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Interregional Seminar on

DEVELOPMENT AND MANAGEMENT OF RESOURCES OF COASTAL AREAS

Berlin (West), Hamburg, Kiel and Cuxhaven
31 May to 14 June 1976

Editors: Karl-Heinz Szekielda · Bernd Breuer

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PROCEEDINGS

An Interregional Seminar organized by the Seminar Centre for Economic and Social Development of the GERMAN FOUNDATION FOR INTERNATIONAL DEVELOPMENT, Berlin (West), and the Ocean Economics and Technology Office of the UNITED NATIONS, New York.

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The country monographs of the participants and the technical papers presented by resource specialists for the Interregional Seminar on Development and Management of Resources of Coastal Areas do not in any way reflect the views of the United Nations.

Although certain texts were necessarily edited, the individual contributions were not modified for organization and content. Some photographs, tables and figures which did not have the required quality for reproduction were omitted.

The Editors

INTRODUCTION AND SUMMARY

THE UNITED NATIONS AND COASTAL AREA DEVELOPMENT

Jean-Pierre Lévy
Ocean Economics and Technology Office
United Nations

Coastal areas are uniquely suited to support a variety of activities and to serve diverse human needs for food, energy, transport and recreation. Some two-thirds of the world's population lives near the coast and a majority of the world's largest cities — 39 of the 66 with populations over 1 million — are in coastal areas.

Over 90 per cent of the world's fish catch comes from the continental shelf and upwelling regions, which constitute about 10 per cent of the world's oceans. At present, approximately 8 per cent of the world's total animal protein supply comes from the sea, a proportion which may well increase as the world fish catch increases. Further, about 18 per cent of the world's oil production comes from offshore areas and it is estimated that 68 per cent of the world's ultimate recoverabl hydrocarbon resources lie in coastal waters 200 metres in depth or less. Further, the coastal area is a source of many other raw materials in the form of sand, gravel or lime-shells and a variety of placer minerals. Salt for instance, as an extracted product from the oceans, contributes significantly to the use of salts and metals in industry.

Coastal areas also are, or are becoming, focal points for tourism, trade, industrial production and waste disposal.

Obviously, the unmanaged growth of competing demands for coastal space, both landward and seaward of the shoreline, cannot continue without producing congestion and serious conflicts among uses, leading to the deterioration of the coastal environment itself. The planning of economic activities in coastal areas, when done on an unco-ordinated sector-by-sector basis, often does not take account of negative interactions between activities which act to reduce the potential value of one or more activities. Proper planning and co-ordination of marine activities can, on the other hand, not only help to manage conflicts but also take advantage of positive interactions between coastal activities. The value of treating coastal areas as a planning entity within the overall framework of national development planning is not always fully recognized and very often countries lack the administrative and legislative basis for implementing such an approach. Particularly for developing countries with a narrow range of marine-related activities and a largely untapped resource potential, there is a need and an opportunity for managing the growth of individual sectoral activities so as to obtain the optimal mix of activities which maximizes the contribution to national development, while ensuring the continuing productivity of the coastal environment.

It was in keeping, therefore, with clearly perceived needs and trends that the United Nation's Economic and Social

Council acknowledged that the rational development of coastal areas, capitalizing on the growth opportunities inherent in marine resources and ocean space, could add a new dimension to the development of many developing countries and constituted an important factor in national development planning.

Responding to the specific concerns and directives of UN Member States for positive action in this field,* the Department of Economic and Social Affairs, through its Ocean Economics and Technology Office, is implementing a programme of activities aimed at assisting developing coastal states harness the potential of their coastal areas to the overall development effort.

The conceptual framework and springboard for the programme is provided in a comprehensive, multidisciplinary study prepared by the Ocean Economics and Technology Office entitled "Coastal Area Management and Development" (Doc. E/5648) which was well received by UN Member States in 1975.

On the basis of the problems and opportunities associated with coastal area development identified in this study, specific activities have been designed to meet particular needs. Work is now well underway for the preparation of a manual on coastal area development that will describe the application of certain planning methods and techniques for use by planners, economists and engineers in developing coastal states. The manual will also serve as a guide to the economic and technical activities of United Nations organizations and agencies that are relevant to coastal area management and development.

In recognition of the central importance for an integrated approach to coastal area development of an appropriate institutional and legislative infrastructure, a survey and analysis of global scope has also been initiated of existing institutional arrangements and legislation relating to coastal areas. Guidelines will ultimately be developed to assist Governments in devising legislative and institutional/co-ordination arrangements most appropriate to their needs in developing their coastal areas within the context of an integrated planning effort.

Steps have also been taken for the establishment of a marine coastal technology information system (MACTIS) which will function as mechanism for facilitating communication between consumers and suppliers of specific coastal technologies.

On the operational side of the coastal area development programme, in order to assist in the preparation of practical proposals for action and thereby give operational significance to the concept of integrated coastal area development, the United Nations also convened a meeting of Experts on Coastal Area Development at United Nations Headquarters in New York in November 1974. The recommendations that emerged at this

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* Economic and Social Council Resolutions 1802 (LV) and 1970 (LIX).

meeting, which brought together eight experts from four major coastal regions — the Persian Gulf,* South-East Asia (Malacca Strait), the Caribbean and West Africa (Gulf of Guinea) — as well as experts from the competent organizations of the UN system in technical and scientific matters and in development planning, helped lay the groundwork for a number of operational programmes now in the making that promise to yield tangible benefits before the end of the decade.

For the Persian Gulf area, an interdisciplinary team ef experts organized and recruited by the UN to carry out a prefeasibility study for Coastal Area Development in the Gulf, under the auspices of the United Nations Environment Programme (UNEP), has recently completed its mission and will report its findings soon. The Caribbean will be the focus of attention at a series of meetings to take place in the near future, including the first session in July of the newly-established Regional Association for the Caribbean and Adjacent Regions (IOCARIB) of the Intergovernmental Oceanographic Commission (IOC). A major background study on coastal and marine eco-development in the Caribbean, prepared by the United Nations Ocean Economics and Technology Office in co-operation with UNEP, is expected to assist Governments in the region to formulate a plan of action for the Caribbean.

A preliminary draft programme for coastal area development in the South-East Asia region has been sent to the Economic and Social Commission for Asia and the Pacific (ESCAP), and a very positive response, including an offer to assist in developing and implementing a programme, has been received from ESCAP/CCOP (Committee for Co-ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas). The Ocean Economics and Technology Office, together with CCOP, is now carrying out the background work for assessing the feasibility fo convening a regional workshop or seminar in the area as an initial step in developing a coastal area development programme for the countries concerned.

For West Africa, a background report suggestive of a possible draft programme for coastal area development in the Gulf of Guinea area has been transmitted to UNEP as well as to the Executive-Secretary of the Economic Commission for Africa for comment and for suggestions as to the type of assistance and involvement they may wish to provide.

* The use of the term "Persian Gulf" to describe the gulf geographically situated between Iran and the Arabian Peninsula, is based on conventional practice. It should be noted, however, that some UN delegations use the term "Arabian Gulf".

While the regional/sub-regional approach that has found expression in these and other operational activities is applicable only when conditions are faviourable and in any event is intended as an aid and a supplement to action of the national level, it offers a number of advantages.

For example, such an approach will encourage the fuller and more effective participation of the United Nations Regional Commissions in coastal area development and the harmonious integration of a number of specialized agency activities that have long been conducted at the regional and sub-regional levels. More recently, UNEP has also adopted a regional approach to the protection of specific bodies of water.

The regional approach to coastal area development also has the considerable advantage of stimulating and benefiting from technical co-operation between the countries of a given region in relation to such matters as the exchange of experience and the pooling or sharing of resources and expertise as well as in relation to those problems associated with coastal area development that can only or best be addressed at the inter-country level.

In regard to education and training, an integrated approach to coastal area development obviously must be supported by a wide range of skills and expertise encompassing both physical sciences and social sciences and related disciplines. Some of human resources skilled in these disciplines may be available and need only be mobilized and organized in relation to the task at hand. In other cases, education and training gaps may have to be filled.

A number of measures have been taken, in the field of training and education, in support of coastal area development, including the preparation of a world register of courses and training programmes, the planning of a two-month training course for selected participants from developing countries, and support for and participation in a number of the activities relating to training, education and mutual assistance (TEMA) that are being developed under the auspices of the IOC.

From its inception in 1973, the UN coastal area development programme — and the various activities which comprise it — has been envisaged as a fully joint UN system-wide undertaking. Such a collaborative effort is in accord with the directives of the Economic and Social Council and is inherent in the requirements for implementing an integrated approach, which by definition must draw upon and synthesize a wide range of diverse sectoral and disciplinary inputs from all co-operating organizations and agencies.

In order to ensure that co-ordinating arrangements within the UN system are responsive to the dimensions of this task, the UN organizations and agencies that are members of the Sub-Committee on Marine Science and its Application of the Administrative Committee on Co-ordination, the UN's central intersecretariat co-ordination mechanism in the marine field, have embarked on a serious and promising undertaking to increase the effectiveness of the Sub-

Committee as an instrument for ensuring close and harmonious co-operation within the United Nations family of organizations.

The present Seminar, the first of its kind under United Nations auspices, is an important component in this panoply of related and mutually reinforcing activities and in a very real sense represents a fusion of the separate but closely linked dimensions of concern which they address. The forthcoming deliberations will undoubtedly reflect and benefit from the intellectual input that has gone into these activities as they have evolved thus far. More importantly, however, they will refine and sharpen our collective thinking in this important field of endeavour and contribute to progress on a number of fronts, ranging from the conceptual to the operational. Regarding the latter area, as participants well aware, the Seminar is structured in such a way as to ensure that the wide and impressive array of expertise assembled here is brought to bear on the development of proposals for action, on a sectoral or on an intersectoral basis, that will receive full expression in follow-up activities at the national, sub-regional or regional levels as appropriate.

SUMMARY REPORT OF THE INTERREGIONAL SEMINAR ON DEVELOPMENT AND MANAGEMENT OF RESOURCES OF COASTAL AREAS

I. ORGANIZATION AND PROCEEDINGS

1. The objectives of the Interregional Seminar on Development and Management of Resources of Coastal Areas should be viewed in the light of recent decisions of the Economic and Social Council of the United Nations (Resolutions 1802 (LV) and 1970 (LIX)). Having recognized that the coastal areas in many developing countries represent one of their most valuable possessions and should be fully and rationally developed, the Council requested the Secretary-General of the United Nations to provide necessary assistance to developing countries with respect to training, institution building, programme formulation and acquisition of appropriate technology required to facilitate coastal area resource development. As an important part of the United Nations effort, this Interregional Seminar was organized jointly by the UN Ocean Economics and Technology Office and the German Foundation for International Development.

2. Participating in the Seminar was a group of officials of developing countries selected on the basis of their profession and experience pertinent to coastal activities. They were assisted by a group of resource specialists with expertise in a variety of disciplines essential to coastal development and management. The Seminar was intended to provide the participants with an opportunity to exchange information, compare national experience and be exposed to the alternative approaches and solutions to coastal area programme development. The Seminar therefore consisted of two phases: general technical discussion to provide a common perspective, followed by workshops that examined the technique for developing coastal area programmes under a variety of conditions. An overview of the nature and extent of already perceived national issues and problems was brought forth by the presentation of monographs prepared by the participants. The wide spectrum of technical papers presented by the resource specialists helped the participants to better analyse the interactions of natural and human processes and provided a basis for selecting solutions from among a set of alternatives.

3. The general discussion led to a number of conclusions, some of which are particularly worthy of mention:

FIRST, the participants unanimously endorsed the view that the concept of integrated coastal area programmes was particularly valuable for promoting co-ordinated development and solving multiple-use conflicts.

SECOND, the need was recognized for continuing UN assistance to facilitate programme development and the acquisition of technical information.

THIRD, the participants agreed on an approach to programme development based on an analysis of activities (functional analysis) a tool useful for the rigorous evaluation of complex situations.

4. A number of options were explored by the participants for organizing the workshops that followed the general discussion. The decision was reached by consensus that the preferred organization was along language lines, which for some also provided a basis for a regional perspective. Therefore one English, one French and one Spanish workshop were formed for the second phase of the programme. The groups were composed of the following individuals:

ENGLISH-SPEAKING GROUP

	NATIONALITY	DISCIPLINE/AREA
D. Baker	Barbados	Town planner
S.K. Comal	India	Ports
A. Soegiarto	Indonesia	Ecologist/oceanology
Y. Nir	Israel	Geological survey
P. Reeson	Jamaica	Ecologist
J. Mumba	Kenya	Fisheries
F. Al-Abbar	Kuwait	Landscape architecture
A. Aderounmu	Nigeria	Fisheries
U. Pongsuwana	Thailand	Fisheries
T. Maembe	United Republic of Tanzania	Fisheries
R. Kolenc	Yugoslavia	Planning
I. Simunovic	Yugoslavia	Urban planner

FRENCH-SPEAKING GROUP

	NATIONALITY	DISCIPLINE/AREA
O.L. Sacramento	Benin	Planning
E. Garnier	Haiti	Fisheries
R. Ettehad	Iran	Planning
A. Chaguer	Morocco	Fisheries
Y. Aziaha	Togo	Urban planning
M. Bouhlel	Tunisia	Oceanography
A. Oumarou	United Republic of Cameroon	Tourism

SPANISH-SPEAKING GROUP

	NATIONALITY	DISCIPLINE/AREA
F.A. Flores	Ecuador	Naval engineer/ports
J.A. Guevara	El Salvador	Natural resources
H. Caballero	Honduras	Natural resources
J.A. Ramirez	Mexico	Fisheries
G. Bergman	Nicaragua	Industry and commerce
A. Brack-Egg	Peru	Flora and fauna

Resource personnel available to all of the groups included:

J. Armstrong	J. Goodman	L. Neuman
L. Capurro	D. Krause	M.A. Robinson
E. Fez	R. Lee	K.H. Szekielda
E. Garrido	J.P. Lévy	M. Tavasszy

5. The participants favoured the selection of a single topic for consideration by all groups. The task addressed was defined as follows:

"Consider and analyse a Coastal Area Development Programme (CADP), including at least four potentially conflicting uses (e.g., renewable and non-renewable resources, tourism, transportation, etc.)."

This afforded the opportunity for all the participants to gain the experience of developing a programme that would take into account a wide diversity of interests and experience.

6. In order to accomplish this task it was proposed that each group use the functional flow diagram, shown in Fig.1, as a model for a systematic approach, modified as necessary to fit the perceived needs and constraints of the working group.

The following information was also requested for each step in the process:

a) What problems are raised by the application of each step illustrated in the model approach to the CAD process?
b) What alternative approaches can be considered for fulfilling each step?
c) What is the rationale for the selection of the alternative approach?
d) What results come from applying the chosen step in the process?

Program Development Process

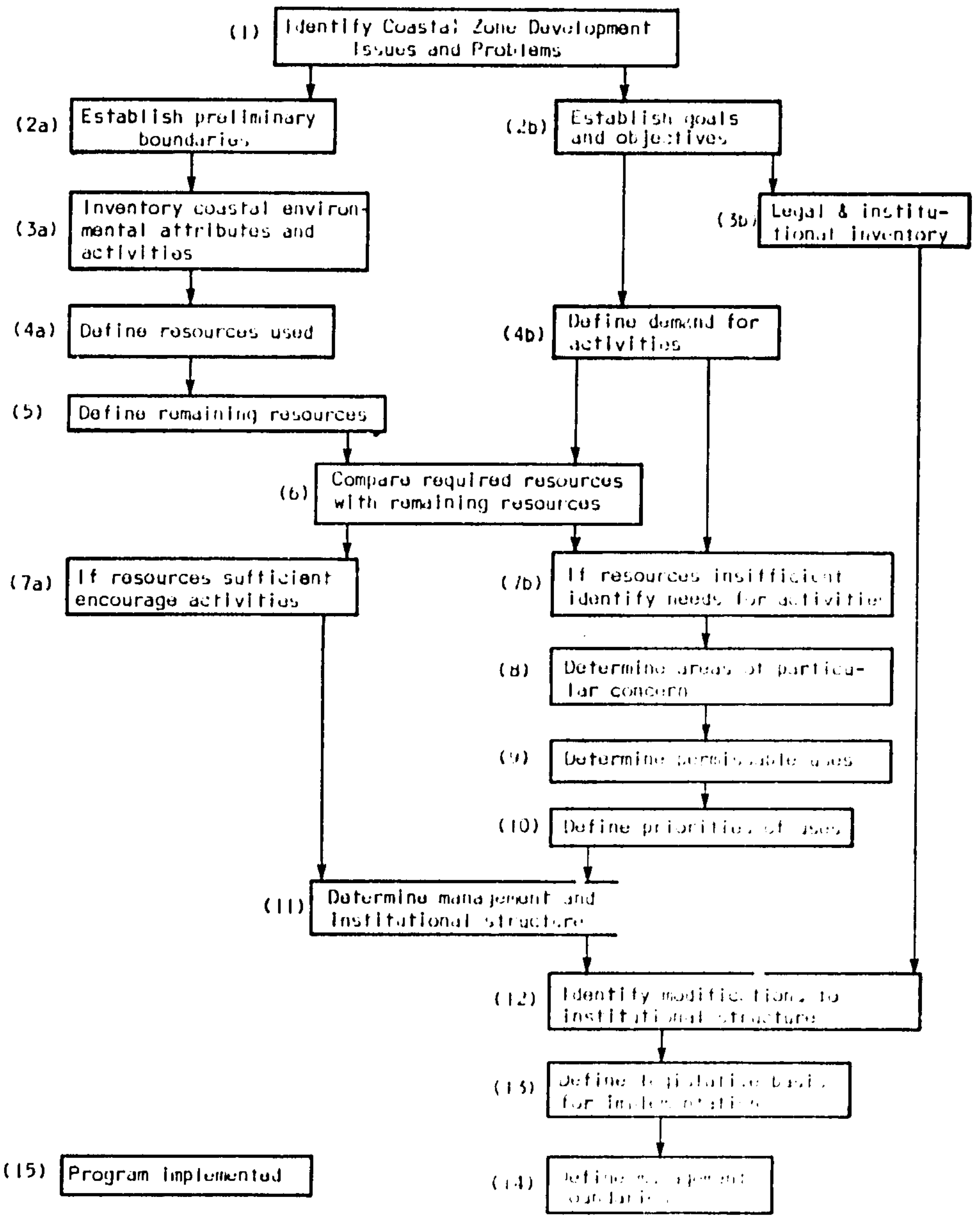

Fig. 1: Flow diagram used as the model for the working groups.

II. SYNTHESIS OF THE CONCLUSIONS AND RECOMMENDATIONS OF THE WORKING GROUP

While each working group reached conclusions and made recommendations which are set out in full in their reports, those major elements that were not common to all are identified and grouped conveniently as follows:

A. ACTION AT THE NATIONAL LEVEL

1. There is a need to ensure an integrated approach to coastal area planning which would link all applicable sectors of national economic activity with this unique environment at every stage of the process.
2. There is a need for a suitable economic and administrative infrastructure for coastal area programme development. When such a structure did not exist, the groups strongly recommended that action be taken to establish them at a level that would ensure necessary co-ordination and implementation.
3. There is a need to train scientific and technical personnel at all levels and to increase technological capability for comprehensive coastal area research, planning, management and control.
4. There is a need to take into account all ecological factors when developing coastal activities to ensure compatibility and suitability of proposed uses.

B. ACTION AT THE INTERNATIONAL LEVEL THROUGH THE UNITED NATIONS SYSTEM

The United Nations and the specialized agencies should continue to strengthen their activities in:
1. Assisting developing countries to establish data bases, acquire methods and techniques, and formulate regulatory measures necessary for integrated coastal area resource development and management.
2. Assisting developing countries to focus on national and regional coastal area development and to increase their human resources through training courses, programme development and institution building.
3. Promoting co-operation and co-ordination among developing countries in research and the exchange of information and the establishment of suitable mechanisms for these tasks.

III. METHODOLOGY USED BY THE WORKING GROUP

The processes employed by each working group in performing its task had certain similarities and differences:
1. All groups simplified the process provided as a model.
2. All groups utilized the experiences of the members for identifying important factors to be considered in assessing compatibility and impact of coastal area uses.
3. All groups utilized the information matrix as a device for organizing the thoughts of the working groups' members, who had widely diverse interests and experience.

4. The most significant process difference between the groups was the depth to which a scenario was developed, including socio-economic and ecological considerations. The approach varied from a very detailed description to only the most general of expressions.

The substance derived from the workshop process also had certain commonalities:

1. In the area of commonalities, all groups identified from their experience potential multiple uses that included tourism, the recovery of non-renewable resources, the recovery of renewable resources, and ports.
2. The significance of an adequate data base for the integrated planning process was readily apparent when the groups attempted to quantify compatibility and impact.
3. There were no substantive differences between the groups.

In conclusion, there are a few general comments that can be offered as to the overall operations of the working groups.

FIRST, the groups offered the participants an excellent but severely compressed simulation of the type of environment in which they might expect to develop a real coastal area programme: diverse interests, diverse experience, incomplete information and perhaps conflicting goals and objectives.

SECOND, the importance of adequate information for detailed decision-making was amply demonstrated. Where information does not exist, only the most general of descriptions of a programme can be made. The absence of adequate data does not, however, imply "no action". Concepts can be developed but not pre-tested.

With all its limitations, the working group process has proven its great advantage in dealing with such complex issues as coastal area management.

REPORT OF THE ENGLISH-SPEAKING WORKING GROUP

This summary is not in the form of a narrative report, but rather seeks to delineate the process whereby the group evolved a methodology, derived in principle from the Goodman/Armstrong framework. Section I therefore gives a sequential breakdown of the group's deliberations. Section II outlines in more detail the first key stage — developing a scenario derived from the problems and interests of the participants. Section III comprises the second key stage of applying the scenario to the Goodman Flow Chart. Section IV gives the conclusions derived from Sections I-III. Finally, Section V lists related but separate recommendations for specific UN action.

1. PROCESS

<u>Step 1</u>

List the multiple activities theoretically possible within a coastal region and of interest to the participants:

Industry
Mariculture
Fisheries
Tourism
Transportation
Port development
Recreation
Mineral resources
Agriculture
Housing
Desalination plant
Defense
Salt
Energy from tides, winds, and waves
Culture and historical conservation
Wildlife
Water resources
Wetlands

Step 2

Group the uses into four general categories:

Renewable resources
Tourism - recreation
Transportation and infrastructure
Non-renewable resources

Step 3

Choose four representative activities for each of these categories:

Renewable biological resources - fisheries
Non-renewable resources - petrochemical industry
Transportation and infrastructure - development of a port
Tourism and recreation

Step 4

Determine those resources for which potential conflicts might arise:

Fisheries (including coastal aquaculture) require

boat building
gear
terminal facilities
energy
market
social infrastructure
transportation
fishing ground (sea space)

Petrochemical industry requires

land
raw materials
energy
dumping space
site
market
semi-finished or finished products
labour

labour amenities, transportation
water supply
environment

Port development requires
sea-bed and space
land space
dredging
navigation
transportation
communication
freshwater
energy
human resources and training

Tourism and recreation require
hotels
land space
marina/jetties
beaches and sea
transport
attractions (ancillary social facilities)
telecommunications
environment - conservation - national and
underwater
parks
waste disposal
culture
water
energy
labour

Step 5

Refer to flow diagram box 1 (Problems and Issues) taking the example of the petrochemical industry.

The main problem of pollution can best be identified with respect to the nature of interaction with other uses by breaking down into its constituent parts:

extraction
transportation
refining
ancillary industries

Step 6

Establish a matrix comprising the petrochemical industry broken down into its constituent parts together with the other chosen activities also broken down into their constituent parts, to be filled in individually by each member of the group.

Step 7

Assess where the matrix fits into the flow diagram. Decided that it satisfied the requirements of boxes 6 to 10 but because of the complexity could not cover box 2a (boundary definitions).

Step 8

Draw up guidelines therefore to establish boundary definitions for each activity to be considered under one or more of six headings:

Physical; for example, 200 m depth of water for oil exploration
Legal; for example, one legislative capability to control territorial waters to the territorial limit
Socio-economic; for example, human resources (specialists), locational requirements of ancillary industry
Functional: for example, the space needs of chosen activity
Environment impacts
Precedent

Step 9

Place all the variables so far revealed into a contextual framework by formulating a scenario covering the physical, economic and social charecteristics of a mythical developing country named "Xanadu".

Step 10

Fill in the Goodman Flow Chart according to information derived from the scenario.

Step 11

Evaluate differences in individually completed matrices as a means of identifying information needs.

2. SCENARIO

Introduction

Xanadu is a small fictitious country with an area of x sq. km. The country supports itself largely through agriculture which is conducted mainly in the hinterland. Agricultural products are transported via railroad to neighbouring states. As part of its overall development policy, following its recent independence, Xanadu intends to develop its trading and commercial capability and at the same time exploit its coastal area resources in an integrated fasiion.

Topography

The country is comprised largely of highlands with a relatively limited flat coastal zone, the soils of which are essentially sedimentary.

Climate

Xanadu is a tropical/subtropical country.

Coastal resources

(i) wetlands: extensive areas of the coastal zone are wetlands surrounding the rivers draining the interior highlands. At present a town is situated on the banks of the major river with limited port facilities. These limitations include relatively shallow waters and poor berthing facilities.

(ii) fisheries: at present the fishery exists at an artisanal level with the use of unmechanized sailing craft operating over the continental shelf close to shore. The near-shore pelagic fish stocks and the assemblages of fish around the coral reefs are exploited by means of gilnets, handlines, traps and spearfishing.

(iii) beaches: by virtue of its amenable climate and the good beaches existing adjacent to the coral reefs, Xanadu has a potentially good but poorly developed tourist industry.

(iv) minerals: the results of recent petroleum exploration have shown that there are economically exploitable oil reserves on the continental shelf.

Human resources

The coastal area of Xanadu has a low rural population but the urban area is densely populated. The labour force is essentially unskilled with a corresponding low level of income. Unemployment is high and politically the people are unsophisticated.

3. FLOW CHART

Application of scenario to Goodman Flow Chart in order to illustrate methodology for resolution of conflicts.

Box 1:
- unemployment
- lack of foreign exchange
- malnutrition
- absence of infrastructure for commerce

Box 2a:
- environmental impact
- physical
- legal
- socio-economic
- functional
- precedent

Box 2b: Deal with problems identified in Box 1 by:
(i) establishment of petrochemical industry (employment and foreign exchange);
(ii) an expanded fishery operation (protein and employment);
(iii) an expanded tourism industry (employment and foreign exchange);
(iv) establishment of a port to provide necessary infrastructure to facilitate other activities.

Box 3a: Scenario

Box 3b: Port authority (small)
Chamber of commerce (loose control)

Box 4a: Resources under-exploited at present, although insufficient suitable dry land for development of a port.

Box 4b: The goals in Box 2b are based on projected demands for the activities over the next ten years. There is need for skilled labour. There is need also for an information dissemination system.

Box 5: No problem is anticipated at this stage.

Box 6: Resources are adequate at present but a deficiency of dry land could occur at a stage beyond the 10-year projected programme.

Box 7a: Resources sufficient at present, to absorb anticipated consequences of proposed development.

Box 7b: Despite sufficiency of resources by and large, activities have been identified for resource allocation and limiting uses.

Box 8 and Box 9: Wetland areas for reclamation to allow for construction of port and urban expansion. Wetland reclamation will be restricted by ecological considerations and the need for providing environmental safeguards.

Box 10: The four uses could be perhaps ranked in the following order of priorities:

(i) oil
(ii) port
(iii) fisheries
(iv) tourism and recreation

It must be specified that this ranking in an unactual case would have to be preceded by a comprehensive survey taking into account economic, social, environmental, and other appropriate factors.

Box 11: (i) The oil exploitation could perhaps be done by an international oil company working under the supervision of the government of Xanadu.
(ii) A major port authority would have to be set up.
(iii) A directorate of fisheries and one for tourism will need to be established.

Box 12: A port authority would be set up.

Box 13: Legislative action would be required for setting up the port authority and for supervision and regulation of the oil company.

Box 14: Management could be by a coastal area management authority accountable to the national planning agency. The authority could include representatives of the major users of the coastal area and also have functions for regional, environmental and physical planning. Facilities for research and data collection would be required as well as a scheme for training skilled workers necessary for the various developmental activities. Technical details of constitutent units, for example, the fishery would be worked out by the authority concerned, in this case, the director of fisheries. Areas of interaction and conflict would be ruled on by the proposed authority which would be vested with powers necessary for this purpose.

4. CONCLUSIONS

Establish, if necessary by legislation, a regional environmental physical planning authority as depicted in the organizational diagram in Fig. 2. The authority should have (i) operational function of external integration with the national planning agency and intersectoral integration (internal), and (ii) decision-making function in determining environmental issues of development and construction.

5. OTHER RECOMMENDATIONS FOR FUTURE ACTION BY THE UN AND ITS SPECIALIZED AGENCIES

(i) Regional seminars should be organized that focus on specific problems of common interest to coastal states where regional co-operation is most likely to prove feasible.

(ii) Training seminars or workshops should be organized by the UN Ocean Economics and Technology Office with the co-operation of other UN specialized agencies on:

1. the methodology of assessing socio-economic and environmental impact on developments within coastal areas
2. methodology for compiling an integrated inventory of data required.

(iii) The UN Ocean Economics and Technology Office, with the assistance of other UN agencies and interested parties should form a task force in order to formulate general guidelines for the development and management of the coastal zone, applicable to the majority of developing coastal states.

(iv) The UN Ocean Economics and Technology Office, with the assistance of other UN specialized agencies should develop means of accommodating the possible requests from Member States in the development and management of their coastal area programmes.

(v) The necessary steps in implementing the above recommendations should be taken within a reasonable time.

(vi) Countries should develop the capability to acquire the environmental data and information needed for coastal development and management using where appropriate the assistance of the competent agencies of the UN and other bodies.

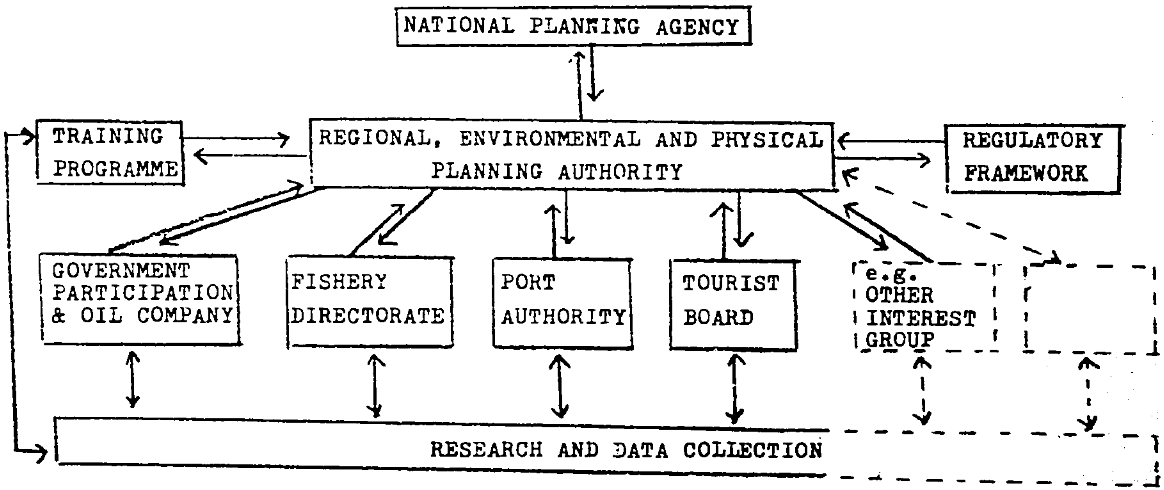

Fig. 2: Proposal for a regional planning authority

REPORT OF THE FRENCH-SPEAKING GROUP

The French language working group held its first session on Monday, 7 June 1976, with the aim of drawing up a report presenting the results of the work undertaken by the participants since 31 May.

The Chairman opened the session and gave a resumé of the subject matter of which the group had been convened to discuss.

The floor was then taken by each of the participants in turn and by the experts; the comments following the discussion were adopted unanimously.

- Considering the need to promote the development of coastal areas in developing countries,
- Considering that the coastal areas of developing countries have a double role:

Firstly, vis-à-vis the interior the coastal areas must be developed on the basis of their own resources because their development controls that of the hinterland in all respects.

Secondly, the coastal areas should ensure contact with the interior and it is through the coastal areas that a country carries out its trading.

- Considering the need to formulate a general development plan taking into account the conditions prevailing in each country,
- Considering the population particular to coastal areas in many countries,

1. The group recommends the planning of the development of coastal areas in developing countries using the integrated method which involves action in all appropriate sectors at the same time.
2. The group further recommends that care should be taken to prevent any of the activities unduly influencing the others.

Examples:

Port development may have an adverse effect on certain activities.

The oil industry may be incompatible with tourism.

In certain cases tourism may degrade the whole of a coastal area and create the need for purification plants.

3. The group notes the existence of problems regarding the utilization of coastal areas and agrees with the Rapporteur General of the Seminar that the solution of conflicts can be identified through the analysis of four major uses of coastal areas.
4. The group notes that every development plan must involve the following three phases:

a) Formulation of a study of the basic data

At this level information specific to each area must be collected. This may include information on

- hydrology
- sedimentology
- biology.

In short, it is necessary to undertake an initial morphological study.

b) Decision to develop a coastal area

A development plan may have two areas of impact. For example, if there is a chance of discovering oil, it is essential to prepare a study on the impact of this plan on the natural environment. The oil industry may have an impact on other activities. It should be examined whether such a project has adverse ramifications for fishing or positive ramifications for other sectors, in which case it is necessary to decide whetheror not there is a conflict. In any event, scientists should be involved in the preliminary analysis. Economists are likewise needed to calculate the costs, which are likely to determine the choice.

c) Problem of a posteriori prediction

This involves predicting the consequences which an implemented project may have and the actual follow-up. It would therefore be necessary to monitor work in order to ascertain whether the consequences which were foreseeable at the time of implementation have occurred as expected or have been more serious.

Following this survey the problem of methodology was discussed. After exchanging opinions the group opted for the listing of all uses to which the theory of graphs can be applied. Using this theory, it was possible to define in the case of the five selected uses the factors of interference listed in Table 1.

The group concluded that the effects of interactions of all the uses of coastal areas are relative. For example, urbanization in coastal areas may in certain cases be beneficial to tourism but may in other cases be harmful to agriculture and vice versa.

The group also noted the existence of the three following types of interaction:

- compatible uses
- incompatible uses
- particular cases.

1. Compatible uses

With regard to compatible uses, the group after intensively analyzing the facts relating to the problems, noted that whatever the type of development envisaged, infrastructure represents the most basic and essential requirement.

2. Incompatible uses

The group also observed that general activities relating to renewable resources may be incompatible with those relating to non-renewable resources.

For example, the exploitation of oil fields may prevent fishing. Mining is also detrimental to agricultural development but on the other hand may have a positive effect on the settlement of the population, industrialization and urbanization.

3. Particular cases

There are numerous and varied cases. Table 1 lists four cases in which development of certain sectors is justified.

