of wildlife from mangroves.

Prawn farming

The Govt. of India has put a ban on intensive or semi-intensive type of prawn farming practices, especially along the ecologically sensitive mangrove areas. Extent of mangrove areas that are reclaimed for prawn farming practices and that of abandoned ponds are not clearly known.

- To restore and recover abandoned shrimp ponds, with mangrove planting.
- To develop environmentally sound aquaculture integrated with mangrove silviculture and fisheries for benefit of local communities.

Reduced fresh water supply

The freshwater supply that feeds estuarine mangroves is reduced due to poor rainfall and dam construction in upstream areas. The freshwater is required for germination, and sprouting of seeds and seedlings of mangroves.

- To prevent the water flow reduction in rivers that feed mangrove habitats.
- To ban any waterway barrier that affects the mangroves drastically.

Hyper-salinity

The brackish waters, which accumulate in the bowl-shaped mangrove habitat during monsoon, turn hyper-saline during summer, ultimately killing or retarding the growth of mangroves and those central areas thus become barren after some years. This situation becomes serious due to poor precipitation and poor flux of freshwaters/tidal waters.

- To flush the dry hypersaline soil with tidal waters through the construction of artificial creeks.
- To drain the stagnant saltwater in the mangrove habitats before summer.

Heavy siltation

Siltation blocks the river mountains and reduces the fertility of estuarine systems.

- To implement massive planting programmes to strengthen the river banks.
- To plant mangroves on the mudflats that are formed newly by siltation.

Natural calamities (danger of frequent storms)

- To identify the cyclone-prone areas and strengthen it with mangrove planting.

15.5.5 Conservational Strategies

The Govt. of India launched a Scheme on Conservation and Management of Mangroves in 1986 through its Ministry of Environment and Forests. In this context, a National Committee on Mangroves consisting of forest managers and scientists was constituted to advise and oversee implementation of the scheme. Based on the recommendations of the National Committee, 32 mangrove areas all along the country have been identified for intensive conservation and management. Management Action Plans have been prepared for the identified areas and grants have been released to the

respective State Government/Union Territories for implementation of Management Action Plans. Main activities of the management action plan include afforestation, regeneration of degraded mangrove areas, protection measures, eco-developmental activities so as to reduce human pressure on the mangrove ecosystem, and education and awareness related to conservation of the fragile ecosystem. The National Committee reviews regularly the progress of implementation of management action plans on the identified areas.

The National Committee has identified thrust areas for management-related research activities for funding, so as to integrate the research findings with management of mangroves. The thrust areas are as follows:

- Taxonomy and distribution of mangrove species.
- Status of endangered/threatened species and measures for their conservation.
- Restoration of degraded mangrove areas.
- Status of health of mangroves.
- Biodiversity of mangroves including flora, fauna and microorganisms and their interrelationships.
- Studies on aquaculture in the mangrove areas.
- Impact of mangrove afforestation on the coastal erosion and role of mangroves in flood damage control.

The Govt. of India protects mangroves with the support of legislative and regulatory measures. The mangroves are recognized as ecologically sensitive areas under the Environmental (Protection) Act-1986. Mangroves and activities are regulated under 6(1) category of the Coastal Zone Regulations.

Mangroves can be developed as 'cash crops' and as sources of high value commercial products and fishery resources and as sites for a burgeoning ecotourism industry. Their unique features may also make them ideal sites for experimental studies of biodiversity and ecosystem function (Kathiresan & Bingham, 2001). All this will require that the resource is understood, carefully managed, and protected. Involvement of local communities in coservation and education in 'wise' use of our precious mangrove resources will ensure that these unique ecosystems and flourish.

15.6 SUCCESSFUL CASE STUDY OF COASTAL SALINE REGION OF WESTERN INDIA

Vankar Cooperatives Take to Vanikama 1: In a Coastal Saline Region of Western India

Genesis

Historical deprivation of socially and economically marginalised groups in degraded environments often lead to learned helplessness among such groups. Some of the factors that contribute to this state of helplessness include: a) fragile ecosystems and poor natural resource base, b) limited access to new technology and financial resources, c) low self-image and lack of faith in one's own skills and intellectual resources.

The Vankars (scheduled caste people) of a coastal saline region of Gujarat called the Bhal found themselves in precisely such a situation about two decades ago. It was largely through the courage and visionary zeal of a few of their leaders, that the community was able to emerge from this state of helplessness into a state of self-help and self-esteem. Recognizing the limits to economic emancipation through individual management of resources, the Vankars decided to resort to community action. Joining forces with an urban based NGO called the Behavioral Science Center (BSC)[3], they established over the next decade, a string of cooperatives which made possible the demarcation of open-access saline wastelands as a common pool resource, for the

exclusive use of the scheduled caste. Pooling of land, labor and knowledge pertaining to the use of local resources and experimentation to build upon local knowledge and adopt technology from outside the region were integral parts of the strategy.

