

## An Integrated Approach to National Marine Resources Development

*by*

JEAN-PIERRE LEVY\*

The oceans have always inspired poets and writers. They were the origin of life; they nurtured the growth of early civilizations and are likely to become an essential economic element for future generations. For centuries, use of the oceans was limited to two main activities: fishing and transportation. Even though the contribution of these two activities to the well-being of peoples was obvious and essential, their growth proceeded relatively slowly until the 19th century. Only after the industrial revolution of the last century and with the impressive scientific and technological advances achieved during the 20th century, especially following the Second World War did use of the marine domain undergo a dramatic diversification and expansion.

In fact, it has been only during the last decade that consciousness of the potential of the ocean has developed and it has been examined within the context of the economic development on a world scale.

The Third United Nations Conference on the Law of the Sea, which began in 1973 and has met in several sessions, has contributed greatly to the growing interest of states in their marine resources. The acceptance of the new concept of "Exclusive Economic Zone" (EEZ), and the design of a formula for determining the extent of the jurisdiction of coastal states over the resource of their continental shelves — developments in which Sri Lanka has a particular stake in view of the morphological features of its margin — have placed potentially large amounts of resources at the direct disposal of states. Even before the Conference on the Law of the Sea adopted a Convention, a new regime was emerging as a result of the practice of States. This regime offers great opportunities and poses a challenge that many states will have difficulties meeting in relation to the expertise and financial or technological means at their disposal. However, in view of the potential offered by marine resources for national economic development, the initial efforts required to meet this challenge are well worth pursuing.

\* Chief, Ocean Economics and Technology Branch, Department of International Economic and Social Affairs, United Nations Secretariat, New York.

## I. The economical potential of marine resources

The greatest economic potential of ocean resources lies relatively close to the shores of coastal states. This is true for renewable as well as for non-renewable resources, and before analyzing the administrative problems confronting the rational management of ocean resources, it seems appropriate to recall briefly their variety and extent.

### 1. Fishing

World fisheries production has grown substantially in recent years, from some 55 million tons during the 1960s to some 70 million tons during the 1970s with about 10 per cent of the total coming from internal waters. Many experts consider that this production could be increased substantially. However, experience has shown that such an expansion will require effective action to reduce marine pollution and to set a foot rational management of stocks and conservation measures in order to avoid the over-exploitation of some species. World fisheries production has increased since the Second World War at a faster rate than the increase in world population. However, this increase, in the order of 7 per cent per annum, has been highly unequal in terms of species fished and of the geographical regions where the catches have been made. A more intensive utilization of fish species which are little known or which are very small in size for such uses as the preparation of fish meal, animal feed or protein concentrates for human consumption may be foreseen. Such concentrates could greatly reduce protein deficiencies from which a large proportion of humanity suffers. Estimates of possible fisheries production depend above all on the types which are included. The total annual production of living organisms in the ocean is enormous, in the order of 100,000 millions of tons, but the bulk of that production is in the form of zooplankton, microscopic or near microscopic plants and animals whose exploitation is not currently envisaged. In terms of the production of fish and other organisms likely to be useful in the near future, current estimates of the biological potential of the oceans run to sum 120 million tons. Inland water fisheries, it is also estimated, might reach some 20 million tons around 1985. In Sri Lanka, commercial fishing has been developing rapidly, with production rising from 97,000 tons in 1970 to 180,000 tons in 1980. The marine coastal fisheries out to a distance of about 25 miles account for 88% of this total. The maximum sustainable annual yield from this area is estimated to be approximately 250,000 tons, with two thirds being pelagic fish. The Fishery Development Plan aims to increase the production of fish to 300,000 tons by 1983, with a concomitant increase in employment and income levels in the fisheries sector.

### 2. Aquaculture

The potential of aquaculture must also be stressed. Current production of about 5 million tons per annum could be increased if it were decided to develop it in those zones which are favourable and which are, in fact, relatively numerous. In this area, the extent of commercial operations has not increased as rapidly as might have been hoped, due to technical and financial limitations. It is possible that in the future, one of the essential contributions to be made by aquaculture to the use of biological resources of the sea will be as the mechanism for transforming catches of low value but of large volume, such as krill, into products of greater economic desirability. A large volume programme in this area could certainly produce at least a partial answer to the problems posed by the protein shortages often implied in demographic projections for the century to come.

### 3. Transportation

A similar evolution in terms of intensity of use has taken place in the field of transportation. From the frail bark to the supertanker, development has been far-reaching. The arrival of the steamship transformed maritime transport and gave it a new impetus. However, it was especially the energy demands of recent decades that brought the need to transport enormous quantities of hydro-carbons, which in turn required parallel development of a greater number of larger vessels. Thus, whereas the number of merchant ships tripled from the beginning of this century, the tonnage of these ships has multiplied by twelve.