TABLE 1

Interference of different uses

	Infrastructure	Renewable Resources	Tourism	Non-renewable Resources	Urbanization
Infrastructure		100% +	100% +	100% +	100% +
Renewable resources	7 + 0 -		100% +	100% -	6 + 1 - I
Tourism	7 + 0 -	7 + 0 -		6 - 1 + H	6 + 1 - To
Non-renewable resources	7 + 0 -	7 + 0 -	6 - 1 + H		5 + 2 - To B
Urbanization	7 + 0 -	6 + 1 - I	6 + 1 - To	5 + To 2 - B	

Legend: - incompatible

+ compatible

To: case particular to Togo

I : case particular to Iran

H : case particular to Haiti

B : case particular to Benin

In the coastal zone of the Caspian Sea in Iran urbanization might have an adverse effect on the exploitation of renewable resources.

In Haiti tourism has to give way to the exploitation of non-renewable resources.

In Benin and Togo the exploitation of non-renewable resources and urbanization bear no relation to each other and the former does not profit the latter. Finally, rapid urban growth in Togo is affecting tourism.

It is important to know the grounds for these different cases, and to analyse systematically the justifications put forward in this regard.

In the case of Iran, the incompatibility between urbanization and the exploitation of renewable resources, principally agriculture, affects the coastal zone of the Caspian Sea. The conflict arises from the fact that despite the size of the country irrigable land is in short supply. The urbanization of the coast is affected by those in a position to have country houses in the region. This however will be to the detriment of arable land. For this reason there is justification in promulgating an act prohibiting the parcelling out of properties.

Tourism in Haiti is a priority but the management and exploitation of existing non-renewable resources also takes precedence.

In the case of Benin, the conflict involves urban development and the exploitation of non-renewable resources.

The exploitation of non-renewable resources in developing countries is limited to extraction operations. The accompanying infrastructure consists of only very basic urban amenities. People attracted by the exploitation of a mine, for example, disperse once the mine has ceased to operate. It should be added in this context that a mono-industrial town is very vulnerable to economic fluctuations.

In countries with a dependent economy the management of non-renewable resources is not generally integrated in the country's economic and social development plan.

Since the enterprises involved in exploitation operate with minimum costs, they fail to take any measures to improve the environment they pollute owing to absence of concern for the hazards which environmental factors represent for the health of their workers. This applies equally to Togo where tourism and urbanization appear to be two incompatible activities.

Togo has a coastline of 53 km of which the agglomeration of Lomé (capital) alone occupies 25 per cent. The rapid development of tourism is being accompanied by the establishment of a hotel infrastructure in Lomé and along the coast. The population density in this area has led to accelerated urbanization. In 1970, 21 per cent of the population lived in one-tenth of the country's total area. In 1960, the corresponding figure was 18 per cent. The coastal area, which constitutes the country's principal tourist potential, has been absorbed and for this reason, it is necessary to plan the integrated development of the whole coastal zone.

Table 2

MATRIX OF IMPACTS

Activities	Impacts	Physical 1*	Physical 2**	Chemical 1*	Chemical 2**	Biological 1*	Biological 2**	Economic 1*	Economic 2**	Social 1*	Social 2**	Average
Infra-structure	ports	1.9	2.0	1.7	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.95
	energy	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	roads, etc.	1.1	1.7	0.3	0.3	0.6	1.4	1.7	1.9	1.9	1.9	1.3
	wastes	1.4	1.7	1.6	1.1	2.0	1.7	1.4	1.4	1.6	1.4	1.5
Renewable resources	terrestrial	1.7	1.6	1.6	1.4	1.7	1.4	1.9	1.4	1.9	1.6	1.6
	marine	1.4	1.0	0.3	0.4	1.3	1.0	0.7	1.0	0.9	0.9	0.9
	wastes	0.4	0.7	0.9	0.9	0.9	1.0	1.0	1.0	0.9	0.9	0.9
Tourism	hotel complexes	1.0	1.3	0.6	0.7	0.9	0.9	1.1	1.3	1.1	1.3	1.3
	sites	0.6	0.7	0.4	0.6	0.6	0.6	1.0	1.1	0.9	1.0	0.8
	wastes	1.0	1.3	1.3	1.1	1.1	1.0	1.1	1.1	0.9	1.0	1.1
Nonrenewable resources	hydrocarbons	1.1	1.3	1.1	1.1	1.4	1.4	1.3	1.1	1.0	1.0	1.2
	ores and construction materials	1.3	1.3	1.1	1.1	1.1	1.4	1.1	1.3	1.1	1.4	1.2
	wastes	1.1.	1.3	2.0	2.0	1.9	2.0	1.6	1.3	1.6	1.6	1.5
Urbanization	buildings	1.0	1.0	1.0	0.4	0.6	0.6	0.9	0.9	0.9	0.9	0.8
	industries	1.1	1.3	1.4	1.6	2.0	2.0	1.3	1.6	1.3	1.7	1.5
	wastes	1.1	1.4	1.3	1.3	1.3	1.6	1.6	1.6	1.6	1.6	1.4

Key: 2.0 Activities (special studies required)

1.0 Problems possible

0.0 No problems

1* : Estuaries and lagoons

2** : Sandy coasts

The group met for a third working session on the same day during which the effects of all the uses of coastal areas were studied in detail.

In the course of Tuesday, 8 June 1976, the group convened for two working sessions. During the first part of the session, the matrix of impacts (Table 2) was defined and the second part was devoted to the reading and adoption of the report and the recommendations presented by the Rapporteur.

The second session involved an analysis of the matrix of impacts which was revealed to be a valuable working instrument for the following reasons:

1. It can be used to define priorities and consequently to make a selection between them.
2. Once a selection has been made, it is possible to examine the nature and scope of specific measures to be taken in relation to the planning and development of coastal areas.
3. It represents an instrument providing suggestions which each country can adapt to its own situation.

RECOMMENDATIONS OF THE FRENCH-SPEAKING WORKING GROUP

The first Interregional Seminar on Development and Management of Resources of Coastal Areas, held in Berlin (West) from 31 May to 10 June 1976, recommends to the developing countries that they:

1. Recognize the urgent necessity of establishing infrastructure, particularly fishing ports, both concomitantly and prior to all programmes for the planning and development of coastal areas.
2. Recognize the need for the involvement, harmonization, co-ordination of geologists, oceanographers, town planners, and engineers in all projects for the planning and development of coastal areas; this applies to the preliminary as well as to the subsequent stages of the project. In other words, it is important to arouse the interest of the relevant sectors such as agriculture, tourism, finances, etc.
3. Recognize the necessity of involving local populations in all coastal area planning projects by preparing questionnaires with a view to collecting a maximum of information on the area insofar as relevant records are non-existent, and taking into account the following:

   a) If, for instance, a port is to be constructed, it is necessary to analyse the active and the passive systems, to clarify the function of the port, and to assess compatibility with natural systems and cultural values (necessity of knowing winds, currents, swells, waves, etc.).

   b) The objective of planning in coastal areas is in all cases to apply science to useful ends and to make it possible for man and activities to co-exist in a rational manner.
4. Recognize the necessity of considering the objectives set for the development and management of resources of coastal areas in the framework of national objectives, bearing in mind the problems raised during the course of

this Seminar.
5. Recognize the necessity of orienting the training of scientific and technical staff to the needs arising from the implementation of programmes for the development and management of coastal areas.
6. Establish national and regional bodies to co-ordinate the different sectors interested in the development and management of coastal areas.
7. Collect basic data needed to establish a plan for the development and management of resources of coastal areas in order to be able to define the limits of the plan and ensure its success.
8. In conclusion, it is possible, taking into account what has been said, to evaluate the costs and benefits arising from the conflicts between the various uses.

REPORT OF THE SPANISH-SPEAKING WORKING GROUP

The Working Group first deliberated at length on how to carry out their work. The method suggested by the Rapporteur was completely changed for practical reasons relevant to the countries of the members of the Working Group. The method adopted is considered useful for the structuring of a development programme for the coastal areas of the individual countries. The Working Group did not discuss the problems of each individual country because this would have gone beyond the terms of reference of the Group. However, it was considered advisable to mention important problems arising in some countries.

The deliberations were conducted according to the following pattern:

1. Discussion of the capacities and realities of the coastal areas.
2. Identification of general and specific problems of the countries of the Working Group members.
3. On the basis of the problems identified, the most urgent recommendations were elaborated; first, those of a general nature, and then some specific recommendations addressed to the United Nations and to the individual countries.

INTRODUCTION

One of the principal characteristics of developing countries is the fact that, having neither skilled manpower nor a developed industrial infrastructure, they must depend almost exclusively on their natural resources. This situation, together with the fact that frequently the means of developing these resources are lacking, results in the need either to call in outside know-how or to export the resources as raw materials. This has led in many instances to serious economic and social problems. It is therefore of cardinal importance that the technical capacities and know-how required for the development and management of natural resources be fostered at the national level.

This phenomenon, typical of the classical resources of the mainland, has even graver consequences with regard to the development of maritime resources, since many developing countries are as a rule not prepared to manage the marine environment. The complicated procedures connected with all types of marine resources exploitation tend to remove this problem even further away from the area of concern of the respective developing conntry. The coastal area, which forms part of a country's territorial waters, is one of its most valuable possessions. This area must therefore play a major role in the over-all development of the country. The development of the coastal area calls for the use of the most modern technologies on a comprehensive scale, if unsolvable problems are not to arise, as is unfortunately the case in many coastal areas in the world today.

With regard to the coastal area, the call for more rational, more comprehensive, more environment-minded development of resources is of even greater weight, since human activity in this spehre is of recent date and since the body of knowledge on the ecosystem of the ocean is still relatively restricted.

Efficient management of coastal areas is therefore extremely important. This is particularly so in developing countries in view of the limited experience gained in connexion with the development of coastal areas, excluding of course those countries which have developed a major fishing industry in the course of just a few decades.

In order to contribute to the formulation of a coastal area development programme, so urgently needed not only by the developing countries but also by the majority of the developed countries, the Working Group undertook to examine in depth existing problems, final objectives, existing or foreseeable conflicts, and project development, the main intention being to bring forth ideas and recommendations which would consitute a contribution to this coastal area development probtamme.

1. INVENTORY

The coastal areas of our countries are plagued with serious problems, both general and specific.

General problems

a. A widespread problem of considerable impact in our countries is the lack of knowledge on coastal areas. Basic data which would ensure the rational exploitation of resources are either lacking completely or so incomplete and unrelated that they are unusable. This problem results from:

- the more or less acute shortage of academics who can research the physical, chemical, geological, and ecological aspects of the coastal area;
- the lack of government measures aimed at stimulating coastal area research;
- the small number, if not total lack of research centres specialized in coastal area researeh.

b. None of our countries has established a coastal area development programme conceived exclusively for the coastal area. This problem is of even greater importance, since without such a programme it is not possible to undertake the integrated and co-ordinated management and use of coastal resources. The causes of this problem can be summarized as follows:

- There is no central body invested with exlusive competence for the planning of coastal region exploitation. The result is that competence for coastal region management falls to various sectors which frequently set up good but one-sided development plans which do not take into consideration aspects which fall outside their competence. A few countries do have a national planning authority, but as a rule such an authority does not consider the coastal region to be an ecological unity requiring its own comprehensive planning.
- The state is in general not aware of the far-reaching economic, social, ecological and political importance of the coastal area. The result is that there is too little incentive properly to integrate and co-ordinate coastal area development.

c. All the countries have excellent and often numerous legal regulations governing the use of certain resources or activities in connexion with coastal areas. These regulations, however, relate only to certain aspects, are incomplete and complicated, and lack inner continuity. The reasons for this are:

- the lack of co-ordination in the management and planning of coastal areas;
- frequent disregard for ecological or environmental variables; if they are taken into account, only certain aspects are considered.

d. Complete absence of control or insufficient control of the application of the available regulations, which are thereby valid only in theory. The main reasons are:

- lack of an administrative infrastructure in some countries;
- lack of a specific control or supervisory authority. Where such an authority exists, it is insufficiently developed and therefore inefficient.

e. A particularly worrisome problem is the complete or partial shortage of qualified personnel for the research, planning, management and administration of coastal areas. In many cases highly qualified experts are available, but they lack the funds to convert their knowledge into practice. This problem is most evident in the fields of integrated planning and ecological research. The reasons for this are:

- the lack of universitiies or the inadequate expansion of existing university facitities. In addition, the universities concentrate on the training of experts qualified in one field, those who are therefore not conscious of the coastal areas as integrated ecological units;
- the general lack of research institutions covering the whole gamut of coastal area resources.

<u>Specific problems</u>

It is often difficult to sort the various specific problems into categories, since this can cause confusion. We have used a scheme which is based on the various economic activities.

a. Fishery problems

1) The biggest problem in this context is the one-sided and undifferentiated exploitation of fish stocks; one sector dominates the whole situation and determines the use of the coast on the basis of economic principles which pay no regard to the whole problem of social, economic, ecological, and political interaction. Typical examples are Peru and the exploitation of anchovy stocks, Mexico and the exploitation of crustaceans (shrimps, lobsters, prawns), etc.

2) The rapid growth of fishing ports in many coastal areas without the necessary infrastructure and involving problems with respect to transport, conservation, and marketing of fish products.

3) Traditional fishing or fishing as a craft without the application of modern methods or the organization needed to guarantee optimal use. This has severe socio-economic consequences for the skilled fishermen and are further aggravated by competition from the highly developed fishing industry.

4) Insufficient exploitation of the existing fish stocks as a result of inadequate integration in the country's plans of other resource uses, of poor accessibility, etc.

b. Agricultural problems

1) Farming in the areas directly adjacent to the coast causes disturbances in the ecosystems of the coastal areas which may have severe local ecological consequences. The prime causes are the deforestation of mangrove forests in order to supply the banana plantations with props; the uncontrolled use of insecticies and pesticides which pollute the rivers and sea, etc.

c. Forestry problems

The mangrove forests represent extremely important ecosystems on account of the resources they contain, e.g., trees (wood and props), molluscs, crustaceans, and fish.

In many countries conflicts arise in the use of these forests, i.e., conflicts between the preservation of the fish stocks, wood utilization, and the development of cultivated land in the vicinity, e.g., banana and cotton plantations.

d. Mining problems

Mining and the establishment of mining industries in coastal areas are harmonized with comprehensive development programmes which take account of effects on the environment. This is a central problem in sand and oil production, and the siting of refineries and concentrators, etc. The washings from mining products, waste from the mining industry, and metal ore drilling operations frequently cause severe alterations in biotic and abiotic coastal resources.

e. Tourist problems

When coastal areas are used for tourism the panorama is sometimes dominated to such an extent that problems are created similar to those which occur in the case of a monoculture, i.e., influx of sewage, traffic jams, alterations of the original landscape on account of the destruction of coasts and forests, geomorphological dangers (high-rise buildings, air currents, naval bases, removal of dunes) and changes in customs and habits. In many cases the advantages of tourism (financial revenue, human contacts, cultural stimulus) fail to compensate in the long run for the problems which it provokes.

While large-scale tourism can become a problem in some countries, coastal areas in other countries are not used for tourism because of their inaccessibility and the lack of measures to promote the necessary infrastructure, etc.

f. Problems in connexion with ports

Various activities severely pollute coastal areas and hence cause a reduction of resources. The detrimental effects of thoughtless deforestation of river valleys and the subsequent increase in erosion; the diversion of sewage from the towns; the washing of mining products on the coast or in the interior; industrial waste from refineries, paper factories, the chemical industry, etc.; and insecticides are particularly lasting.

This problem is particularly worrisome when it occurs in areas which are of special importance on account of their biotic resources, e.g., river mouths, mangrove forests, etc.

2. RECOMMENDATIONS

Before formulating the recommendations of this Working Group, it is appropriate to summarize the main aspects of the coastal environment and that which one wishes to make out of it: The ecosystem of the sea is in close relationship with all complicated phenomena which relate to a natural intermediate stage, as is the case in the area where mainland and water meet as well as in the prolongation of the continent towards the large ocean basins. The dynamic equilibrium of this ecosystem is the result of many variables which act simultaneously and about which one must be very well informed before taking action on any one of them.

The main objective of any basic study for the adequate management of these areas is the understanding of this ecosystem and its quantification, if possible with the aid of a mathematical model. Only in this way will rational utilization be possible.

A sectoral investigation of this problem, particularly in relation to a single resource or scientific discipline, should not be permitted; the study should be comprehensive in character from the very beginning. The same applies to the uses.

Every study on the environment requires systematic observations over long periods of time (temporal series) and adequate statistics of the ways in which man utilizes the environment.

On the basis of this premise and the problems discussed, the Working Group considers it necessary to formulate the following general and specific recommendations.

General recommendations

a. As a basic rule for the adequate management of the environment, one must above all recognize the significance of the coastal region within the problems of the country and identify the various intended uses. This presupposes that a corresponding national policy exists. The objective of this policy must be the integrated planning of the coastal region. For the reasons mentioned above, in connexion with the comprehensive character of the problems to be solved, this policy should not be formulated by a government organ which is responsible only for the partial utilization of the sea. Neither should it constitute an integration of the requirements of the various organs responsible for the various uses of the ocean. It must be emphasized that these organs, be they ministries, secretariats, departments, etc., are per se administrative organs and not policy-formulating organs.

For this reason the following is recommended: National policy on the use of coastal regions should be formulated by the highest state planning organ within the framework of the general national planning context.

b. National policy on the integrated use of the coastal region must take the form of a Programme for the Development of the Coastal Region (PDCR), which should be elaborated by the aforementioned supreme planning authority. This PDCR must take account of all aspects and variables of the coastal regions with regard to objectives, inventory, conflicts, and implementation of the programme.

For this reason, we recommend the following: National policy on coastal regions should take the form of a Programme for the Development of the Coastal Region. This Programme should be formulated at the supreme planning level of the state, its implementation should be secured.

c. After having established a national policy on the uses of the coastal region, it is necessary to take measures for its rational development. This cannot be done without sufficient knowledge of the bahaviour of the entire ecosystem; otherwise, there is the risk of this ecosystem being affected very unfavourably, undesirable and irreversible results being the consequence. This knowledge of the ecosystem must be based on thorough and long-term studies, a fact which often discourages government organs who are oriented towards short-term results. In view of the critical situation of the region, as mentioned before, it is preferable not to use the coastal region for some time rather than use it wrongly. For this reason the following is recommended: From the very beginning a comprehensive study of all aspects of the maritime ecosystem is to be envisaged in the form of a mathematical model. This involves the establishment or development of an institution staffed by experts from the disciplines of ecology, geology, physics, and chemistry, who from the very beginning aim towards the integrated utilization of the coastal region. A sectoral study of the problem is out of the question; the preparation of the comprehensive study of the problem should not be entrusted to a state organ which is responsible for only one type of

utilization of the coastal region.
d. Prerequisite for any type of ecological study is information on the potential existence of maritime resources in the coastal areas, the magnitude of development possibilities, and environmental characteristics (basic data) as well as data derived from the systematic observation of all these aspects. Due to the increasing number of countries engaging in oceanographic research and the action of the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO) within the framework of its activities concerning the exchange of oceanographic data (IDOE), several of these countries have already established a national oceanographic institute which collects, processes, records, and disseminates oceanographic data.

Due to the negligible oceanographic research activities in these countries, however, these institutes are not adequately utilized. Furthermore, data available in the various state organs on the existence, behaviour, and use of coastal resources are often scattered, incomplete, and not easily comparable with other data.

In view of the recommended integrated management of coastal regions and establishment of information centres, the following recommendation is made: In co-operation tith the various specialized agencies, the Intergovernmental Oceanographic Commission of UNESCO should discharge an advisory function in connexion with the adquateness and organizational structure of the state information sources on coastal area resources.

<u>Specific recommendations to the United Nations</u>

a. Organization of a Sub-regional Seminar on Latin America for the purpose of exploring more deeply the aspects discussed at this Seminar and of co-ordinating measures at a more specific level.
b. The technical and financial aid measures of the international organizations relating to development projects with a foreseeable impact on coastal areas should take into consideration the environmental variable.
c. Support of training programmes and promotion of implementation of model projects which illustrate the advantages of integrated planning.
d. Promotion of regional co-ordination agreements for the solution of problems which are common to several countries of a sub-region.
e. Supply of basic data, for example, tolerance indices for the pollution of the water, the air, etc., to the developing countries for use in elaborating standards for the control of effects on the environment.

<u>Specific recommendations to the individual countries</u>

a. Structuralization of a coastal region development programme whose implementation is binding for all sectors concerned as regards use and administration of coastal resources.
b. Provision of training, including advanced training for teaching staff and all scientific and technical personnel needed at all levels by the country for comprehensive

coastal area research and for the planning, management, legislation, and control of coastal areas.

c. Participation of experts of various disciplines in the elaboration of coastal area legislation in order to harmonize divergent concepts and avoid omissions which would have an adverse effect on the integrated utilization of resources.

II NATIONAL CONTRIBUTIONS

BARBADOS

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COASTAL AREA CHARACTERISTICS

POPULATION AND SETTLEMENT

Barbados, the most easterly of the Antilles, is one of the smaller islands of the Caribbean with a total land area of 166 square miles (about 106,000 acres). It is 21 miles long and has a maximum width of 14 miles. It has 66 miles of coastline.

The population of the island at the time of the 1970 census was 241,000. It is now estimated to be in the region of 250,000. This gives a gross population density of 1,480 persons per square mile and places it among the most densely populated countries in the world along with other island states like Hong Kong, Singapore and Malta (Fig. 1). It is certainly the most densely populated island in the Caribbean. This is an important background factor in any consideration of the current and potential use of the coastal areas, more particularly as one of the island's two major industries, tourism (the other is sugar) relies heavily on the beaches as a natural asset and is becoming a major land user of coastal areas and secondly, because the distribution of resident population has become increasingly concentrated along the south and west coasts.

As the Population Distribution Drawing clearly indicates however, the major concentration of population is to be found around the island's capital and port, Bridgetown, located at the confluence of the south and west coasts, where nearly half the total population of the island live.

Outward residential growth of Bridgetown has tended to be rather sprawling and low in density. It is now beginning to encroach on the rural inland areas. There is considerable scope for infill and increasing residential densities within the existing built up area of Bridgetown before allowing any further expansion of the urban area.

This is, however, of less immediate interest to the study of coastal areas than the secondary trend of population build-up fanning outwards from Bridgetown along the south and west coasts.

The south coast has always been more densely built up and the developed area extends further inland than on the west coast. New residential subdivision has in recent years penetrated beyond Oistins further along the coast almost as far as the airport. Conversely areas on the coast between Bridgetown and Oistins have lost resident population as a result of the accelerated change over to tourist oriented uses.

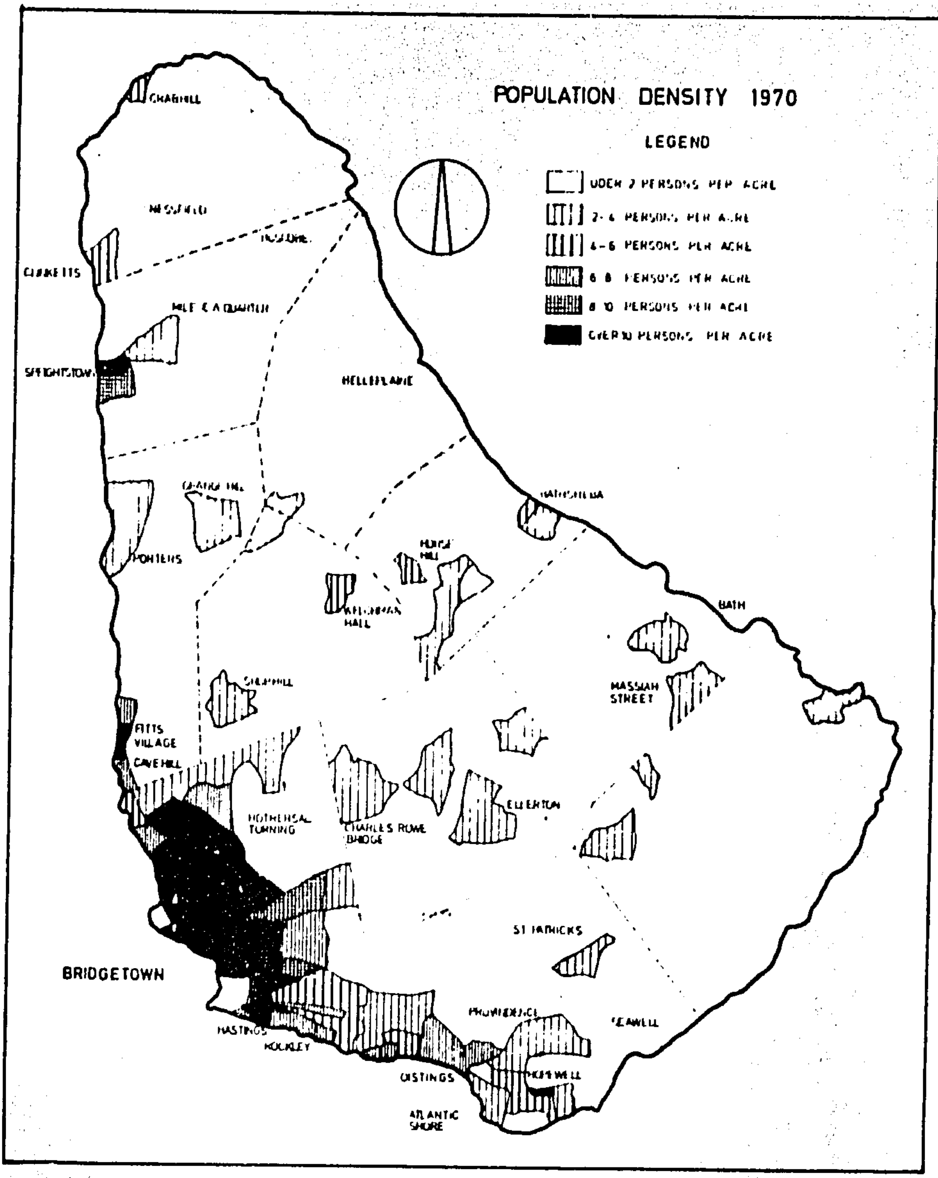

Fig. 1: Population density of Barbados. 1970.

On the west coast population growth has not been so marked partly because:

(i) Most new developments which have taken place between Holetown and Speightstown have been of lower density;

(ii) New development almost exclusively for tourist use, as at Holetown, does not show as a growth of resident population in the census;

(iii) Development has taken place along a relatively narrow strip of land for the most part on the seaward side of the coast road. Further development in depth inland is restricted by the Water Protection zones along considerable areas.

The over-all physical structure thus emerging from the trends in population movement (and tourist development) is of a coastal linear corridor of varying width extending on either side of Bridgetown south east almost to Seawell Airport and northwards to Speightstown, a distance of about 20 miles. Within this corridor is considerable scope for future infill and growth and provided care is taken not to overload the infrastructure, particularly roads (already some congestion) and beaches; it may well be that the best strategy is to concentrate further growth here. It would have the advantage of leaving substantial areas of coastline relatively undisturbed and, second, would not encroach on the good inland agricultural areas.

PHYSICAL CHARACTERISTICS

Barbados is unusual geologically as it is not of volcanic orgin. About 6/7 of the island is coral rock which in most places is 100 feet thick or more. Under this coral cap are sandstones and clay. This gives a typical coastal terrain of coral terraces with inland cliffs that were once sea cliffs — which then meet the sea either as cliffs backed by sea racks, or as fine white coral beaches. In the remaing 1/7 of the island, on the east coast, the coral cap is absent resulting from a fault which stripped off the coral and exposed the underlying sandstones and clay. This, makes for a more rugged and exciting scenery; large coral boulders having been thrown down are now deposited along the shore.

GEOLOGY/WATER SUPPLY/SURFACE WATER DRAINAGE

The geological structure of the island is the key to its system of water storage and supply. Water occurs in Barbados as all ground water, which has infiltrated through the coral cap, and is held in the pores of the coral stratum with the downward movement arrested by an underlying clay stratum. Near the shoreline the fresh water is held in a hydrostatic balance with the heavier sea water, and is obviously prone to salt water intrusion if the aquifer is overdrawn. This storage is called sheet water. It happens that since the slope of the coral/clay interface is in that direction, the sheet water areas are mostly along the

South and West Coasts.

It is estimated that these resources could supply 35 million gallons per day, as against the present average water consumption of 20 - 23 million gallons per day.

The resulting water supply is in fact very pure. As the water passes through the very fine pores of the coral most of the impurities are filtered out. Thus no filtering or artificial additive other than a small trace of chlorine is necessary. The supply is trapped by wells direct from the stored rainfall.

The location of the wells mostly on the South and West Coasts is of considerable significance as a development constraint. Around each well used for domestic supply a large area has been zoned off and laws passed to prohibit any new building or other development in the area, because untreated human sewerage is the principal potential source of contamination to the water supply. The rest of the island is also divided into various zones in which certain types of development are restricted and which impose strict conditions for sewerage disposal and storage of oils and dangerous chemicals.

SURFACE WATER DRAINAGE

Again the properties of the coral line limestone have a marked influence on surface water and storm water drainage. The porosity ensures the enlargement of surface and underground fissures into deep gullies and caverns so that surface water rapidly drains through. This is especially so on the higher areas further inland.

In the coastal area of the South and West, however, inspite of these natural advantages considerable problems with surface water run off persist. The reasons for this are:

(i) The coastal main highway tends to act as a physical barrier to water flowing down from higher areas because of inadequate culverts, and all run offs from the catchments must pass under the road;

(ii) Much physical development has taken place in the past without regard to drainage considerations;

(iii) Ground levels in many places along these Coasts are too low to permit a fall and therefore flow of surface water to the sea.

This last condition results in a back up of stagnant water more particularly in the vicinity of the concrete surface water outfalls located at regular intervals along the Coast. These outfalls invariably terminate within the zone where sand movement is constantly changing the shape and profile of the beach, depending on tidal and wave conditions. Erecting structures in this dynamic zone leads to accretion of sand (sand bars). The outfalls can often thus be instrumental in causing coastal erosion, since sand built-up in one area often results in sand loss elsewhere. The sand bars can also aggravate the minor flooding which sometimes occurs during times of heavy rainfall.

The only area of the island with a persistent flood problem is part of Bridgetown urban area, including part of the town centre, within the catchment of Constitution River. But even here high flows on the river are only of short duration; for much of the year the river is low or dry. Attempts to cost alternative methods of limiting, but not eliminating, flooding here have shown that the amount of damage caused would not justify the outlay of capital expenditure to remedy the situation.

On the East Coast, the Scotland District (see Fig. 2) has none of the advantages pertaining to the coral caps' ability to absorb water. The oceanic clay of the coastline is therefore deeply scoured and eroded by rainfall. The general instability of the soil poses severe problems to development and consequently the area remains largely wild and unspoiled.

AREAS WORTHY OF PRESERVATION (Fig. 3)

Inspite of the rapid extension of urbanisation along the South and West Coasts there still remain substantial areas around the North and East Coasts of unspoilt natural scenery, as well as areas of ecological significance. The distinction between areas of ecological importance which have to be preserved without change in their natural state, and areas of natural beauty where varying degrees of limited and strictly controlled development can take place, is an important one in the context of a crowded island with twin pressures of tourism and population affecting the use of coastal areas. Each area has to be examined carefully to determine what is essential to be conserved and the impact different types of change can have on the natural habitat.

NORTH COAST

Includes areas both of ecological significance and of natural beauty. The various bays and coves could in future be combined as a coastal national park.

LAMBERT POINT TO CLUFFS BAY (1)

The area centres on Archer's Bay already extensively used as a picnic spot which the Government has agreed in principle to acquire. On either side a strip 300 feet wide inland from the Coast would suffice. The dense vegetative cover leading down to the sea, e.g., at Cluffs is spectacular, and no development should be allowed. Some improvement of access and car parking could be acceptable for utilisation of Archer's Bay recreationally.

CLIFFS OF NORTH POINT (2)

Includes stacks, inlets, arches, caves and blow holes as well as Animal Flower Cave (under cliff caveon with coral formations in pools; open to public); no pressure for development of this area due to barren character.

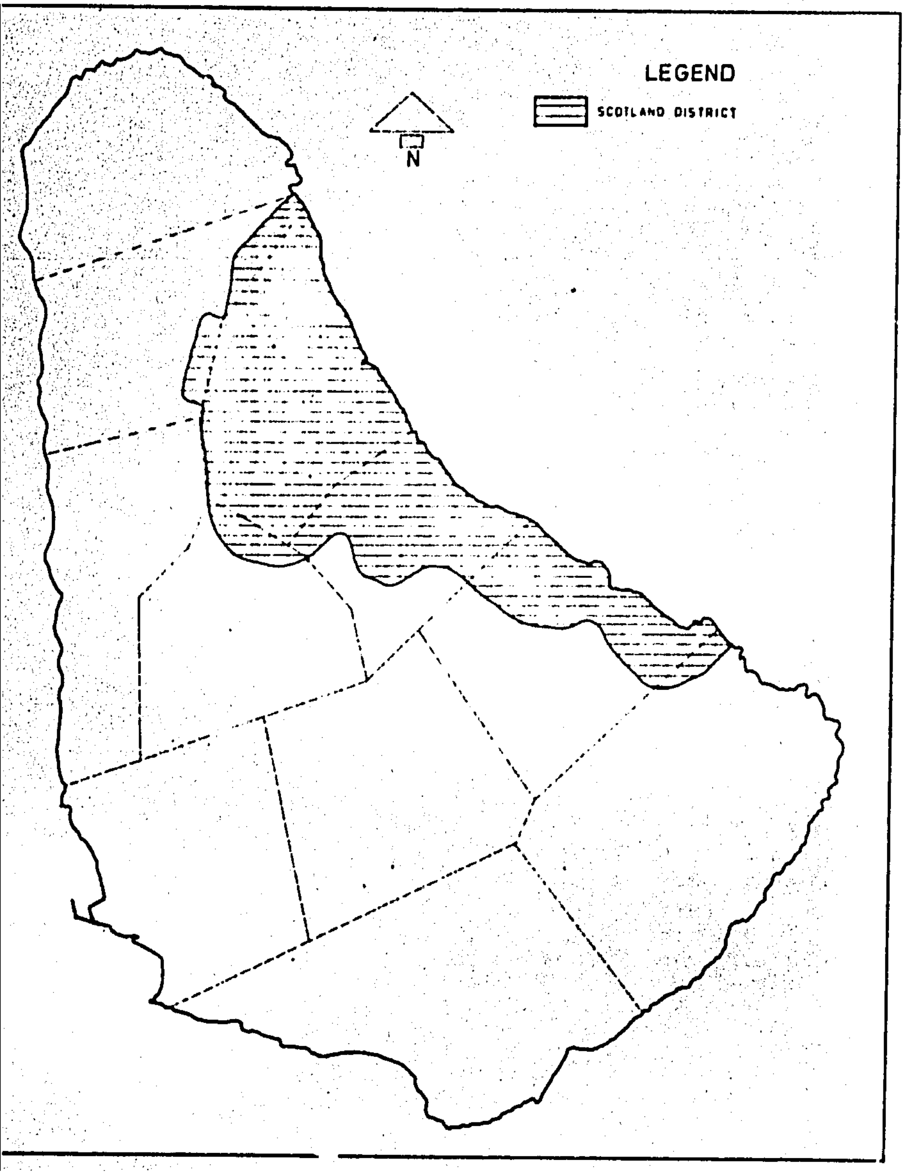

Fig. 2: Location of Scotland District.