The Vankars saw in the proposed cooperatives a unique opportunity to a) improve their access to resources and markets; b) improve their ability to use these resources to create common pool assets; and c) to cope with the variety of risks involved in starting the new venture. But above all, they saw the tremendous possibility of bringing about a seachange in their social and economic status.

Starting with a single cooperative in Vadgam village in 1979, the cooperative movement of the Vankars spread to neighboring villages. By 1990 there were eight cooperatives which had federated together to form a two tier structure. The cooperatives established their own technology to cultivate a salt tolerant tree species popularly refereed to as gando bawal or "the mad babool" , (*Prosopis juliflora*). The wood cultivated on these lands had poor market value but the charcoal made from this wood fatched a good price in urban markets. The establishment of such plantations over more than 1112 acres of saline lands proved to be the turning point for the Vankars, who picked up their new found confidence to establish several other economic enterprises during the next decade.

Raising the Mad Babool: Tribute to Local Ingenuity and Knowledge Systems

The saline wastelands of the Bhal had defied solutions over the past generations. The levels of salinity ranged from 4 to 100 millimhos/cm. This was interspersed with patches of alkalinity. It was through a process of trial and error that the cooperatives developed and mastered simple techniques to harness the productive potential of these lands. A number of incremental innovations took place, making it possible to establish plantations of “gando bawal” on land with salinity upto 8 millimhos/cm. Microcatchment water harvesting structures were created to harvest the rainfall needed for individual plants. The moisture was enough to mitigate the moisture stress caused due to salinity. It was also available uniformly over the monsoon season, resulting in significant growth during the months of July through November.

Outcomes

The Vankar cooperatives today have diversified into fisheries and rice milling in a big way. They have also been able to set up community services for credit and supply of agricultural inputs. A few have purchased their own tractors which provide services to individual farmers. Others have set up their own fair price shops and health care services. A survey conducted to assess socio-psychological change among the Vankars during 1990 showed significant differences between the behaviour of villages with and without such cooperatives.

Source: The World Bank/WBI’s CBNRM Initiative, Author Astad Pastakia (1998)

15.7 GENERAL INTEGRATED COASTAL MANAGEMENT PRACTICE IN SOUTH ASIA REGION

In the earlier section, you read about the successful venture of a Gujarat Tribal Community. Let us now examine the Integrated coastal management practice currently being developed throughout the region. In most countries legislation requiring coastal states to prepare coastal management plans is relatively recent; in others such as Sri Lanka coastal management has been a concern since 1963. In 1979 a lead agency, the Coast Conservation Division (CCD), was set up to help coordinate sectoral activities between relevant agencies and government department in Sri Lanka.

The implementation of the Coast Conservation Act by the CCD in 1981 was an important first step in the evolution of a Coastal Zone Management Plan, which was finally approved in 1990. This plan was concerned primarily with coastal erosion and shore front construction. CCD's planning and regulatory programme for the coastal zone is complemented by research and planning activities for the National Aquatic Resources Agency (NARA) established in the same year as CCD. Looking to the future, CCD activities are projected to broaden to cover wider issues of concern in the coastal zone. The agency itself will aim to transform its primarily regulatory function to one of a service-orientated organization, which facilitates locally based planning and implementation efforts. The lessons learned from the 18 years of experience of the CCD should be recognized at an early stage during the development of ICZM programmes in the region. They may be summarized as follows:

1. Coastal management in Sri Lanka has evolved a necessarily supportive national framework but has not yet focused on how to involve coastal communities and local government in the resource management process.
2. Coastal management activities are presently too restricted to coastal erosion management and regulatory development along the shorefront.
3. Resource management that focuses on regulation is too narrow in scope and cannot meet the complex needs of coastal communities. Regulation alone tends to alienate the coastal residents affected.
4. Facilitating co-operation between sectoral interests has not been easy. Strong leadership by a coordinating agency is needed if it is to be effective in pro-active approaches to coastal management.

In India the coastal regulation zone (CRZ) notified in July 2000 Pachmarahi in Madhya Pradesh as an eco-sensitive zone.

In India, we have legislation and the Government of India's notification of 19 February 1991 declared coastal land up to 500 metres from the high tide line along the seas, bays, estuaries, creeks, rivers and backwaters as 'Coastal Regulation Zone' (CRZ). The high tide line is defined as the line up to which the "highest high tide reaches at spring tides". In order to control excessive exploitation of coastal resources and unrestricted development, the notification prohibited certain activities within the CRZ. Among other things, it included the setting up and expansion of industrial operations and processes except those directly related to waterfront or needing foreshore facilities. However, the notification provides that the CRZ's extent can be modified while preparing the 'coastal zone management plan' and it cannot be less than 100 metres from the high tide line.

