

## *Theme 3 : Coastal Zone Management*

# Research and Development for Coastal Zone

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In order to evaluate the impact of developmental activities and mega cities on the coastal zone, it is essential that we have a sound quantitative understanding of the oceanographic processes within the seas around India - for the judicious and sustainable exploitation of its resources and for evaluating future changes as a result of human interference. In other words we must understand well the science of the coastal zone to enable us to use it in a manner that keeps the environmental damage to a minimum. This in brief should be the objective of R&D work in the coastal zone. In order to achieve this objective we shall have to answer a number of questions.

To begin with we must know how the system of coastal currents operates and what its links with the large-scale circulation are. This is necessary because the coastal zone receives most of the materials including pollutants from the land and their dispersal in the marine environment is mainly determined by physical processes.

Similarly we should have an understanding as to how the suspended matter is mobilised in the coastal zone. This is important in the context of coastal erosion that occurs when the balance between the sediment supply and removal is altered. Many coastal inlets are subjected to dredging. Where will the dredged material go



and what will be the effect of structures such as seawalls of dams on the stability of shoreline? These are some of the important questions that must be answered.

It is also very important to understand how carbon and other biogenic elements such as nitrogen, phosphorus and sulphur are processed within the coastal zone both within the water column and sediments. These elements are transported from the land to the coastal seas by air and rivers. There are of course some natural fluxes of these elements, but these fluxes are being modified greatly due to human activities. The coastal zone in the vicinity of large population and industrial centres receives enormous amounts of sewage and other effluents. Similarly, as a result of extensive use of detergents and fertilisers on land, the rate at which nutrients such as nitrogen and phosphorus are added to the sea has at least doubled. Therefore, we must have a comprehensive understanding of the way these elements are processed for assessing the impact of human interference.

Two other related questions are: How does the coastal zone exchange matter with the open ocean and what is the role of coastal zone in regulating chemical composition of the atmosphere? The purpose is to make inventories of various input and output terms in order to determine what comes in and what is exported out, and how this balance is being altered anthropogenically. In short, what we want to know is how the natural biogeochemical cycles (sea level rise, modified fluxes of dissolved and suspended materials, etc.) are affected by human activities.

The biota plays a dominant role in the biogeochemical cycles, and the coastal ecosystems are among the most diverse and most sensitive. Efforts are currently underway to understand the role of coastal ecosystems in determining coastal morphodynamics and to see how they respond to global change. For this we must have detailed information as to the present status of mangrove and coral reef ecosystems and should be able to suggest measures for their conservation.

There are two other important questions related to the rapidly growing need to utilise coastal waters for food and other purposes: How can the

marine food production be increased to its full potential through mariculture with minimal damage to the environment and how can we contribute to the development along coastal zone (harbours, single point moorings, submarine pipelines, diffusers for industrial effluent etc.) through improved engineering designs?

Finally, it is often said that the past holds the key to the future, the key is quite rusty though. So the question is: Can we really predict future trends by looking at the records of paleo-environmental changes preserved in coastal sediments?

Now the strategy that we can adopt for answering these questions is as follows: We must have a sound research programme that should preferably form a part of ongoing international efforts under projects such as LOICZ and GOOS. It should be emphasised that an international co-operation in coastal zone research is essential for the simple reason that the oceanographic processes do not recognise (and are not confined to) national boundaries. Two important components of the research plan are observations and modelling. The observations should be both short term to be undertaken through area surveys using research vessels as well as long term through remote sensing with the aid of satellites and data buoys. They should cover a broad spectrum of physical, biological, chemical and geological parameters. The data so collected must then be processed and integrated through models.

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The models will essentially be of three kinds. The Budget models are the simplest that must provide reasonable estimates of various input and sink terms. The Process models will describe specific processes such as hydrodynamic or circulation models, ecosystem models and bio-



geochemical models. Eventually by coupling the process models we should be able to construct complex system models that lie at the pinnacle of the modelling activity. These models must have a predictive capability. That is we must be able to use them to predict future changes that may be caused by anthropogenic perturbations.

This information must then be effectively disseminated to enable the planners to use it for an optimal utilisation of the coastal zone resources. It is obvious that there must be an active and continuous interaction between the R&D personnel, eventual users and planners so that the models are verified and upgraded.

Long-term monitoring of the environment is another important requirement for which

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we have to develop adequately trained and sufficient manpower. And so the human resource development should be given a high priority.

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