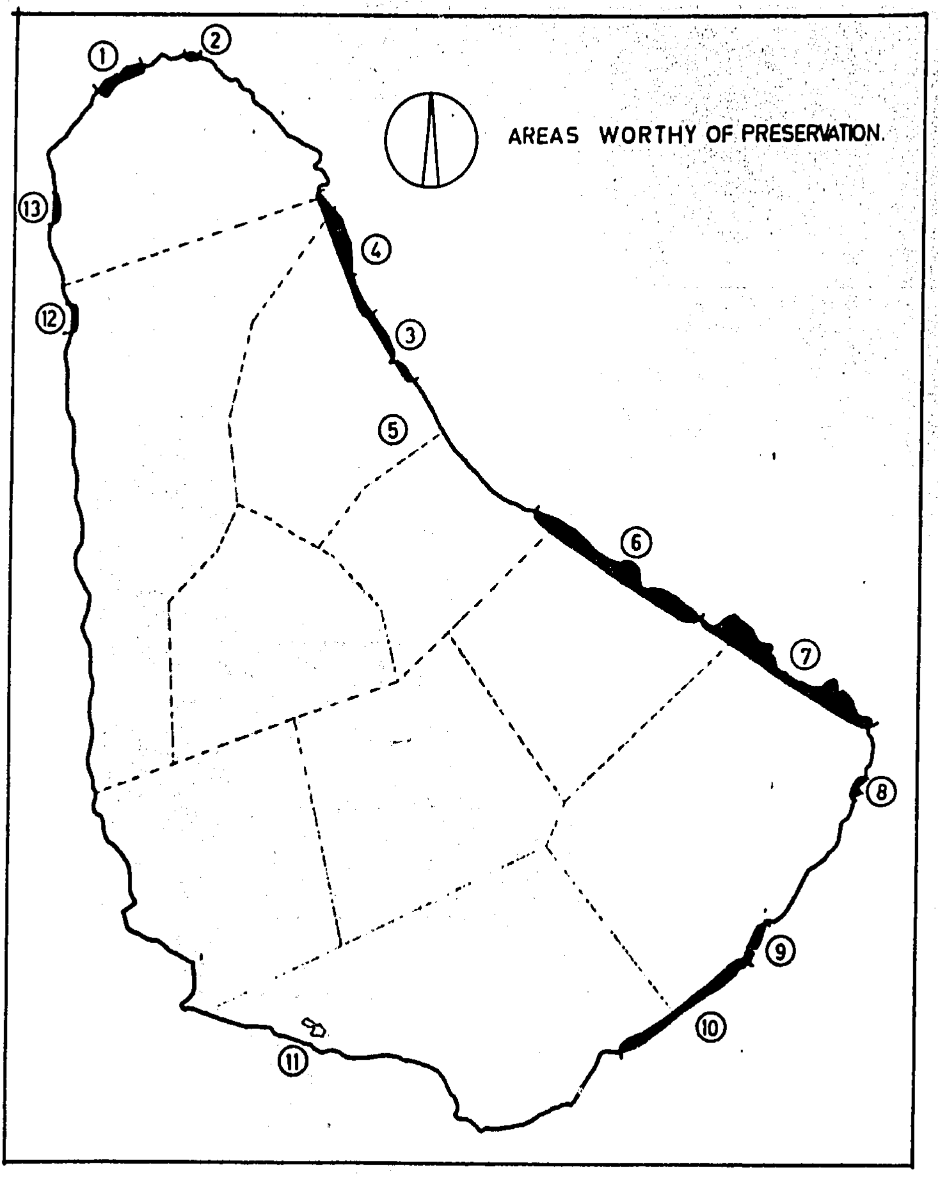

Fig. 3: Areas worthy of preservation.

EAST COAST

There are three major areas (Nos. 3, 4 and 5), on a much larger scale than the North Coast, with potential to be linked as a National Park.

WALKERS SAVANNAH AREA (3)

Contains the most extensive sand dune area on the island; with the only characteristic tropical sand dune vegetation. An access road with car parking facilities could be provided. Some limited development behind sand dunes could be permissible.

GAYS COVE/PICO TENERIFFE/THE CHOYCE (4)

An area of exceptionally fine natural scenery, also of geological interest. Pico Teneriffe, although only 263 feet high, is outstanding, falling to the sea at a steep angle, with a fine exposure of the oceanic series. It can be seen for many miles. Pressure for development is limited. Sheep grazing is common.

CHALKY MOUNT AND EAST COAST ROAD (5)

The area is unique to Barbados. Chalky Mount rises to 549 feet and is a miniature mountain range of bold relief including a fine pinnacle ridge, with broken cliffs facing North and South. The village is famous for its pottery industry.

The seaward frontage of the East Coast Road is free of development and provides excellent view of boulders on shore thrown down by slippage. Limited development on landward side exists but should not be intensified.

TENT BAY TO CONSET BAY (6)

A coastal strip 300 feet wide from the cliff or high water mark would adequately protect the attractiveness of this coastal stretch.

SOUTH EAST COAST (Conset Bay to Foul Bay)

The southern boundary of Scotland District is taken as the starting point for this section of coastline. There is a gradual built-up of population but the area remains essentially rural with scattered fishing villages.

CONSET BAY TO THE CHAIR (7)

Contains land where pressure for residential subdivision could soon be felt and it may not be possible for the whole area as shown to be preserved. A 300 feet wide strip would preserve some good cliff scenery and fine rugged terrain lying on the seaward side of the inland escarpment.

PALMETTO, BOTTOM AND PEAT BAYS (8)

The three (3) bays together extend for 1 mile only and constitute a small but most beautiful stretch of coast. Peat Bay, for instance, is small, almost perfectly semi-circular with vertical cliff walls 30 feet high hemming in a level sandy floor in which coconut palms grow, their palms overlooking the cliff.

FOUL BAY (9)

A large bay, well-defined by run of the cliff from each end of the bay in a semi-circle. Unusual for good bathing beach, no residential or hotel in immediate vicinity. Restriction on further building 300 feet from top of cliff, preservation of undercliff wood and sand dunes required.

SOUTH COAST

Defined for this exercise from Paragon Cliffs to Carlisle Bay. Includes area of major urban/tourist development.

PARAGON TO OLIVER'S BAY (10)

Fine cliff scenery, including highest cliffs on the island (100 feet). Limited by inland cliff, providing inland terraces. Proximity to airport and consequent noise problem restrict further development and aid conservation.

GRAEME HALL SWAMP (11)

Located in the midst of South Coast built-up area. Were it not for important natural drainage function and danger of flooding, it would probably have been developed. Swamp contains a unique growth on the island of Mangrove and has become a wintering habitat for a number of bird species. Proposals for development mean that only preservation of limited part of the area is feasible.

WEST COAST

SIX MEN'S BAY (12)

This one of the few remaining "windows" to the sea on the West Coast, is a fishing village of wood chattel houses unaffected by tourist development.

MAYCOCK'S BAY (13)

A wide beach of fine white sand with extensive heavily wooded and undercliff area. No housing, hotels or vehicular access. It is a possible site for a cement plant which if sited on cliff top, need not irretrievably spoil natural beauty.

RESOURCES AND USES OF THE COASTAL AREA

NATURAL RESOURCE ENDOWMENT

Barbados' main natural asset, is its fine white beaches, No mineral natural resources have yet been discovered and the island's other natural endowments are basically geographical ones.

Historically, Barbados was well placed to become a port and a thriving centre for commerce. The combined effects of the North East Trade Winds and the convergence of the North and South equational currents make it the most convenient first land-fall for sailing ships approaching the Caribbean from Europe. Added to this, it has had the further advantage of being South and East of the main hurricane strike areas in the region.

For tourism the island has a natural advantage in climate as a result of the cooling breezes of the Trade Winds, which make it somewhat cooler than other islands in the region. Moreover, there are clearly recognisable wet and dry seasons and the time of year when skies tend to be clearest and the cooling Trade Winds most pleasant, corresponds with the North American and European winters. The island is also well placed geographically to receive tourists from South America.

A further natural asset is the reef surrounding the island which is not only the natural habitat for fish, but ensures shark-free beaches.

An unfortunate aspect of the fishing industry has been small-scale dynamiting of the reef. Although probibited by law sine 1904, it has continued spasmodically until quite recently. It not only destroys fish life and therefore affects inshore reef catches, but affects the growth of coral. An important decision has therefore been taken to protect a 2 mile stretch, 1/4 mile from the shore of the best and deepest coral by establishing a Marine Underwater Park off Holetown, where there will be complete restriction of activity likely to damage underwater flora and fauna.

THE FISHING INDUSTRY, INCLUDING SHRIMPING (see Fig. 4)

The island's fishing operation is mainly limited to inshore fishing in small open boats which do not go beyond 25 miles, because of lack of navigation. The average yearly catch of 7 - 10 million pounds provides about 2/3 of the island's demand for fresh fish.

It is a traditional industry giving rise to many small fishing villages and is a direct source of employment for 1,400 men who man the 570 small boats; total employment extends into the service and distribution trades the industry generates.

The fishing is seasonal which does create problems of continuity of employment. For instance, the flying fish, by far the largest part of the catch, only hit the island between November and June each year.

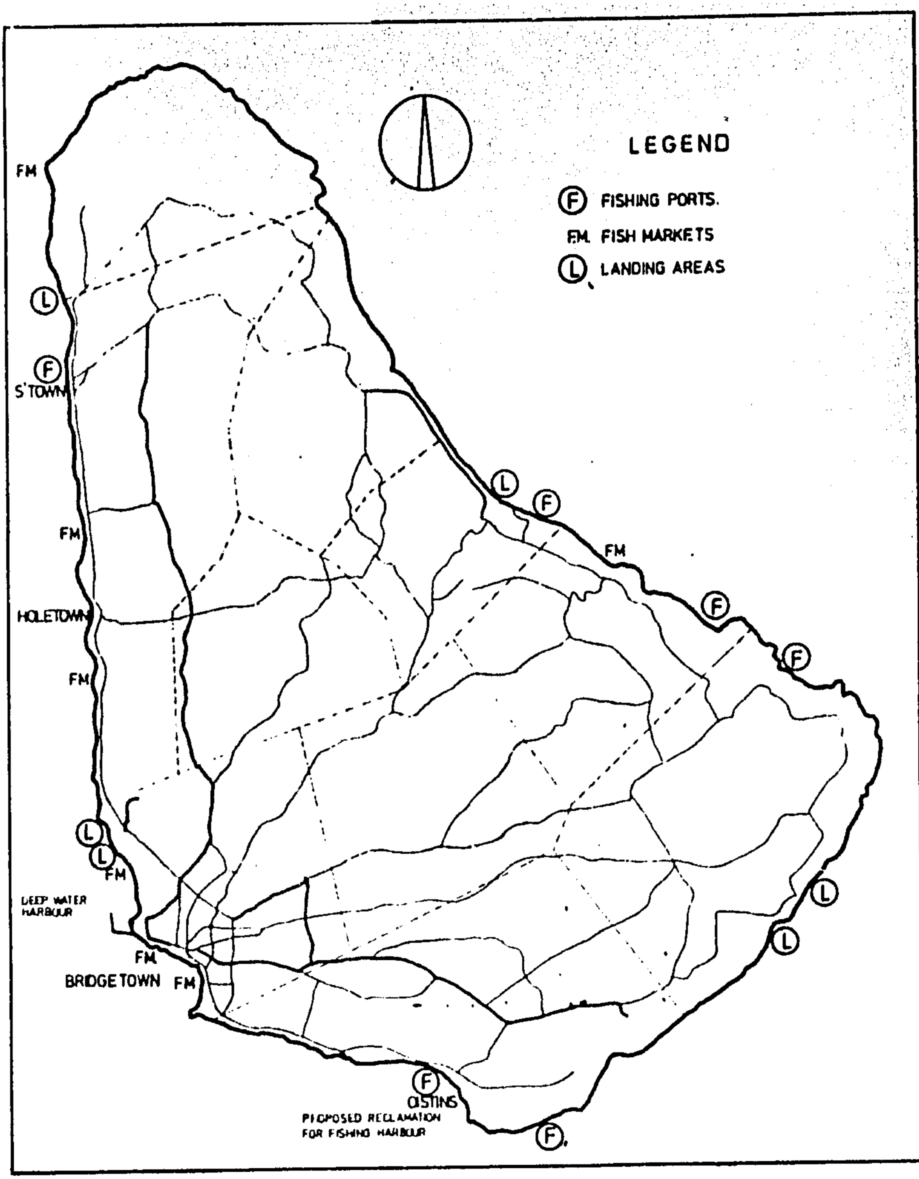

Fig. 4: The fishing industry including shrimping.

The major landing area markets are in Bridgetown (2), Oistins and Speightstown, which deal with over half the recorded landed catch. The other landing areas are on numerous scattered locations around the coasts (see Fig. 4). Facilities at landing areas include market buildings at the larger ones, and at smaller ones, covered sheds and fresh water supply. Electricity is now being installed at selected centres. Government's policy is to concentrate such improvements as this and provision of berthing facilities at a few selected centres and thus reduce the number of landing areas.

At the moment there are no modern fishery harbours on the island. The feasibility of reclaiming 2 acres of land from the sea at Oistins is therefore being investigated with a view to providing a landing pier for 120 vessels, a new market and cold storage facilities. If in addition to this, the three ice factories and three cold storage plants in Bridgetown — all readily available for more intensive use during the seasonal glut of fish — are considered, there is clear indication of the potential for expansion, once the industry can be re-organised with slightly bigger boats and navigation equipment to enable further deep sea fishing.

After a period of non-operation, the shrimping industry was re-established in 1973 with a fleet of 20 refrigerated fiber glass trawlers, and the shrimp processing plant on the water-front between the Careenage and the Deep Water Harbour was reinstated.

To begin with, operations were successful. It was intended that nearly all the catch should be for export, and in the last quarter of 1973, for instance, nearly 300,000 pounds worth ($1.1 million dollars) were exported. More recently the world wide drop in the shrimp catch and the cost of fuel for the boats compared with competitors with oil supplies, has resulted in a short-term problem.

TOURISM (see Fig. 5)

The major growth of tourism into one of the two most important industries on the island occurred relatively recently, starting in the early sixties, gaining momentum over the last 10 years and now showing signs of levelling off.

The following table charts the growth in number of visitors from 1964 - 74.

Year	Visitors	Absolute Increase	%
1964	57,625	-	-
1965	68,418	10,793	18.7
1966	79,104	10,686	15.6
1967	91,565	12,461	15.8
1968	115,697	24,132	26.4

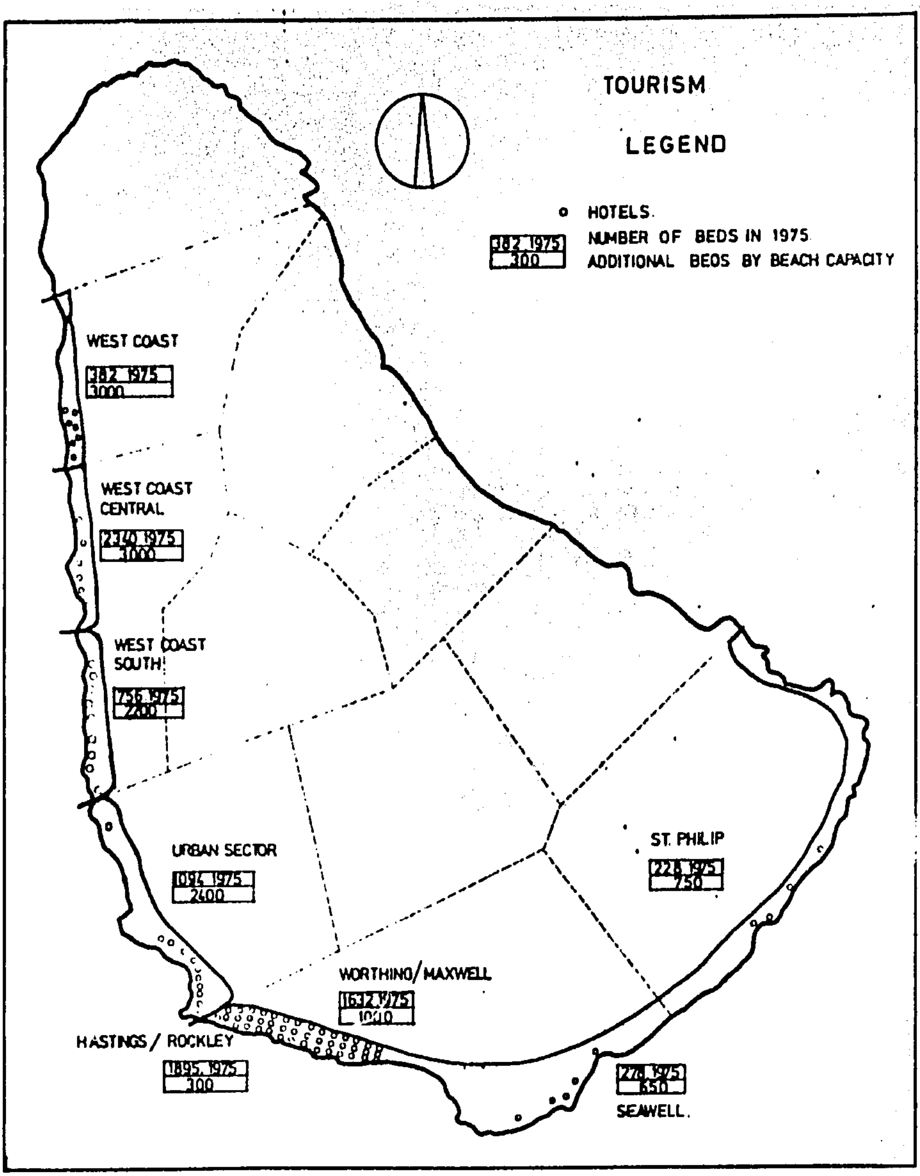

Fig. 5: Tourism in Barbados.

1969	134,303	18,606	16.1
1970	156,417	22,114	16.5
1971	189,975	32,658	20.9
1972	210,349	21,274	11.3
1973	222,080	11,731	5.6
1974	230,718	8,638	3.9

Direct employment in tourism (hotels, restaurant and bars) is currently 4,500 - 5,000 persons; the variation reflected in these figures is seasonal and has been diminishing as a result of increasingly successful efforts to maintain tourist numbers during the former "slack" period of the summer months (April to December).

Although tourism now plays a key role in the economy of the island and has a considerable, albeit difficult to define, social impact, for the purposes of this paper, it is considered that its physical impact as a user of land and beach resources should be the main focus for further examination.

Total accommodation on the island is about 9,000 beds and one important feature is the unusually wide range of accommodation from minimal cost guest houses to luxury hotels.

Tourist development has been characterised also by:

(i) A relative absence of large hotels and as a consequence high rise buildings. The four largest hotels, each have about 300 beds (150 rooms) and are 6 - 8 stories high. Two of these are located in the urban hinterland of Bridgetown. Development elsewhere with very few exceptions has not exceeded 4 stories. Thus to a large extent the small scale character of the island has been retained.

(ii) The location of tourist accommodation has been related very closely to land with either beach frontage or in close proximity to beaches, preferably good bathing ones.

In certain densely built-up sections of the South Coast the situation has been reached where most of the land with beach frontage is taken up and hotel developers are now prepared to consider sites on cliffs without beach frontage on the assumption that a construction of a groyne into the sea would create a beach.

It was shown at the first section of this paper how storm-water outfalls on the beach can cause problems of sand accretion. The Hilton Hotel's groyne created such a large expanse of beach that eventually counter measures had to be taken to halt further accretion of sand. The Government's Coastguard Station caused similar problems with an over wide beach and silting difficulties for coastguard and fishing vessels.

It has been decided therefore not to allow any further groynes until a comprehensive study is completed which would establish a framework for allowing such structures without causing coastal erosion or loss of land elsewhere on the coast.

(iii) The best beaches and therefore most of the luxury hotels are found on the northern section of the West Coast between Holetown and Speightstown.
The hotels tend to be low rise 2-3 storey developments set in spacious landscaped surroundings at low densities (20 - 40 beds per acre), usually well set back from the beach. In the immediate vicinity of Holetown, however, is a large scale higher density, holiday condominium resort (1,000 beds) with good shopping facilities.

(iv) The South Coast has tended to specialise in lower priced guest house, small hotel and, more recently, apartment hotel accommodation. It tends to be higher density (50 - 100 beds per acre), on smaller sites. Beaches tend to be less wide and development closer to the high water mark. There has been a proliferation of small tourist oriented night clubs, bars and restaurants, sometimes in conflict with the amenity of residential areas.

TOURIST CAPACITY OF THE ISLAND

Looking to the future, the beaches again could be the key variable in arriving at an environmental capacity for the island.

As part of the Review of the Physical Development Plan, a study was carried out of beach capacity. It took place in those areas where tourist development existed and was assessed could be extended or intensified. The island was divided into 12 tourist development zones and beaches graded with regard to quality of swimming (3 grades), and depth of beach (3 grades). From the grades, different densities of occupation were assumed and on the basis of these figures, total beach capacities were calculated for each zone. An allowance was then made for 20% of beach capacity to be occupied by local residents at any one time and from a questionnaire survey of visitors, that 50% of the tourists staying in a zone would be occupying beaches in that zone at any one time.

The study indicated the additional number of tourist beds which each zone could accommodate and by this method arrived at an over-all total for the island of 27,000 beds. Other constraint factors led to the reduction of this figure for projection to 1995 to 25,500 beds.

The land requirement for such an expansion would be of the order 200 - 300 acres depending on density of development.

It has already been noted in the context of Population Distribution that on the South Coast particularly, residential use is being supplanted by tourist development, but this has not resulted in a land use conflict. Although no specific study has been undertaken on the subject, it appears that:

(i) As Bridgetown continues to predominate for all types of employment, it is accessibility to Bridgetown which is more important in house choice than location on a beach. Moreover, there is no competition with tourism in terms of land availability in the sector of Bridgetown where major residential expansion has taken place.

(ii) Another locally acceptable alternative location for residential use is slightly further inland on the coastal terraces overlooking the ocean, with, it is felt, the advantage of breezes and views.

(iii) Beaches are considered by many more appropriate for recreation than residential use because of high house maintenance costs and the heat in the summer months.

COMMUNICATIONS/ROAD NETWORK (Fig. 6)

There is a dense network of roads throughout the island, all of which are paved and generally maintained in good condition. Pavement widths, alignments and grades are not to modern standards reflecting their origin as cartroads. With some notable exceptions they are, however, generally adequate for the island's needs. The radial pattern of the routes reflects the pre-eminence of Bridgetown as the centre of all activity.

The comprehensive coverage of roads is of importance to tourists who can get around to most parts of the island easily by bus or mini-moke, and heavy rains do not normally cause roads to be closed as in some other islands.

The most heavily travelled route follows the South and West Coasts of the island from the airport through Bridgetown to Speightstown. This highway is recognisedd to be inadequate, most especially in Bridgetown where it merges into a dense maze of relatively narrow streets.

Difficulty arises, however, in any major widening or improvement on this route because older development is very close to the carriageway and would therefore involve costly acquisition, redevelopment and disruption. In view of this factor, the feasibility of entirely new routes has been investigated.

The Physical Development Plan proposes a Spine Road which is expected to traverse the town, skirting the central commercial core, with the dual role of feeder road and by-pass to Bridgetown. The other proposal, the Outer-City by-pass, would aim to connect the main tourist areas on the South and West Coasts and would more clearly by-pass Bridgetown and pass through agricultural rather than built-up areas. No final decision has been taken on either route.

AGRICULTURE

The rationale for concluding that a residential/tourism land use conflict does not exist in Barbados, has already

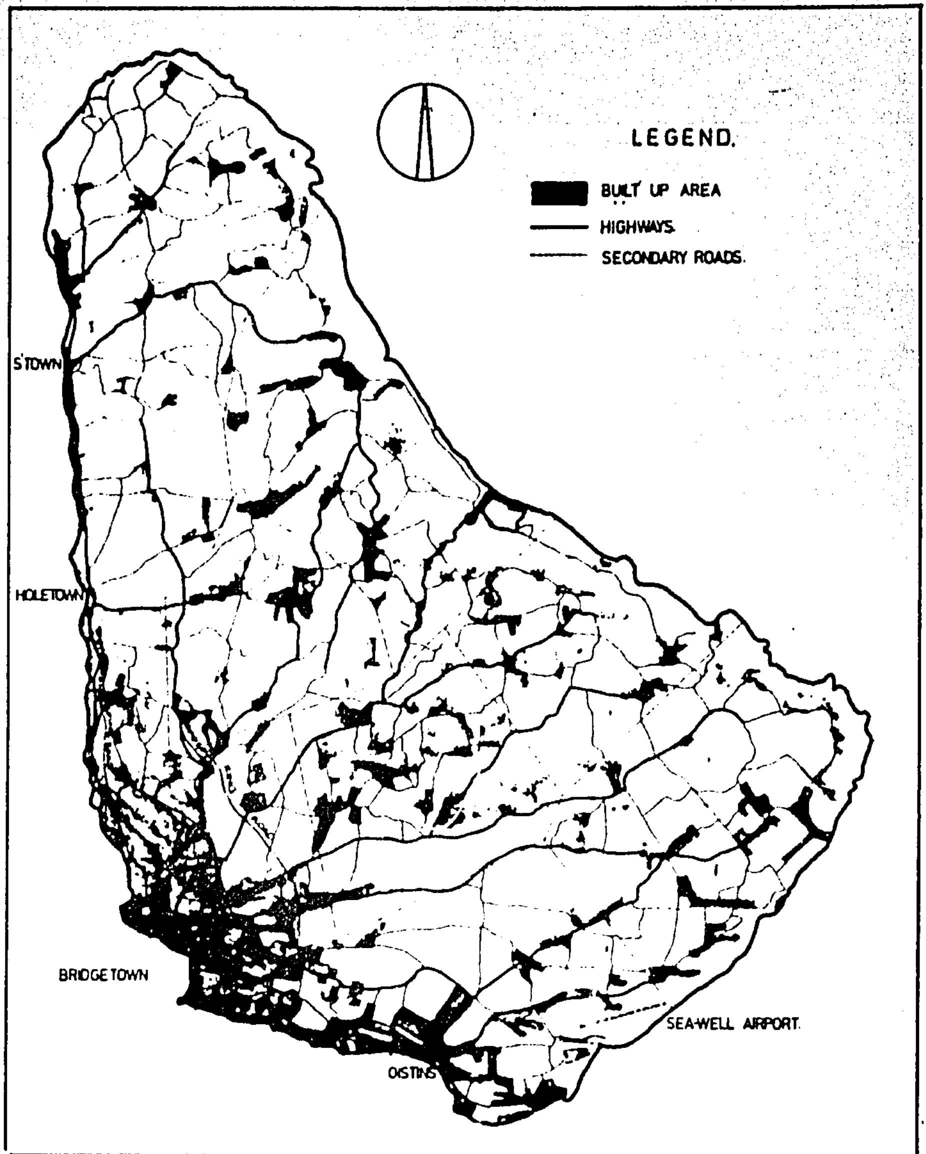

Fig. 6: Network of roads.

been given.

There is no conflict with agriculture either because, on the whole, coastal areas of the South and West, with sandy soils and low rainfall, cannot support arable crops including cane. The land is termed rab land. Spasmodic grazing of goats and sheep is all that can be achieved.

The East Coast does have more extensive grazing areas, where a local breed of sheep, the black belly, famous for prolific breeding and with great export potential, is flourishing. Also in this area in order to stabilise and avoid slippage of land the Soil Conservation Unit has been specially set up to initiate measures such as (i) reforestation of the foreshore for wind belts, (ii) terracing, and (iii) fruit tree planting. This has linked up with the campaign to grow more food by selling fruit trees to the public at minimal cost.

WASTE DISPOSAL

SEWAGE

The main problem has been in the low lying central Bridgetown area where sewage disposal is water borne either to wells, septic tanks, or dry pits and where 50% of the buildings (mostly poor houses) still retain the privy pit. Work is just beginning on the installation of a modern sewerage system with treatment plant to serve an area of 0.8 miles and 51,000 population and will remove the foci of surface pollution from wells and septic tanks, and the few outfalls which pollute the sea at some points.

Elsewhere, in the main areas of population along the South and West Coasts, the same methods obtain, except that larger hotels are required to have treatment plants which serve at suitable points into the ocean. No major problems of sewerage disposal have arisen, and there are sanitation advantages in the disposal of sewage into the sub-soil provided that the density of urban development using this method is not increased and proper monitoring of the situation is undertaken.

GARBAGE

The chief problem related specifically to coastal areas has been the continuing practice in the fishing villages and other small settlements (often adjacent to tourist development) of throwing garbage, including dead animals, into the sea. The problem was exacerbated until recently by infrequent and unreliable garbage collection services and also the prohibition on burning rubbish on the beach.

The need here is for a programme of environmental health education to emphasise the sea as a resource rather than a utility.

POWER STATIONS

Barbados has no rivers or natural waterfalls which could be used as sources of energy. The country's power supply is provided by two power stations sited on the South West Coast, to take advantage of easterly winds which take the occasional emission of particulate matter out to sea, thus minimising on shore air pollution.

RECREATION

The beaches are the biggest recreational attractions to residents and tourists alike. For the tourist there is swimming, sunbathing and water sports. In a very real sense for the Barbadian, the beach performs the same function as a park or community centre might elsewhere. It is a place where people walk, meet, play beach cricket and swim. Thus, all beaches in Barbados are public and specific attention has been paid to retain, and where possible, improve public ascess to the beaches. New hotel developments are required to provide pedestrian rights-of-way. In order to protect passage along the beach no fence or enclosure of private property is permitted within 30 feet of high water mark. New building development is not allowed close than 100 feet from high water mark.

There are two landscaped Esplanades where free public performances are given by local bands and groups. The Animal Flower Cave on the North Coast is an under-cliff cavern with rock pools containing sea anenomes. On the East Coast is the first purpose created picnic spot where wooden benches and tables are provided as permanent fixtures in a pleasantly wooded area overlooking the Atlantic.

If the proposals for national parks outlined in the first section are followed, more of these type of facilities will be provided as well as cliff walks along attractive stretches of coastline.

PORT AND SHIPPING

CAREENAGE AND BRIDGETOWN

A unique and characteristic feature of Bridgetown is the inlet of harbour and wharf facilities, dredged and widened from the Old Constitution River, which penetrates East/West right through the town centre and is called the Careenage. Loading and unloading of cargo vessels goes on here amid the hustle and bustle of a busy central thoroughfare.

The Careenage has been in use for more than 300 years. It used to be the only safe land locked anchorage for all craft, but since the opening of the Deep Water Harbour in 1961, it has concentrated on the inter-island schooner trade where it has the particular advantage of having the only dry dock in this area available for repairs. It is also the berthing point for the Shrimping Fleet, pleasure craft and numerous small fishing vessels.

It is considered that certain elements of inter-island cargo trade more suited to bulk handling, e.g., cement, should more logically be carried on at the Deep Water Harbour, and a Port Development Plan, recommends over the next 10 years a gradual scaling down of cargo handling operations at the Careenage such that it would tend to specialise in serving smaller more picturesque vessels from smaller nearby islands and providing berthing facilities for pleasure and fishing craft.

DEEP WATER HARBOUR

The Deep Water Harbour was constructed along with a land reclamation scheme in 1961. The port was to be a multi-purpose facility for general cargo, sugar molasses export, cruise liners and service calls. In the years since 1961, it gradually became congested and unable to handle efficiently the number of calling ships.

A plan was therefore made to extend the port facilities, implementation of which is just now being initiated. A first priority is to increase and modernise available transit shed space to cater for the growing shipping trend of containerisation expected over the next 10 years, which increases pressure on shore facilities.

New installations will include a bulk handling facility for cement (removed from Careenage), and for any other cargo imported in sufficient quantities. It is viable this will include grain (and provision of flour mill), and also fertilisers and animal feed to stimulate local agriculture.

The other proposed new installations - extension of berthing facilities, reclamation of land for marine oriented industry, a large shallow draft basin and a medium draft basin — are optional developments, dependent on external factors, not capable of accurate assessment at this time.

The possibility of extending the facilities for the cruise liner shipping trade (110,000 - 120,000 passengers per annum) was also examined, but it was concluded that further berthing facilities to expand the ports' present capacity of 3 cruise ships per day could not be economically justified. Moreover, it would tend to overstrain transportation, restaurant and hotel services, as well as increase port congestion.

INSTITUTIONAL AND REGULATORY FRAMEWORK FOR
COASTAL AREA DEVELOPMENT

TOWN PLANNING LEGISLATION

<u>Town and Country Planning Act 1965</u>
<u>Town and Country Planning Development Order 1972</u>

The Act was the consolidating legislation after two earlier interim Acts which had sought to control the rapidly expanding Bridgetown area. It extended powers of control to cover the whole island and under a system modelled on British Town Planning legislation brought the use of land under comprehensive control by requiring planning applications for all building, changes of use, and subdivision of land.

Decisions on these applications were to be made in accordance with the principles and policies laid down in a Physical Development Plan for the island. The Plan was prepared, but was never approved. It is now under review.

Under the Regulations of the 1972 Order, control is exercised over the design (including height), layout and density of buildings (important in tourist facilities), as well as access water supply drainage and health requirements. for which the Town and Country Planning Office acts as a co-ordinating agency for other departments.

TOURIST RELATED LEGISLATION

Condominium Act 1971

Enables subdivision of buildings into multiple ownership without attachment of land areas. Surrounding lands can be retained in common ownership.

Hotel Aids Act

Ministry of Tourism is empowered to aid certain small/medium sized hotel projects which satisfy certain requirements, after planning permission has been obtained.

ENVIRONMENTAL CONTROL LEGISLATION

Waterworks Act 1895 and Amendments

Set up the Government Waterworks Department to control all matters relating to the supply and extraction of water.

Health Act 1969
Health Services (Building) Regulations
Health Services (disposal of offensive waste)

The regulations enable the Ministry of Health to control comprehensively sanitary installations, and sewage and waste water disposal for all buildings and land.

Highways Act 1945

Gives the Ministry of Communications and Works the power to keep clear highways, water courses and drainage channels and propose improvements.

Implementation Agency Legislation
Parks and Beaches Commission Act 1970

Set up a Commission with main responsibilities of:
(i) Improving the maintenance and cleanliness of beaches and parks;

(ii) Initiate projects for establishment of new parks, e.g., Marine Under Water Park;
(iii) Policing beaches and parks under their jurisdiction against destruction or spoilage.

Soil Conservation Act

Set up a Board to:
(i) Scrutinise all development of the Scotland District to prevent further erosion;
(ii) Initiate programmes for restabilising the area.

OTHER LEGISLATION

Land Acquisition Act 1949

Enables Government via the Ministry of Housing/Lands to acquire land by compulsory purchase for any public purpose approved by Cabinet, and has included purchase of coastal sites for recreational use.

Land Valuation Act 1972

Introduced a land tax based on site value and improved value (including buildings). Was intended to encourage clearance of derelict buildings and vacant site "ripe" for development.

NON-STATUTORY AGENCIES

National Trust

Is a voluntary body incorporated by Act in 1961 with an influential "pressure group" role. Within its over-all objectives is a firm commitment to preserving and enhancing areas of natural beauty and local flora and fauna on the coastline. The Trust has acquired some property to this end.

Caribbean Conservation Association

Is a regional organisation, based in Barbados, financed by member Governments, represented by bodies such as National Trust concerned with the environment. Is undertaking a detailed inventory of natural endowments of the region.