The Government of India has set up the 'National Coastal Zone Management Authority' and similar State authorities to regulate the CRZ. The State Governments are required to prepare 'coastal management plans'. Thus, the Central and the State Governments control the development in coastal areas. Ministry of Environment and Forests must clear development projects after assessment of their environmental impact. However, the procedure is frequently changed to suit the requirements of interest groups.

The lessons learned from Sri Lanka, Pakistan and India have many common features, namely the need for investment in seeking alternatives for coastal communities dependent on artisanal fisheries; the need for community involvement at all stages in the development of a management plan; the need for a multicultural approach to management of the coastal zone and a formal strategy to effect such a proposal; the need to combine both regulation and incentives in any management action and finally the need for targeted, interdisciplinary research on specific problems in the coastal zone.

15.7.1 Good Coastal Management Practice

At this point it is worth reiterating what constitutes good coastal management practice. Essentially there is no generalized prescriptive recipe for the management of coastal resources; each case, each site brings with it its own unique set of issues for consideration. There is however a general framework within which coastal resources

can be sustainably exploited through appropriate policymaking, management, and technological intervention - this framework as you would have under stood by now is integrated coastal management (ICM). It is most effective when it is pro-active and the process of developing ICM can be described as a series of steps. These are

I Awareness

- Developing awareness of the value of coastal resources within national economic and social development programmes.
- Developing awareness of the ability of coastal ecosystems to sustain more than one economic activity.
- Developing awareness of the common dependence of different groups of people on the availability of goods and services generated by coastal systems and their conservation.

II Cooperation

- Promoting cooperation among different sectoral agencies, the private sector and community groups, to achieve common objectives.

III Coordination

- Developing coordinated policies, investment strategies, administrative arrangements and harmonized standards by which performance can be measured.

IV Integration

- Implementing and monitoring policies, investment strategies, administrative arrangements and harmonized standards as part of a unified programme, and making adjustments where necessary to ensure stated objective are being met.

ICM can operate at all levels of governance. It is not always necessary to wait until national guidelines are in place before attempting to use the ICM principles. Key elements of good practice in ICM, which apply to all coastal management situation, include the following:

- The adoption of a systematic, incremental approach to developing and implementing ICM projects and programmes.
- The involvement of local communities in the ICM process.
- The establishment of mechanisms for integration and coordination.
- The establishment of a sustainable financing mechanism.
- The development of ICM capacity at all levels.
- The monitoring of the effectiveness of ICM projects and programmes.
- Integrating environmental, economic and social information from the very beginning of the ICM process.

What lessons are to be learned from the exploitation of coastal habitats in South Asia thus for and what elements of good coastal management practice need to be reinforced in the region? These aspects can best be assessed and understood by summarizing the problems, causes of the problems, and actions that should be taken in the following situations/cases.

Case history 1: The extraction of coral and sand resources in the region

PROBLEMS:

- Removal of large quantities of dead and living coral reef for construction purposes, exotic coloring for making jewellery and other decorative objects leading to reduced coral cover and long-term damage to the reef. Because of changed conditions at mined sites coral fail to re-establish themselves. Thus the reef habitat is degraded with consequent loss of associated fish, and sea defense potential of the living reef.

- Considerable quantities of sand have also been removed from marine habitats where sediment budgets are unknown. So the dynamic equilibrium of coastal system can be disturbed. Problems of land erosion have been reported as resulting from such extractive processes.

CAUSES:

- A failure, until recently, to encourage the use of and improve the quality of alternative building materials.
- An increasing demand for construction materials as a result of increased population pressures and tourism.

ACTIONS:

- To develop alternatives and improve building materials and encourage their use through education of local residents and those in the construction trade.
- To provide more detailed estimates of sediment budgets on coastlines earmarked for sand extraction, before sand is removed.
- To encourage collaborative, participatory projects between coastal communities and government departments whereby participants actually regulate resource extraction themselves.

Case history 2: The conversion of mangrove areas to shrimp farms

PROBLEMS:

- There has been significant loss of mangrove habitat in countries in the region as a result of conversion of mangrove areas to intensive shrimp farming. Consequently there is reduction in biodiversity, nursery and refuge areas for fish and shellfish of economic importance, sea defense potential and a whole range of other goods and services.
- Because of poor aquaculture practice in shrimp farms, problems of disease and environmental pollution have led to low yields, chemical alteration of pond characteristics and ultimately abandonment of ponds.
- Without supply of nursery fry there are major demands on wild fry, which can lead to high mortality of other shrimp and fish larvae during their capture.

CAUSES:

- The high financial gain from exploiting shrimp worldwide and high demands for the product.
- Inappropriate sitting and inadequate management of shrimp ponds.

