

# ECOLOGICAL AND ENVIRONMENTAL CONSTRAINTS

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Earlier in the morning most of us were here when Dr. Desa introduced the vision of the coastal zone. I'll start with that now. Coastal zones occupy no more than 10% of the ocean areas and less than a percent of its volume, yet the role they play in ocean productivity and our lives is tremendous. They account for more than one fourth of the total production in the oceans and sustain a diversity of ecosystems. All ecosystems that we know of from the tropical or the temperate waters, are at the boundary of or in the coastal zone. And they account for the highest percentage of fish catch, probably because most effort is concentrated within the coastal waters. Other marine products like salt and chemicals also come from the coastal zone. The coastal waters are also a repository of natural products like sediments that are brought from fresh water rivers and man-made pollutants. Except for the atmospheric airborne pollutants, most others are terrestrial or river-borne and they eventually end up in coastal waters. Having recognized the importance of coastal zones, and the need to use them sustainably, let us now look at the constraints in our efforts to get them to be the way we want them in the long run.

We can classify the constraints as ecological and environmental. When we say environmental, it is the physical and chemical attributes of the habitat where the organisms live and when we say ecological, it is the way they interact with the habitat. There are a few ecological constraints, and I will cover some examples. There is the question of decreasing fish production. When we talk about it we only see one side and don't see what the other mechanisms

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are that control it. Look at the coastal waters; it's not only the fishes that are produced there but also a million other organisms which sustain the fish production. So when we say that fish production decreases, it is not only the fish that is lost but a number of other organisms as well, and the whole food chain stands affected. The point is that, we will have to look at the constraints holistically and not only that part which is visible, apparent and gets glamorous publicity. You then come to the question of biodiversity. When you look at the coastal waters, they have the highest biodiversity thanks to the diversity of the ecosystems. A large number of marine animals and plants are found only in coastal waters and if one of them is removed, then the chain reaction is tremendous, because each component interacts with the other one and forms a network. As a result, the removal of one is going to affect the sustainability, the productivity as well as the sustainable utilization of the coastal resources. The same argument holds good for a bio-medical potential.

The conventional wisdom is that when you have resources, you use them. However, when we say use them, it means use them for common benefit, both for immediate and for long term economic gains. Biotechnological potential doesn't include only those organisms that have medicinal properties but also those with genes that can be used for industrial purposes and other processes. The coastal zones don't act as one unit, they always interact with other ecosystems. Look at coastal fisheries as an example. Most of the prawn catch in the coastal waters is not dependent on the productivity per se of the coastal waters but is dependent on the productivity of the mangroves which adjoin the coastal waters, because the mangroves serve as feeding grounds and as nurseries for the larvae. A major part of the diet of shrimps in their early life is detritus and the only place where they can get enough of that, is the mangrove. They go there, they grow there, and come back to the coastal waters for breeding. So if you remove the mangroves

remove the means of their feeding and you remove coastal shrimp fisheries. In fact, there has been ample evidence in literature and in documents to show that the extent of mangroves removal has decreased proportionally the magnitude of the shrimp catch.

Habitat alteration is also a constraint in the biological sense. When you change the habitat to suit other needs, you remove the organisms which depend on this habitat. Even though the coastal waters are highly cosmopolitan with a lot of organisms that can withstand a range of abnormal conditions like the changes from fresh water to sea water or temperature fluctuations from less than 15 degrees in winter to more than 30 degrees in summer, still most of them are tuned to a certain range of conditions in the habitat. When we take our resource out of the ecosystem, very often we end up taking out the things that we don't want and quite often we also discard them. For example, when you go for trawling you find a lot of other organisms also in the net, but you retain the good fish and throw the others out, which are by then dead. Though the latter may be an unwanted product for you, it is still a wasteful exercise, because all these organisms together maintain the energy flow and keep the fisheries of the ecosystem intact. Remove one set of organisms, and you are going to affect the whole ecosystem's functioning.

It is not only taking out of a species that would affect the ecosystem but also putting a new species there. Alien species cause lot of damage and one of the serious constraints under this class which we never thought of, and which we are going to face in future, is the impact of genetically modified organisms or the GMOs. Faced with the shortage of food resources, the thrust at present is to go for aquaculture to supplement the fish yield from coastal waters. When you talk of aquaculture, it is no more simply captive breeding it's not that you catch a fish, put it in a pond, let it grow and take it out and sell. The thrust is to modify them in some

other way, every way possible genetically, so that the yield is higher. It is perfectly all right as long as you keep the modified organisms within the constraints of a pond. The moment you release them into the wild, either intentionally or unintentionally they are going to interact with other components. Some of them can be beneficial but quite a lot of them can be catastrophic. This is one aspect which many people have not thought of.