CONCLUSION AND THE NEED FOR CO-ORDINATION

From the foregoing list of legislation it is apparent that a number of bodies are involved in the implementation of policies related to coastal areas, but there is no systematic collection of data. Neither is there any real co-ordination. There is quite considerable scope for consultation but co-ordination tends to be restricted to financial control, with decisions on projects made on an individual basis, the initiative for bringing up projects resting with an individual ministry or department, which decides its own priorities. As a consequence the link between comprehensive development planning and implementation and management is rather tenuous.

Comprehensive development planning is vitally necessary so that the balance between — (i) the use of natural resources, (ii) infrastructure and (iii) the carrying capacity for urban development of coastal areas — is maintained. As far as coastal areas are concerned: (i) the beaches (natural resource), (ii) water supply and sewage disposal (infrastructure) and (iii) the amount of urban/tourist development, environmental capacity has not yet been exceeded with the exception of roads on South/West Coasts. But the situation needs to be constantly monitored and correlated to the present and proposed development of the area concerned.

In particular, the maintenance of high quality water supply is of paramount importance and will require integration of a water resource development plan with the over-all physical and economic planning of the island. Protection of the purity of water supply is intimately connected with methods of sewage disposal. Thus, it could be that water supply and sewage should come under one autonomous body rather than be separated between the Ministry of Health and the Waterworks Department.

Similarly, it is essential for an effective Stormwater Drainage System to take account fo the ultimate development plan for the area it is to drain, and requires the co-ordination of the various infrastructure projects for coastal areas including the Bridgetown Harbour Extension, the Bridgetown Sewerage Scheme and major road proposals.

What these examples point to is the need to have properly integrated data collection in related subject areas, perhaps best correlated in a Physical Development Plan which would be an on-going and cyclical process of monitoring and review.

BENIN

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I. APERCU GENERAL

La République populaire du Bénin se trouve dans la proéminence occidentale de l'hemisphere nord du continent africain. Située a l'est de cette énorme avancée, sa facade s'ouvre au sud sur l'océan Atlantique par 125 km de côte.

Elle s'étend :

En latitude, entre les 6ème et 12ème parallèles nord; elle est donc située tout entière dans la zone tropicale humide.

En longitude, à cheval sur le méridien de Paris, entre le 1° et le 3° $40'$ a l'est du meridien international de Greenwich (Angleterre) dans la partie nord et entre le 1° et le 3ème degré dans la partie sud.

La zone côtiere est faite d'une succession de lagunes et de petits cirques encombrés de bancs de sable, qui forment une voie d'eau intérieure ininterrompue depuis le delta du Niger jusqu'à Cotonou.

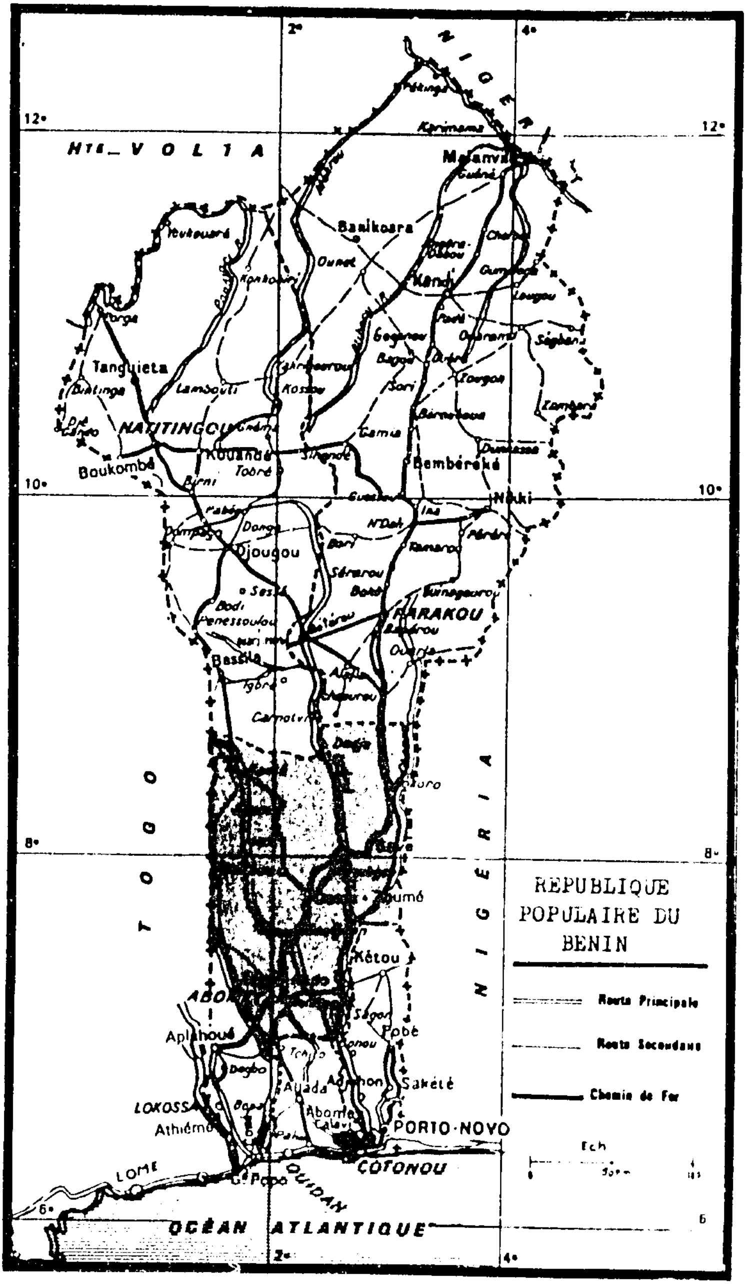
Après une brève interruption entre Cotonou et Ahozon, situé à 30 km environ à l'ouest de Cotonou, le cordon lagunaire reprend pour ne s'arrêter qu'à Lomé (Togo). La côte ne présente pas de sites naturels favorables à l'installation d'un port. Elle est défendue par la "Barre", ce qui explique l'existence des ports en eau profonde de Cotonou et de Lomé.

Du point de vue des quantités annuelles de précipitations, on observe des différences importantes entre les zones est et ouest du littoral béninois. La partie est de la frontière nigériane a Porto-Novo (Sémè) est beaucoup plus arrosée (1 400 a 2 000 mm en moyenne) que la partie située a l'ouest de Ouidah (République populaire du Bénin) ou l'on note des hauteurs moyennes annuelles de 900 a 1 100 mm. L'est est le royaume des forêts mésophiles. De Ouidah à l'embouchure de la Volta (Ghana), la végétation est beaucoup plus avare. C'est la savane. Cette partie du littoral serait, à l'origine, revêtue du même manteau végétal que la partie est. Très tôt entamées par l'homme, les fôrets primitives et secondaires ont disparu. Elles ont été remplacées par la palmeraie, la cocoteraie et la savane sud-soudanaise.

La République populaire du Bénin a une superficie de 112 600 km^2 sur laquelle évolue une population de 3 197 000 personnes (1975). Elle se répartit comme suit:

- Population rurale : 2 766 000 habitants
- Population urbaine : 431 000 habitants
- Densité : 25 km^2

Cette population est très irrégulièrement répartie. Dans le centre-sud et le sud-est, elle atteint 400 habitants au km^2. Dans le sud, 15 p. 100 du territoire national


REPUBLIQUE POPULAIRE DU BENIN
Route Principale
Route Secondaire
Chemin de Fer
HTE_VOLTA
NIGER
TOGO
NIGERIA
OCÉAN ATLANTIQUE
Malanville
Banikoara
Kandi
Tanguieta
NATITINGOU
Kouandé
Boukombé
Bembéréké
Nikki
Djougou
PARAKOU
Bassila
Savè
Kétou
ABOMEY
Aplahoué
Pobè
LOKOSSA
Athiémé
Allada
Sakété
PORTO-NOVO
COTONOU
OUIDAH
LOME
12°
10°
8°
6°
2°
4°

concentre 61,3 p. 100 de la population totale du pays.

La zone côtière, basse et sablonneuse, et limitée par des lagunes en voie de comblement, est large de 2 à 5 km. Partout la densité de la population y dépasse 150 habitants au km^2.

Comme on le voit, la frange côtière joue un rôle très important dans la vie économique de la République populaire du Bénin. Région très peuplée, elle est la porte d'entrée et de sortie des Républiques du Niger et du Bénin. Ses ressources servent à entretenir en partie les populations du Bénin, du Niger, de même que celles du Bas-Togo et de l'Etat de Lagos au Nigéria. Dans la suite de notre exposé nous étudierons trois phénomènes distincts :

- Le cordon lagunaire;
- Les bancs de sable;
- La plate-forme continentale béninoise de l'océan Atlantique.

II. LE CORDON LAGUNAIRE

Le cordon lagunaire du Bas-Bénin fait partie de la chaîne lagunaire et de lacs qu'on observe sur les côtes africaines depuis la Casamance au Sénégal jusqu'au Congo.

1. Principaux lacs du Benin

Source : Service topographique

Nom du lac ou du marais	Type	Superficie	Région
La Nokoué	Fluvio-maritime	138 km^2	Sud-Est (Cotonou)
Lac Ahémé	Fluvial	78 km^2	Sud-Ouest (Guezin)
Lac Toho	Fluvial	15 km^2	Ouest (Athieme)
Lagune de Porto-Novo	Fluvial	35 km^2	Sud-Est (Porto-Novo)

Les lagunes de la République populaire du Bénin comptent parmi les lagunes tropicales les plus productives du monde. Les rendements de la pêche en lagune de Porto-Novo ont dépassé une tonne a l'hectaire - une tonne de produits animaux, soit bien plus que la production des meilleurs pâturages des pays européens ou américains.

Pour accroître leur développement, les pays du tiers monde ont recours à la technologie qui a fait le succès des pays economiquement avances. De ce fait, ils sont confrontes aux mêmes problèmes écologiques. C'est en particulier le cas du Bénin où, après la construction du port en eau profonde de Cotonou, les lagunes du Benin sont en péril.

2. Appauvrissement biologique du lac Nokoué et de la lagune de Porto-Novo

a) Résultats d'études

Le Centre Technique Forestier Tropical, organisme de recherches français, a étudié en detail (1963, 1964, 1965 et 1969) la baisse de la production halieutique du lac Nokoué et de la lagune de Porto-Novo pendant les 10 années qui ont suivi la construction a Cotonou d'un port en eau profonde. Le tableau récapitulatif des conclusions de ces études (CTFT, 1969) est reproduit ci-après.

Méthode de pêche	Production annuelle (en tonnes) 1959	1964	1969
Eperviers	7 500	5 600	2 800
[Pièges, filets a crevettes semblent diminuer, mais des fluctuations masquent la tendance generale.]			
Acadja	3 720	550	1 200
Pêche générale	4 200	3 150	1 600
Huîtres	négligeable	0,5	0,5
TOTAL :	15 420	9 300	5 600

Il est bien clair que la production de ce lac a gravement baissé : en simplifiant la courbe, elle est tombée de 1 000 tonnes par an. Ces chiffres ont pour base des pêches de contrôle, faites dans des conditions uniformes.

b) Causes et effets

Des études réalisées par le Centre Technique Forestier Tropical, il ressort que la perte en production halieutique du lac Nokoué et de la lagune de Porto-Novo est le resultat direct de la construction du port autonome de Cotonou.

En effet, avant la construction de ce port, un courant marin côtier apportait régulièrement du sable pour fermer le chenal de Cotonou. La seule ouverture naturelle qui servait alors d'exutoire permanent du lac Nokoué et de la lagune de Porto-Novo était à Lagos, à 100 km plus loin à l'est. Pendant les plus grandes crues de l'Ouémé, le banc de sable qui fermait le chenal était ouvert naturellement pour laisser couler les eaux du lac vers la mer. L'ouverture du chenal ne durait que quelques mois, le sable apporté par le courant côtier le refermant tres rapidement.

L'alternance de l'ouverture et de la fermeture du chenal de Cotonou créait un cycle où le chenal restait normalement fermé, ne s'ouvrant que pour de courtes périodes. La durée de ce cycle était de trois à cinq ans.

Dans la situation actuelle, le courant côtier susmentionné a été supprimé par la construction des digues du port de Cotonou. Il en résulte l'ouverture permanente du chenal et la suppression du cycle décrit ci-dessus, qui provoquent des changements dans l'équilibre biologique du lac Nokoué et de la lagune de Porto-Novo.

Avant l'ouverture permanente du chenal, la fermeture de ce dernier pendant une longue période occasionnait un dépôt d'alluvions riche en matières minérales apportées par les eaux des cours d'eau se déversant dans le lac Nokoué, notamment l'Ouémé et la Sô; de même les matières organiques déposées par les populations riveraines du lac Nokoué et de la lagune de Porto-Novo, sur laquelle était fondée la richesse de ces lagunes en poissons. Actuellement, après la construction du port de Cotnou, la vitesse des courants des fleuves pendant la crue et la turbulance prolongée des eaux, provoquée par les marées, empêchent un long séjour des matières organiques et inorganiques susmentionnées dans le lac Nokoué et la lagune de Porto-Novo, les entraînant rapidement en mer. Les végétaux aquatiques, notamment le plancton, qui utilisent directement les matières minérales pour leur formation n'ont plus le temps de pousser en abondance comme autrefois, les matières minérales étant directement entraînées en mer, sans séjour prolongé dans le lac. Les animaux aquatiques, mangeurs de végétaux, deviennent moins abondants. Les animaux aquatiques carnivores diminuent également; c'est le cas notamment des poissons.

Ainsi, les prises de filets, surtout de filets éperviers qui fournissent à peu près les 50 p. 100 de la production totale du lac Nokoué et de la lagune de Porto-Novo accusent une perte totale annuelle de 25 a 50 p. 100 environ. Les autres méthodes de pêche ont également souffert.

La pêche aux "acadjas", sorte de pisciculture pratiquée à l'aide de branchages plantés dans l'eau, pour former des parcs rectangulaires ou circulaires, est l'une des plus importantes au lac Nokoué et à la lagune de Porto-Novo. Les zones délimitées par ces parcs servent de refuges aux poissons, surtout les <u>Tilapia</u> qui s'y reproduisent, y croissent et s'y nourrissent des plantes qui poussent sur les surfaces submergées.

L'entrée de l'eau salée dans le lac Nokoué et la lagune de Porto-Novo par le chenal de Cotonou ouvert en permanence, a pour conséquence un apport important d'organismes étrangers aux deux lagunes. Parmi ces organismes, le taret, mollusque rongeur de bois, cause des dégâts considérables.

Dans plusieurs régions du lac Nokoué et de la lagune de Porto-Novo, on a assisté à la disparition totale des acadjas. Même dans les régions du lac où on pratique toujours cette méthode de pêche, la perte en bois due aux dégâts de ces mollusques est considérable.

Les déprédations dues aux tarets ne se limitent pas seulement aux effets sur les acadjas. Les maisons bâties sur pilotis (en bois) ne durent plus que la moitié du temps qu'elles duraient avant la construction du port; et les pirogues qui duraient plus de sept ans auparavant, ne durent plus que deux ans actuellement.

En 1969 la production en poisson du lac Nokoué et de la lagune de Porto-Novo accuse une perte totale d'une valeur de 491 millions de francs CFA environ (9 820 T a 50 frcs CFA le kg) par rapport à l'année 1959.

Si on tient compte de la diminution des activités annexes à la pêche (commerce du bois pour la construction d'acadjas, commercialisation des produits de la pêche, etc.), la valeur de la perte en production du lac Nokoué et de la lagune de Porto-Novo citée ci-dessus, pourrait être doublée.

c) Remèdes

Il est possible de remédier a cette baisse de la production halieutique du lac Nokoué et de la lagune de Porto-Novo et a l'action des tarets par la construction d'un barrage sur le chenal de Cotonou.

La forme à donner à ce barrage mérite un examen attentif. En effet, il y a deux thèses qui s'affrontent a son sujet :

1) Les uns sont d'avis de construire un simple enrochement ou déversoir qui serait assez bas pour laisser échapper l'eau des crues mais fermerait le chenal le reste du temps, sauf aux plus hautes marées. Les avantages de cette solution sont : son faible coût et la facilite de son entretien.

Un simple déversoir empecherait certainement les alluvions riches en minéraux apportes par la crue du fleuve de s'échapper. Mais il est hautement probable que la grande productivité autrefois observée dans le lac résulte de l'action mutuelle des alluvions minérales et de l'eau de mer (CIFT, 1965). On ne peut donc pas garantir que le lac retrouverait sa richesse passée, du fait de la faible salure qui deviendrait celle de ses eaux dèrriere ce déversoir; elle aurait pour effet d'éliminer completement sans aucun doute, Bankia bagidannais. Le taux minimum de salinité que tolère cette espèce est élevé (16 g/l); elle se reproduit en dehors de la lagune, semble-t-il, et c'est la marée qui y porte ses larves; or, la marée ne se ferait pas sentir dans la lagune. Teredo petiti, en revanche, peut propérer dans une salinité aussi faible que 3 g/l, et même survivre plusieurs mois en eau douce. Comme le déversoir proposé laisserait entrer chaque mois dans la lagune une certaine quantité d'eau salée, le danger subsiste de voir ces tarets continuer à sévir.

En outre, le barrage-déversoir certes empêcherait non seulement le passage des organismes marins comme B. bagidaensis, mais aussi la circulation des cervettes, larves ou adultes, entre la lagune et la mer, ce qui mettrait fin à la pêche aux crevettes.

Même une meilleure prise de Callinectes et de Macrobrachium ne pourrait compenser cette perte. De même, on peut s'attendre à voir la faune de poissons changer, au bénéfice des espèces d'eau douce. A cet égard, le principal motif d'inquiétude est Ethmalosa fimbriata. La race locale de E. fimbriata est si bien adaptée à la lagune qu'elle va jusqu'à s'y reproduire; mais on peut se demander si elle pourrait supporter les faibles salinités qui resulteraient du blocage permanent du chenal. Il n'y a malheureusement pas sur place d'autres planktonograges qui pourraient prendre la place de cette espèce.

ii) Les autres voudraient un barrage plus complexe, avec des écluses qu'on pourrait manoeuvrer pour remettre le lac dans un état aussi proche que possible de celui d'autrefois.

D'après ce que nous savons de l'écologie du lac et de la biologie des organismes qui l'habitent, le régime hydrologique le plus souhaitable devrait être à peu près le suivant. Le lac resterait ouvert sur la mer pendant deux ou trois mois après toute grande crue. Cela permettrait un échange de poissons et de crustaces, et une salinité suffisante pour éliminer I. Petiti (salinité supérieure à 30 g/l). On fermerait alors la lagune en barrant le passage aux larves des organismes marins, tels que B. bagidaensis. On garderait le lac fermé, si possible, les années où la crue serait faible. On ne peut evidemment appliquer un programme de ce genre que si l'on a un barrage muni d'écluses facilement manoeuvrables; c'est donc un barrage de cette conception que, du point de vue biologique, il est souhaitable de construire.

d) Conclusion

L'appauvrissement biologique du lac Nokoué et de la lagune de Porto-Novo est dû à l'ouverture permanente du chenal de Cotonou, résultant de la construction, dans ladite ville, d'un port en eau profonde.

Il entraîne la baisse de production halieutique de ces lagunes et les dégâts occasionnes par les tarets.

Pour y remedier, il est necessaire de construire sur le chenal de Cotonou, un barrage muni d'écluses facilement manoeuvrables.

3. Les ressources biologiques des lacs Ahémé et Toho

Ces deux plans d'eau situés dans la partie ouest de la République couvrent respectivement 78 km^2 et 15 km^2. Ici aussi la nature est menacée, et si la nature est menacée l'homme l'est aussi, car elle vit avec nous comme nous vivons d'elle.

Les agressions de l'homme vis-à-vis des lacs Ahémé et Toho sont d'origine anthropique.

Les pratiques abusives des pêches constituent le premier danger. Les pratiques traditionnelles de pêche ne causaient pas de graves préjudices aux ressources vivantes des plans d'eau. Mais avec la pression démographique, on a assisté à l'usage du grand filet dont les mailles de 13 millimètres retiennent jusqu'aux alevins.

Ces pratiques déplorables qui éliminent indistinctement les jeunes poissons et les adultes étaient autrefois évitées grâce à des interdits coutumiers. Aujourd'hui ces interdits sont bafoués et les vieux lacustres ne peuvent que déplorer la disparition des tribunaux de pêcheurs qui punissaient alors efficacement les fautifs.

Aujourd'hui des recherches sont en cours à la Direction des pêches. Elles permettront dans un avenir proche d'évaluer l'importance des ressources en poissons et en crustacés de nos lacs et lagunes. Elles aboutiront à une réglementation et à un contrôle de la pêche (quotas de capture, dimension de mailles de filets...). Ces mesures assureront une exploitation rationnelle des stocks.

Un autre problème à résoudre est celui de l'assechement progressif des plans d'eau béninois. Certes tout lac est appelé à la longue à disparaître, à moins d'un dragage périodique. En République populaire du Bénin, la source d'énergie principale en milieu rural est le bois. Afin de satisfaire leur besoin, les populations se sont livrées à une exploitation irrationnelle de la forêt de mangroves. On appelle mangrove une association forestière halophile des côtes, des estuaires et des lagunes, installée sur un sol vaseux. Elle est constituée de palétuviers (Rhizophora), de fougères (Acrostichum) et d'avicennia formant parfois des forêts impénétrables dans la zone intertidale. Cette formation végétale diffère des autres forêts par l'absence de lianes, de mousses, de plantes épiphytes et par le petit nombre d'espèces.

Le résultat était, rivage dénudé, plus d'évapotranspiration, d'où évaporation intense des eaux. D'autre part, les rhizophora, avec leurs longues racines qui plongent dans l'eau constituent un milieu idéal pour la reproduction des poissons.

Pour terminer, examinons les effets de la pollution sur nos lacs. Bien qu'encore à ses débuts, la pollution des lacs n'en constitue pas moins un nouveau péril. Sa terre d'election est le lac Nokoué et son emissaire la lagune de Cotonou.

En effet, le lac Nokoué qui abrite de nombreux villages lacustres bâtis sur l'eau reçoit tous les jours les déjections humaines et les eaux ménagères de plus de 30 000 personnes. Quant à la lagune de Cotonou, elle recoit journellement 500 m^3 de déjections humaines et une dizaine de tonnes d'eaux résiduaires d'origine industrielle.

Comme on peut le constater, la pollution bactérienne de nos lacs est le fait des eaux résiduaires, des ordures menagères et surtout des excréments rejetés par les riverains des lagunes. C'est le péril fécal. Chaque litre d'eau d'égout charrie de 2 a 3 milliards de bactéries, sans parler des virus. Parmi ces bactéries et virus, certains sont susceptibles de transmettre à l'homme des maladies, telles que l'hépatite virale, le choléra, la typhoide, la fièvre paratyphoide, et la poliomyélite.

Or, la lagune se défend beaucoup moins bien que la mer contre ces germes. En mer, les bactéries d'origine terrestre charriées par les eaux d'égouts, trouvent un milieu hostile à leur prolifération. C'est ce qu'on nomme le pouvoir auto-épurateur. Ce pouvoir auto-épurateur est le fait de contraintes physico-chimiques; une teneur en sel élevée et une température généralement plus basse que celles auxquelles sont habituées les bactéries d'eaux d'égouts. Les eaux de lagune, elles, sont généralement plus chaudes et moins salées que les eaux de mer : deux circonstances qui nuisent au pouvoir auto-épurateur de la lagune.

L'océan est d'autre part relativement pauvre en M.D. dont se nourrissent les bactéries. La lagune, elle, du fait en particulier de ces rejets d'eaux d'égouts en est beaucoup plus riche; autre circonstance défavorable au pouvoir auto-épurateur de la lagune.

En mer, les eaux d'égouts sont diluées rapidement dans un volume infini d'eau. Dans la lagune, le volume d'eau intéressé est bien moindre : circonstance aggravante supllémentaire.

Enfin, dans l'ocean les bactéries étrangères sont agnossées par les organismes du milieu marin virus qui les parasitent, zoophaneton qui les consomme et algues qui les empoisonnent par la secrétion de substances antibiotique. Les populations naturelles de la lagune, dans la mesure où elles sont perturbées par les pollutions, sont moins a même d'exercer cette activité. Cela a été constaté à plusieurs reprises sur les grands lacs américains. Ce sont justement les espèces d'algues les plus actives du point de vue antibactéries qui sont les premières éliminées dans les milieux pollués. Ces lacs, comme nos lagunes, sont sensibles aux pollutions.

Toutes ces circonstances ont poussé la Commission Nationale de l'Environnement à entreprendre un projet de construction d'une unité industrielle de traitement des déchets. Car il ne faut rien exagérer, l'océan n'est pas un dépotoir et son pouvoir auto-épurateur n'est pas infini. Il a ses limites.

III. RESSOURCES BIOLOGIQUES DU MILIEU MARIN

La République populaire du Bénin s'ouvre au sud sur l'océan Atlantique par 125 km de côte. La plate-forme continentale a une largeur de 13 km seulement, mais les eaux territoriales béninoises semblement assez poissonneuses à cause des alluvions qu'y déversent les fleuves Ouémé et Mono.

Longtemps, ces ressources sont inexploitées. Les populations de la zone côtière du Bénin ne s'aventuraient pas en mer. Ce sont les peuplades venues du Ghana (les Awlans, Kéta) qui venaient de temps a autre s'installer et pêcher à la nasse. Leur embarcation légère ne s'aventurait pas très loin des rivages. Jusqu'à la construction du port de pêche de Cotonou, la pêche en mer au Bénin était a l'état embryonnaire. Une société nationale de pêche (SONAPECHE) fut créee en 1975 pour développer la pêche en mer. Le tableau ci-après montre la progression de la production de la pêche industrielle au Bénin.

PRODUCTION DE LA PECHE INDUSTRIELLE

Source : Service des peches   Unite : kg

	1972	1973	1974	1975
Bars	455 182	507 794,6	519 769,2	1 251 997,3
Capitaines	231 485,5	252 684,8	396 978,9	422 068,5
Fritures	326 095	402 128,8	735 943,3	1 393 631,5
Machoirons	114 001,5	97 682,7	128 576,9	243 662,4
Disques	36 088	37 335	51 686,9	108 698,9
Daurades grises	52 718,5	78 788,4	135 142,6	122 454,3
Daurades roses	25 121,5	13,877,7	4 462	4 949
Raies	152 024	191 589,5	209 784,2	311 415
Soles	57 964	55 578,2	81 722,5	178 468
Requins	13 672	16 222,2	30 208,3	20 797,1
Carangues	300	1 958,6	18 699,1	37 335,5
Elops	450	-	-	-
Crabes	-	-	5 184,3	3 293,9
Crevettes	2 661,9	1 279,6	1 207,1	259,6
Langoustes	-	-	-	-
Divers	12 327	8 662	46 624	115 983,5
TOTAL	1 480 189,9	1 665 582,1	2 437 999,4	4 215 035,0

PECHE MARITIME ARTISANALE

Production des bateaux cordiers-ligneurs par trimestre de 1974 à 1975

Source : Service des pêches   Unité : kg

	1974			1975				
	3ème trimestre	4ème trimestre	TOTAL	1er trimestre	2ème trimestre	3ème trimestre	4ème trimestre	TOTAL
Daurades et mérous	16 747,8	21 793,7	38 541,5	13 261,8	7 932,8	3 847	4 622,7	29 665
Raies et requins	1 206,8	2 441,9	3 648,7	519,0	599,5	689,5	154,9	1 942,9
Faux thons	1 936	473,6	667,2	216,2	462,3	-	77,2	755,7
Divers	472	1 012,2	1 059,4	183,9	404,2	1 241,8	10 226,6	39 625,3
TOTAL	18 195,4	25 721,4	43 916,8	14 180,9	9 398,8	5 779,0	10 226,6	39 625,3

Le 24 mars 1976, le Gouvernement béninois a, conformément aux dispositions de Genève, porté la largeur des eaux territoriales béninoises à 200 miles. Les eaux territoriales béninoises sont relativement riches, mais faute de moyens ces ressources n'ont pas été correctement evaluées. L'absence de vedettes garde-côte fait que nos eaux territoriales sont fréquemment violées par les pêcheurs étrangers.

Très riches en crevettes, elles sont sillonnées par de nombreux bateaux.

Au total, nous dirons qu'en matière d'évaluation des ressources, tout reste à faire.

IV. L'EROSION DES RIVAGES

1. INTRODUCTION

Les rivages de l'océan sont le théâtre de phénomènes importants d'érosion et de pollution dus à la création du port de Cotonou.

D'après les recherches que nous avons effectuées, il y a lieu, pour une approche rationnelle du problème, de distinguer deux cas :

a) Le cas des phénomènes liés à la création du port en eau profonde de Cotonou. Ce cas concerne les érosions qui se produisent a l'est des ouvrages portuaires.

b) Le cas du littoral au niveau de la ville de Grand-Popo. En effet, ces deux cas ne peuvent être confondus Le premier cas est lié à l'intervention de l'homme, et les érosions qui en ont résulté sont consécutives à un arrêt total du transit de sable pour les ouvrages portuaires.

Le deuxieme cas est un phenomene naturel, engendre par une reduction accidentelle semble-t-il du transit de sable.

2. PHENOMENES D'EROSION LIES A LA CREATION DU PORT DE COTONOU

a) Généralités

Le port de Cotonou est un port en eau profonde gagné sur la mer par la construction d'ouvrages maritimes qui font saillie sur la ligne du rivage.

Les côtes du golfe du Bénin, du cap Saint-Paul à Lagos sont constituées par une plage sablonneuse très régulière, à peine incurvée d'une dizaine de degrés sur la direction ouest-est. Cette côte est le théâtre d'un transfert de sable d'ouest en est dont l'importance varie suivant le site.

b) Les causes du phénomène

Il est établi que le long des rivages marins constitués de matériaux meubles (sables ou galets), les mouvements de la mer produisent des transports de matériaux dont l'importance varie selon la nature de ces matériaux : les caracteristiques de la houle, l'angle d'incidence des vagues, etc.

Ce phénomène existe au droit de Cotonou et l'importance de transport de sable observé a été estimée a 1 500 000 m^3 environ.

Le long des plages soumises à ce genre de transport, toute implantation d'ouvrage maritime pose donc des problèmes de maintien des sites : en effet, toute jetée s'avançant sur la plage provoque, suivant le cas, des atterrissements de matériaux, soit en amont ou soit à l'aval, et une érosion à l'aval ou à l'amont.

Dans le cas de Cotonou, les matériaux ont tendance à s'accumuler a l'amont, ce qui entraîne une érosion à l'aval.

On se trouve des lors en presence de trois possibilités lorsqu'on veut implanter un port sur une côte de cette espèce, soit:

- Rétablir la continuité naturelle de transport en prenant le sable à l'amont pour le déposer à l'aval par pompage;
- Construire un port îlot relié au rivage par une estacade sur pilotis qui n'interrompt pas le débit solide;
- Enfin, accepter d'arrêter et d'accumuler le débit solide en sachant qu'une érosion va se produire à l'aval.

C'est cette dernière solution qui a été retenue à Cotonou.

En effet, la première solution entraîne des frais d'exploitation très élevés puisqu'il faudra non seulement utiliser de l'énergie pour le pompage, mais encore entretenir et renouveler périodiquement le matériel. (Ces frais peuvent être estimés à peu près à 150 millions par an.)

Quant à la deuxième, en plus des frais d'exploitation plus élevés en raison de l'extra-portage entre les magasins situés sur le rivage et les navires, elle n'offre aucune possibilité d'extension ultérieure, ce qui est genant en cas d'accroissement du trafic.

Le port à accumulation de sable qui a été finalement construit, arrête complètement le transit de sable, mais en contrepartie provoque un important affouillement du rivage à l'est de l'ouvrage.

Il a été estimé que le voisinage immédiat de la ville de Cotonou doit être protege (en particulier le débouché lagunaire) et que, par ailleurs, compte tenu de la faible valeur des terrains d'une part, et pour des raisons d'économie de l'autre, il était préférable de laisser le phénomène de l'érosion se produire librement; c'est ce qui explique que nous assistons actuellement à un recul continu du rivage à l'est de Cotonou. Nous allons examiner ci-apres, successivement, quels ont été les moyens de défense mis en place et quel a été l'effet de l'érosion jusqu'à ce jour. Nous examinerons ensuite les solutions possibles et leur incidence financière.

c) <u>Moyens de défense actuellement en place</u>

Le systeme de défense mis en place pour la protection des côtes contre les effets de l'érosion est très sommaire. Il comprend un jeu d'épis en mer et en lagune repartis comme suit :

i) Un ouvrage principal appelé épi-ouest, implanté en prolongement de la berge ouest de la lagune, à 2 200 mètres environ de l'enracinement de la jetée principale du port.

Il a pour rôle, d'une part de protéger le rivage entre le port et la lagune et, d'autre part, d'empêcher l'érosion de gagner l'embouchure de la lagune. Il présente une avancée de 150 mètres environ sur la ligne du rivage.

ii) Un épi-est, construit à deux kilomètres environ de l'épi-ouest. Son rôle est de limiter le recul du rivage et d'empêcher que les effets de l'érosion n'aillent affouiller les piles et les culées du port sur la lagune.

iii) Un épi en lagune de faible longueur (80 mètres), situé environ à 450 mètres de l'enracinement de l'épi-ouest et destine a limiter les deplacements du chenal vers l'ouest.

iv) Une défense longitudinale de la rive ouest de la lagune reliant les enracinements de l'épi-ouest et de l'épi en lagune.

d) Les effets et l'importance de l'érosion

Les effets de l'erosion étaient prévisibles et ont fait l'objet de longues études, aussi bien théoriques qu'en laboratoire sur modèle réduit, avant l'execution des travaux du port.

Ces études ont démontré que :

- Le recul maximal du rivage se produira à environ 1,5 km du dernier épi et atteindra : après 10 ans, 290 mètres; après 25 ans, 600 mètres; après 50 ans, 980 mètres;
- Les zones protégées par les épis connaîtront une érosion relative d'une centaine de mètres, mais les lignes du rivage se stabiliseront après deux ans environ.

e) La situation actuelle de l'érosion des plages

Les résultats prévus par les études ont été obtenue assez fidèlement.

- La zone protégée par l'épi-ouest, c'est-à-dire la portion de rivage comprise entre la lagune et le port (hôtel de la plage, chambre de commerce, etc.), a connu une érosion intensive pendant les premières années mais s'est stabilisée depuis 1967.
- La zone comprise entre l'épi-est et la lagune a connu un recul de 200 mètres environ, mais tend a se stabiliser elle aussi.
- Au-dela de l'épi-est l'érosion s'exerce librement et son effet s'observe jusqu'au-delà du PK.11. Le recul du rivage, très important à un kilomètre environ de l'enracinement de l'épi où il atteint 250 mètres environ, décroît à mesure qu'on s'éloigne vers l'est. A titre indicatif on peut dire que ce recul (mesure sur les vues aeriennes au 1/10 000ème) est de 200 mètres environ au PK.7, 100 mètres au PK.9 et 50 mètres environ discontinuer tant que le sable sera arrêté par les ouvrages portuaires. Son effet s'accentuera ou se ralentira suivant que l'arrêt du débit solide sera total ou partiel.

f) Les moyens de lutte contre l'érosion

La lutte contre l'érosion a egalement fait l'objet d'études théoriques et en laboratoire avant la construction du port.