ACTIONS:

- Appropriate evaluation of sites selected for shrimp culture including a chemical, assessment of soil type prior to establishment of ponds, realistic economic evaluation of mangrove areas and cost-benefit analyses of conversion.
- Improved environmental management of ponds through better education of site managers and workers.
- Rehabilitation of damaged areas through remediation of abandoned ponds and restocking of mangroves.

Case history 3: Effects of environmental pollution in the coastal zone

PROBLEMS:

- Sewage from domestic urban areas and tourism facilities and the absence and/or inadequate collection and treatment of sewage.
- Industrial pollution from urban areas and run off from agricultural lands.
- Tanker and ship bilge discharges in coastal waters.
- Dredging activities in inshore waters.

CAUSES:

- Increased urbanization by rural people of coastal areas and in some cases informal settlements that compound environmental pollution associated with discharge of water and disposal of garbage.
- Inappropriate siting and construction of outfalls and poor treatment of existing discharges.
- Intensification of world tanker traffic in the region.

ACTIONS:

- Invest in low cost sewage collection and treatment facilities for local communities.
- Enforce regulations land standards of tourism development in terms of waste water discharges.
- Demand EIA procedures are followed prior to the modification of the site. If possible a general environmental assessment, which should be seen as a pro-active process, should precede EIA. The former would enable environmental information to be incorporated into the planning process before development of a coastline is even contemplated.
- Develop oil spill contingency plans based on oil spill trajectory predications and sensitivity mapping of sensitive areas.
- Create a response network and training for clean-up operations.
- Ratify existing conventions and other instrument, which provide protection and assistance when marine pollution occurs.

Case study 4: Reef-related fisheries in South Asia

PROBLEMS:

- Over fishing is taking place in the coastal zone of many countries.
- The MSY of certain aquarium fish, groupers has already been exceeded and beche de mer and giant clam have also been over exploited.

CAUSES:

- Lack of enforcement of regulations and legislation.
- The high market prices paid for products such as beche de mer, giant clam and grouper.
- The high numbers of rural poor, which depend on fisheries as a last resort.
- Inadequate education to assist fishers in the use of more sustainable fishing methods.

ACTIONS:

- Development of fishery management plans within the framework of ICM.
- Analysis of standing stock, catch data and socio economic issues.
- Development and implementation of regulation of fishing activities.
- Promote suitable mariculture and aquaculture.
- Protective zoning of critical ecosystems such as mangroves and coral reefs.
- Increase returns from fisheries by minimizing post harvest losses and improving storage and processing.
- Involvement/education of fishers, and local communities.

Case history 5: Coastal tourism

PROBLEMS:

- Deterioration in coastal water quality and coastal erosion.
- Degradation and loss of habitats such as mangroves and coral reefs.
- Increasing traffic noise and congestion.
- Social conflicts between tourists and local communities.

CAUSES:

- Rapid increase in the number of tourists in the region, exceeding the 'carrying capacity' of some sites.
- Ill-conceived development of resorts in the coastal zone and lack of appropriate management strategies in controlling tourism development.

ACTIONS:

- Environmental education of tourists, tour promoters, resort owners and dive guides.
- Implementation of codes of practice for environmentally sensitive tourism development enforcing set back, landscaping, adequate water supply and waste disposal, and good diving practices.
- The enforcement of regulations of building construction and environmental protection.

Case history 6: River basin management and the coastal zone

PROBLEMS:

- Increased or reduced siltation of rivers, reduced river flow, salinisation of ground waters.
- Deterioration in the status of coastal ecosystems, particularly mangroves and coral reefs.
- Consequent loss of livelihoods and habitation of coastal communities.
- Increased susceptibility of coastal communities to the effects of natural and man made perturbations e.g. cyclones and sea-level rise.

CAUSES:

- Increased population pressures and the need to establish habitation in marginal areas.
- Increased abstraction of water upstream; the creation of dams and flood embankments.
- The lack of freshwater flow and nutrient supply to mangrove ecosystems.
- A potential increase in silt load to ecosystems such as coral reefs.

ACTIONS:

- The integration of river management plans into a broader management programme which includes the coastal zone, where appropriate.
- Support for international agreements, which promote management of river basins.
- The greater coordination of agencies dealing with management of river basins and the design and implementation of management policies that deal with activities from source to sink in the river basin.
- An improvement in the understanding of river sediment budgets as they might affect coastal dynamics.

15.7.2 Common Weaknesses

Above case histories indicate that the marine habitats of South Asia are subject to a wide range of uses by man, with resource exploitation a major concern for every country in the region. In some instances the lack of sustainable extraction is all too evident, e.g. coral mining; intensive shrimp farming; beche de mer, grouper, and giant clam fisheries. Despite the very varied nature of case histories described there are five common weaknesses evident in almost every example. They are:

1. A lack of enforcement of existing legislation.
2. A need to involve greater community participation in management of resources.