Several other environmental conditions are also changing in nature. I'll make just one point. When you talk of sewage pollution, you generally talk of urban sewage, but it is the kitchen waste and the food waste which has become more important than sewage pollutants. Look at the number of products sold in the shops in plastic packages and tin cans. In quantity they practically outnumber the quantity of sewage pollution generated. Erosion is also a serious environmental constraint now, because, when structures come on the water front, they alter longshore currents, they alter the transport of sediments on the shore. It is a fact that when sediments are prevented from moving, they get accumulated at one point and the other place where they would normally have moved to, gets eroded. There are also other forms of habitat alterations. A physical one is reclamation; you use areas for purposes other than what they are normally meant for, like conversion of mangroves for aquaculture and chemical alterations come mainly as pollutants in the ecosystem. Another threat to the sustainability of the coastal environment is the sea level rise. Actually sea level rise is not only a question of loss of coastal zones, also has an impact much inland because the sea water intrudes into the ground water aquifers and renders potable water saline and makes fertile areas barren. Another problem is equitable resource sharing. The common human tendency is that if you want more, you take it and don't worry about what is going to be left for tomorrow!

I need not explain at length all these to the audience, but what

What we do in NIO is that when we are asked for advice about the development of any ecosystem, including the coastal zone, we worry about all these points together and try to have a holistic approach. We have definitions of carrying capacity. We look from the Research and Development point of view and the science plan we have. Carrying capacity is the ability of the ecosystem to cater to a vast range of uses, both extractive and invasive. Extractive use is the situation where you take resources out from the sea and use it elsewhere. In invasive use, you don't take anything out but still you affect the environment. Tourism and the dumping of wastes are two good examples of invasive uses. Carrying capacity has two components, one is supportive that gives resources for the benefit of mankind, the other is assimilative, and takes the wastes back and assimilates them. When we exceed both the levels, we damage the ecosystem. If the ecosystem has to cater to all these needs and yet should not wind down in the long term, then we must succeed in keeping it as much biologically productive and as much ecologically stable as it was. We must also maintain the species balance i.e. it should not be a monopoly of one or two species but the range of species have to remain in balance.

What we normally do is based on experience with industrial projects along the coast, interaction with the different agencies in coastal zone management, and outcome of international conventions like that of the biodiversity convention after the Rio summit. We look at these in a holistic way and concentrate on three steps when we go for management. The first one is the resources that the ecosystem can offer us, be they food fish or aquarium fish. In case, they are from a coral reef, other resources like marine algae minerals, biodiversity and biomedical potentials, aesthetics of the environment etc. are also considered. Tourism is a resource though it can also be a threat. Other resource forms like energy are considered because most of the threats come basically from a haphazard use of energy or pollution problems associated

with the generation of energy. So we think of plans where fossil fuel or other types of energy generation can be replaced by natural processes by using wave, wind, tidal or solar energies.

Having done that, we look at the next point, the threats. What type of threats do we face in trying to make the activities sustainable? We have several of them, like the very common problems of over utilization where most of the activities are concentrated in the coastal zone, selective utilization where we always go for high value products and discard the remaining, and the destructive methods. Most of the methods we use for extraction are not eco-friendly like the trawlers which do not have turtle exclusion devices etc. In most instances, we also lack scientific data and then naturally, pollution is a problem. Other threats are physical ones such as shipwrecks, dredging, altering the physical and chemical aspects of the environment and construction activities. Tourism is another type of threat, in the sense that apart from activities for construction for tourism there are also activities of the tourists themselves like the way they handle the environment, the way they interact with the environment, and the way the wastes are discarded.

What we do next is draw guidelines or suggestions as to how you can manage them and what elements should go into the management. You have to think of measures to help the ecosystem maintain its biological productivity, one of the critical factors that helps an ecosystem to run forever. Naturally the sustenance of biodiversity goes along with that. Then you look at the harmful practices - when you take a resource, there are those practices which are beneficial, economical, and non-destructive for the habitat and also comfortable in terms of yield that the ecosystem can sustain. In fishery biology, we have a concept called maximum sustainability, which means there is a limit to which you can fish, and if you exceed that, you get more fish but then it starts dwindling

the following years. So you tend to draw attention to how much can be taken out, and when and how. Children are told that you do not eat fish in the monsoon because that's the time they produce babies. The same goes here: when you have a species and when you know that it is its breeding period, then its fishing should be closed.