Marine transportation activity has developed in such a manner that the impact it has on the marine environment constitutes a source of conflict with other uses. The most important consequences has been the necessity to establish precise routings for ships, especially in zones having high traffic density. Traffic separation schemes have multiplied and there are now some sixty of them in the world. They govern, in precise fashion, the courses that must be steered by ships in high traffic zones. Nevertheless, despite all the precautions taken, accidents have increased and have added to the worsening of the state of the marine environment.

#### 4. Pollution

If pollution by hydrocarbons is the most spectacular and the most keenly felt, especially by the inhabitants of coastal zones, it must nevertheless be placed in the context of a global phenomenon. In fact, 60 per cent of marine pollution originates on land. Along with the development of fishing and marine transport, the sea has been increasingly used as the universal dumping ground for the refuse that man produces in constantly increasing quantities. For centuries this particular use of the marine environment passed unnoticed. It was only with the advent of our industrial civilization and the proliferation of noxious substances that the problem of the sea's capacity for absorption has arisen. Marine pollution is due to the substantial increase in the various chemical products reaching the oceans, to the discharging of artificial materials produced by man, such as plastics and pesticides which cannot be absorbed by nature, and to sewage or the dumping of wastes.

Contrary to what was thought until relatively recently, namely that the sea could absorb our wastes without hazard or deleterious effects, it has become imperative to face the fact that use of the sea as a dumping ground is in direct conflict with its use not only as a source of food or amenities, but especially as an essential link in the life cycle within our biosphere. These broader considerations involving the marine world go very far beyond the purely conflict level of competitive uses to affect, in the long run, the fundamental problems of survival of the human species.

To preserve and develop the potential of the sea for future generations, it is essential at once to take the measures necessary to avoid an irreversible deterioration of this environment. Enough countries seem of late to be facing this necessity for some optimism to be permissible. From the point of view of the widespread development on a large scale of the resources of the sea, planners and economists must take account of the cardinal importance of what may rightly be called an "anti-resource."

Although marine pollution is not a major problem for Sri Lanka at present, far-sighted legislation has been enacted for its control. A traffic separation scheme adopted by the Intergovernmental Maritime Consultative Organization (IMCO) (now the International Maritime Association) will be put into effect in the southernmost point of Sri Lanka off Dondra Head. This is a focal point for east-west traffic, particularly tankers en route to the Malacca Straits. Such a scheme will reduce the threat of accidents and collisions.

#### 5. Hydrocarbons and solid minerals

Currently, despite the increasing importance of fisheries and marine transport, hydrocarbons and to a lesser extent, solid materials, constitute in economic terms the largest resources of value for the future. Exploration and prospecting for hydrocarbons at sea have increased on a world-wide scale spurred partly by price increases. These activities are being carried out off the coasts of more than 80 countries. Almost 90 percent of the offshore petroleum discovered thus far lies in some 60 enormous reservoirs containing at least 500 million barrels each. Following upon the discovery and production from

the reservoirs off Alaska, the Mexican deposits appear to match those of Saudi Arabia in size. The work undertaken on the continental shelves moves to ever greater depths and many areas which did not seem in the past to have any economic potential are being reassessed. To meet a constantly growing demand, the production of marine oil fields has risen from 103 million tons in 1960 (10 per cent of world production), to 440 million tons in 1974 (17 per cent of world production), to 440 million tons in 1974 (17 per cent of world production). It is estimated that this proportion could rise to between 30 to 35 per cent by the beginning of the next century.

Large-scale efforts are being made in nearly all the submarine regions which have sedimentary basins containing sediments at least 1,000 meters thick. The potential of the marine subsoil beyond the continental shelves, though thought to be small, has not yet been explored on account of prohibitive costs and technological problems that have not yet been overcome. However, such exploration cannot be excluded in the long run. Exploration wells have already been drilled at depths of more than 4,000 feet of water in several locations. It has been estimated that the subsoil of the earth still holds about 925 billion barrels of undiscovered petroleum of which 382 billion, or 51 per cent, are under sea.

Although no major discoveries have yet been made in the Sri Lanka off-shore, a reconnaissance survey of the entire shelf has been completed and detailed seismic surveys are underway, under lease agreement issued by the Ceylon Petroleum Corporation. The deeper water areas may have a significant petroleum potential but no exploration has yet begun.