3. A lack of relevant scientific information needed to underpin sustainable management, and a requirement to improve dissemination of what is already known throughout the region.
4. A complex array of institutional agencies involved in the management of a single resource with often an inadequate coordination of environmental policy by the nominated lead agency.
5. Few truly integrated coastal management programmes, apart from one or two exceptions in the region.

It is worthwhile considering briefly each of above weaknesses in turn.

- **Enforcement of existing legislation**

  Enforcement of existing legislation is often a universal problem in many management programmes. Countries in South Asia have been among the first to recognize such weaknesses and have adopted practices, which encourage compliance with bans and licensing schemes. Their experiences show that too much reliance on regulatory measures can lead to hostility and a breakdown of relations between the enforcing body and local community. In Sri Lanka, a failure to regulate coral and sand mining in the 1980's by bans and licenses led to an alternative approach being adopted by the Coast Conservation Department. This involved public education of adults and schoolchildren of the importance of sustainable management of marine resources, and also community based collaboration in management of resource extraction.

  More effective management of mining activities followed, proving that penalties and incentives used together can provide valuable tools in achieving compliance of enforcement. Incentives might include economic benefits (tax incentives, tradable permits, user charges) capital investments (construction of public works, acquisition of land rights) education and training programmes and participation in policy and decision making processes. It is quite clear that such an approach works very well where the geographical area of jurisdiction is small and where the goals of the policy are well understood and accepted to be fair, both by public officials and coastal residents.

  However, even considering the vast geographical extent of islands in the Maldives there is scope for greater effectiveness of public education and community management. Such a programme could be effected through the Ministry of Atolls Administration, and the network of respected chiefs in each atoll, with the same positive consequences as those achieved in Sri Lanka. Land based projects in India, such as the social forestry programmes in West Bengal and other States, have also proved to be successful in both rejuvenating and raising new forests through community participation. Encroachment and felling are minimized as local communities experience the economic benefits of locally managed forest resources in cooperation with the Ministry of Environment and Forests.

- **Community participation**

  It is clear that public participation in management programmes is fundamental to their successful implementation. Perhaps the single greatest weakness in all the case histories cited above has been the failure to involve local people in resource management decisions, whether it be alternative coral mining strategies in the Maldives, conversion of mangroves to intensive shrimp farms, EIA procedures, fishing bans, improved fish processing, tourism conflicts, and flood action plans in Bangladesh. Underlying such involvement is the need for meetings to educate and explain relevant issues and ultimately the election of respected individual to advisory committees that truly represent community views.

One of the central concerns of ICM is to integrate participatory mechanisms into decision-making processes and into the planning, implementation and evaluation of ICM programmes. Stakeholder participation is a process whereby stakeholders those with rights (and therefore responsibilities) and/or interest play an active role in decision-making and in the consequent activities which affect them. A participatory approach to management increases the probability that the rights and interests of stakeholders are fairly reflected, thereby encouraging ownership, and improving the likelihood that local stakeholders will cooperate in any proposed management scheme.

Participatory processes may operate at all levels with government departments in which regulation of resources may be devolved to the local community and where management policies may be derived from community involvement, to collaborative research projects between government scientists and local fishers/farmers. A model for the former is described in the following integrated management case history while a model for the latter has been developed in East India and Bangladesh. These projects concerned the integration of aquaculture into agricultural practices and involved the selection, testing and development of innovations relevant to local need and conditions. Research scientists worked in collaboration with local farmers and farm based trials were integrated with on site research. Such models could be very easily transferred to the coastal zone, particularly in the case of mariculture of beche de mer, and giant clam, where participatory projects between scientists and local communities may reverse the non-sustainable extraction of these species. Similar collaboration, between scientists involved in marine algae culture and local fishers, could also yield benefits. Such initiatives should develop closer partnerships between those living in the coastal zone and those (locally and remotely) directing their efforts towards support of sustainable management through research. In this way strategic research becomes focused on relevant problems.

- **Applied science underpinning management**

  A lack of scientific knowledge of coastal ecosystems and their linkages (as they affect management decisions) is a common problem worldwide and its mention might be seen, by some, as an excuse for failing to take action when conflicts of interest become difficult to resolve. In the case of South Asia, where the marine habitats are both extensive and remote, it is not surprising that many areas have not been studied. Indeed there was greater scientific interest in the distant habitats (Chagos, Maldives, Laccadives, Andamans and Nicobars) in the late nineteenth century than ever since. Thus there remains, with the limited trained manpower available, considerable ignorance of both the extent and status of marine resources in the region. The inadequate scientific database is a significant limitation, both in identification of priority issues and strategies to cope with them. Much of the science practiced in the region continues to be descriptive and there is a need to identify applied problems, which can be tackled by interdisciplinary team of scientists, engineers, economists and social scientists.