When we look at the diversity of harvested resources, one cannot fail to recognize that some of the problems of the coastal zones come with the dependence of the local population on the resources. Very often these areas are occupied by the local population that uses these resources for a long time because they don't have any other means. If you go to the Gulf of Kutch, the mangroves have been cut by the local population. The reason is simple, they use that as fire wood. Now the government told them, no more cutting of mangroves, they are protected. Fine. Then where is the fellow going to get wood for his fire? Nobody thought about that. They didn't even want to talk about it. They just bluntly said you can't cut. The fellow has no gas or kerosene so he goes illegally at night and cuts. The law remains where you want it - on paper. But that's not the correct thing. If you don't give an alternative you can't stop him from cutting down that resource. It's the same story with corals at Lakshadweep. Now for 30 years there has been a hue and cry that corals are being removed for building purposes but, where else can the locals go for construction materials? To bring construction material from the mainland costs a lot - a bag of gravel or sand may cost about 3 or 4 rupees but they would have to spend double that amount to transport it from Kochi or Mangalore to the island. They can't afford that, so the best thing then is to go for the natural resources next door - mine the coral and build the houses. The Government has been saying that they can't do that, coral mining is banned but they could not stop it because they did not realize that you can't tell the islanders to stop without giving something else to construct a house with. The Government can

construct because it can afford to bring material from the mainland. Now finally it has woke up to the realization that unless it gives material, it can't stop them, so it has constituted a board called Building Material Board which is charged with the responsibility of bringing the things from the mainland and giving them at a nominal cost, at the same price as on the mainland. The point is that, unless we think of these things and provide the population with alternative resources, you can't prevent them from degrading the environment.

The next step is restoration. Some of the habitats like mangroves or even coral reefs have already been damaged and unless we restore them, we can't bring back the balance. They may develop an equilibrium now but we can't restore the original equilibrium unless we resort to restoration.

Regulation of other invasive uses, like tourism, is also of critical importance. Tourism is a thing which will stay for ever - we can't prevent it because man has got a right to go and see places in his life time. Thus the only point is that you can promote it at the risk of damaging the environment. I recall what Dr. Goreau, a coral reef researcher, once said. He showed a slide of a hotel in the Caribbean built for promotion of reef tourism and said that he stayed in that hotel. He also said when his father was alive, and when he was diving, there was a reef below the hotel! The point is, tourism has become such a business that catering to tourists has become the very source of destroying what they have come to see. Nearer home, the endless chain of hotels on the beach for tourists, destroying the serenity and fragile ecology of the beaches, is another good example. And then there is the problem of regulation of tourists activities - the carrying capacity. When you talk about tourism, there is another definition for carrying capacity, that is, the amount of infra-structure we have that can cater to a certain amount of tourists, like accommodation or even the beach areas.



de the area by the number of persons using it and then decide, this area can cater to about thousand tourists but don't exceed the limit. We also suggest that R & D activities have to be evolved along with management plans because the use patterns and implications change during the course of time. The R & D activities have to keep pace with changes that occur, and suggest measures that are needed.

One more point is the zoning plan. The coastal zone can be planned in such a way that each zone caters to one need and one type of user. And if we try, we can protect the zones by rotating them or closing them temporarily from use, so that the impact felt on a particular zone is not chronic. These measures release the ecosystem from pressure and allow it time to revert back to its original state. The process of monitoring the impact of human activities, surveillance to prevent illegal activities, and education and training also naturally form components of the management plan. Another important thing is the flexibility of the management plan itself - we need to have a provision for review of the measures at periodic intervals because, the concepts of management and use patterns are not static but evolve as a function of the changing importance of the system in terms of resources, uses or threats.

Perception of the trend of use pattern is thus an essential part of management. We can't have a fixed idea that for the next 20 years or 30 years, the policy will be like this or like that. Even two decades back, there was neither any pressure on the resources nor was there any consciousness about the environment. Now it is not a question of only economy but that of socio-economy. Can the social fabric withstand the impact? Do the gains go to the rightful "owners" of the ecosystem? Do the rights of dependant populations get violated and so on. Here is where NGOs can play a role since they are not constrained by lobby groups. Crisis management plans are also important. However carefully we plan a management action plan,

there will be events that we would have not foreseen, and that are catastrophic in nature. The crisis management has to, in a sense, foresee the unknown and be prepared to tackle it. One more point that I wish to mention here is over-capitalization. There is a serious concern now in most parts of the world that when you have a resource you tend to over-capitalize. You put all your energy and efforts and money in that and you find that after one or two years it collapses, you don't know what to do with the money you spent, or the facility created and you are left with something which you cannot even dispose of, or make use of. Examples abound even in our own state: too many trawlers, too many hotels or even too many taxis! It would be more sensible if the magnitude of these activities are assessed well in advance and limits on how much can be allowed to be invested are drawn to ensure that these are not overdone. There are quite a few other points like these, but to summarise what we need is a management plan that caters to the interests of every stake-holder, including mother nature which is the biggest and a silent stake-holder, and where the sustainability of the resource is the foremost reference.