## 6. Renewable energy

It is likely that rapid technological progress will come about due to enormous economic pressure with regard to the supply of energy. The seas and oceans are a perpetual source of renewable energy that appropriate technology could harness at projected costs which are becoming competitive with conventional sources. Non-conventional sources of marine energy include, among others, thermal gradients, waves, and tides, currents and bio-conversion. In principle, oceans provide an environmentally sound and viable energy source, but under certain geographic and physical circumstances.

### Ocean thermal energy conversion

Ocean thermal energy conversion (OTEC) is designed to exploit the differences of temperature between the warm upper layers of the ocean and much colder deeper waters. The greatest differences are to be found in a zone stretching from the 30th parallel N. to the 30th Parallel S. at depths ranging from 500 to 1,000 metres. There must be a temperature difference of at least 20°C to operate a system economically the principle of which was put forth by the physicist Jacques d'Arsonval in 1881, a prototype having been tested by George Claude in 1930 off Havana. Though the principle has thus long been known, it has never been the subject of industrial application on a large scale. Recently, however, the energy crisis has stirred renewed interest in tapping this source.

Because of its favourable physical setting and the need for new sources of energy, OTEC has appeared to be an attractive alternative for Sri Lanka. Electricity generation from non-hydro sources would be needed by the late 1980's.

His Excellency, the President of Sri Lanka, J. R. Jayawardene recognize the need to examine the feasibility of an OTEC power plant and requested the National Science Council (NSC) to prepare a report. In a series of meetings including one with the NSC itself, and an examination of possible sites, it was established that OTEC appears to be a viable option for Sri Lanka and more detailed systematic investigations should be carried out.

The most basic requirement for OTEC development, as noted above, is the availability of an adequate temperature difference resource. On the basis of archival data from U.S. National Oceanic and Atmospheric Administration's Oceanographic Data Center and other sources, the annual mean  $T$  between the surface and 1000 meters was  $21.3^{\circ}\text{C}$ .<sup>(4)</sup> An annual average  $T$  greater than  $20^{\circ}\text{C}$  is available at 800 meters. There is sufficient depth to reach the cold water supply on all sides of the island except the north and northwest.

Sri Lanka has not only the thermal resources and large and growing demand, but a technical capability to actively participate in OTEC development. Given its capability of supplying large amounts of environmentally clean energy, OTEC may play a significant role in meeting some of Sri Lanka's future energy demand.

## II Coastal Area Management and Development

### 1. The marine dimension in development.

As the above illustrates, the existing, and even more, the potential contribution of marine resources and uses to development is very substantial. Harnessing this "marine dimension" to the development process offers great opportunity at the same time that it poses a great challenge. Of particular significance to coastal states is that portion of the marine dimension within the 200 mile extended resource jurisdiction. Although the absolute marine area contained within such marine jurisdictions will vary according to a number of factors, their establishment universally (except in cases where geographical proximity between two or more states dictates a more restricted delimitation) would bring over 35 per cent of the world's oceans under national jurisdiction. While the potential economic value in the aggregate of extended resource jurisdictions will also differ from country to country, in global terms as well as for a large number of coastal states, the economic importance of the area within the 200-mile limit is very great. This area, together with a band of land adjacent to the coastline, constitutes the wider coastal area. Historically, the coastal area has been the focus of human settlement and economic activity. The continued development of economic activity in the coastal area, including marine-based activity, will increase the pressure on the coastal environment and will, in the absence of proper planning, result in the emergence or intensification of conflicts among uses. In anticipation of such circumstances, a comprehensive approach is required for the rational management of coastal area development, while maintaining environmental quality.

### 2. Developments in Sri Lanka.

In Sri Lanka, the origin of interest in coastal problems was the construction of protective structures to arrest coastal erosion. In the early stages, several agencies carried out independent efforts including breakwaters, quay walls, fishery harbours, flood protection and salt water extrusion schemes for cultivation. In the early 1960's, studies by independent consultants recommended the establishment of a separate Department of the Coastal Belt to undertake a planned programme of coastal investigations and data collection. In 1964, coast protection was transferred to the Colombo Port Commission and within ten years it became clear that coast protection should be expanded to encompass coastal conservation. Thus, the concept was introduced of adopting preventive measures to control and manage unrestricted human activities that cause coastal erosion.

A Coast Conservation Law, drafted and expanded to encompass the concept of coastal zone management, requires a coastal zone management plan to be prepared within three years.

Coastal activities such as hotel development, sand mining, ports and harbours, coastal transportation and fishing are all affected by current activities of the Coast Conservation Division (CCD) and to a greater extent by the new law. The growing importance of coastal areas in both urban and touristic centres had made the impact of the new, comprehensive approach taken by the CCD widely felt and beneficial.