  Whatever expert advice is given by the scientists it should be both objective and balanced to suit both regional and local needs; it cannot be given in isolation. Management strategies which are adaptive and in which science is a significant part of the planning, evaluation and modification of the programme, offer a valuable forum for interdisciplinary interaction and are likely to yield more effective environmental policy as a result.

- **Institutional problems**

  Specific institutional obstacles to ICM include sectoral bias toward planning and management of human activities, fear on the part of agencies of losing control over resources and revenues they may generate, lack of clear mandates for a role

that different agencies should play in coastal management, lack of policy direction to foster interagency cooperation and coordination, lack of funding to implement ICM, failure to integrate scientific information into policies and plans and a focus on short term financial returns.

A valuable lesson that has been learned is that total reliance on sectorally based management can lead to competition for the allocation and exclusive use of areas and resource. Many coastal systems are capable of directly and indirectly supporting the developing of different sectoral activities and integrated approaches to the management of coastal areas can reduce adverse economic, environmental and social impacts from development. Experience has shown that agencies can be encouraged to cooperate with one another in resolving common problems and working towards a consensus on how to improve the allocation and use of coastal resources. Already in certain coastal management issues in South Asia e.g. coral and sand mining in Maldives and Sri Lanka, tourism in Maldives and Sri Lanka lead agencies have been appointed. The number of agencies involved in these issues is still considerable and coordination between all involved could be improved.

Integrated Coastal Management in South Asia: The Case of Muthurajawela Marsh and Negombo Lagoon

Every country in the region can boast of isolated examples of good management practice but the case histories described illustrate that these practice are rarely fully integrated in the true sense. One exception is a major initiative in Sri Lanka, which was undertaken in 1989 as an integrated coastal development for an estuarine system (Muthurajawela Marsh and Negombo Lagoon) on the western coast of the island, north of Colombo. This project involved several Sri Lankan Government agencies with outside assistance from the Netherlands Government.

The estuarine ecosystem is situated in a heavily populated urban location; it provides livelihood to about 3000 fisher families, and serves other multiple uses with a high annual economic value (Table 15.2). About 80% of families, who are dependent on fisheries, have a monthly income of less than US$ 15. Pressure on the fishery resources is high, and destructive fishing methods are used. Unplanned landfill, mangrove encroachment and the sitting of illegal housing all impose additional pressures on the environment.

Table 15.2: Estimated annual economic value of multiple uses of the estuarine ecosystem

Direct Use	**Value (US$ million)**
Lagoon fishery	3.0
Coastal shrimp fishery	0.5
Coastal small pelagic fishery	1.5
Discharge outlet and sink value for 45 industries in Ekala Industrial Zone	6.0
Discharge outlet and sink value for local domestic and muncipal waste	3.0
Recreational value for tourists	0.1
Amenity value	2.0
Anchorage for marine fishing craft	6.0
Land for housing in Muthurajawela Marsh	0.3
Intertidal sand shoals as land for housing	1.1
Total	**23.5**

The coastal wetland is 6,232 ha in extent and consists of a lagoon (3164 ha), which is connected to the sea by a single narrow opening in vicinity of Negombo town. The marsh (3068 ha) extends southward from the lagoon. The main inflowing river drains a catchments of 727 km^2 and discharges at the junction of the lagoon and marsh. The entire wetland is separated from the sea by a sand barrier on beach rock formed during past sea level changes. Some of the major management issues in the area include:

- Changing land use patterns affecting watershed vegetation, run-off rates, hydrology and use of agrochemicals.
- Land-use control by local government officials who have little understanding of the environmental linkages between elements of the wetland complex.
- Rapid population growth with an expected land need for new housing to exceed 4,000 ha in the next 10 years.
- Illegal encroachment of poor families onto the marsh areas.
- A potential labour force projected to be 50,000 by 2001 while the number supported by fisheries will decrease.

The first step taken was to develop a Master Plan for the estuarine area based on four characteristics of the ecosystem, namely;

a. linkages,
b. structural complexity,
c. resilience and,
d. dynamic stability.

First an ecological and mapping survey was conducted, together with an evaluation of the socio-economic status (occupation, land tenure and use and other perceived problems) of the community and an evaluation of potential investors/projects for the area. On the basis of this information a zoning plan was drawn up which addressed the issues of development, ecology and equity. Four zones were recommended and a range of scenarios (in terms of size of zones) was proposed. A series of open meetings were then held to negotiate allocation of land areas to different uses. As a result of this open negotiation, land apportionment was as follows: a conservation zone (91% of the continuous wetland), a buffer zone (6.4% of the continuous wetland) a mixed urban zone (2.5% of the continuous wetland), and a residential zone (41.7% of the total planning area).