Il a été constaté à ce sujet qu'on peut diminuer l'effet de l'érosion,

- Soit en réintroduisant par pompage à l'aval du port une partie du transport littoral; on diminuerait l'effet de l'érosion de moitié environ (475 mètres en 50 ans au lieu de 980 avec l'introduction de 30 p. 100 du transport); mais, comme on l'a vu plus haut, c'est un moyen onéreux.

- Soit en construisant des épis qui reportent l'effet de l'érosion plus à l'est.

Les essais en laboratoire ont montré que deux épis de 120 mètres de longueur, espacés d'un kilomètre, permettent au rivage d'atteindre son profil d'équilibre au bout de quatre ans avec un recul maximal de 200 mètres. Avec des épis de 170 mètres de même espacement, le profil d'équilibre est atteint en deux ans avec 120 mètres de recul maximal.

g) Mesures proposées

Il est possible dans une certaine mesure de chercher à enrayer les effets de l'érosion dans l'état actuel des choses. Mais les épis, à la condition qu'on en contruise suffisamment, n'ont d'autre effet que de limiter le phénomène dans la zone à protéger et de reporter plus loin sa pleine repercussion.

Malgré ce résultat imparfait, ces ouvrages reviennent assez cher à Cotonou en raison notamment de l'éloignement des carrières où doivent être extraits les enrochements à mettre en oeuvre.

On peut cependant lorsqu'il y a des points ou des zones pour lesquels une protection est jugée indispensable, construire des ouvrages de défense. Compte tenu de la nature du littoral, l'ouvrage classique est l'épi perpendiculaire au rivage. Une batterie d'épis espacés d'un kilomètre et ayant 150 mètres environ de longueur peut permettre la défense d'une zone donnée, en limitant à une centaine de mètres l'effet de l'érosion avant le profil d'équilibre.

Pour proteger toute la côte jusqu'à Sèmè, il faudrait envisager la construction de 16 épis environ. Le coût approximatif d'un épi de 150 mètres serait de l'ordre de 60 millions. Sur cette base l'ensemble de la protection reviendrait à : 60 millions x 16 = 960 millions.

On peut toutefois, en raison des nécessités, n'entreprendre que des protections partielles.

On peut se demander s'il n'est pas possible d'envisager une solution moins classique qui puisse donner un résultat provisoire en attendant de trouver les moyens de financement qui permettraient d'entreprendre la protection définitive.

Dans les régions actuellement attaquées par l'érosion, on a pu constater que les cocotiers ne résistaient guère à l'action de sape des vagues, et cela en raison de la nature de leurs racines fragiles d'une part, et d'autre part peu fichées dans le sol. L'idée est donc venue qu'en plantant le long de la côte soumise à l'érosion une essence végétale aux racines solides et profondement enfoncées, on pourrait, dans une certaine mesure, attenuer l'importance du phénomène en retardant son effet.

La Commission a pensé qu'il pourrait être intéressant de tenter un essai qui ne coûterait pas cher et qui, s'il était concluant, permettrait de sauver d'importantes surfaces de terres plantées en cocotiers.

Cet essai pourrait se faire au PK.10, sur un kilomètre environ de longueur et 10 mètres de profondeur.

L'operation couterait :

- Pour la plantation : 100 hommes/jour à l'hectare;
- Pour l'entretien pendant trois ans : 120 hommes/jour, soit un total de 220 hommes/jour.

A raison de 280 francs l'homme/jour, on arrive à un total de 280 x 220 = 61 600 francs, soit 62 000 francs x 1,4 = 86 800 francs (pour tenir compte des charges sociales.

Le Gouvernement pourra mettre cette somme à la disposition de la SNAFOR pour tenter l'expérience.

3. EROSION DU LITTORAL AU NIVEAU DE LA VILLE DE GRAND-POPO

a) Généralités

La côte est une côte basse rectiligne et sablonneuse qui ne présente, en dehors des embouchures du Mono et de l'Ouémé, aucun accident hydrographique.

Cette côte est donc stable et, mises à part les embouchures qui se deplacent parfois en fonction des débits solides, on n'observe pas de changements notables pendant des décennies; le transit de sable dont elle est le siège n'étant arrêté par aucun obstacle.

Cependant, depuis quelques 45 ans, on assiste à une érosion progressive du littoral au voisinage de Grand-Popo. L'influence du phénomène est telle que la ville est de plus en plus abandonnée et que le reste des habitants découragés ne se donnent plus la peine d'entretenir les constructions existantes, ce qui donne à cette cité qui fut naguère un centre commercial florissant, l'aspect d'une ville morte.

b) Importance du phénomène

Une étude faite en 1954 par la mission de l'Ouémé a estimé que le rivage a reculé de 100 mètres en 25 ans, ce qui correspond à un recul moyen de 4 mètres par année.

Si l'on estimait que le phénomène s'est poursuivi au même rythme jusqu'à nos jours, on peut considerer que le recul total ne doit pas être loin de 200 mètres. Ce chiffre est toutefois assez loin de celui que nous a donné le maire de Grand-Popo qui estime à environ un kilomètre l'effet de l'érosion.

En regardant les cartes marines de Grand-Popo datant de 1867, dressées par les Services hydrographiques de la Marine, on peut constater que la langue de sable separant le littoral de la lagune a toujours été assez étroite pour permettre un tel recul.

On peut donc penser que le chiffre d'un kilomètre est surfait et que celui de 200 mètres qu'on peut deduire de l'étude de 1954 apparaît plus vraisemblable.

c) Explication du phénomène

Les recherches hydrographiques entreprises au titre de l'étude de l'implantation d'un port sur la côte ont permis de découvrir, au large d'Agoue, des formations rocheuses constituées par des grès sableux à ciment calcaire à une dizaine de mètres de profondeur, un peu au-delà de la zone de la barre.

Ces formations seraient relativement récentes et localisées.

On peut penser que le phénomène d'érosion subitement apparue dans le site Grand-Popo, est lié à l'existence de ces formations.

Il est probable que ces formations rocheuses sous-marines, constituant un éperon sur le fond de la mer, puissent perturber le transit de sable le long du littoral en diminuant le débit par l'obstacle qu'elles opposent au cheminement normal, ce qui, en contrepartie, entraînerait une érosion des côtes à l'aval. Il ne s'agit là toutefois que d'une hypothèse qui mérite d'être vérifiée à l'occasion d'une étude plus poussée.

d) <u>Situation actuelle</u>

A l'ouest de Grand-Popo, le ruban sableux utilisable a une largeur qui varie entre 500 et 600 mètres. Au droit de la ville et à l'est, cette bande sableuse n'a plus que 80 à 150 mètres, largeur qui va en diminuant au fil des années.

Actuellement, Agbétice, un village jadis important situé a 2,5 km de la ville de Grand-Popo a entièrement disparu. Le village d'Agonè-Kamè est inaccessible - voie carrossable à partir de Grand-Popo. La population active a dû abandonner une ville qui n'est plus occupée, en dehors des autorités et agents de l'Etat, que par quelques pêcheurs et de vieilles personnes à qui leur âge ne permet pas d'aller travailler ailleurs. Ceux que nous avons pu rencontrer se plaignent de manquer de tout et d'être obligés de se déplacer jusqu'à Comé, à 15 km, pour faire leur marché.

e) <u>Solutions possibles pour la lutte contre le phénomène</u>

Il est techniquement possible, en construisant des épis en mer à l'est de la ville, de ralentir puis de freiner le phénomène de l'érosion. La protection qui doit s'étendre aussi aux villages voisins, doit se developper sur quatre kilomètres environ, ce qui correspondrait à quatre ouvrages. Le coût de ces épis serait d'environ 40 000 000 l'unité, soit 160 000 000.

Mais une telle protection ne fait que reporter plus loin le phénomène et dans quelques années l'embouchure du Mono et la plupart des villages situés à l'est de Grand-Popo poseraient à leur tour le problème de la défense de la côte contre l'érosion. On n'aura alors rien fait d'autre que de déplacer le problème.

Par ailleurs, il est permis de se poser le problème de la rentabilite de l'opération : la bande de terre à proteger aurait une largeur moyenne de 100 mètre. Une protection sur quatre kilomètre permet alors de récupérer 4 000 x 100 = 400 000 m^2, soit 40 ha.

On peut considérer qu'en raison du voisinage de la mer, la moitie seulement, soit 200 000 m^2 de ces terres sont utilisables. Dans ces conditions, le mètre carré récupéré reviendrait à $\frac{160\ 000\ 000}{200\ 000}$, soit 800 francs, auxquels il faudrait ajouter la valeur vénale initiale du terrain.

Il ne semble pas que l'opération soit interessante, compte tenu de la nature des constructions à sauver.

Il reste la solution du transfert. Depuis quelques années, aussi bien les autorités que les ressortissants de Grand-Popo ont pensé que la meilleure disposition pour sortir de la situation serait de transferer la ville à l'ouest de son site actuel. A cet effet, un lotissement est en cours d'installation, mais il semble que les travaux d'urbanisation de la zone de recasement soient interrompus pour des motifs inconnus. Il serait souhaitable que ces travaux soient repris en vue de leur achèvement dans les délais raisonnables.

4. CONCLUSION

Il ressort des développements ci-dessus :

a) Qu'en ce qui concerne l'érosion à l'est de Cotonou le phénomène est lié à la création du port en eau profonde de Cotonou, ce phénomène ayant été prévu et tacitement accepté avant la construction du port. Dans ces conditions, il appartient à l'Etat de rechercher les moyens de lutte les plus appropriés.

Nous preconisons qu'une aide soit demandée à un organisme international (PNUD, COI, FAO) afin de procéder à l'étude approfondie du phénomène en vue de la détermination et de la construction des ouvrages de protection necessaires.

On peut toutefois, à titre d'expérience, essayer une protection provisoire peu onéreuse, en plantant une haie de filaos sur un kilomètre au PK.10, afin de voir si ce moyen de lutte peut se révéler efficace au point d'être étendu à toutes les places menacées et de retarder les effets de l'érosion en attendant la mise en place des ouvrages susvisés.

b) Que, s'agissant de l'effritement de la place au droit de la ville de Grand-Popo, on se trouve en face d'un phénomène naturel qui ne peut être combattu qu'au prix de dépenses très élevées peu compatibles avec le bénéfice qu'on peut en tirer pour l'immédiat.

Il est donc recommandé de favoriser et d'encourager le transfert des populations dans le nouveau lotissement en création à l'ouest du site actuel de la ville.

Cependant, il serait souhaitable de rechercher le financement de l'étude proposée au chapitre III afin de determiner les moyens de lutte les plus adaptés à la nature du phénomène.

Pour terminer nous prions les organisateurs d'accepter cette étude sommaire que nous n'avons pu approfondir faute de temps. Nous accepterons volontiers de compléter verbalement nos insuffisances au cours des colloques.

SINTESIS DESCRIPTIVA DE LOS RECURSOS Y ECOLOGIA DE LA ZONA DEL LITORAL CONTINENTAL DE LA REPUBLICA DEL ECUADOR

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INTRODUCCION

Las costas Ecuatorianas se extienden desde la boca del río Mataje al Norte hasta el estero Capone al Sur en la desembocadura del río Zarumilla.

El perfil del litoral ecuatoriano es, con excepción del sector meridional de Chile, el más accidentado de las costas sudamericanas del Pacífico, gracias al Golfo de Guayaquil que se introduce profundamente en la masa continental, confundiéndose con el gran estuario del Guayas.

Este amplísimo golfo está subdividido en 2 secciones por la isla Puná: La del Noroeste llamada Canal del Morro y la otra llamada Canal de Jambelí que se confunde con el río Guayas.

Entre este río, el mayor tributario del Pacífico en Sud América, y el brazo de mar que es el Estero Salado, se forma una larga península, en cuya base está asentada Guayaquil.

En el mismo golfo, pero hacia la parte Sur-oriental, en las costas de la provincia del El Oro, se asienta Puerto Bolívar, ciudad de bastante importancia para la exportación.

Doblando la punta de Santa Elena, que cierra por el Norte el Golfo de Guayaquil, se encuentra la amplia bahía del mismo nombre en el que se asienta el mayor balneario de la costa ecuatoriana, Salinas, y el activo puerto de la Libertad.

Más hacie el Norte, doblando, así mismo, los cabos de San Lorenzo y San Mateo, ya en tierras de la provincia de Manabí, se halla la amplísima había de Manta donde se asienta el puerto del mismo nombre.

Un poco más al Norte y en la misma provincia, se asienta una abrigada bahía con una entrada entorpecida por escollos, el atractivo puerto de Bahía de Caráquez.

Muy cercano a la línea ecuatorial se destaca en el perfil del litoral, el Cabo Pasado.

Doblando por fin en tierras de la provincia de Esmeraldas, el cabo de San Francisco y una serie de puntas como Tortuga, Galera y Gorda, se abre la amplia desembocadura del río Esmeraldas, el segundo de la costa ecuatoriana en cuya margen izquierda y a unos 2 kilómetros del mar se asienta el puerto del mismo nombre.

La costa sube 5 millas al Este, tuerce al Noroeste en la Punta Verde, sigue al Este hasta el río Vainilla y se extiende una llanura que se prolonga hasta Colombia. La playa ya no tiene accidentes hasta la boca del río Santiago, y empiezan una serie de pantano e islas rodeadas de manglares que se llaman Tola, Santa Rosa y San Pablo. Luego comienza el delta del Mira, girando la costa al Noroeste en la fronter de la república. El gran seno, entre la punta Mangles y la boca del Santiago, se llama Bahía de Ancon de Sardinas.

Aspectos físicos

El Océano Pacífico, que baña la costa del Ecuador, es con mucha ventaja el más grande de los océanos. El área del océano bajo soberanía del Ecuador se divide en dos partes; la una se extiende 200 millas de la costa y la otra cubre un radio de 200 millas alrededor de las Islas Galápos situadas a 600 millas del continente.

La corriente principal de la costa Oeste de Sur América es conocida como corriente de Humbolt que corre de Sur a Norte y es parte del sistema de corrientes del Pacífico Sur que corre con un sistema anti horario. La corriente de Humbolt se origina en las regiones sub-polares, de la corriente originada de los vientos occidentales. En la parte Sur del Ecuador esta corriente se desvía hacia el Oeste y se transforma en la corriente Ecuatorial Sur.

Una rama continúa en la dirección Norte-noroccidental bordeando la costa Ecuatoriana y se encuentra, con variaciones de acuerdo a un periodo aparentemente de varios años, con la corriente del Niño, que es una ramificación de la corriente contra ecuatorial formada por aguas calientes y tropicales.

Hacia el Norte del Ecuador se encuentra el frente ecuatorial, donde gracias a vientos opuestos del Sur, las corrientes calientes del Norte y fría del Sur son prevenidas de mezclarse. Una explicación de las periódicas incursiones hacia el Sur, de la corriente del Niño es la debilidad exepcional de los vientos de cambio Sur-orientales.

Existe una total ausencia de datos de altura, periodo, frecuencia y dirección de aproveche de las olas del Océano que chocan contra las costas ecuatorianas.

Climáticamente, la parte del océano que bordea la costa del Ecuador se define como sub-tropical.

El mar aproximadamente 600 millas al Norte y al Sur del Ecuador tiene un porcentaje de vientos fuertes (fuerza) de menos 1%.

En las costas, las tormentas de las que se conoce algo son las del 6 de Diciembre de 1969 en Manta con vientos y olas aproximadamente del Sur-oeste y la otra reportada sin fecha en San Lorenzo con vientos del Norte.

La tormenta de Manta es de mucha importancia, ya que destruyó parte del rompeola en el puerto. Por fotografías y testigos, aunque las olas llegan al tope del rompeolas, éste nunca fue totalmente cubierto por el agua.

Es muy probable que esta misma tormenta haya atacado a Bahía de Caráquez y posiblemente a San Lorenzo, dando como resultado un cambio de la topografía del mar en estos puertos.

Cuencas hidrográficas y precipitación fluvial

La parte Norte del Litoral es la de mayor pluriocidad y consiguiente su zona selvática tiene mayor humedad permne. Las orillas del mar y estuarios de los ríos al Norte del río Santiago son espesos manglares. En la zona central o Sur del litoral o costa se nota marcadamente la temporada de lluvia que vulgarmente se denomina invierno desde Diciembre hasta Mayo y la temporada de sequía llamada verano, de Mayo a Diciembre

Lo más importante de ésta región es la existencia de algunas cuencas hidrográficas que abarcan extensas áreas de influencia sobre tierras de alto valor ecológico, y así se tiene al Norte las cuencas del río Santiago y del Esmeraldas. La primera contiene los más extensos bosques de maderas finas que no han sido explotados sino en mínima parte debido a la falta de vías de comunicación.

Las tierras en la cuenca del río Esmeraldas se hallan explotadas parcialmente en sus recursos madereros y han ido transformándose en agrícola de variada producción y alto rendimiento.

En la zona central se encuentra la cuenca del río Portoviejo que abarca una importante zona agrícola de la provincia de Manabí.

La cuenca del río Guayas ocupa la mayor parte del litoral o costa, con tierras de gran valor para la producción agrícola tropical.

El río Guayas con sus principales afluentes, el Daule, el Babahoyo, el Quevedo fueron por mucho tiempo y hasta hace pocos años, las principales arterias de la basta zona agrícola para los productos de exportación con centro en el puerto de Guayaquil. Al Sur se encuentran las costas menores del Jubones, del Santa Rosa y del Arenillas que abarcan también tierras de gran productividad agrícola.

Cerca de las 3/4 partes del litoral se haya cultivada y el resto lo constituye una exuberante floresta o selva tropical.

La península de Santa Elena y pequeños sectores de las costas de Manabí son tierras semi-áridas por la escasez de lluvias y carencia de irrigación.

En el litoral se producen períodos de lluvias torrenciales cíclicos cada 6 o 7 años, así como también inviernos secos que tienen carácter catastrófico para la agricultura zonal.

En la tercera semana de Febrero de 1975, en el litoral, y particularmente en las provincias de Manabí, Guayas y los Ríos se produjeron lluevias torrenciales, habiendo sufrido los estragos varias provincias. Graves inundaciones se produjeron en Portoviejo, Rocafuerte, Chone, Guayaquil, Milagro y muchas otras poblaciones, con la destrucción de centenares de casas y millares de hectáreas de sembríos, la interrupción de carreteras y caminos, con derrumbes y hundimientos.

El puerto de Bahía de Caráquez quedó aislado por la completa destrucción de las vías terrestres, y Portoviejo se reportó el registro de 192 m.m. de lluvia en 6 horas y la destrucción de la represa del río Briceño informándose que lluvias semejantes no se habían visto durante 40 años.

A fín de formarse una impresión del efecto de la lluvia los anuarios metereológicos publicados por el Instituto Nacional de Metereología e Hidrografía fueron consultados:

Usando las estadísticas para 1970 el orden de precipitación anual fue:

San Lorenzo	2.397 m.m.
Esmeraldas	742 m.m.
Guayaquil	695 m.m.
Bahía de Caráquez	610 m.m.
Manta	333 m.m.
Puerto Bolívar	140 m.m.

Este patrón se mantiene por lo general para otros años.

Sismología

El Ecuador se encuentra sobre un cinturón muy activo de terremotos. En la región se encuentran muchas fallas lo cual aumentan las condiciones conducentes a movimientos terrestres.

Los registros obtenidos por el observatorio astronómico de Quito demuestra que todos los puertos se encuentran expuestos a terremotos, pero es notable que la provincia de Esmeraldas y el mar a lo largo de la costa de Esmeraldas figuran regularmente en la lista de lugares que experimentan terremotos y tamblores.

En Enero de 1958, Esmeraldas estuvo afectada por un terremoto de severidad moderada acompañado por olas sísmicas, este evento fue seguido por una serie de temblores menores que duraron los dos meses siguientes. El Piloto Sudamericano lleva un comentario al efecto, y es que como resultado de este terremoto, se puede haber producido cambios en la configuración del fondo del mar y en la profundidad de agua existente.

Las Islas Galápagos han sido recientemente una región muy activa.

Amplitud de marea y horarios

El nivel de recorrido de la marea varió poco a lo largo de la costa del Ecuador. La dirección de la ola de la marea es hacia el Sur, pero en tablas publicadas por el Instituto Oceanográfico Ecuatoriano, de las cuales se han tomado el horario de la marea alta y baja a lo largo de la costa, es evidente que la configuración costanera y la topografía submarina tienen una influencia considerable en los horarios de marea alta y baja en cada puerto.

En el cuadro 1 podemos observar la comparación de la amplitud de la marea y los horarios.

Visión geológica

En la llanura costanera la cordillera de Chongón y Colonche, que se extiende desde Guayaquil, hasta Jipijapa y Portoviejo, forma el núcleo geológico de la región. Lo constituyen depósitos de la formación cretacea, con rocas eruptivas, en particular pórfidos. El sector comprendido entre este núcleo y los Andes ha sido rellenado con sedimientos terciarios y más recien-

COMPARACION DE LA AMPLITUD DE LA MAREA Y HORARIOS

Puertos (de norte a sur)	Amplitud de la marea (en metros)	Hora de la pleamar	Hora de bajamar	Amplitud aproximada de las mareas (en metros)
San Lorenzo	2,10	01:34	07:29	3,80
Esmeraldas	1,80	01:35	07:21	3,30
Bahía de Caráquez	1,70	01:21	07:46	2,70
Manta	1,50	01:10	07:29	2,60
La Libertad	1,30	02:24	07:17	2,40
Guayaquil (ciudad)	3,00	04:30	11:35	4,10
Puerto Marítimo	2,70	05:07	11:34	4,40
Posorja	2,00	02:33	08:82	2,60
Puerto Bolívar	1,80	02:03	08:21	3,20
San Cristóbal	1,30	00:32	06:18	--

tes aún, sobre todo donde los cursos de agua fluyen en ángulo recto con respecto a la dirección de la Cordillera Andina.

En torno, pues, a las elevaciones de Chongón - Colonche y de los solevantamientos que se continúan más hacia el Norte, hasta Esmeraldas, se desarrolla una costa ondulada, con alturas que van desde los 20 metros hasta los 200 metros, entre los que afloran rocas sedimentarias, esquistosas, areniscas ferruginosas, cuarzosas, con abundancia de fósiles marinos que atestiguan su condición de lecho marino.

Hacia el Sureste, entre capas de terrenos pretenciarios, terciarios y cuaternarios, se encuentra el asiento de formaciones petrolíferas, que se extiende desde las faldas de los cerros costaneros hasta el mar, cubierto en gran parte de toblazos y en otras de valles ondulados.

La estructura de esta zona geológica se presenta cuarteada en blocks con un complejo sistema de fallas que han determinado la acumulación del preciado hidrocarburo, formando los reservorios subterráneos su conjunto de rocas areniscas porosas, recubiertas de areniscas lenticulares. Todo el petróleo de esa región se encuentra dentro de capas terciarias.

Contaminación en las costas ecuatorianas

a) Descargas directas (cuadro Nº 2)

Las informaciones recibidas indican que no existe tratamiento de las descargas domésticas en las ciudades costeras y se efectúan directamente en la orilla, excepto en la ciudad de Esmeraldas (60.000 h.) que efectúa sus descargas por medio de una tubería submarina de aproximadamente 1.000 metros de longitud.

Manta la ciudad costera de mayor número de habitantes y a la vez puerto comercial y principal centro pesquero del país, tiene en construcción lagunas de oxidación para tratamiento de la descarga doméstica.

b) Descargas indirectas (cuadro Nº 3)

Al igual que las ciudades costeras, las ubicadas junto al cauce de los ríos no cuentan con tratamientos de sus descargas excepto Portoviejo (59.000 h.) a orillas del río del mismo nombre que cuenta con lagunas de oxidación.

En el cuadro Nº 3 se presentan los datos de población de las principales cuencas hidrográficas, anotándose que los mayores problemas sobre contaminación por desechos domésticos corresponden a las cuencas de los ríos Esmeraldas y Guayas.

A la cuenca del río Esmeraldas aportan a su caudal gran cantidad de ríos y recibe descargas de ciudades localizadas en la región interandina incluyendo la capital del país Quito (595.000h. y 2.800 mt. de altura) cuyas descargas domésticas e industriales van al río Machangara.

La cuenca del río Guayas es el sistema hidrográfico más extenso del litoral y a sus orillas se encuentra la ciudad de Guayaquil (814.000 h.) cuyas descargas domésticas e industriales constan en el cuadro Nº 4.

CUADRO Nº 2

Descargas domésticas directas al mar (Ecuador)

Ciudad costera	con tratamiento	sin tratamiento	en la orilla	por tubería	nº aprox. de hab. (1974)
San Lorenzo		x	x		9.000
Esmeraldas		x		x	60.000
Bahía de Caráquez		x	x		11.000
Manta		x	x		64.000
Manglaralto		x	x		13.000
La Libertad		x	x		26.000
Salinas		x	x		12.000
Playas (General Villamil)		x	x		11.000
Puerto Bolívar		x	x		10.000

Población

Se estima que la población en el Ecuador está creciendo en un 3,4% anual, lo que muestra uno de los porcentajes más rápidos del mundo.

En 1972 la población era estimada en 6,6 millones comparada con 4,7 millones en 1962.

CUADRO Nº 3

Población de las cuencas hidrográficas (Ecuador)

Cuenca Fluvial	Número de ciudades con la siguiente población: menos de 50.000	>50.000 <100.000	>100.000 <500.000	>500.000 <1.000.000	>1.000.000	Población estimada de la Cuenca Fluvial
Río Santiago	6	-	-	-	-	19.000
Río Esmeraldas	57	1	-	-	-	835.000
Río Chone	10	-	-	-	-	104.000
Río Portoviejo	12	1	-	-	-	162.000
Río Guayas 1/	109	1	-	1	-	1.738.000
Río Balao	3	-	-	-	-	11.000
Río Jubones	26	-	-	-	-	104.000
Río Santa Rosa	5	-	-	-	-	31.000
Río Arenillas	4	-	-	-	-	12.000

1/ Incluye los ríos Taura y Naranjal

CUADRO Nº 4

Descargas domésticas de Guayaquil (Ecuador)

Volumen de las descargas:	Total	:	171,7 lt./seg.
	Al Estero Salado	:	103,0 lt./seg. (60%)
	Al Río Guayas	:	68,7 lt./seg. (40%)

Descargas al Estero Salado

	sólidos en suspensión mg./lt.	% disuelto mg./lt.	Nitratos mg./lt.	fosfatos mg./ lt.	Colifomes/100 ml. Total	Fecal
Media Marea	1.0-562,0	0,0-2,2	--	--	17.000-1.700.000	3.300 1.300.000
Pleamar	4,0-21,5	0,0-6,9	0,26-1,5	0,6-3,1	35.000-160.000	4.000 22.000

Aunque en 1972 la costa y la sierra tenían aproximadamente la misma población, la costa está creciendo con mucha mayor rapidez que la sierra, 4,1% al año contra el 2,7%. Sólo la provincia de Pichincha (capital Quito) en la sierra está creciendo en un porcentaje más rápido que el 3% anual, lo que iguala al crecimiento de porcentaje en las provincias de la costa todas las cuales están creciendo en un porcentaje más rápido que el 4%, excepto Manabí, al 3,4%.

Mientras no es posible calcular la exactitud de estos cálculos, parece como si hubiera un incremento en la concentración de población en la costa, ya que esta área ofrece mayor número de oportunidades de empleo.

Dotación de recursos naturales

Agricultura

Los principales productos agrícolas del litoral pueden ser divididos en dos grupos:

De exportación: Banano, cacao, café, caucho y madera.

De consumo interno: Arroz, caña de azúcar, oleaginosas, algodón, frutas tropicales como naranjas y otros cítricos.

Pesquería

Los recursos ictiológicos de las aguas jurisdiccionales del Ecuador son inmensos, porque el refrescamiento de las aguas tropicales del Pacífico causado por el último ramal de la corriente Humbolt que se dirige hacia el Archipiélago de Galápos, vuelve más propicio el "habit" que las especies ictiológicas más codiciadas por la industria pesquera extranjera, hallándose en dicho sector los grandes "cardumenes" o bancos multitudinarios de peces de toda clase y particularmente de las variedades grandes de atún y de las pequeñas de sardinas; y en las inmediaciones de las Galápagos se encuentran periódicamente también grupos de ballenas que vienen desde las aguas Antárticas.

El mar territorial considerado como la quinta región del país varias veces más grande que el suelo continental, es la más rica en recursos naturales, de aprovechamiento inmediato para la alimentación humana.

La pesca de consumo interno consta de camarones, langostas, cangrejos, conchas u ostras y toda clase de peces.

La industria camaronera constituye uno de los principales renglones pesqueros del Ecuador, cuya estadística alcanza anualmente 5.000 toneladas métricas y su exportación llega a un valor CIF de alrededor de 5,6 millones de dólares por año.

Existen en el mar territorial dos especies principales de atunes que los pescadores industriales del Ecuador explotan: la albacora o atún de aleta amarilla y el listado o bonito de altura o barrilete. Estas dos variedades constituyen el 95% de la pesca atunera del país.

En el puerto de Manta existen procesadoras y enlatadoras de pescado para la exportación y el consumo interno.

Petróleo

En la costa Ecuatoriana existen los yacimientos de petróleo de la península de Santa Elena, explotados por la compañía Anglo Ecuatorian Oil Fields desde hace 40 años, dichos yacimientos van disminuyendo paulativamente su producción y aquellas refinerias tuvieron que importar grandes cantidades de petróleo para su refinación durante la última década, a fin de llegar a abastecer las necesidades nacionales que experimentan un permanente incremento anual.

Debido a que las refinerías existentes en la península de Santa Elena son insuficientes para atender la demanda de necesidades del país, el gobierno resolvió la construcción de una refinería estatal en Esmeraldas donde se han iniciado los trabajos en su primera etapa.

Transportes

Ferrocarriles: Quito-Ibarra-San Lorenzo, es importante por ser el único medio de comunicación con la extensa zona de San Lorenzo en la provincia de Esmeraldas.

Carreteras

Existe la siguiente red de carreteras que unen a las diferentes ciudades del litoral.

Quevedo - El Empalme	26 K.
Quevedo - Rocafuerte - Bahía de Caráquez	203 K.
Quevedo - Portoviejo - Manta	164 K.
Quevedo - Balzar - Daule - Guayaquil	156 K.
Quevedo - Catarama - Babahoyo - Guayaquil	182 K.
Manta - Jipijapa - Guayaquil	197 K.
Guayaquil - Milagro	49 K.
Guayaquil - Machala - Puerto Bolívar	138 K.

Puertos

El principal puerto del país es Guayaquil, el que ha sido centro de las exportaciones e importaciones durante toda la historia de la nación. Desde 1961 entra al servicio Puerto Nuevo, situado en el costado Occidental de la ciudad con sus instalaciones portuarias modernas y muelles que permiten acoderar a los barcos grandes directamente, por lo que hoy se le considera como "Puerto Marítimo", porque el acceso desde el golfo se lo hace por un estero acondicionado como canal marítimo.

El puerto de Guayaquil está conectado con muchas líneas de vapores internacionales que lo comunican con todo el mundo.

En la costa ecuatoriana hay otros puertos que tienen ventajosa situación geográfica que no se les aprovechaba antes por carecer de facilidades portuarias. Solamente en los últimos años se comenzaron a construir muelles, instalaciones portuarias en Manta y Puerto Bolívar que yá se hallan en servicio. En Esmeraldas se viene construyendo las instalaciones portuarias desde hace tres años. San Lorenzo tiene un muelle de la vía férrea. Salinas tiene muelles para barcos pequeños. Hay servicio de cabotaje marítimo con todos los puertos del país periódicamente con el Archipiélago de Galápagos.

Vías fluviales

En la actualidad la importancia de la navegación fluvial ha disminuido por la existencia de la red de carreteras.

Las principales vías fluviales del litoral son:

Guayaquil - Puerto Bolívar - Santa Rosa;
Guayaquil - Daule - Balzar
Guayaquil - Baba - Vinces - Palenque - Quevedo
Guayaquil - Babahoyo - Catarama - Ventanas
Esmeraldas - Majúa - Quinindé
Limones - Borbón - Maldonado por el río Santiago y Cayapas.

Transporte marítimo

En Septiembre 24 de 1971 fue expedido el Decreto Nº 1447-C que dió creación a transportes Navieros Ecuatorianos "TRANSNAVE", con la finalidad de efectuar la explotación de transporte por agua dentro y fuera del país, rescatando así al mismo del dominio de las empresas navieras extranjeras.

Incursionando el campo internacional de carga general, atendiendo los tráficos del Norte de Europa dentro de la conferencia Europa Pacífico Sur Magallanes y del Pool Europac II, agrupación a la que ingresó el 3 de Abril de 1974, en su reunión de principales realizada en Viña del Mar, en la cual aceptaron a "TRANSNAVE" como miembro en pleno derecho. También interviene en el tráfico hacia Asia dentro de la conferencia naviera del Japón, es además miembro de la Asociación Latinoamericana de Armadores (ALAMAR).

En el transporte de carga general opera con un moderno buque propio, el M/N. "Isla Puná", adquirido a la antigua y experimentada empresa naviera Hapag Lloid en Junio de 1974, con quien tiene firmado un convenio de cooperación técnica y servicio conjunto.

Transnave posee el 55% de las acciones de la Flota Petrolera Ecuatoriana (FLOPEC) empresa formada en asociación con la compañía naviera Japonesa Kawasaki Kissen Kaisha. En ella opera con cinco buques tanqueros propios de 32.000 toneladas y 35.000 toneladas de registros de carga crudo.

Actualmente Transnave ha asumido la operación racional y rentable de 2 naves con que cuenta la Flota Bananera Ecuatoriana, las mismas que fueron especialmente construídas para esta Empresa.

Con la M/N. Calicuchina, Transnave realiza el servicio turístico hacia las Islas Encantadas, Archipiélago de Colón o Galápagos.

El Ecuador es además accionista de la Flota Mercante Grancolombiana junto con Colombia.

Turismo

Los enclaves turísticos más bellos y atractivos cercanos a Guayaquil son los balnearios marítimos de Playas, Salinas, Manglaralto y otros numerosos lugares de la costa que son centros de deportes marítimos recreacionales de yachting, pesca y natación.

A lo largo de toda la costa de la provincia de Manabí, existen hermosas y lindas playas que constituyen atractivos para el turismo. El principal centro turístico es Manta por su bellas playas, fácil acceso por buenas carreteras y comodidades de alojamiento. Desde Manta pueden visitarse varios lugares que son balnearios pintorescos que recién están desarrollándose, como las playas de Crucita, San Jacinto, Bahía de Caráquez y otras que desafortunadamente carecen de agua dulce.

En la costa Esmeraldas se encuentran bellas playas con hermosos paisajes y clima agradable que le dan sitial destacado para turismo.

Cabe destacar que organismos gubernamentales se hayan empeñado en la creación de parques nacionales y parques de recreación al igual que adecuación de balnearios para lograr que estos constituyan un elemento de vital importancia para el desarrollo turístico a nivel nacional, internacional y popular, para lo cual será preciso, ampliar y mejorar las vías de acceso, servicio de agua potable, alcantarillado, telecomunicaciones, energía eléctrica, hoteles, moteles y hosterías.

Plan integral de transformación y desarrollo

Este plan ha sido formulado por la Junta de Planificación y Coordinación Económica con el asesoramiento de varios organismos que han analizado los problemas fundamentales de la economía nacional y los propósitos de evolución social y económica del conjunto de grupos humanos del país.