Through education activities pointing out the now well-appreciated dangers of natural coastal hazards, developers are beginning to value such initiatives as the Coast Conservation Guidelines for Developers and Hoteliers in the Tourist Industry, prepared by the CCD. Currently, coral mining activity is a major focus of attention and with the new law the legislative authority to control this highly destructive activity is in hand. The CCD is exercising an important and wide-ranging effect upon coastal development and is raising the general consciousness of the country with respect to the need for integrated planning and the incorporation of environmental considerations into regional planning.

### III. Management Issues and Alternatives

Broadly speaking, and for purposes of management, one can distinguish three types of marine resources :

1. Those which have been traditionally developed for a long period of time but which may need further evaluation and rational development in order to maximize their benefits on a long-term basis. This category includes near shore minerals, construction materials such as sand and gravel and fisheries.
2. Potential resources, that is, resources whose existence is inferred from an examination of oceanographic, geological or geophysical data, of whose initial or continued development is predicated on scientific and technological advances. Ocean thermal energy conversion for example falls within this grouping as do hydrocarbons that cannot be exploited with existing technology.
3. Sub-economic resources, namely existing resources which, under prevailing economic and technical conditions, are not susceptible to development. Among those resources, one can mention pharmaceutical products from marine flora and fauna, and certain kinds of dissolved minerals in sea water, etc.

However great the potential of the first and second categories of resources, any government, in establishing its marine policy, is faced with the problem of assigning priorities and devoting the necessary resources to implementing these priorities. However, a national policy which taken account of the entire spectrum of resources and uses of ocean space is a fundamental requirement of marine management. The absence of an ocean resource policy makes the allocation of funds and national effort between land-based and marine development a haphazard affair. Within marine sectors, the formulation of priorities is also difficult in the absence of a clear policy.

Turning from policy formulation to the implementation of a comprehensive, integrated approach to the management of the coastal area, it should be noted that in practically all developing countries and in a number of industrialized countries the development of institutional arrangements required for such an approach has not kept pace with the expansion and diversification of activity in the marine sector. Traditional institutional arrangements have proved to be ill-suited for carrying out the tasks and functions associated with an integrated approach.

The following briefly reviews this traditional institutional setting and considers alternatives.

## 1. Traditional governmental approaches

With the development of modern societies and the ever-growing responsibilities of central governments, states have witnessed the multiplication of ministries and have entrusted them with ever-growing responsibilities. In the maritime field, the growth and expansion of uses of the ocean space and its resources has often prompted governments to establish new ministries, but more often to assign new marine-related functions to existing ministries. Thus, while for the past centuries and until fairly recent times, the uses of the oceans were limited to traditional low-level fisheries, commercial trade, and naval power, nowadays, it is necessary to add to those uses the exploitation of solid minerals, the physical conservation of coast lines, the development of off-shore hydro-carbons, the protection of the marine environment, the development of maritime communications, tourism, etc. Typically, therefore, in all modern governments, from 5 to 15 different ministries have specific responsibilities in ocean affairs, in addition in most cases to responsibilities related to land-based activities. Such a juxtaposition of responsibilities is, in most instances, logical and virtually unavoidable since administratively speaking, ocean and land affairs cannot always be easily separated. For example, it would be relatively difficult and inefficient to establish, at the ministerial level an administration dealing with land communication and another completely separate administration dealing with maritime communications. In another area, should a government decide to establish institutional arrangements for the environment, it would be extremely difficult to allocate to two separate organizational entities, responsibilities for terrestrial pollution on the one hand and ocean pollution on the other, in view of the close relationship between the two and taking account of the fact that much of the ocean pollution originates from on-land sources. More over the almost inevitable dispersion among many ministries of responsibility for marine related matters has resulted in a vertical, sectoral approach to development. This is to say that to some extent, each ministry has a vested interest in the development of the resources or activities falling within its sphere of competence. It also means that each ministry enters into competition with others, as far as the allocation of funds within the overall national budget is concerned.

One important consequence of the vertical approach is that development in one sector frequently takes little or no account of parallel or related developments in other sectors. Such a situation should not be considered as wholly disadvantageous in as much as it leads to a healthy competition within the government for the allocation of resources, and tends to favour the most rational and cost effective investments. It does, however, have a certain drawback in the fact that it may lead to conflicts or overlapping among sectoral activities, and more important, engender a situation in which it will become increasingly difficult to pursue an overall marine policy that optimizes the uses of ocean space and its resources.