The Master Plan was approved by the Cabinet of Ministers in 1991 for implementation, and a multi agency steering committee without legal power was convened for supervision and monitoring of implementation. This committee included both community and non-governmental representation. The plan was prepared in such a way that separate components could be implemented independently by each responsible agency, but with co ordination by the steering committee. Over the period 1991-94 five major activities were planned. They were:

1. Developing a relocation and community development package for encroacher communities living on Muthuragawela Marsh.

A package for 200 households, in the first instance, was prepared in consultation with target families. These families were relocated to a site where they were given legal ownership of land, financial assistance for house construction and improved amenities. Responsibility for the relocation was given to a local respected Non-Governmental Organization (NGO). The initial relocation proceeded successfully and was to serve as the template for all remaining encroacher communities. However there was a change in the presidency of Sri Lanka in 1993, consequently the contrasting needs of local communities were accommodated in the Conservation Management Plan.

2. Preparation of an EIA for sand filling the area designated as a mixed urban Zone, followed by a land use plan and marketing plan for the new land.

An EIA report for a 4 million m^3 sand fill was made available for public enquiry and subsequently approved by the Central Environmental Authority. The sand fill has been completed, drainage installed and an arterial road constructed. Land use and marketing plans for the Mixed Urban Zone were prepared with a major focus on employment generation.

3. Preparation of a detailed conservation management plan for the conservation zone.

This area comprised a multiple use area that included a segment of the marsh and the lagoon. The marsh provided housing and served as a flood buffer while acting as a habitat for range of plants and animals while the lagoon provided a livelihood for fishers. A major problem foreseen for this zone was the integration of community groups (fishers from 26 villages) into the planning process. In order to do these, workshops were held on environmental education and the need for sustainable exploitation of resources. Data obtained in the earlier scientific surveys were used in the management plan, which emphasized the important ecological linkages between watershed - marsh - lagoon and sea. Ultimately community representative agreed that lagoon productivity had to be safeguarded. The resulting conservation management plan included four basic tenets:

- that sustainable use of the lagoon resources was a basic condition.
- that community involvement in management was essential.
- that measures for pollution control should be instigated.
- that alternative job opportunities be created which included development of environmentally sound recreation and eco tourism.

4. Preparation of a land use plan and screening of investment proposals for the buffer zone.

Planning for the buffer Zone was not straightforward with a range of different ideas on potential land use and control. Views ranged from those of developers who suggested total control by the private sector to protect their investment, to those of local communities who wanted right which would not be influenced by politically powerful groups or individuals. A draft land use plan, incorporating the viewpoints of all sides, has now been produced which aims at recreational use by both private and public sectors.

5. Development of a cost recovery system for conservation management.

The Central environmental authority identified a visitor centre that would provide information and excursion to national and international tourists, nature education for children and a place for studies and community activities as a viable mechanism to earn money to pay for conservation management activities. The visitor centre has been highly successful, attracting over 1000 visitors per month, well above anticipated usage. It currently employs 25 staff who are engaged as guides, rangers, and in general maintenance duties.

This case history highlights the importance of community participation management process. Since the beginning of the project, the fishing communities have become increasingly active in planning the protection of lagoon resources. The lagoon fisher folk have organized themselves into the Negombo Lagoon Integrated Fishermen Organization (NLIFO) and have met and presented the Minister of fisheries with a draft Conservation Management Plan. Community participation is not only providing momentum to plan implementation but it has also been contributing to greater coherence and environmental awareness in the coastal community. NLIFO is currently collaborating with the local administration to address one of the most difficult tasks

for management of the area boundary demarcation of the lagoon to prevent further encroachment. Such collaboration is a particularly good indicator of institutional strengthening, since for decades fisher and the local administration criticized each other, rather than working to prevent further encroachment. In 1997 a boundary was constructed along the most critical area, using the monies raised by the local community organization. The boundary has enabled the CCD (in partnership with government agencies) to begin to take firm action against illegal land filling with community support.

Progress with further management of the area is not without its problems, however, some local NGO's oppose tourism as an alternative livelihood; the Ministry of Fishers plans to develop a major anchorage in the outlet of Negombo Lagoon, while other groups object to the increased power of community participants. Despite these setbacks the present Government has approved the continued implementation of the Master Plan and already there are direct socio economic benefits to be seen from its implementation. These include:

- Sustained income and employment for about 3,000 fishing families in the Negombo Lagoon.
- Improved living conditions and secures land title for 2000 local families, with new job opportunities in eco tourism and resource management in the marsh and conservation areas.
- Housing for 9,500-16,500 new residents and permanent employment in industry, transport, trade and service for 14,000-28,000 workers in the mixed urban zone.
- Permanent employment for about 250 workers at a future golf course and another 300-500 in potential activities associated with a marsh botanic garden, urban park, sports complex and herbal garden.

The weaknesses identified in other case histories described earlier have been avoided here. Scientific information was gathered and fed into the management process at an early stage, thus allowing the plans to evolve around the principles of ecosystem function.