Debemos mencionar resumidamente el plan que se encuentra en marcha porque es de esencial naturaleza geográfica, puesto que se refiere a la evolución del medio físico y su inter-relación con el desarrollo económico de las actividades humanas en las que influyen diversos factores que entre los principales están el ecológico, climático, vegetación, fauna, trabajo, población rural y urbana; recursos energéticos, minerales e hidráulicos y todo otro elemento que pueda contribuir al bienestar humano.

El plan contiene proyectos y programas específicos factibles de ser cubiertos por los recursos que dispone y se prevee dispondrá el país.

El plan global comprende:

a) Políticas:
   - Política de reforma agraria
   - Política de colonización
   - Política financiera
   - Política de cooperación técnica internacional
   - Política científica y tecnológica
   - Política tributaria
   - Política de crédito externo
   - Política de comercio exterior e integración
   - Política de normalización para la participación social

b) Sectores productores:
   - Programa agropecuario y forestal
   - Programa pesquero
   - Programa de geología y minería
   - Programa de hidrocarburos
   - Programa industrial
   - Programa de artesanía y pequeña industria

Programa de turismo

c) Sectores de infraestructura

Programa de transportes y comunicaciones
Programa de carreteras y terminales terrestres
Programa de transportes automotor
Programa de ferrocarril
Programa de transporte acuático
Programa de transportes aéreos
Programa de telecomunicaciones
Programa de correos
Programa de energía eléctrica
Programa de urbanismo
Programa de vivienda
Programa de agua potable y alcantarillado
Programa de metereología e hidrología

d) Sectores Sociales

Programa de recursos humanos
Programa de educación
Programa de salud

En su afán de cumplir el plan programado, el gobierno ha emprendido en su ejecución, destacándose la reorientación de la estructura productiva agropecuaria dirigida a satisfacer las necesidades alimenticias básicas de la población; la defensa de las 200 millas de mar territorial y sus recursos; la ejecución de los programas de electrificación que proporcionan energía económica a las clases populares modestas; la política petrolera; la ejecución de amplios programas de vivienda, protección social, etc.

Dada la importancia de los recursos pesqueros, el gobierno expidió la ley de fomento y desarrollo pesquero en Febrero de 1974, considerando una programación de obra de infraestructura para un amplio aprovechamiento de las riquezas ictiológicas, estableciendo normas técnicas indispensables para el desarrollo pesquero, la creación de complejos pesqueros e instituciones de capacitación. Los estudios de prefactibilidad de puertos pesqueros, y la creación del Instituto Oceanográfico Ecuatoriano, para la investigación de los recursos marítimos; medidas que contribuirán para obtenerse la tecnificación y el desarrollo de las actividades pesqueras.

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Dr. Guiseppe Bicchierai

PROGRAMA DE FOMENTO Y DESARROLLO PESQUERO
Ministerio de Recursos Naturales y Energéticos

ATLAS GEOGRAFICO DEL ECUADOR
Mayor Ing. Francisco Sanpedro

ORDENACION Y APROVECHAMIENTO DE LOS RECURSOS DE LA ZONA COSTERA DE LA REPUBLICA DEL EL SALVADOR

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Ministerio de Agricultura y Ganadería

1. Generalidades

La República de El Salvador está situada en la América Central, en la zona tórrida, al Norte de la línea Ecuatorial y al oeste del Meridiano de Greenwich, entre los paralelos 13° 09' y 14° 27', latitud norte y los meridianos 87° 41' y 90° 08' longitud Oeste del Meridiano de Greenwich. Limita al Norte con la República de Honduras, al Sur con el Océano Pacífico (321 Kms. de Costa) al Este con la República de Honduras y la República de Nicaragua (Golfo de Fonseca por medio), al Oeste con la República de Guatemala.

A diferencia de los otros países de la región Centroamericana, posee costas sólo en el Océano Pacífico. Tiene un promedio de 90 Kms. de ancho y 262 Kms. de largo, con una superficie aproximada de 21,040.79 Kms.^{2}.

El artículo 8 de la Constitución Política del El Salvador establece entre otros aspectos, que el país tiene una mar adyacente hasta la distancia de doscientas millas marinas contadas desde la línea de la más baja marea. Esta disposición constitucional tiene una gran trascendencia para el desarrollo económico y social del país, dada la presión demográfica constituída por una población en rápida expansión, actualmente de alrededor de 4,000,000 de habitantes y con una tasa de crecimiento geométrica del 3.5% anual.

2. Características físicas de la zona costera

2.1. Extensión y ubicación geográfica

La zona costera del país ha sido determinada tomando como base una altura entre 0 y 200 metros sobre el nivel del mar, exceptuando las tierras de esta altura que son parte de los valles interiores. La extensión estimada de dicha zona es de 3,571 Km^2., aproximadamente el 17% del área total del país.

2.2. Composición morfológica, características físicas, químicas y clasificación agrológica del suelo

En términos generales, la Zona Costera está formada por áreas planas o casi planas. En su extensión longitudinal se encuentra interrumpida por los bloques de los macizos montañosos del Bálsamo y de Jucuarán. Las dos mayores planicies costeras son: (a) la que se extiende desde la bocana del río Paz hasta el bloque montañoso del Bálsamo, cerca de la Barra El Maguey; y (b) la que se extiende desde el Puerto de La Libertad hasta la montaña de Jucuarán. En el tramo intermedio se encuentran las planicies aluviales de los ríos Jiboa, Lempa y Grande de San Miguel.

El otro gran paisaje que tipifica a dicha Zona es el sistema de Bahías y Esteros, que incluye una serie de bocanas formadas por algunos ríos. Entre los esteros principales están la Barra de Santiago, El Estero de Jaltepeque, la Bahía de Jiquilisco y la Bahía de La Unión.

Las características físicas de los suelos, especialmente en la planicie, son muy heterogéneas a pesar de presentar formas externas bastante similares. En lo que a textura se refiere, la mayor parte de los suelos que comprende la planicie y pequeñas elevaciones de terrenos se tipifican por presentar textura franco-arcillosa, franco, franco-arenosa, y franco-limosa. Predominan en cuanto a la estructura, los tipos de bloques subangulares, granulares, migajosos y sin estructura. La consistencia en la mayoría de los casos es friable, aunque también se encuentran suelos arenosos o areno-francosos en que es suelta o muy friable. En lo referente a porosidad, casi todos estos suelos presentan buena porosidad y por lo tanto, adecuadas condiciones de aereación. En lo que respecta a las condiciones químicas de los suelos de la planicie costera, éstas se presentan de moderadas a buenas, estando por lo general en bajos niveles el nitrógeno; medio-alto el fósforo; alto el potasio; y medio bajo el de la materia orgánica. El PH comunmente oscila de moderadamente ácido a neutro, aunque en los manglares oscila de ligeramente alcalino a fuertemente alcalino.

En la clasificación de las tierras, de acuerdo al Sistema Americano (USDA), la predominancia es de tierras clase II y III, y en menor medida clase V. Las tierras clase II predominan en los departamentos de Usulután y La Paz, aunque se encuentran diseminadas en algunas áreas de La Unión, Sonsonante y Ahuachapán; estas son tierras de alta productividad. La clase III existe primordialmente en La Paz, Usulután, Sonsonate y Ahuachapán y son de mediana productividad. La clase V se encuentra en La Unión, La Paz, Ahuachapán y Sonsonate; por lo general no son cultivables salvo para arroz y pastos, teniendo una mediana productividad. En pequeña porción existen tierras clase I, con una altísima productividad y tierras clase VII para fines forestales. Se encuentran además algunas tierras clase IV y VI en los pequeños peniplanos, colinas y serranías que forman la intersección de la planicie costera con la Cadena Montañosa Central, así como tierras clase VIII sólo aptas para parques nacionales, zonas silvestres o para protección de cuencas hidrográficas, que se ubican en La Unión y en menor proporción en Ahuachapán.

En general, las tierras de la Zona Costera se caracterizan por ser las mejores y más productivas del país.

2.3. Composición hidrológica y grado de contaminación

Dentro de la red hidrográfica tienen especial importancia el bajo Lempa y los ríos Jiboa, Grande de San Miguel, Paz y Banderas.

En la vertiente de la Cadena Costera nacen numerosos ríos que desembocan directamente en el mar; la suma de sus cuencas es de alrededor de 5.000 Km^2. Actualmente la Dirección General de Recursos Naturales Renovables del Ministerio de Agricultura y Ganadería, opera una red nacional de 125 estaciones hidrométricas (111 superficies y 14 subterráneas).

En la Zona Costera se encuentran 8 cuencas principales, para las cuales se ha calculado un volumen promedio anual de escorrentía de 4,849 millones de Mts.^{3} y un caudal promedio de 260.4 mts.^{3}/segundo en la estación lluviosa y 45.4 mts.^{3}/segundo en la estación seca. Los principales depósitos de aguas subterráneas del país se encuentran en la Zona Costera y sobresalen por su potencial de agua subterránea el río Lempa, Grande de San Miguel y el complejo San Pedro-Sensunapán-Banderas. El rendimiento seguro de los depósitos subterráneos ubicados a lo largo de la costa es de 30.5 mts.^{3}/segundo (Anexos 1 y 2).

Entre los cuerpos de aguas marítimas, el más importante es el de la Bahía de Jiquilisco, con 121.2 kilómetros cuadrados.

La calidad química del agua sufre degradación debido fundamentalmente a tres órdenes de factores: (a) desechos industriales y domésticos que sin el debido control o tratamiento fluyen a los cuerpos de aguas; (b) retorno de aguas de regadío que arrastran fertilizantes, sales minerales, etc.; y (c) descargas de pesticidas en los cuerpos de agua. Ilustra el deterioro de la calidad del agua el caso de la contaminación del río Lempa, el cual pasa de 3,600 coliformes por cada 100 mililitros con las descargas del río Suquiapa, a 93,000 con las del río Acelhuate de la Zona Metropolitana de San Salvador, según la División de Saneamiento Ambiental del Ministerio de Salud Pública y Asistencia Social.

2.4. Composición climatológica

El Salvador pertenece al cinturón climatológico de los trópicos semihúmedos. Tiene una estación lluviosa y una seca; la primera va de mayo a octubre y la segunda de noviembre a abril. El promedio anual de lluvias es de 1,865 milímetros y los promedios anuales de temperatura oscilan entre los 22 y 27 grados centígrados. Los promedios mensuales de humedad relativa oscilan entre 58% y 90%, correspondiendo los valores altos a la época lluviosa, especialmente a los meses de junio y septiembre, mes este en que alcanza su máximo. En el año se manifestaron en cuanto a los vientos, los siguientes rumbos dominantes: (a) Octubre-Febrero: Alrededor del norte (período de "nortes" procedentes de América del Norte), especialmente durante el día; y (b) Marzo-Septiembre: Durante la tarde "Brisa Marina" de rumbo alrededor del sur. Las velocidades varían entre 70 y 200 kilómetros por hora, dependiendo de la altura al nivel del mar.

2.5. Importancia ecológica de la zona costera

Los bosques salados o manglares, constituyen uno de los recursos de mayor importancia económica de la Zona Costera. Su área se estima en 35,423 has., distribuidas básicamente en 4 áreas: (a) 3,413 has. en la Barra de Santiago; (b) 5,720 has. en el Estero de Jaltepeque; (c) 19,847 has. en la Bahía de Jiquilisco; y (d) 6,443 has. en la Bahía de La Unión. La temperatura media anual en tales áreas es de 27° C.

La asociación de los bosques salados está constituida prin-

principalmente por las siguientes especies: (a) Mangle (Rhizophora mangle L.); (b) Sincahuite (Laguncularia racemosa gaertn F.); (c) Ishtaten (Avicennia nitida Jacq); (d) Madresal (Avicennia bicolor Standley); y (e) Botoncillo (Conocarpus erecta L). Alrededor del 80% de la proteína para consumo humano extraída de los esteros y del mar es producida directa o indirectamente por los manglares, ya que aquí gran cantidad de matoria orgánica inerte es convertida biológicamente en materia de alimentos. La producción maderera de los bosques salados se estima en 30,000 M^3. al año, con un valor aproximado de C 513,971 (USA $ 205,588.40).

Los bosques de latifoliadas y coníferas de la costa prácticamente han sido exterminados, quedando apenas unas 7,200 has. diseminadas de bosques principalmente de latifoliadas.

La vida silvestre de la zona, particularmente la asociada con manglares y el litoral, es sin duda la más sobre-explotada. La población de aves silvestres ha sido reducida a menos del 30% de lo que existía hace 15 años. Muchas especies han sido eliminadas en un 80% o más de su área de distribución en este mismo período.

Casi todos los principales moluscos y crustáceos explotados comercialmente han sido reducidos a niveles extremadamente bajos. Reptiles de valor comercial como la iguana y en cierta forma el caimán y el cocodrilo, han sido reducidos a menos del 10% de los que existían hace 15 años.

2.6. Areas inundables

Las áreas más expuestas a inundaciones están localizadas en el Bajo Lempa (23,700 has.) y en la desembocadura del río Grande San Miguel (1.400 has.)

3. Características económicas de la Zona Costera

3.1. Areas de explotáción minera

El Centro de Investigaciones Geotécnicas ha determinado que existen apreciables cantidades de hierro y titanio en las arenas negras del litoral del país. Para todo el litoral, esta Oficina Científica calcula que las arenas negras (concentrados enriquecidos magnéticamente con 55-60% de hierro) alcanzan de 10 hasta 100 millones de toneladas métricas.

En 1969 la referida Oficina realizó observaciones en la zona litoral de la Costa de El Salvador, en la Distribución de las concentraciones de minerales pesados, estableciendo las siguientes regularidades: (a) las áreas de mayor concentración se hallan con mucha frecuencia, inmediatamente al occidente de desembocaduras de ríos; (b) la anchura y el espesor de las áreas de concentración son constantes, generalmente por varias centenas hasta 1.000 Mts., con anchuras promedio de 20 a 30 metros, encontrándose un total de 10 áreas litorales con extensiones de 500 a 900 Mt.; y (c) dichas áreas están ubicadas al Noreste de Acajutla, al Oeste de La Libertad y en las desembocaduras de los ríos Lempa y Jiboa. En tales áreas, los únicos minerales de valor económico son la magnetita y la ilmenita, es decir, los minerales de fracción magnética; por eso, el contenido elemental de las arenas oscuras se limita a hierro (Fe) y Titanio (Ti).

Los lugares de los depósitos minerales de mayor importancia están localizados en Acajucla, La Libertad, y Bocana de La Chepona en la Bahía de Jiquilisco. Con respecto a la cantidad de reservas minerales, cada kilómetros de playa contiene aproximadamente 150.000 TM. de arena de playa, de las cuales alrededor de 30.000 TM. son hierro y unas 40.000 TM. son Titanio. Las playas al Occidente de Acajutla tienen una longitud aproximada de 28 Km. y la playa cerca de La Libertad 12 Km.; por lo tanto, y de una manera preliminar, se puede indicar que aquí existen 1,200,000 TM. de hierro y 1,600,000 TM. de Titanio.

El Ministerio de Economía, regula la operación de 144 establecimientos salineros, los cuales están distribuidos en la forma siguiente: (a) en el Departamento de La Paz, 1, 1; (b) en el de Usulután, 33; y (c) en el de La Unión, 110. Para el período 1973-74 se ha determinado estimativamente una producción de 34,707,552 Kg. de sal, con un valor de C 2,902,534 (U.S. $ 1,161,013.60).

3.2. Areas agrícolas

El uso actual de los suelos de la Zona Costera es predominantemente agrícola, destacándose los siguientes cultivos: (a) Algodón, en las planicies de Usulután, San Miguel, La Paz y Sonsonate; (b) Cereales, como arroz, maíz, frijoles, sorgo, etc., que se cultivan casi uniformemente a través de toda la costa, pero predomina su cultivo en los Departamentos de Usulután, La Unión y Ahuachapán; y (c) Caña de Azúcar, en La Paz, Sonsonate y Ahuachapán.

3.3. Areas de riego

La Dirección General de Obras de Riego y Drenaje del Ministerio de Agricultura y Ganadería ha elaborado estudios de prefactibilidad para regar un área de 69,900 has. (Anexo 3).

3.4. Explotacion de los recursos pesqueros

Los principales cuerpos de agua salobre para la explotación pesquera son las Bahías de Jiquilisco y La Unión, el Estero de Jaltepeque y la Barra de Santiago. También se encuentran dentro de la Zona Costera algunos cuerpos de agua dulce de gran significado pesquero, como son la Laguna de El Jocotal y alrededor de 36 Kms. del Río Lempa.

La pesca industrial se encuentra concentrada en la Bahía de Jiquilisco, donde operan 11 compañías camaroneras con un máximo de 72 barcos. También funcionan en el lugar 3 plantas procesadoras, especialmente de camarón.

Según datos de la Sección de Caza y Pesca del Ministerio de Economía, en 1975 el volumen de extracción de camarón fue de 4.145.7 TM. (peso bruto) y las exportaciones de 3.252.9 TM., con un valor de C 25,494,068 (U.S. $ 10,197,627). La extracción de pescado fue de 1,738.1 TM., con un valor de C 2,141,279 (U.S. $ 856,511.60) (Anexo 4).

La producción de la pesca artesanal en cuerpos de agua dulce y salobre tiene un volumen total anual de pescado de 2,017.5 TM. para 1975, que comprende de 90.9 TM. de lagos y ríos y 1.926.6 TM. de agua salobre. En esta actividad operan 6 Cooperativas de pescadores con un total de 925 socios y con una capacidad instalada de 572 embarcaciones y 218 motores con lo cual logran una producción anual de alrededor 1,000 TM. con un valor estimado de C 1.3 millones (U.S. $ 520.000) (Anexo 5).

Actualmente se cultivan 36.1 has., con una producción estimada de 3.000 Kg./ha./año, con un valor de C 1.65 el Kg. (U.S. $ 0.66).

3.5. Protección y mejoramiento de la Zona Costera

Administración de bosques

La Dirección General de Recursos Naturales Renovables tiene establecidas Agencias Forestales en La Unión, Usulután, La Herradura y Metalío; y sub-agencias en Los Jiotes (La Unión), Puerto Parada (Usulután) y Puerto El Triunfo (Usulután).

Administración de Puertos

Los Puertos son administrados por la Comisión Ejecutiva Portuaria Autónoma (C.E.P.A.).

Administración de area turística

Las áreas turísticas y recreativas son de dos clases: (a) Estatales; y (b) Privadas. Las primeras son directamente administradas por el Instituto Salvadoreño de Turismo (I.S.T.U.). En cuento a las segundas, sus propietarios las administran enmarcados por las disposiciones legales pertinentes, cuya jurisdicción le compete al I.S.T.U.

3.6. Infraestructura costera de mayor relevancia

Carreteras y caminos

A lo largo de la costa salvadoreña existe una carretera de primera clase que parte desde la frontera con Guatemala al Occidente, hasta la frontera con Honduras al Oriente del país. Dicha carretera tiene ramales pavimentados que se comunican con los principales puertos y ciudades de la Zona Costera, lo mismo sucede para el interior del país.

Ferrocarriles

Las vías principales de ferrocarriles se dirigen desde la capital a los puertos de Acajutla en el Occidente y Cutuco en el Oriente. El sistema cuenta con 17 locomotoras Diesel, con una capacidad de arrastre unitario de 850 TM. y con 3 locomotoras de vapor con una capacidad de arrastre de 250 TM. por cada una.

Puertos y Transporte Marítimo

Los principales puertos del país son los de Acajutla, La Libertad y Cutuco; existen además el Puerto de El Triunfo y Puerto Parada, que son de menor importancia. De acuerdo a datos de Ferrocarriles Nacionales de El Salvador (FENADESAL), en 1975 el movimiento de carga registró los siguientes datos: (a) Puerto de Cutuco: 103,807 TM. de importación y 131,746 TM. de exportación; y (b) Puerto de Acajutla: 1,278,453 TM. de importación y 328,467 TM. de exportación. El período de mayor movimiento de transporte en el año corresponde al primer trimestre, debido al primer trimestre, debido al volumen de productos de exportación.

Telecomunicaciones

Existe una vía de comunicación marina, por medio del cable submarino, ubicado en el Puerto de La Libertad. La infraestructura de Telecomunicaciones es administrada por la Administración Nacional de Telecomunicaciones (ANTEL) que es un Ente Autónomo Gubernamental.

4. Características sociales y salubridad

4.1. Población y asentamientos humanos

La Zona Costera concentra el 7.02% de la población total del país con 249,597 personas distribuidas en 15 municipios. De estos habitantes 125,801 son del sexo masculino y 123,796 del femenino. La densidad demográfica es de 70 habitantes por Km^2., que es apreciablemente baja en relación al indicador general del país, que es de 200 habitantes por Km^2 (Anexo 6). El Instituto Salvadoreño de Transformación Agraria (ISTA) ha establecido comunidades planificadas en la parte de la Costa en las siguientes Haciendas: El Encantado, Metalío, Bola de Monte, Shutía, Obrajuelo, y San Antonio Potrerillos, con un número aproximado de 260, 200, 165, 85, 400 y 185 familias respectivamente (1,195 familias en total).

4.2. Control de plagas

La Dirección General de Salud del Ministerio de Salud Pública y Asistencia Social, mantiene una campaña permanente de control de la Malaria. En cuanto al control de las plagas agropecuarias, los agricultores además de sus propios medios y esfuerzos, cuentan con la asesoría y en ocasiones con la intervención directa del Ministerio de Agricultura y Ganadería.

5. Instituciones que tienen programas específicos en la Zona Costera

Las Instituciones Gubernamentales que tienen programas específicos de especial significado en el ordenamiento y aprovechamiento de los recursos de la Zona Costera son:

- Dirección General de Recursos Naturales Renovables, con Programas de Conservación y Desarrollo de los recursos naturales Renovables, especialmente en los aspectos de Uso Múltiple de los Recursos Hidráulicos, Determinación del Uso Potencial del Suelo, Desarrollo Forestal y Ordenación de Cuencas Hidrográficas, Aprovechamiento de los Recursos Pesqueros, Ampliación y Mejoramiento del Servicio Hidrológico, Ampliación y Mejoramiento del Servicio Meteorológico.
- Dirección General de Salud, con Programas de Control del Paludismo.
- Comisión Ejecutiva Portuaria Autónoma, con Programas de Implementación y Administración de Obras Portuarias y Ferrocarriles.

- El Ministerio de Defensá y Seguridad Pública, con el Programa de Vigilancia y Control Legal de los Recursos Marinos a través de la Marina Nacional.
- Centro de Estudios e Investigaciones Geotécnicas, con Programas de Estudio de los Recursos Geológicos.
- Instituto Salvadoreño de Turismo, con Programas de Administración, Control y Estudios de Aprovechamiento del Recurso Turístico.
- Ministerio de Economía, en Control para explotación de recursos pesqueros y minerales, y Control de Calidades.
- Dirección General de Riego y Drenaje, con Programas de riego y drenaje.
- Instituto Salvadoreño de Transformación Agraria, con Programas de desarrollo rural.
- Ministerio de Educación, con el Programa de Bachillerato en Navegación y Pesca.

6. Leyes y reglamentos relacionados con el ordenamiento de los recursos de las Zonas Costeras

Los principales instrumentos jurídicos que inciden en el desarrollo de la Zona Costera son la Ley de Arrendamiento de Tierras; Ley del Instituto de Transformación Agraria (ISTA); Ley Forestal; Ley de Caza y Pesca Marítimas; Ley de Riego y Avenamiento; Decreto de Regulación de la Explotación Salinera; Reglamento sobre Descarga de Desechos por los Barcos surtos en los Puertos; y Ley del Instituto Salvadoreño de Turismo.

7. Problemas de la Zona Costera

Entre los principales problemas de la Zona Costera se destacan los siguientes: Las inundaciones periódicas; la contaminación del recurso agua; el mal drenaje, erosión, alta salinidad, y pedregosidad de los suelos; y los daños ecológicos ocasionados por los riesgos desmedidos de productos químicos de alta concentración, tales como insecticidad y herbicidas.

ANEXO 1

DISPONIBILIDAD DE LOS RECURSOS HIDRAULICOS DE LA ZONA COSTERA
REPUBLICA DE EL SALVADOR, C.A.

CUENCA	AREA Km²	CAUDAL PROMEDIO ANUAL Mt3/Seg.	AGUA SUBTERRANEA Mt3/Seg.
C. Entre Paz-Sonsonate	674	11.2	1.0
D. Sonsonate	875	20.2	3.0
E. Entre Sonsonate-Jiboa	1.399	23.2	1.0
F. Río Jiboa	608	5.3	1.3
G. Entre Jiboa-Lempa	956	9.5	4.0
H. Entre Lempa-Grande de San Miguel	968	16.3	4.0 1/
I. Río Grande de San Miguel	2.356	39.6	15.2
J. Goascorán y otros	2.241	27.7	1.0
TOTAL	10.077	153.0	30.5

FUENTE: Servicio de Hidrología, Dirección General de Recursos Naturales Renovables, Ministerio de Agricultura y Ganadería.

1/ Presenta las mejores condiciones hidrológicas en el país, pero tiene limitaciones en su explotación, por el peligro de introducción salina.

A N E X O II

DISPONIBILIDADES EN LAS PRINCIPALES CUENCAS,
DURANTE EPOCA LLUVIOSA Y SECA
REPUBLICA DE EL SALVADOR, C.A.

C U E N C A S	VOL. EST. LLUVIOSA EN MILLONES DE Mt^3	VOL. EST. SECA EN MILLONES DE Mt^3	VOL. ANUAL EN MILLONES Mt^3	CAUDAL PROMED. EST. LLUVIOSA Mt^3/Seg.	CAUDAL PROMED. EST. SECA Mt^3/Seg.
C. Entre Paz-Sonsonante	309.7	44.6	354.3	19.5	2.8
D. Sonsonate	529.3	111.7	641.0	33.3	7.1
E. Entre Sonsonate y Jiboa	643.5	92.8	731.3	40.5	5.9
F. Río Jiboa	130.0	39.2	169.2	8.2	2.5
G. Entre Jiboa-Lempa	260.1	40.8	300.2	16.4	2.6
H. Entre Lempa-Grande de San Miguel	420.1	94.7	514.9	26.5	6.1
I. Río Grande de San Miguel	1.021.3	299.4	1.250.7	64.4	14.7
J. Coascorán y otros	823.9	57.7	881.6	51.6	3.7
T O T A L	4.137.9	710.9	4.848.8	260.4	45.4

FUENTE: Servicio de Hidrología, Dirección General de Recursos Naturales Renovables, Ministerio de Agricultura y Ganadería.

A N E X O III

SITUACION DE LOS PROYECTOS DE RIEGO EN LA
ZONA COSTERA
REPUBLICA DE EL SALVADOR

PROYECTO (1)	Fuente de Suministro	Sistema de Riego	Ha. a regar (Miles de Ha.)	ESTUDIOS REALIZADOS					
				Agro-económicos	Agro-ecológicos	Hidrológico	Geológicos	Pre-Factibilidad	Factibilidad
Río Paz - El Rosario	Ríos y Pozos	(2) Grav.	5.0	+	+	+	+	+	-
Sonsonate - Banderas	Ríos	Grav.	3.9	+	+	+	+	+	-
Jiboa	Ríos	Grav.	9.0	-	-	-	-	-	-
Bajo Lempa	Ríos	Grav.	35.0	+	+	[illegible]	+	+	-
Usulután - Vado Marín	Pozos	Grav.	10.0	-	+	+	+	+	-
Jecetal - San Dionisio	Ríos	Grav.	7.0	-	-	+	+	-	-
			69.4						

FUENTE: Dirección General de Riego y Drenaje - MAG.
(1) Datos a 1975
(2) Grav. = Gravedad

SIMBOLOGIA: + Estudio Relizado
- Estudios sin realizar

MINISTERIO DE ECONOMIA
Sección Pesca y Caza Marítima
San Salvador, El Salvador, C.A.

ANEXO IV

CUADRO DE PRODUCCION DE CAMARON Y PESCADO, Y EXPORTACIONES CORRESPONDIENTES AL PERIODO ENERO A DICIEMBRE DE 1975
REPUBLICA DE EL SALVADOR, C.A.

MESES	ESPECIES COMERCIALES					PESES COMESTIBLES	PESES P/ HARINA	EXPORTAC.	VALORES	
	BLANCO	CAFE	ROJO	CAMARONC.	TOTAL			Camarón y Camaronc.	COLONES 1/	DOLARES
Enero	88.8	16.3	25.1	81.4	211.6	164.7	53.9	236.4	1,566,950	626,780
Febrero	62.4	28.8	24.6	5.1	120.9	147.8	74.2	136.8	1,202,583	481,033
Marzo	61.5	20.6	41.1	10.4	133.6	109.7	27.8	119.6	1,208,999	483,599
Abril	65.0	15.9	19.3	102.7	202.9	137.5	42.6	119.3	1,141,451	465,580
Mayo	48.0	22.1	33.6	174.0	277.7	125.4	5.8	175.6	1,344,107	537,642
Junio	62.5	10.5	14.2	284.6	371.8	125.8	13.0	261.5	2,178,363	871,345
Julio	58.8	6.3	55.9	393.6	514.6	95.4	10.4	328.9	2,263,439	905,375
Agosto	65.0	9.3	53.9	335.2	463.4	101.7	30.4	366.6	2,547,037	1,018,814
Septiembre	91.0	24.8	19.3	283.5	418.6	97.4	4.8	304.8	2,410,883	964,353
Octubre	74.2	6.3	23.3	399.1	502.9	78.4	6.9	399.4	3,212,699	1,285.079
Noviembre	102.2	12.5	11.3	362.0	488.0	114.2	16.2	412.2	3,101,973	1,240,789
Diciembre	123.4	8.1	40.8	267.4	439.7	124.7	29.2	381.6	3,315,525	1,326,210
TOTALES TM.	902.8	181.5	362.4	2,699.0	4,145.7	1,422.7	315.4	3,252.9	25,494,065	10,197,627

1/ Un colón equivale a 0.40 centavos de dólar.

PESCA ARTESANAL EN 1975
REPUBLICA DE EL SALVADOR, C.A.

A N E X O V

R U B R O	VOLUMEN DE EXTRACCION T.M.	V A L O R C	V A L O R $
I. AGUAS SALIBRES			
A. Cooperativas			
a) La Unión	61.7	104.817	-
b) El Tamarindo	277.1	250.701	-
c) El Triunfo	50.2	33.559	-
d) La Libertad	358.0	484.870	-
e) Acajutla	260.1	387.595	-
	1.007.1	1.261.542	-
B. Esteros y Bahías	919.5	1.933.421	
T O T A L	1.926.6	3.194.963	$ 1.277.985
II. CUERPOS DE AGUAS CONTINENTALES (Dulces)			
a) Laguna El Jocotal	60.8	88.530	
b) Río Lempa	30.1	39.130	
T O T A L	90.9	127.660	51.064

FUENTE: Servicio de Recursos Pesqueros, Dirección General de Recursos Naturales Renovables, Ministerio de Agricultura y Ganadería.

ANEXO VI

POBLACION DE LA ZONA COSTERA POR MUNICIPIOS
EL SALVADOR, C.A.

MUNICIPIOS DE LA ZONA COSTERA DE EL SALVADOR	POBLACION TOTAL		
	TOTAL	MASCULINO	FEMENINO
Santa Isabel Ishuatán	6.763	3.499	3.264
La Libertad	18.064	9.205	8.859
San Juan Nonualco	12.944	6.389	6.555
San Rafael Obrajuelo	5.589	2.791	2.798
San Luis	4.887	2.487	2.400
Usulután	46.421	22.670	23.751
Jiquilisco	40.604	20.317	20.287
San Dionisio	3.093	1.607	1.486
Concepción Batres	12.004	6.105	5.899
Puerto El Triunfo	7.268	3.671	3.597
La Unión	33.653	16.971	16.682
Conchagua	20.763	10.867	9.896
Intipucá	6.897	3.540	3.357
Acajutlo	28.659	14.679	13.980
Juacuarán	1.988	1.003	985
TOTALES	249.597	125.801	123.796

FUENTE: Ministerio de Economía
Dirección General de Estadísticas y Censos
IV Censo Nacional de Población de 1971
Vol. 1

HAITI

Emmanuel Garnier
Directeur Général Pêche
Dept. Agriculture, Ressources Naturelle
Développement Rural
Port au Prince

La République d'Haiti occupe le tiers de la partie ouest de l'Ile d'Hispagnola qu'elle partage avec la République Dominicaine. Elle est située entre Cuba et Porto Rico selon les paralleles 18° et 20° de latitude nord, 71° et 74° de longitude ouest. Elle est bornée par l'Océan Atlantique au nord, par la mer des Caraibes au sud, par le passage du vent a l'ouest, et à l'est par la République Dominicaine.

CARACTERISTIQUES DES COTES

Les côtes haitiennes s'étendant de la Baie de Mancenille au cap St. Nicolas vers le nord, des Pédernales au cap Tiburon vers le sud, et le golfe de la Gonaive à l'ouest. La zone littorale s'étend sur 1 100 miles. Au large des côtes se trouvent 3 grandes îles dont la Tortue au nord ouest, La Gonave à l'ouest et l'île à vache au sud. Il en existe d'autres plus petites : Gde. Cayemite, Grosse Caye. Les fonds de pêche de faible profondeur sont rares; en général des fonds de 100 brasses se situent à une faible distance des côtes. Vers le nord se trouve une ceinture de fonds plats, 3 à 5 miles de large, de Fort Liberte à Port de Paix. A l'ouest de Port à Piment à Pointe au diable, la zone Dame Marie au Cap Carcasse offrent seulement des eaux peu profondes. Sur les côtes sud, existent beaucoup de fond peu profonds, de trou Gros-Pierre à la pointe Flamands.

Le long du littoral, on trouve de petites anses et de petites baies qui sont des abris naturels pour les petits bateaux de pêche. En général, la côte est à pic avec de larges plages sablonneuses et graveleuses. Les zones plates ne s'approfondissent que graduellement; elles passent façilement à 100 brasses. Parfois, la mer se déchaîne et gêne les opérations de pêche. Ce qui est courant sur les côtes nord et sud.

CLIMAT

Les vents dominants soufflent du nord est, de décembre à avril; de l'est pour le reste du temps; ils ont une vélocité de 12 noeuds de janvier a mars, et de juillet a septembre. Ils sont de 10 noeuds d'avril à juin, et d'octobre à décembre. Nous enregistrons parfois des cyclones qui affectent serieusement les régions côtière (Cayes, Anse à veau). La température et les précipitations sont variable, étant donné la topographie accidentée du pays. Les alizés apportent vers les côtes un climat marin plus équilibré que celui des côtes sud et ouest où la température peut atteindre 90° et même davantage en n'importe quel mois de l'année; elle peut être de 100° au cours de juillet et août. Entre décembre et mars, on peut enregistrer des intervalles frais accusant 60°. Au milieu de l'été, la température moyenne peut atteindre 72° la nuit, 90° le jour sur les côtes ouest. Les points les plus secs sont môle St. Nicolas, Gonaives et Tiburon qui reçoivent 20 à 25 pouces précipitations annuelles. Les mois de décembre à mars sont les plus secs sur les côtes ouest et sud. Sur les côtes nord, les pluies sont peu abondantes.