## 2. An Integrating Mechanism

In considering various possible alternatives to the 'traditional' approach described above, it is necessary to bear in mind the essential functions that any array of institutional arrangements for marine affairs should ideally perform. These are:

- a. Policy-making.
- b. Comprehensive planning and management.
- c. Establishment of a legal and regulatory framework.
- d. Implementation of adopted plans, programmes and projects.
- e. Co-ordination, control and evaluation of marine activities.
- f. Research, advisory and technical services
- g. Financing of projects and training of personnel.

At the highest level, namely the policy-making and planning level, one conceivable institutional alternative could consist of the establishment of a "super-agency" for the oceans, that is, an organ at the ministerial level that would centralize under one roof responsibility for all marine activities.

It is doubtful however that the idea of establishing such a central organ to oversee all marine activities will gain wide application in view of the multiplicity of activities of a totally different nature taking place in the marine environment. A single administrative unit having such a broad mandate and a wide-ranging expertise and competence is difficult to imagine in practice and, with one qualified exception the Ministry of the Oceans, which has been established in France, no state in the world has yet established a 'super' ocean agency. Even in the French case, it should be noted that the Ministry of the Oceans has been given responsibilities essentially in the areas of fisheries and transport and has not taken over existing maritime responsibilities entrusted to other ministries. In fact, France has also created a specific co-ordinating mechanism in marine affairs in order to assist the Government in developing its 'marine policy'. None the less, even with the attribution of major responsibilities to a specific ministry, it is necessary to establish other mechanisms or arrangements, and variations thereof, for ensuring proper co-ordination among the several ministries having responsibilities in marine affairs. Such arrangements should be established at the highest level—for example, an inter-ministerial committee—in order to ensure a capability to adopt and direct the implementation of a coherent overall national marine policy which would lead to the rational management and development of ocean resources. Once such an inter-ministerial co-ordinating committee is established and entrusted with responsibility within the framework of a national marine policy for formulating general guidelines and directives for the development of marine resources, it must, in order to discharge its functions, have a comprehensive picture both of ongoing marine activities and of potential marine activities and of the interactions among them. It follows, therefore, that the high-level inter-ministerial Committee would require the support of an intersectoral technical advisory body—for example, a planning board—responsible for developing an integrated and coherent overview, a blue-print so to speak, of marine affairs activities, both ongoing and potential, that would permit the committee to establish policy directives and set priorities. This guidance would in turn be used by the planning board to develop an integrated marine affairs programme and plan.

Then, in each sector, it would be the responsibility of each Ministry concerned both to translate the approved plan into specific programmes and projects, and to implement such programmes and project.

To summarize, the institutional arrangements delineated above would consist of 2 horizontal, cross-sectoral layers—the interministerial co-ordinating committee for policy making and a planning body for providing a comprehensive overview and for plan formulation—and a vertically organised sub-structure of sectoral ministries and agencies for project formulation and implementation.

Any institutional set-up is, of course, only a means to an end, which is to optimize the contribution of marine resources and uses to national development over the long run rather than to maximize this contribution in the short run. For example, in the case of Sri Lanka, the sedimentary basin surrounding the coast of the country may have a potential for hydrocarbons, and at the same time, temperature differences in the ocean in certain areas close to the coast would allow the operation of ocean thermal energy conversion (OTEC) plants. The developments of offshore hydrocarbon deposits, should they exist, would represent a tremendous economic stimulus for strengthening the balance of payments' position of the country; yet the establishment of OTEC plants on a small scale might bring, especially if associated with aquaculture or fresh water production, direct benefits to specific areas of the country. If the above possibilities were considered as alternatives, it might be concluded too hastily that the macro economic approach (balance of payments) should prevail over the micro economic approach (local energy



needs). An integrated consideration of the problem, however, might lead to a different decision which might promote both developments. The same would hold true in a number of other cases including coastal area protection and development of fisheries.

In conclusion, it will be essential for coastal country such as Sri Lanka that enjoys jurisdiction over a vast area of ocean space to assess the resources and uses with that area and to adopt an overall marine policy that forms an integrated component within its national development plan. Such a policy to be effective, has to set out priorities and be translated through appropriate administrative mechanisms into specific projects, preferably complementary but at least not in conflict with each other. The process through which this is accomplished, however, must take account of the full range of potential development activities and uses, and yield a selection of priority developmental activities and projects whose co-ordinated implementation will minimize conflict and respond most effectively to national needs. Even if the application of such an integrated approach results in the commencement of development in only a few areas of particular importance to the national economy it would represent an important step in making best use of marine resources and uses and would pave the way for an orderly and effective expansion of marine development activity over the long run.

#### REFERENCES

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