15.8 A FUTURE VISION OF ICM IN SOUTH ASIA

There are considerable skills in the South Asia region, not only in the multiplicity of disciplines needed for ICM but also in negotiation and conciliation with both scientists and policy makers. These skills should be recognized on a regional basis and opportunities provide for greater interaction between scientists, practitioners of ICM and policy makers on a regular basis. The ASEAN Australian Marine Science Project on living Coastal Resources (part of the ASEAN-Australian Economic Cooperation program), which operated over the period 1984-1994 in neighbouring South East Asian countries, is a good example of how regular meetings, technical workshops, symposia and newsletters, fostered valuable interdisciplinary exchange and cross fertilization of ideas on the status and management of key coastal ecosystems.

An extension of this model will be developed in the Global Coral Reef Monitoring Network (GCRMN) for South Asia, which is shortly to be initiated from the IUCN office in Sri Lanka (funded by the Department for International Development, UK). The aim of this initiative is not only to support environmental assessment of coral reef ecosystems but also to link such assessments with the solution of key managerial issues as they affect coral reefs in the region. Ultimately it is the aim of the international Coral Reef Initiative (of which GCRMN is a part) that other ecosystems, such as mangroves and seagrasses, are considered in a similar way to coral reefs and that a network of expertise is built up in the region.

The South Asia Cooperative Environment programme (SACEP) has a central role to play in regional coordination of integrated coastal zone management which you have

already read in Block 2 of this course. Such a role was recognized in 1994 when the Economic and Social Commission for Asia and the Pacific (ESCAP)/UNEP/SACEP Intergovernmental Meeting in New Delhi endorsed integrated coastal zone management as a priority element for sustainable development of marine and coastal areas in the region. The Action Plan proceeding from that meeting highlighted the need for regional cooperation and proposed that pilot activities in ICM should be initiated in individual countries. The guidelines for the development of pilot projects were very ambitious, involving preparation of coastal profiles, analysis and forecasting, definition of goals and strategies and implementation of management plans. In the early stages of development of ICM capabilities it is perhaps wise to begin with existing small-scale projects, to learn from the lessons that they provide and to expand from a solid foundation, which recognizes the centers of expertise within the South Asia Region.

The challenges in ICM for South Asia, like any other region in the world, are considerable. However, unlike other parts of the world, ICM is recognized by all those countries bordering the Indian ocean as a high priority; project are already underway which demonstrate successful integrated management that relies on community participation and programmes have been initiated which will begin to coordinate regional expertise. The future success of ICM in the region rests not in elaborate, over ambitious plans but in solid achievements at the local level using the many and increasing skills of personnel in the region.

SAQ 2

i) Describe the major steps in good coastal management practice.
ii) What measures do you suggest for prevention of environmental pollution in coastal zones of India?
iii) List the common weaknesses which you have studied in cases histories of this unit.
iv) Describe how community participation can help in ICM process.

15.9 SUMMARY

Let us summarize what we have studied so far:

- Water is essential for life of human being and other organisms. Although water exists in substantial quantities on earth, however, human activities are continuously affecting this resource both quantitatively and qualitatively. Effective use of water and associated resources is essential.
- Coastal resources are one of the important resources of water and continuously affected by human activities at coasts. An integrated coastal management programme involves integration of government and community, science and management and policy and legislative framework.
- The essential elements of integrated coastal management are **integration** and **co-ordination**. Any policy and management action which has been designed to address coastal development conflicts must be founded on a sound understanding of natural processes and ways in which these may be disturbed; on political, socio cultural and economic conditions; on present and future demands, as well as social costs involved.
- The challenges in ICM for South Asia, like any other region in the world, are considerable. However, unlike other parts of the world, ICM is recognized by all those countries bordering the Indian ocean as a high priority; project are already underway which demonstrate successful integrated management that relies on community participation and programmes have been initiated which will begin to coordinate regional expertise. The future success of ICM in the region rests not in elaborate, over ambitious plans but in solid achievements at the local level using the increasing skills of personnel in the region.

15.10 TERMINAL QUESTIONS

1. Define coastal zone and make a map to show the coastal lines of India. Describe the characteristic of coastal zone.
2. Do you agree with the coastal area management system given by Chua 1993. What are the merits and demerits of this system?
3. Describe the Management Issues of Coastal Zones with examples from India. Also suggest some actions apart from those described in the unit.
4. Which of the case history are related to the India Coastal areas and why.
5. Make a list of questions you would like to ask for making a plan for ICM of mangrove conservation in India.
6. What is your Future vision of ICM in India?
7. Do you think that Participatory Coastal Resource Management can sustain the growth and developments of Coastal zone if yes/no give reasons?

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APPENDIX

S.O.16(E), [4/1/2002] - Gujarat State Coastal Zone Management Authority [html], [pdf], and [word].

S.O.17(E), [4/1/2002] - Daman and Diu Coastal Zone Management Authority [html], [pdf], and [word].