COURANT OCEANIQUES

Les eaux sont influencées considérablement par des courants océaniques. Vers le nord, une branche du courant équatorial nord passe a 20 miles des côtes se deplacant est-ouest embrassant des profondeurs d'environ 2 400 brasses. Ce courant charie peu de nourriture; il est cependant le trajet des poissons migrateurs. Un autre courant suit la direction sud oeust à travers le passage du vent et rencontre le contre-courant cubain venu de l'est, au large du cap de Dame Marie. De 60 à 70 miles, au large des côtes sud, existe une autre branche du courant équatorial nord; il suit la direction est à travers les Caraibes à une vitesse de 0,5 à 0,7 noeud; il est probablement un autre passage ou route pour la migration des poissons. Il mporte de signaler que les eaux d'Haiti sont plutôt pauvres en poisson par suite d'une carence en sels nutritifs indispensables au développement des planctons. Les eaux côtières sont claires et bleues, et les remontées d'eau (upwelling) sont quasi nuls, ce qui explique la pauvreté de cette région en sels nutritifs.

LA PECHE

Elle présente un aspect artisanal; elle est pratiquée par 15 000 pêcheurs dont 2/3 s'y adonrent entièrement; le reste partage ses activités entre la pêche, l'agriculture et le commerce. Les pêcheurs s'eloignent à peine à 10 miles du rivage et utilisent des canots à rame et à voile; ils pratiquent diverses méthodes pêche : à la ligne, à la senne de plage, à la nasse, à la palangre. Les embarcations utilisées sont de fabrication locale, très bien faites mais necessitent quelques améliorations telles que aménagement de cales pour protéger la capture contre l'ardeur du soleil; motorisation pour créer plus de mouvement et faciliter les recherchent relatives aux nouveau fonds de pêche, etc. Les pêcheurs actifs travaillent environ 200 jours par an avec une moyenne de capture d'environ 5# par sortie (les fonds sont épuisés; les forts vents, les mers demontées gênent les opérations de pêche).

ESPECES LES PLUS EXPLOITEES

Noms communs	Familles	Noms communs	Familles
Saurel	Carangidae	Perroquet	Scaridae
Pagre	Lutjanidae	Becune	Sphyraenidae
Sardine	Clupeidae	Mulet	Mugilidae
Thazar	Scombridae	Merou	Serranidae
Grondeur	Pomadacidae	Requin	Carcharhinidae
Tautague	Labridae	Thon	Thunnidae
Langouste	Paluniridae		

COMMERCIALISATION

La production nationale (4 800 T) est très au-dessou des besoins nutritionnels de l'homme haitien. Au moment au débarquement, au port des clients arrivent en voiture, à pied ou à dos d'animaux; ils s'approvisionnent soit pour leur usage personnel, soit pour des fins commerciales. Il n'existe pas de véritables marchés aux poissons; le produit est vendu étalé avec d'autres produits moins périssables; c'est un poisson salé qui est toujours de mauvaise qualité étant donné l'humidité relative de l'air et les conditions physicochimiques du sel local qui manque de pureté. Il n'est pas superflu de mentionner qu'il existe des entreprises sises à Port au Prince préposées à la vente de poissons frais. C'est un poisson très cher, par suite du prix élevé de l'électricité et de la manutention.

QUELQUES ASPECTS DE NOTRE COMMERCE DE POISSON AVEC L'EXTERIEUR

IMPORTATIONS

Articles	Kilos	Valeur
Poisson salé, séché, fumé	1.375.625	₲-2.525.823.00
Crustacés, mollusques frais	14.070	₲- 10.205.00
Conserves de poisson	112.682	₲- 431.727.00
	1.502.377	₲-2.967.755.00

EXPORTATIONS

Articles	Kilos	Valeur
Poissons	889	₲- 4.446.00
Langouste	100.000	1.813.231.00
Lambis	4.420	7.300.00
Ecaille carette	3.289	99.755.00
Coquillage de mer	835.566	570.998.00
	944.164	₲-2.495.730.00

DEVELOPPEMENT DE LA PECHE FLUVIALE

L'économie nationale est essentiellement agricole; l'agriculture occupe 73% de la population et assure à peine une production de subsistance; il en découle que la malnutrition affecte 69% environ de la masse rurale, les petits enfants particulièrement. Pour contrecarrer l'effet désastreux de cette situation, le Gouvernement a créé un Service de Pisciculture qui a pour objectif de produire, de distribuer des alevins, de construire des viviers pour les familles paysannes, d'ensemencer toutes les pièces d'eau disponibles aussi que les rizières. Une Station Piscicole sise a Damien assure une production moyenne annuelle de 100 000 alevins dont 60 000 carpillons et 40 000 Tilapia Mosambica.

Le pêche fluviale est de très grande importance en Haiti; elle fournit un poisson abondant, à bon marché; elle vient au secours des enfants d'âge préscolaire sous-alimentés. Le niveau peu élevé de la consommation en proteine a de grave conséquences sur le développement physique de la population rurale en particulier. Les cas de mortalite infantile accusent 140 a 200 pour 1 000 selon les régions. La sous-alimentation en est la cause principale.

Pour bien saisir le role socioéconomique de la pêche fluviale en Haiti, nous soumettons le tableau ci-après relatif à la composition du régime alimentaire annuel moyen en Haiti, en kilo, par habitant et par an.

COMPOSITION DU REGIME ALIMENTAIRE
ANNUEL MOYEN EN HAITI

EN KILO, PAR HABITANT, PAR AN

ALIMENT	kg/hab/an
Ceréales et dérivés (blé, maïs, riz, etc.)	63.0
Racines et tubercules (pomme de terre, manioc,etc.)	69.4
Sucre et sirop	66.8
Légumes	68.6
Fruits (banane, mangue, avocat)	145.5
Viande (boeuf, volaille, autres)	8.0
Oeufs	0.9
Poisson (frais et sale sec)	1.8
Lait, Fromage et dérivés	11.2
Matières grasses	6.6
Divers (clairin, rhum, café)	10.6

Source: Alimentation et Nutrition en Haiti
par Evan Beghin et W. Fougère

DEVELOPPEMENT DE LA PECHE MARITIME POUR L'AVENIR

Suivant le démographe Paul Moral, le cadre physique d'Haiti accuse seulement 12 000 km^2 de terre cultivée; la population nationale (1975) est de 4 599 723 habitants. On déduit, ipso facto, que chaque km^2 doit pourrir environ 400 personnes. Cette situation explique la cherté des vivres sur les marchés ruraux et urbains. En conséquence, parallèlement a la pêche fluviale, nous avons integré un programme de pêche maritime côtière dans le plan quinquennal de développement actuellement en voie de planification en Haiti. En voici les points importants:

1-Dénombrement de nos pêcheurs par arrondissement
2-Formation des cadres
3-Recherches océanographiques (physiques, biologiques)
4-Formation de Coopératives de pêches ou noyaux de base pour le développement
5-Assistance technique sous différentes formes
6-Matériel de pêche moderne pour les coopératives : motorisation, filets divers
7-Etablissement d'une usine de glace écaille
8-Installation d'une usine pour fabriquer les nappes de filet

9-Etablissment d'une saurisserie expérimentale
10-Principes de règlementation pour protéger les espèces; les pêcheurs
11-Questions de délimitation des eaux territoriales
12-Création d'un système de credit maritime
13-Améliorations de la Station expérimentale Piscicole de Damien
14-Extension intensive de la pisciculture

Ce programme va augmenter, dans une large mesure, la production nationale et entrainer, ipso facto, une baisse des prix et une tendance à l'augmentation de la consommation du poisson, malgré le faible pouvoir d'achat de la masse rurale (80% de la population). Nos pronostics se justifient à travers les pages qui suivent et qui mettent en relief l'effet de la démographie sur la demande de poisson salé et sur la consommation annuelle de poisson 1971.

PROJECTION DE LA DEMANDE DE POISSON SALE EN FONCTION DE LA POPULATION

Annee	Population en milliers d'habitants	Consommation totale de poisson T.M.	Consommation poisson salé T.M.
1971	4.315	7.150	3.000
1972	4.445	7.330	3.080
1973	4.570	7.540	3.170
1974	4.695	7.750	3.260
1975	4.820	7.950	3.340
1976	4.945	8.160	3.430

Consommation par Personne 1.65 kg.

Source : Mission FAO/BID

DENSITE APPROXIMATIVE DE LA POPULATION
PAR ARRONDISSEMENT EN 1971

Arrondissement	Superficie en km^2	Population	Habitants par km^2
Total du Pays	27.700	44.599.723	156
Port au Prince	3.430	877.275	256
Gonaives	1.870	186.736	100
Hinche	1.770	133.541	75
Jérémie	1.540	240.857	156
Jacmel	1.510	299.059	199
Anse a veau	1.240	150.327	121
Mole St. Nicolas	1.230	80.081	65
Aquin	1.220	160.625	132
St. Marc	1.200	117.554	123
Belle Anse	1.100	52.240	47
Port de Paix	1.100	136.423	124
Dessalines	1.000	174.584	176
Port Liberté	990	68.870	175
Cayes	970	272.652	281
Vallière	900	47.877	53
Mirebalais	850	126.480	149
Léogane	810	274.548	339
Lascahobas	790	40.089	51
Marmelade	690	113.345	164
Limbé	650	36.532	56
Cap Haitien	490	199.811	408
Borgne	280	80.265	286

Source : Institut Haitien de Statistiques
(Septembre 1971)

ARRETE CREANT LE SERVICE DES PECHES

Moniteur No-101 4 Septembre 58

Article lèr - Le Service des pêcheries est un Organisme technique permanent relevant directement du Secrêtaire D'Etat de l'Agriculture, des Ressources naturelles et du développement rural.

Article 2 - Cet Organisme a pour mission :
1. De conseiller et d'assister les pêcheurs professionnels maritimes haitiens et les êleveur de poissons d'eau douce tant du point de vue technique que du point de vue économique dans le but d'augmenter les quantités de poissons captures.
2. D'encourager et d'organiser la distribution, la consommation, la transformation et, en général, l'ensemble du commerce des produits de la mer et des eaux douces pour assurer un développement harmonieux de l'Industrie de la Pêche.
3. D'exercer un controle technique et comptable des activités des entreprises commerciales individuelles, coopératives ou autres s'occupant soit de la capture, soit de la transformation, soit de la distribution, soit de l'exportation, de l'importation du poisson et d'autres produits de la mer.
4. De conduire des travaux de recherches tendant à améliorer les conditions actuelles de la pêche en mer ou en eaux douces et à mieux connaître, en vue d'une exploitation rationnelle, la faune et la flore marines et d'eau douce du pays et des régions avoisinantes.

Article 3 - Le Service des pêcheries ne peut en aucun cas partiquer a pêche à des fins commerciales; néanmoins, les poissons et autres animaux ou plantes captures ou recueillis au cours de ses explorations et recherches, seront écoulés sur le marché, et le produit des ventes sera, sous la responsabilité du Directeur du service des Pêcheries et de ses délégués, gardé dans le fonds de roulement soumis au contrôle mensuel de la cours supérieure des comptes, mentionné à l'Article 4 ce-dessous.

Article 4 - Le service des Pêcheries recevra, chaque année, sous rubrique separée, dans le cadre du budget de la Secrétaire d'Etat de l'Agriculture, des ressources naturelles et du développement rural, les moyens financiers nécessaires pour lui permettre d'accomplir la mission qui lui est dévolue par l'articl 2 du présent Arrêté. En plus des frais de fonctionnement il sera acordé au Service des pêcheries un fonds de roulement soumis aux reglé de la comptabilité commerciale dont le Directeur et ses Délégués seront personnellement responsables envers le Secrétaire d'Etat de l'Agriculture, des Ressources Naturelles et du développement rural. Ce fonds de roulement dont les balances seront reportées d'une année fiscale à l'autre, sera soumis également au contrôle de la cours supérieure des comptes et sera consacré exclusivement à l'achat et à la vente aux pêcheurs, même à credit et long terme, au plus bas prix possible; du matériel de pêche de manière à produire les même résultats qu'un système de crédit supervisé. Ces achats de matériels de pêche pourront être effectués par commandes directe du Service des Peches, sans passer par les magasins de l'Etat, en raison du caractère unique du Service des Pêcheries.

Article 5 - Le Service des Pêcheries comprend :

1. Une Direction générale
2. Une section administrative
3. Une Section d'extension de la Pêche maritime
4. Une Section d'extension de la Pêche en eau douce
5. Une Section d'économie et de vente
6. Une Section de biologie

Article 6 - Le Directeur doit être un Spécialiste diplomé possédant, de notoriété publique, une large expérience en matière de pêche en mer et en eau douce. Il est responsable de toutes les activités, quelle que soit leur nature, du Service des Pêcheries et rend compte de sa gestion directement au Secrétaire d'Etat de l'Agriculture, des ressources naturelles et du développement rural. A cet effet, il est tenu de remettre au dit Secrétaire d'Etat un rapport trimestriel sur les activités du Service.

Article 7 - Sous reservé de l'approbation du Secrétaire d'Etat de l'Agriculture des ressources naturelles et du développement rural qui leur donnera force exécutoire, le Directeur du Service des Pêcheries est autorisé à prendre des mesures intérieures pour assurer la bonne marché de l'organisation.

Article 8 - Le présent arrêté sera publié, exécuté à la diligence du Secrétaire d'Etat de l'Agriculture, des ressources naturelles et du développement rural. Donné au Palais National à Port au Prince, le 20 août 1958, an 155eme de l'Independance.

Par le Président : Dr. Francois Duvalier

Le Secrétaire d'Etat de l'Agriculture des ressources naturelles, du developpement rural :

Henri Marc Charles

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MONOGRAFIA DE LAS COSTAS DE HONDURAS

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Dirección General de Recursos Naturales Renovables

Introducción

El presente trabajo tiene por objeto dar a conocer las principales características generales del país y de sus costas en particular, sus problemas principales y los esfuerzos que se realizan para promover el desarrollo, especialmente de las zonas costeras. En el desarrollo del presente trabajo se hará especial énfasis en las consecuencias desastrozas, para la economía nacional, producida por el Huracán Fifí, ocurrido a mediados de septiembre de 1974, cuyo impacto negativo proyectará sus efectos durante muchos años.

Honduras es un país tropical, con una superficie de 112.088 Km^2, situado en el centro de la América Central, entre los 16°2' y 12°58' Latitud Norte y los 83°10' y 89°21' Longitud Oeste del Meridiano de GREENWICH. Tiene fronteras con tres de los cuatro restantes países del área y cuenta con costas en el Atlántico y el Pacífico. Limita al Norte con el Mar Caribe o de Las Antillas en una extensión de 683.3 Km; al Sur con Nicaragua, la Costa del Golfo de Fonseca de 162.2 Km. y El Salvador; al Este con Nicaragua y el Mar Caribe y al Oeste con Guatemala.

Su topografía es montañosa con numerosos intermontanos distribuidos en todo el territorio. Los más importantes son: los de Sula, Lean y El Aguán en la Zona Norte; la temperatura en las costas varía entre 73 y 86 F; con una precipitación media anual de 2.200 milímetros aproximadamente, tiene una población de 2.592,000 habitantes, posee una tasa de crecimiento poblacional de 3.4% con un Producto Nacional Bruto (PNB) en 1975 de 991.850 millones de dólares a precios corrientes. La moneda del país es el lempira (L. 2.00 = U.S. $ 1.00).

El país presenta en sus aspectos económicos y sociales las características típicas de un país poco desarrollado, de escasa participación industrial en la formación de su Producto Nacional Bruto, fundamentalmente dependiente de la exportación de materias primas y con un limitado mercado interno, para sus productos agropecuarios y de origen industrial.

I. Características de la Zona Costera

Honduras presenta la forma de un rombo alargado, posee costas en el Atlántico con una extensión de 683.3 Km., y la costa Sur de 162.2 Km., sobre la Zona Norte se encuentran ubicadas algunas de sus ciudades principales, San Pedro Sula con aproximadamente 150,000 habitantes y La Ceiba con 52,000 habitantes, el puerto más importante por su mejor acondicionamiento es Puerto Cortés, le siguien en importancia La Ceiba y Tela, por tales puertos se realizan las exportaciones de banano, café, maderas y otros productos.

1.1. Suelos

Los suelos de la Costa Norte son de origen aluvional, de materiales humíferos o de descomposición orgánica, depositadas en la superficie próximas a los ríos, y que han sido conducidas por las aguas; esta región cuenta con valles importantes como el Valle de Sula y el Valle del Aguán, los cuales son irrigados por los ríos Ulúa y Chamelecón el primero y por el río Aguán el segundo.

El Valle de Sula se encuentra limitado por cadenas montañosas, que han sufrido una fuerte desforestación, lo cual ha producido una baja compactación de los suelos.

1.2. Pérdidas Osacionadas por el Huracán Fifí

Según el Consejo Superior de Planificación Económica, los principales daños se reflejaron en la pérdida de cerca de 10,000 vidas humanas, con una cifra que se elevó a casi 140,000 damnificados, los cuales en su mayoría perdieron todas sus pertenencias.

Además de lo anterior, el mayor impacto se concentró en el sector agrícola, dada la importancia de éste en la estructura productiva de Honduras su repercusión negativa perdurará durante varios años.

Las principales pérdidas fueron en la actividad bananera, estimándose que alcanzaron un 20% de la producción de 1974 y alrededor de 50% del volumen esperado para 1975, lo que traducido a divisas significa una pérdida de 113.0 millones de dólares durante 1974 y 1975. Además de las pérdidas de producción, la actividad sufrió cuantiosos daños en las instalaciones físicas, tales como canales de riego, cableado, drenajes, centros de acopio, caminos y vías férreas; asimismo se ha generado un fuerte desempleo pues la actividad bananera en la fuente más importante de empleo en el país.

Las pérdidas en maíz y arroz fueron casi totales produciendo un déficit en el abastecimiento, de aproximadamente 50 mil toneladas de maíz y de 10 mil de arroz.

Las existencias de ganado fueron reducidas en alrededor de 60.000 cabezas que adicionado a los daños sufridos en los pastizales y lugares de estancia ha producido graves perjuicios a la producción de carne y leche.

En resumen, pude decirse que los daños totales alcanzaron un monto de 899 millones de lempiras (U.S. $ 450 millones), correspondiendo un 34% de este valor a las pérdidas en el stock de capital y el 66% restante al valor corriente de la producción, durante los años 1974-75 solamente.

1.3. Importancia Ecológica de las Zonas Costeras

Como se ha señalado, la zona más importante de costa, está en la Zona Norte, por su extensión, actividad económica y concentración de población; como consecuencia de ello, es en esta área en donde los disturbios ecológicos son más relevantes. Los efectos producidos en los bosques por la desforestación estimulada por la producción maderera y la quema de las mazas arboreas, tanto por la actividad agrícola, como por el descuido negligente de la población, han producido un cuadro que favorece las inundaciones, por la alteración del ciclo de las precipitaciones así como también por la rápida saturación de los suelos de baja compactación, que origina grandes pérdidas del suelo fértil.

Algunos expertos han señalado que los ríos de la Zona Norte presentan un perfil de cauce muy acentuado en las cabeceras, con una consecuente elevación en los cauces de la desembocadura, lo que obstruye un vertido eficiente de los elevados volúmenes de agua que originan en las crecientes.

La escasez de recursos y la necesidad de aplicar la inversión a proyectos inmediatamente productivos, imposibilita la adopción de medidas destinadas a crear un marco de mayor seguridad, para las actividades productivas que se realizan en los valles.

1.4. Normas de calidad de las aguas

Como todo país en fase de desarrollo inicial, se adopta la actitud de buscar primero los elementos de subsistencia, no importa cual sea su calidad, por ello en Honduras la mayoría de los proyectos de agua potable destinados a satisfacer las necesidades de una población creciente, no cuentan con las instalaciones destinadas al tratamiento de las aguas, para mejorar la calidad de las mismas.

Unicamente existe un proyecto que será concluido en junio de 1976, que suministrará 4.5 millones de galones de agua, para surtir la población de Tegucigalpa la capital del país (300.000 habitantes), que procesará el agua, para garantizar un producto verdaderamente potable.

Otros sistemas utilizan el método de adicionar cloro (Cl) a las aguas, sin embargo, los análisis realizados en laboratorios dan a conocer que con frecuencia no se obtiene un producto que responda a las normas sanitarias.

La deficiencia de los sistemas de tratamiento de las aguas, frecuentemente contaminadas, por las poblaciones aledañas a los ríos, y el vertido de desechos agrícolas e industriales, son causales frecuentes de variadas enfermedades, de la muerte de la fauna acuática, como ocurrió recientemente en el Lago de Yojoa, el 4 de febrero del presente año, en donde una gran cantidad de peces aparecieron muertos, posiblemente, por la presencia de arsénico, depositado para actividades mineras.

El Servicio Nacional de Acueductos y Alcantarillados (SANAA) utiliza los siguientes criterios:

Tabla de valores normales para agua potable

Calidad Bacteriológica

En 10 ml. de agua no más del 10% cada mes debe revelar la presencia de dichos agentes microbianos su presencia en más de 3 muestras no deben tolerarse si el caso ocurre en dos muestras consecutivas. En más de una muestra cada mes si se examina menos de 20 en ese plazo.

Características Físicas

El agua de bebida no debe contener impurezas ofensivas a los sentidos de la vista, gusto, olfato, para el uso general no deben tolerarse valores por encima de:

Turbidez	=	5 unidades
Color	=	15 unidades
Umbral Odorífico	=	3 unidades

Características Químicas

Las siguientes substancias químicas no deben estar presentes en el agua potable a concentraciones superiores de las señaladas aquí:

Subtancias	Concentración en Mg/L	Flour	
		en °C.	Concentración en Mg/l
Aquil Benceno Sulfanato (A B S)	0.5	Promedio Anual de temperaturas máximas del aire °C.	
Arsénico (A S)	0.01		
Zinc (Zn)	5		
Cloro (Cl)	250		
Cobre (Cu)	1		
Carbono Extra-cloroformo	0.2	10 - 12	1.2
Cianuro (Cn)	0.01	12 - 14	1.1
		14 - 17	1.0
Fenoles	0.001	18 - 21	0.9
Hierro (Fe)	0.3	22 - 25	0.8
Manganeso (Mn)	0.5	26 - 32	0.7
Nitratos (NO_3)	45		
Sulfatos (SO_4)	250		
Sólidos disueltos	500	Según datos termométricos durante 5 años como mínimo.	

La presencia de las siguientes substancias o concentraciones superiores a las anotadas dará motivo a que no sean permitidas para el consumo.

Substancias	Mgs/L
Arsénico (As)	0.05
Bario (Ba)	1.0
Codmio (Cd)	0.01
Cromo Hexavalente (crt6)	0.05
Cianuro (Cn)	0.2
Plomo (Pb)	0.05
Plata (ag)	0.01
Selenio (Se)	0.05

Nota: En la zona en que hay exceso de nitratos en el agua por encima de la concentración anotadas, el público deberá estar advertido de los peligros de usarla en la alimentación infantil

II. Recursos y usos de la Zona Costera

La Zona Norte es la de mayor desarrollo industrial del país, debido a la mayor disponibilidad de tierras cultivables, y a la fácil vinculación con los mercados externos. Por ello, la actividad bananera se desarrolla en los Departamentos de Cortés, Atlántida, Yoro y Colón.

La Costa Norte está constituida por los Departamentos que disponen de mayor cantidad de tierras llanas como se puede ver en el siguiente cuadro:

Cuadro de Disponibilidades de Tierras Llanas en Honduras
(Hectáreas)

Departamentos	Extensión Superficial en Km2. Montañas	%	Llanos y Valles	%	Total	Carreteras Existentes
Francisco Morazán	6.722.0	84.6	1.223.7	15.4	7.946.2	633
Atlántida	2.525.2	59.4	1.726.0	40.6	4.251.2	241 CN
Colón	6.274.2	24.6	19.630.0	75.4	0.874.8	316 CN
Comayagua	3.949.3	76.0	1.247.1	24.0	5.196.4	344
Copán	2.597.6	81.1	605.4	18.9	3.203.0	237
Cortés	933.1	23.6	3.020.9	76.4	3.954.0	469 CN
Choluteca	2.109.7	50.1	2.101.3	49.3	4.211.0	400 CS
El Paraíso	5.752.8	79.7	1.4[illegible].3	20.3	7.218.1	562
Gracías a Dios	6.274.2	24.6	19.630.0	75.4	16.630.0	133
Intibucá	2.734.3	89.0	337.9	11.0	3.072.2	277
Islas de la Bahía	230.4	88.4	30.2	11.6	260.6	20
La Paz	2.060.3	88.4	270.3	11.6	2.330.6	212
Lempira	3.955.1	92.2	334.6	7.8	4.289.7	232
Ocotepeque	1.372.7	81.7	307.5	18.3	1.680.2	146
Olancho	21.307.0	87.5	3.043.9	12.5	24.350.9	654
Santa Bárbara	3.463.1	67.7	3.652.2	32.3	5.115.3	476
Valle	276.9	17.7	1.287.7	82.3	1.564.6	186 CS
Yoro	5.073.1	63.9	2.866.1	36.1	7.939.2	390 CN
Totales	71.337.3	63.6	40.750.7	36.4	112.088.0	6.136

2.1. Asentamientos Campesinos

El Estado de Honduras ha reconocido la necesidad de realizar una distribución más justa de los medio productivos, especialmente del suelo agrícola, de cuya explotación directa vive más del 70% de la población.

En su exposición al pueblo hondureño, del 1 de enero de 1974, el Jefe de Estado dijo: "3/4 partes de la población campesina, solamente tienen un poco más de la décima parte de toda el área apta para cultivo. Esto contrasta con la extensión que ocupan las grandes fincas que representan menos del 1% del total y que alcanza el 24.4% de esas mismas tierras".

Hasta el presente en los Departamentos de las dos Costas, se han beneficiado con el proceso de Reforma Agraria, más de 12.000 familias, asentadas sobre una extensión que supera las 60.000 manzanas, como se puede ver en el siguiente cuadro:

Departamento	No. Asen-tamientos	Areas Manzanas	No. Familias
ZONA NORTE			
Cortés	67	9,027	2,020
Atlántida	52	7,159	1,641
Yoro	73	10,999	2,520
Colón	30	18,686	1,048
Islas	1	87	15
Totales	223	45,958	7,244
ZONA SUR			
Valle	19	2,085	686
Choluteca	96	14,241	4,421
Totales	115	16,326	5,107

2.2. Disponibilidad de Agua

La falta de desarrollo de las infraestructuras de riego, hace que la generalidad de los agricultores hondureños pedendan de las formas naturales de suministro como lluvia, es por ello que la regularidad de la producción agropecuaria, se ve muy afectada cuando escasean las precipitaciones.

En segundo lugar, se encuentran las fuentes superficiales, para toda clase de usos. Le siguen las fuentes subterráneas cuyo uso va en aumento. La distribución de las precipitaciones revela a lo largo del año una marcada estacionalidad, en los períodos más secos es necesario el riego complementario, en la Zona Norte se requiere entre marzo y mayo y en el Sur entre enero y marzo.

Para los efectos del riego, hidrográficamente considerada, Honduras comprende dos sistemas o vertientes, la del Atlántico que cubre un 83% del país y la del Pacífico que se extiende en el 17.0% restante.

El siguiente cuadro muestra la extensión de las cuencas.

Nombre del Río	Extensión de la Cuenca en Km^2 (aproximados)
VERTIENTE NORTE	
Ulúa	21,564.13
Aguán	10,845.88
Patuca	24,685.67
Tinto	7,238.07
Chamelecón (no está limitado por no tener estaciones hidrométricas)	
VERTIENTE SUR	
Choluteca	7,034.77
Nacaome	2,531.06
Goascorán y	
Lempa (no están limitados por encontrarse sus límites en discusión en El Salvador)	

El uso del riego está concentrado en los Departamentos de Cortés, Yoro y Atlántida, destinado al riego del banano en una extensión de 32,000 Has. Le siguen en importancia, el destinado al cultivo de caña de azúcar, en los Departamentos de Cortés, Santa Bárbara y Choluteca, que cubre una extensión de 14,000 Has.

2.3. Recursos Marítimos de Honduras

Dado el interés que tiene el Estado de Honduras de promover el desarrollo de las actividades del sector pesquero, se ha considerado oportuno hacer algunas referencias a los recursos aledaños a las costas hondureñas, así como a las actividades productivas que se realizan en base a los mismos.

En Honduras el recurso marino más importante bajo explotación, está constituido por el camarón, que alcanza una producción anual de alrededor de 5.0 millones de libras anuales. Investigaciones realizadas por la FAO entre abril y octubre de 1971, establecen que los dos mejores terrenos de arrastre, de topografía llana, de pendiente suave y de amplia superficie, se encuentran al noroeste de Honduras, entre 82°05' W, 2.100 millas cuadradas, a ésto hay que adicionar, dos áreas que se ubican al Norte del país y tienen superficies de 350 y 400 millas cuadradas.

Según la opinión de los expertos de la FAO, se considera que para una profundidad entre 100 y 380 brazas, un camaronero de 350/400 Hp. podría trabajar con una red de 90 a 100 pies, se requiere de un promedio diario de 600 libras de camarón (350 libras de cola) entero, para que la operación sea rentable.

La pesca de langosta, está adquiriendo cada vez más importancia, en 1975 alcanzó la cantidad de 1.500.000 libras.

2.3.1. Pesca Industrial

Actualmente están operando en el país siete empresas en el mar Atlántico, dedicándose a la captura del camarón, langosta y finalmente pescado, el producto principal es el camarón, siguiendo por su orden los demás.

La pesca del camarón se realiza utilizando redes de arrastre, durando de 4 a 6 horas cada arrastre, el tiempo de permanencia de los barcos es de aproximadamente 16 días por viaje. La captura de la langosta se hace utilizando trampas o nasas.

La flota pesquera en el Atlántico está compuesta por 126 barcos en operación, habiendo un registro de tonelaje por barco que oscila entre 40-150 TM. de Registro Bruto.

Producción de Camarón en los últimos 5 años

Año	Producción lbs.	Barcos aplicados	Promed. prod. por barco
1971	4,373.000	74	59,094
1972	4,708.000	86	54,744
1973	4,308.000	90	47,867
1974	3,960.000	123	32,195
1975+	1,536.537	126	12,202++

FUENTE: Empresas Pesqueras = Datos proporcionados al Departamento de Pesca DIRENARE

\+ Hasta el mes de agosto

++ Este dato no se debe considerar definitivo, ya que los mejores meses de pesca son de julio a diciembre

2.3.2. Pesca Artesanal

La pesca artesanal de Honduras todavía está en un grado incipiente en su desarrollo. Los pescadores realizan su captura en aguas protegidas, o muy cerca de la playa, casi todos usas pequeños botes movidos por remos y velas y en pocos casos son motores fuer de borda.

Los pescadores artesanales están considerados en tres categorías: permanentes, parciales y ocasionales, las que sumas alrededor de 3,000 entre la zona del Atlántico y del Pacífico, la captura realizada por este grupo para el año de 1974 se estimó en 797 toneladas métricas, incluyendo pescado, moluscos y crustáceos.

2.4. Acuicultura

En los últimos años ha surgido un alto grado de interés por los proyectos de acuicultura, tanto por parte del Gobierno como por el Sector Privado.

2.4.1. Sea Farms de Honduras, S.A. de C.V.

Localización : Punta Ratón, Departamento de Choluteca (frente al Golfo de Fonseca).

Inversión : Asciende a .7 millones de dólares, esperan cultivar 2,000 hectáreas con una producción anual de 250,000 libras.

Objetivos : Cultivo de camarón de mar su comercialización.

Estado del Proyecto : Esta empresa lleva dos años y medio de estar haciendo investigaciones sobre este cultivo, pero hasta la fecha no puede decirse que han tenido el éxito esperado, especialmente por la dificultad que han encontrado en combatir algunas enfermedades en los camaroncillos.

2.4.2. Aqua Finca de Camarones

Localización : Omonita, Departamento de Cortés

Inversión : Según estudio económico esperan cultivar en 865 hectáreas y lograr una producción anual de 3 millones de libras, la inversión programada asciende a 6 millones de dólares. Actualmente, mientras se define la situación, están produciendo 10,000 libras al mes, la cual exportan a Estados Unidos de Norteamérica.

Objetivos : Cultivo de camarones de río para la comercialización.

Estado del Proyecto : Esta empresa tiene aproximadamente 3 años de estar dedicada a la investigación del cultivo de camarones de río y asegura haber tenido buenos resultados. Actualmente está negociando con las autoridades gubernamentales algunos aspectos específicos como ser el área de terreno que necesitan, lo cual sobrepasa los límites señalados por la Ley Agraria.

2.4.3. Laboratorio de Investigación en el Golfo de Fonseca

Localización : San Lorenzo, Departamento de Valle

Objetivos : Realizar investigaciones sobre el cultivo de algunas especies principalmente camarón de río, de mar, tortugas, mejillones, ostras y curiles.

Estado del Proyecto : Las investigaciones más avanzadas han sido en camarón de río MACROBRACHIUM AMERICANO. Este laboratorio tiene una capacidad de producción de 300,000 camarones hasta una edad de tres (3) meses, después de esta edad deben ser trasladados a tierra firme para su total desarrollo. En la primera etapa de las investigaciones se ha tenido bastante éxito, actualmente se está entrando a la segunda etapa o sea trasladarlos a los estanques.

En los proyectos acuícolas el Gobierno cuenta con la Asistencia Técnica de la República de China Nacionalista.

2.4.4. Proyecto Las Pelonas

Localización : Amapala, Departamento de Valle

Objetivos : Aplicar los resultados de las investigaciones del laboratorio de San Lorenzo. Establecer un criadero piloto de camarones de mar que contribuya a mejorar el nivel de vida de los pobladores de las comunidades vecinas.

Estado del Proyecto : Se han construído tres estanques de una hectárea cada uno, falta la construcción de un estanque más de la misma dimensión. Se espera depositar los camaroncitos de mar alrededor del mes de julio. La producción anual para el consumo directo que se espera lograr en los cuatro estanques es de 4,000 Kg.

2.4.5. Centro Experimental La Lujosa

Localización : 8 Kms. al este de Choluteca

Objetivos : Cultivo combinado de camarones y pescado. Se pretende que sirva como modelo piloto en la Zona Sur. Elevar el nivel alimenticio de la población.

Estado del Proyecto : Se están construyendo 4 estanques con un área de 75x50 Mts. cada uno, los cuales serán abastecidos de especímenes del Laboratorio de San Lorenzo.

2.4.6. Proyecto El Picacho

Localización : Cerro El Picacho, Tegucigalpa D.C.

Objetivo : Vivero de peces para fomentar el cultivo de esta especie en todo el país.

Estado del Proyecto : Este proyecto tiene 20 años, durante todo este tiempo se han obsequiado especímenes a personas que poseen estanques y que desean reproducir peces en ellas. En los dos últimos años se le está dando un manejo más científico a fin de que las investigaciones permitan lograr un mejor aprovechamiento de esta fuente.

2.4.7. Proyecto Jesús de Otoro

Localización : Valle de Jesús de Otoro, Departamento de Intibucá

Objetivos : Crear una fuente alimenticia en beneficio de la comunidad, brindar una educación técnica y práctica y jóvenes de las escuelas, clubes y demás organizaciones existentes e integrar el proyecto de piscicultura con facilidades recreativas. Este proyecto consistirá en cría de peces, de aves y cerdos, cultivo de hortalizas de arroz y siembra de árboles frutales y coníferas.

Estado del Proyecto : Se están construyendo 9 estanques de 75x50 metros cada uno y debemos reconocer que la lentitud de la administración pública ha impedido concluir estas obras.

2.5. Exploración y explotación de minerales

Prácticamente la explotación minera en las zonas costeras costeras de Honduras no existe. Se realizan algunas explotaciones sobre posibles yacimientos de petróleo, frente a la parte nororiental de la Costa Norte, sin que hasta el momento se hayan publicado los resultados de tales exploraciones.

2.6. Administración forestal

El 10 de enero de 1974, el Estado de Honduras emitió el Decreto Nº 103 nacionalizando los bosques y reservando la comercialización de la madera, a la Corporación Hondureña de Desarrollo

Forestal (COHDEFOR), organización semi-autónoma que fue creada mediante el mismo Decreto.

Actualmente la Administración, cuenta con personal distribuido en las áreas de mayor relevancia en la actividad maderera, en la Zona Norte se cuenta con el siguiente personal.

Z o n a	Ingenieros Forestales	Peritos Forestales	Dasónomos	Bachilleres Forestales	Personal de Campo
Nor-Occidental (comprende los Departamentos de Cortés, Atlántida, Colón y Santa Bárbara)	2	13	1	5	25
Total : 46					

2.7. Turismo

La oferta turística está constituida por sitios naturales, museos y las manifestaciones culturales históricas, folklore, etc.

Las playas representan los atractivos turísticos más importantes dentro de los sitios naturales, las más importantes son: Islas de la Bahía, Tornabé y Punta Sal (Torna-Sal), Tela, Trujillo y Cabo de Honduras, por su dimensión, calidad de arena, transparencia de las aguas, protección y paisajes, han sido consideradas como "de la más alta jerarquía internacional".

La Arqueología Colonial ha proporcionado valiosos aportes, en motivos turísticos entre ellos se encuentra: El Fuerte de San Fernando de Omoa y las Ruinas de una Fortaleza en Trujillo, todos ellos en la Costa del Atlántico o Costa Norte.

Actualmente se cuenta con el siguiente número de hoteles en la Costa Norte:

Lugar	Número de Hoteles
Tela	2
La Ceiba	6
San Pedro Sula	9
Cortés	1
Trujillo	1
Islas de la Bahía	17
T o t a l	36

2.8. Caminos y Ferrocarriles

2.8.1. Caminos

Durante los últimos diez años, se han desarrollado significativos esfuerzos, para lograr acrecentar la red carretera de Honduras, el siguiente cuadro muestra las características del país.

Carreteras	Km.
Asfaltadas	1,240
Transitables en todo tiempo	3,400
Transitables en verano	1,490
T o t a l	6,136

NOTA: Este dato es actualizado diciembre de 1974

2.8.2 Ferrocarriles

La mayor parte de la red ferroviaria ha pertenecido a las dos compañías bananeras que operan en la Costa Norte, la Standard Fruit Co., y la Tela Rail Road Co., las cuales en conjunto tenían la propiedad de un 80% de la red total.

Recientemente el Estado de Honduras se hizo cargo, de los muelles y ferrocarriles que pertenecían a las compañías bananeras, con lo cual el ferrocarril del Estado alcanzó 1,030 Km. entre ramales y líneas troncales.

III. Marco institucional y reglamentario de la ordenación de la Zona Costera

Actualmente el proyecto más importante relativo a la reunión de información y a su análisis, lo constituye el Proyecto Catastro Nacioanal que desde aproximadamente 2 años se viene ajecutando en Honduras, mediante Convenio 522T-024 entre el Gobierno de Honduras y la Agencia Internacional de Desarrollo del Gobierno de los Estados Unidos.

Los costos del proyecto se atienden mediante un préstamo de seis millones de dólares proporcionados por AID, con una contraparte del Gobierno de Honduras, que alcanza un monto equivalente a 2,200,000 dólares (U.S. $).

Los objetivos del proyecto son los siguientes:

Apoyar varios de los programas del Gobierno- que enfocan tres áreas problema. Específicamente, el Componente del Registro de Propiedad asistirá al Gobierno en la emisión de títulos saneados (u otra evidencia de derechos, por ejemplo, una escritura que date de la raíz del Título Confiable), para poder estabilizar la situación de derechos de la tierra en Honduras y establecer la base técnica de la Reforma Agraria. El componente de Administración de impuestos aspira a incrementar los ingresos de las administraciones locales, para fortalecer la capacidad de las minicipales rurales. El inventario de Recursos Agrícolas proveerá la información básica esencial que permitirá a la Oficina de Planificación del Sector Agrícola, recientemente creado, planear apropiadamente y llevar a cabo sus programas de desarrollo agrícola.

En la ejecución del proyecto se realizan las actividades que a continuación se enumeran:

a) Fotografías aéreas
b) Identificación de límites de propiedad
c) Procesos cartográficos
d) Procesamiento automático de datos

Avance del Proyecto:

Se ha realizado en más de diez Departamentos las prioridades establecidas; son los siguientes:

1. Cortés
2. Yoro
3. Atlántida
4. Olancho
5. El Paraíso
6. Francisco Morazán
7. Comayagua
8. Santa Bárbara

Es un proyecto de 66,000 Km^2 incluyendo el Proyecto Demostrativo 71.8 mil Km^2. El resto de Departamentos se cubrirán con fondos del Gobierno de Honduras.

Dependiendo de la misma Dirección está el Proyecto de Desarrollo Integral de La Mosquitia, en donde se tomarán fotografías aéreas.

En vista de la magnitud de los desastres originados, especialmente en la Zona Norte por el Huracán Fifí, se han venido realizando una serie de acciones encaminadas a la reconstrucción de carreteras, ferrocarriles y puentes, en donde participan varias Agencias Internacionales como AID y el BID.

Presentan especial interés el mejoramiento de los causales de los ríos, labor que se realiza actualmente con fondos presupuestarios nacionales.

3.1. Formulación de Leyes y Reglamentos

Durante el año de 1975 se comenzó a elaborar la Ley de Ecología, de la cual a continuación damos un breve resumen:

El Anteproyecto de Ley de Protección del Medio Ambiente tiene por objeto, lograr el mejoramiento, restauración y preservación del medio ambiente, este anteproyecto pretende regular la conducta humana individual o colectiva y la actividad de la Administración Pública y Privada.

Son objeto de regulación, control y prohibición los contaminantes que en forma directa o indirecta produzcan contaminación o degradación del medio ambiente, ya sean causados por actividades industriales, agrícolas, agro-industriales, comerciales, servicios públicos, asentamientos humanos y otros.

El anteproyecto consta de diez capítulos, divididos en cincuenta y siete artículos.

En el primero se describen los objetivos de la Ley.

En el capítulo segundo, se refiere a las disposiciones generales y en el se definen los conceptos esenciales que servirán para la interpretación de los artículos subsiguientes; asimismo se establecen lazos de cooperación con otras instituciones.

El tercer capítulo, comprende la acción educativa básica que emprenderá para la mejor comprensión de la problemática ambiental.

El cuarto capítulo, trata de las investigaciones que en el campo de la protección del medio ambiente se consideran indispensables y de los incentivos que el Estado brindará a las empresas para la importación de tecnología descontaminante.

Los capítulos cinco, seis y siete, establecen todas las reglas para el control, prevención y la eliminación de la contaminación de aguas, suelo y aire.

Los capítulos ocho y nueve se refieren al procedimiento que se seguirá en las inspecciones; y la forma en que serán sancionados los infractores de la Ley.

El último capítulo incluye las disposiciones generales.

COUNTRY MONOGRAPH INDIA

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Geology and Physical Setting of the Coastal Area.

India is a vast country with an area of over three million square kms. and a coastline of over 5600 kms. The discussion in this paper will be restricted to one major metropolitan coastal area, viz., Bombay.

Rocks in the Bombay region originated from the Deccan Traps, a series of vast lava flows emanating from volcanic eruptions at the close of the Createceous period. Over the Deccan Plateau the flow strata have remained nearly, horizontal, but in the Bombay area they are inclined as much as 15°.

Trap rocks are often very weathered near the surface. The material resulting from the breakdown of the rocks is known as "murrum", the hardness and texture of which varies according to the degree of disintegration. Where disintegration is complete, the material becomes a homogeneous stiff yellow clay. The discovery of a submerged forest during the construction of Prince's Dock gives clear evidence that Bombay harbour, once a thickly wooded valley, has subsided below sea-level due to the tilting of the land mass.

The mainland is predominantly coastal plain, with adjoining hills and flat islands. Some hills attain a height of 300 to 400 m and are backed by the Western Ghats, about 50 km to the east, which rise sharply to heights of over 600 m.

The island containing Greater Bombay was originally a group of islands separated by narrow tidal channels. The principal ones were Salsette (the largest), Dharavi, Trombay, Bombay and Colaba. These now form a single island separated from the mainland by the Ulhas River and Basse in Creek to the north and by Thana Creek and Bombay Harbour to the east. Communication with the mainland is provided by a number of road and rail bridges. In effect, Bombay has become a peninsula, 45 km long by 14 km at its widest point.

The Port of Bombay has been tradionally known as the "Gateway of India". It is the largest port on the west coast of India, and it has an advantageous position with respect to the Suez Canal and Europe. Its primacy among the nation's ports has declined somewhat, due to the diversification of trade and production and to the rapid growth of other major ports.

The harbour approach is from the south-west. As one proceeds up the harbour, the mainland to the east is dominated by the hills of Karanje, although higher hills lie behind. Bombay city lies to the west, the harbour being some 8 km in width at this point. The southern section of its waterfront extends 7 km from Prongs Reef Lighthouse through Colaba to the heart of the city, which is the area of the old Bombay Port. Many fine public buildings can be seen from the harbour, and the city presents a fascinating skyline. A naval dockyard now occupies the original site of the Bombay dock. Immediately to the north and covering a waterfront length of nearly 8 km, are the main commercial port facilities, comprising the docks and bunders.

Further up the harbour to the north-east are two islands. The smaller and more westerly of these is Butcher Island, the site of a marine oil terminal built just over twelve years ago. Elephanta Island, 2 km to the east of Butcher Island, is of considerable historical and cultural interest, containing the famous caves which were carved out of solid rock. A quarry on the island supplied much of the rock for the recent docks expansion programme. Pir Pau is 4 km N of Butcher Island to the south of Trombay with Trombay Hill behind, commanding the northern part of the harbour. The old bulk oil berth at Pir Pau is at the northern extremity of the harbour's deep water. East of Pir Pau are the wide mouths of two large tidal creeks: Panvel Creek running as far as Panvel 20 km E of Pir Pau, and Thana Creek which connects with the Ulhas River 26 km N of Pir Pau.

The fine natural harbour made development inevitable, and the Bombay Port Trust celebrated its Centenary in 1973. Facilities for import and export inspired the birth of trade and commercial centres besides industries, stimulating, in turn, the growth of the surrounding areas.

Population in Bombay increased in tune with the growth of the port, being less than half a million at the time the port trust was formed and rising to about six million at the last (1971) Census.

This led, of course, to an inevitable shortage of space, congestion in traffic, and evidence of pollution of the environment. It has become necessary to expand the development of the coastal area so as to spread the activity over a wider zone and to contain ecological disturbances.

Resources and Uses of the Coastal Area

Apart from nature's endorsement as an excellent gateway to commence, the area is a trumming zone of human settlement with a busy network of roads and railways. Despite this, there is much to attract the tourist and plenty of scope sightseeing and for other forms of recreation.

A fishing harbour exists, and this is being developed further. The function of a fishing harbour is to provide facilities for the landing, processing and dispatch of fish, the preparation of fishing vessels for sea and the provision of a sheltered area in bad weather for the fishing fleet. Facilities such as slipways and workshops (for the repair and maintenance of vessels), fish markets, packing halls, ice plants, cold storage, fish processing plants and areas for drying and maintenance of note are also necessary. The provision of sufficient quantities of ice or other cooling facilities is most important as the catch deteriorates rapidly in the warm moist conditions of Bombay. As a general guideline, an area of one hectare per each 2,500 tonnes of fish caught perannum should be provided.

Quay length must allow for high peak rates of cargo handling if quality of the fish is to be maintained. A study has been made of rates of catch unloading both in Bombay and the other ports in India and elsewhere which handle similar types of vessels. This study shows that an appropriate rate for a fish harbour in Bombay would be 50 t/year per metre of quay. The quay length quoted is measured overall and includes berths for bunkering and mooring as well as for discharging. About one-third of the quay would be required for unloading, one-sixth for bunkering and the remainder for layby.

These points are based on the advice of consulting engineers to the Bombay Port Trust, and they reflect the methodical scrutiny that precede all aspects of development requiring capital expenditure.

Recent exploratory oil drilling activity has identified promising oil-bearing structures, known as Bombay High. Offshore oil production, along with increased traffic in other minerals, will have significant multiple effects on ancillary industries. There will also be a significant rise in the demand for skilled labour.

Large volumes of foodgrains, fertilisers, sugar, coal, oilcake, etc. are anticipated to move through the area in the future. Efforts are underway to prepare for this additional traffic by opening up a fresh and virgin area on the east of Bombay port as a new zone of intense coastal development.

To the east of Bombay Port is Elephanta Island. The east side of Elephanta is sheltered from rough weather, and there is natural deep water, known as the Elephanta Deep, between Elephanta Island and Nhava/Sheva. This deep water, the deepest in the harbour, is separated from the main harbour channel by shallows south of the island. Detailed probings and borings have shown that it would be possible to dredge to connect the Elephanta Deep with the main channel at a reasonable cost. Siltation and hydraulic model studies indicate that this channel could be maintained without accessive dredging and that open berths constructed on the east side of Elephanta could be economically maintained.

The present proposals contained in the Bombay Municipal Corporation's Development Plan are to reserve Elephanta Island as a nature reserve and tourist attraction. Provided that sufficient space is resevered on the east side of the Island to meet possible long-term needs of the port, this would appear to be the best policy. Improvement of the facilities for landing from launches is advisable, particularly sophisticated craft such as hydrofoils are introduced.

Nhava and Sheva were originally islands, but Sheva is now connected to the mainland. The connection of Nhava was made by poldering an area of some 600 hectares of mud flats and draining them for growing rice. This was succesful for many years, but the bunds have been breached in recent years and access is now by boat. Sheva is connected by a narrow road across the mud flats which have been extensively developed as salt pans. The present road is only suitable for light traffic. Between Nhava and Sheva is a shallow creek much of which dries out at low water. The creek is used by country craft carrying salt and by fisharmen.

The close proximity of the Panvel-Uran railway to the Elephanta Deep makes major port development of Sheva and Nhava attractive. Extensive topographical surveys, probings and borings have been carried out over a large area so that a wide variety of possible schemes could be compared in sufficient detail. A new part city is planned, and it is hoped that this will draw away some growth from Bombay island, thereby creating new environments at more acceptable levels.

The development of this new area will fully take into account the need for protecting the environment. For example, wind roses will be constructed when planning the location of industries, so that pollution levels are kept within tolerable limits.

Except for tanker dumping, oil pollution in the harbour was found to be at a lower level than in other harbours and estuaries. This is due, to a large extent, to the fact that the city has grown on the west side of the harbour, where it can discharge most of its sewage and other effluents seaward; the areas on the east side of the harbour are, by contrast, relatively undeveloped.

Port Trust Rules, framed under the Bombay Port Trust Act, forbid the discharge of oil or water mixed with oil in the harbour. Punishment may be a fine up to Rp. 500/- and payment of any reasonable expense incurred in removing the oil. These rules provide a basis for controlling oil spillage but it would be advisable to increase the maximum fine and to make arrangements for regular monitoring and for removal of oil.

The pollution problem is being tackled at the national level, and considerable assistance is being received from UN agencies.

The construction of port facilities at Sheva will provide an ideal opportunity to develop an industrial estate which would be most attractive to those industries which would generate substantial port traffic. The areas of Sheva Polder near the dock should be reserved for those industries which would benefit most from being close to deep water berths, even though this might mean keeping some plots vacant for a number of years.

Industries which could be developed at an early date include fertilizer plants, cement grinding mills, oilcake mills, and chemical plants. The polder and the reclamation of Uran mud flats could, however, be planned to include a refinery, petrochemicals, steelworks, shipbuilding, fishing and many other industries. Provision could also be made for free trade zones. An industrial estate at Trombay, served by lighters from Sheva and from the existing docks, would also be attractive to many industries.

Institutional and regulatory framework for coastal area development

The need for planning and coordination of major developmental activities hardly requires emphasis. In what follows the planning and coordination process will be described as it exists presently.

The Bombay Port Trust appointed their consulting Engineers to carry out a comprehensive study and to prepare a model Plan so that future development could be logically planned and fitted into an overall scheme. The terms of reference were, <u>inter alia</u>:

"1. To prepare a Master Plan for the port of Bombay taking into consideration the interests of all the users of the port and harbour and the probable development of the port traffic during the next 50 years.

"2. To study, for preparing the development plan, the available data regarding economic and engineering aspects of the harbour and to supplement the same, where necessary, with further investigations and studies which will include the following:-

(i) Economic investigation

In order to forecast the future requirements of the port, the economy of the region and the hinterland of the port will be investigated and the likely pattern and volume of the traffic will be determined by making use of information already available which will be supplemented and analysed, as necessary, so that the planning will be balanced and firmly based on anticipated requirements and the phasing of the capital development will be so arranged as not to be wasteful.

(ii) Engineering investigation

In order to make the best use of the natural features of the harbour for the future development projects, comparative studies of different locations will have to be carried out. To provide data for such studies, all necessary investigations, including the following, will be carried out:-

(a) Geographical surveys, including hydrological surveys and test borings.

(b) Wave and current recordings in selected areas of the harbour.

(c) Model tests to determine the effects of scour and siltation and of current and wave patterns.

(iii) Traffic investigation

A traffic census will be undertaken and the existing and projected road and rail approaches will be studied so as to assess their capacity and to consider the need for additions and improvements thereto."

The field work undertaken included the following items:-

(a) Collection of data on existing traffic and available information on various commodities;

(b) Discussions with a wide range of authorities and users interested in various facets of port development to obtain their views and further information;

(c) Detailed topographical survey in the Nhava/Sheva/Elephanta area;

(d) Marine surveys and soundings and supervision of boring and probing contracts;

(e) Wave observations, current measurements, siltation observations and recording of berthing velocities at the marine oil terminal;

(f) Supervision of and assistance with the hydraulic model studies carried out by CWPRS Khadakwasla;

(g) Traffic census at the dock gates and survey of the rail approaches;

(h) Assisting, by membership of the Steering Committees, with the Maharashtra Regional Transport Survey and the Study Group of the Maharashtra Economic Development Council.

Theoretical Studies undertaken comprised the:

(a) Analysis of the present and future capacity of the existing docks;

(b) A review of the economic development of the area and predictions of future traffic;

(c) Analysis of the economics of using different sized vessels, particularly for transport of bulk cargoes;

(d) Analysis of a wide variety of different methods of handling future port traffic;

(e) Studies of trends in development of ships and of cargo handling;

(f) Analysis of statistics, traffic records, traffic carried, etc.

It is clear that a very thorough fundamental investigation was carried out before initial recommendations were formulated. A number of specialists were associated with particular aspects of the study. Discussions were held with many organisations.

The report of the consulting engineers was considered by the Bombay Port Trust, who subsequently made some modifications to the texts when making their recommendations to the Govt. of India. The Ministry of Shipping and Transport, which is the administrative Dept. of the Govt. to approve such schemes, is having detailed consultations with the Planning Commission, the Ministry of Finance etc. The State Govt. of Maharashtra, which is responsible for the development of the area except for the port proper, is also consulted on various aspects. These measures ensure a coordinated approach. The aim is to see that the development should yield the "greatest good to the greatest number".

It will be interesting to find out, during the Seminar, the approach to similar problems in other countries. Procedures and practices in India can be improved on the basis of new methods developed elsewhere.

INDONESIA

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INTRODUCTION

The Indonesian archipelago has over 61,000 km of coastlines, probably one of the longest in the world. Since coastal zones provide resources that are of great importance to the majority of people in Indonesia, it is only natural that we devote considerable attention and efforts in developing and trying to manage the coastal zones.

A large proportion of the Indonesian population live in or adjacent to the coastal zones. Population pressures combined with demands for multiple uses of coastal resources — such as urbanization, industrialization, shipping harbours, power plants, recreation, fisheries and aquaculture, nature conservation — result in conflicts of interests. In addition, the impact of human society with its technological manipulations has almost always been accompanied by undesirable effects. However, since changes are inevitable, it is necessary to develop the best means to ensure that they will have the least possible impact and that ecological principles are closely followed in their implementation.

The following is a short overview of the Indonesian coastal zones, their resources, the problems, the plan for development and management.

THE PHYSICAL ENVIRONMENT OF INDONESIA

The physical environment of Indonesia is unique. Geographically, it is located between two continents, Asia and Australia, and two oceans, the Pacific and the Indian Ocean. The archipelago is situated between 94°E and 141°E and between 4°N and 11°S. It consists of 13,667 islands of which only 6,044 have names. Among these, only 994 islands are inhabited (Mugroho, 1967).

Two-thirds of the Indonesian archipelago is covered with waters. It is a very complex system of waterways. Basically, it consists of the broad shallow Sunda Shelf in the west and Sahul Shelf in the east, separated and intertwined by deep seas and deep trenches.

Because of its geographic location, the Indonesian archipelago is strongly governed by monsoon-type climate. Generally, the northwest monsoon lasts from about December to February and the east monsoon from June to August. The rest of the year represents the transition periods from the west to the east monsoon (March-May) and back from the east to the west monsoon (September-November). During the northwest monsoon the wind blows eastward and causes heavy rainfall throughout most of the Indonesian archipelago. Rainfalls combine with the heavy runoff of many rivers from the grater Sunda Islands (Sumatra, Java, and Kalimantan) and result in a general lowering of the salinity nearshore. Sometimes the 30‰ isohaline is pushed far toward the open sea. At the same time the surface current from the area of the South China Sea brings the low salinity water into the western part of the Java Sea, which is surrounded by these three islands, and pushes the higher salinity water eastward. With the onset of the southeast monsoon, these low salinity waters are transported back westward and into the West Java and South China Seas, i.e., they are replaced by waters of the higher salinity from the Macassar Strait and Flores Sea. In September the water masses of high salinity reach their maximal westward penetration.

THE COASTAL RESOURCES

FISHERIES

The Indonesian coastal zones are very important in terms of artisanal fisheries, which comprise almost 90% of the local fishery production in Indonesia. The following table shows the data on the aquatic environment of Indonesia, where fisheries have been developed or could potentially be developed.

Table 1

Data on the Indonesian Aquatic Environment
(after Soegiarto, 1975)

Territorial waters (12-mile limit)	6,850,000 km^2
Continental shelf (up to 200 m depth)	3,000,000 km^2
Length of coastlines	61,147 km
Tidal forests (mostly mangrove)	1,000,000 ha
Swamp forests	14,500,000 ha
Inland open waters	13,700,000 ha
Brackish water ponds	182,000 ha
Freshwater ponds	40,000 ha
Ricefield mix culture	78,000 ha

The current annual fisheries production in Indonesia is about 1.4 million metric tons. About 70% are from marine sectors and 30% are freshwater fishes. In the last five years the average annual increase of catch in marine fisheries was a healthy 8.5%, whereas the freshwater fisheries, due to various factors, almost steadily declined.

Table 2 shows the fisheries production between 1960 and 1970.

PETROLEUM AND NATURAL GAS

As of 1975 the total petroleum production in Indonesia is about 1.5 million barrels per day (BPD) and is expected to reach 2.5 million bpd by 1980. Most of the production is derived from oil fields located in the coastal zone and an increasing proportion is coming from the offshore oil fields. Currently about 20% of the production is derived from offshore wells.

In recent years many reserves of natural gas were also discovered. Some fields have been producing and exporting to Japan and the United States as LNG. Others are still in the developmental/construction stages.

MINERALS

Many minerals are also mined from the Indonesian coastal zones. They include, among others, tins, bauxite, nickels, iron sands, coal, sands and gravels.

INCREASED DEMANDS FOR MULTIPLE USES OF COASTAL ZONES

In addition to the natural resources there are many other uses that take place in the coastal zone. Some of these uses are compatible, but others are sources of conflicts. The following are some of the examples.

HUMAN SETTLEMENTS

The current population in Indonesia is around 130 million people, with an average annual growth rate of 2.5%. A major portion of them live in the coastal zones. As an illustration, for example, 75% of the medium-size cities (population over 100,000) are located in coastal areas. These centres of human seltlements create many problems and give heavy pressures to the surrounding environments, particularly the coastal ecosystems.

In order to alleviate the population pressures in some of the highly crowded islands (e.g., Java and Bali), the Indonesian Government has started an intensive programme on transmigrations. Many of these transmigration programmes are located in coastal areas.

Table 2: Fisheries Production in Indonesia, 1960-1970
(after Soegiarto, 1975)

	1960	1961	1962	1963	1964	1965	1966	1957	1968	1969	1970
Production (1,000 tons)											
Marine	412	525	538	546	590	661	721	790	722	785	802
Inland	347	385	375	386	410	370	400	465	450	429	447
Total	759	910	913	932	1,000	1,031	1,121	1,255	1,172	1,214	1,249
Index (1960 = 100)											
Marine	100	127	130	132	143	160	175	182	175	190	195
Inland	100	111	108	111	118	107	115	134	130	127	129
Total	100	120	120	122	131	138	148	165	154	159	163
Composition (%)											
Marine	54	58	57	57	59	64	65	63	62	68	66
Inland	46	42	43	43	41	36	35	37	38	32	34

AGRICULTURAL DEVELOPMENTS (INCLUDING AQUACULTURE)

Due to the high increase in population, the Indonesian Government has established extensive agricultural programmes. For example, in our First Five-Year Development Plan (1969-1974) almost 200,000 hectares of tidal forests had been converted into agricultural lands and to aquaculture. In the Second Five-Year Development Plan (1974-1979) an additional one million hectares of such swamp forests will be converted to agriculture and aquaculture. At this stage we know very little about the tidal forest ecosystems and what will be the impact on the surrounding environments when opening tidal forests of such magnitude.

HARBOUR AND SEA TRANSPORTATION INFRASTRUCTURE

Because of our maritime and archipelago nature Indonesia has to develop rather intensive sea transport and harbour infrastructures, whether it be for inter-island or for inter-country purposes.

INDUSTRIAL ESTATES

Taking into account easier accessibility, more and more industrial estates are using coastal zones as their sites. Examples can be mentioned here: Pulan Gadung in the greater Kacarta area, Gresili in Surabaya, Cilacap on the South coast of Java. Included here are power plants — steam-powered or nuclear-powered — that have been constructed, are being built or are in the planning stage.

RECREATION AND TOURISM

Development of recreational areas would help to improve our national economy. As an islands nation, beaches and the coastal regions are the logical and attractive choices to be developed. The number of foreign and domestic tourists has steadily increased.

NATURE CONSERVATION

In order to ensure that natural ecosystems will still exist for future studies and other purposes in the near future a number of nature reserves has been established. Currently there are some 166 nature reserves of various kinds in Indonesia covering an are of over 3.5 million hectares. Many of these reserves are located in the coastal zones.

At present the Indonesian Government is exploring the possibility of increasing the area of nature reserves up to 10 million hectares. Taking advantage of this programme and owing to the increasing pressures subjected to the marine and coastal environments a marine park and reserves system is being planned in Indonesia. Many of these marine parks will be situated in the coastal zones.

WASTE DISPOSAL

Is is unfortunate that the coastal zone is traditionally used also for waste disposal, whether directly or indirectly, through streams and rivers. At present, there is no single sewage system in Indonesia. All wastes are literally dumped into the natural environment, including the coastal zones. When the community is still small these waters are able to absorb and digest the wastes. However, when the community grows in size these natural aquatic environments are unable to assimilate what is dumped there. Eutrophication starts, at first rather slowly, but later it accelerates quickly. If necessary steps are not taken, these waters will die and become useless. A number of natural aquatic environments in Indonesia are approaching that stage, particularly those that are located in or around population centres. The following are the sources of pollution in Indonesian coastal ecosystems:

1. Major sources of pollutants
   - domestic wastes and sewage
   - siltation and sedimentation
   - hydrocarbon
   - chlorinated hydrocarbon
2. Potential sources of pollutants
   - industrial wastes
   - thermal wastes
   - radioactive wastes

NATIONAL SYMPOSIUM ON THE ECOLOGICAL APPROACHES FOR COASTAL ZONE MANAGEMENT

The coastal zone is an interphase or ecotone environment. Consequently, many different ecological conditions can be found in a small area. This complexity creates management difficulties since generalities do not apply to all elements of the system and capacity for different uses varies. Realizing the complexity and the urgency of the problems, and to generate interest in an integrated planning and management of the coastal zone, a series of symposia were organized by the National Committee on the Environment in co-operation with the National Institute of Oceanology and the Environmental Education and Research Program of the Bogor Agriculture University. The symposium was entitled "Ecological Approacnes to the Coastal Zone Management." Three meetings were held in the last six months. The first meeting was held at the Bandung Institute of Technology (26 and 27 January 1976); the second meeting was held at the Bogor Agriculture University (29 and 31 March 1976), and the third and last meeting was held on 24 and 25 May 1976 in Jacarta. Participants of the symposia were experts in various fields and representatives of many agencies, research institutions, and universities.

In the meetings 36 papers of various nature (sectoral, technical information, management, plan for an integrated approach) were presented and discussed. In the meetings four concepts for coastal zone classification have emerged based on:

1. Energy of the land-sea interphase
2. A natural ecosystem - geomorphology matrix
3. Geographic analysis of other man-made or natural spatial patterns
4. Political/administrative boundaries

It seems that classification based on the natural ecosystem and geomorphology matrix is best suited for Indonesia. However, it is recognized also that political/administrative boundaries will be important and, therefore, should be taken into account in the implementation of an integrated planning and management programme.

In the question of coastal zone management, it is fully realised that in order to make management programmes effective we must be able to define a coastal zone management unit. The coastal zone classifications mentioned above provide a partial basis for this. A set of criteria was formulated in order to identify as much as possible elements that could be included in a coastal zone management unit.

In the course of the meetings we have also reviewed and formulated a set of management guidelines for various coastal zone activities. All the above-mentioned classifications, set of criteria for the coastal zone management unit and the guidelines, when suitably expanded from their present skeletal forms, should be useful in the continuing effort to develop ecological approaches for regional development.

A FEW UNSOLVED PROBLEMS

How such input as mentioned above can best be made into the development planning and management process. This involves the basic question of how comprehensive strategies of coastal zone planning and management can be established and implemented.

In the planning process we have the National Planning Board at the national level, the Local Planning Board at the provincial level, and the Bureau of Planning at the ministerial/sectoral level. In addition, in order to ensure that any major development plan is ecologically acceptable, the National Committee on the Environment has a regulation stating that before implementation all major developments should have an environment impact assessment.

In managing the natural resources Indonesia possesses basic guidance. Chapter 33 of our Constitution, for example states:

> "Land and water are under State jurisdiction and the resources they contain should be utilized as much as possible for the people's benefit and prosperity."

On the natural resources exploitation, our Supreme People's Council has established the following guidance:

"The natural resources should be used rationally; should not effect the environment; should have an integrated approach of utilization; should take into account the need for the coming generations."

However, there are still a few unsolved basic problems. In the course of our study and discussion on area development and project implementation it was revealed what is perhaps the universal difficulty in coastal management. The coastal zone is under the control of many agencies as well as individuals who may act independently in their decision-making. There is limited co-ordination and, sometimes, overlapping in decision-making control. Even with the involvement of many agencies there is no guarantee that all important resources in an area will be considered worthy of conservation. Nor is there a guarantee that net benefits will accrue to the rural coastal smallholders who are likely to be the group most sensitive to ecological changes. Strategies of coastal zone management must deal with the overall set of problems in the regulation of resource use and economic development in an area. The strategies must be focused, yet comprehensive, extending into regulation of both upland and offshore root causes of coastal problems and bringing co-ordination to existing programmes in the coastal zone.

The basic characteristic of multiple interacting agencies and specialized interest groups setting policy and management cannot be changed. The development of specialized coastal management agencies (e.g., patterned after the concept of water basin projects or authorities) is not likely to be successful except for certain clearly defined situations such as a bay authority for large coastal cities.

The final point to be raised is the matter of authority. Who should be responsible for devising and monitoring coastal management strategies? Is the authority to be split among the existing agencies having sectoral interests in the coastal zone? Should it lie with local-level planning authorities? Is there a need for a committee at the national level which can evaluate strategies, suggest standards and otherwise quide management? Should there be a full-time staff specifically concerned with coastal area development in some central government unit? It is hoped that these few basic problems and questions could get some satisfying answers during the course of discussion in the Interregional Seminar on Development and Management of Resources of Coastal Areas.

PARTING REMARKS

May I take this opportunity to express my sincere gratitude and appreciation to the Ocean Economics and Technology Office of the United Nations and the German Foundation for International Development in selecting and supporting me as one of the participants for the Interregional Seminar on Development and Management of Resources of Coastal Areas.

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IRAN

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INTRODUCTION

L'Iran s'étend sur une superficie de 164 500 km² entre 25°,40' à 39°,40' de latitude nord et 44° à 63°,30' de longitude est.

En raison de sa situation géographique et topographique particulière l'Iran fait partie des zones arides ou semi arides du globe terrestre.

Le plateau central iranien qui rassemble la majeure partie des plaines du pays est bordé par l'Elborz au nord et le Zagros à l'ouest. Ces deux chaînes montagneuses empêchent la pénétration des fronts humides venant du nord et de l'ouest, et expliquent qu'une partie très importante des précipitations du pays se concentrent a leurs piedmonts.

LES CARACTERISTIQUES DE LA ZONE COTIERE CASPIENNE

La mer Caspienne borde le territoire iranien sur plus de 700 km.

Deux provinces, d'une superficie totale de 62 074 km², constituent cette zone côtière, séparée du plateau central du pays par la chaîne de l'Elborz dont l'altitude atteint 4 000 m. La largeur de cette plaine côtière varie de 6 à 90 km. Elle est étroite dans la partie ouest où des montagnes couvertes de forêts surplombant la mer, constituent un très beau paysage.

La pente moyenne des plaines côtières varie de 2 à 5%. Dans ces plaines on distingue la zone des dépôts quaternaires généralement cultivée, et les versants septentrionaux de l'Elborz qui dominent et qui sont couverts de forêts.

Le climat de la zone côtière de la caspienne est de type méditerranéen tempéré avec un taux d'humidité élevé. L'origine de cette humidité elevé est, bien entendu, la presence de la mer elle-même, mais aussi les courants d'air humide venant de la Méditerranée et même de l'océan Atlantique. La température moyenne du mois le plus chaud est de 25°C et celle du mois le plus froid 7°C. La température augmente quand on se dirige vers l'est; la température maximale absolue est d'environ 35°C à l'ouest; elle est de 43°C à l'est. L'humidité de l'air est toujours supérieure à 60%. Les précipitations moyennes annuelles varient de 1 200 mm - 1 800 mm à l'ouest à 600 mm - 1 000 mm à l'est.

Les nombreux cours d'eau pérennes et les nappes souterraines constituent les ressources en eau de la région. La qualité de ces eaux pose peu de problèmes en particulier pour son utilisation dans l'agriculture. Cependant le déversement des égouts domestiques et des déchets industriels dans les cours d'eaux, cree par endroit une pollution importante de ceux-ci. L'écoulement souterrain des nappes salées vers les nappes d'eau douce à proximité immédiate de la mer diminuant la capacité de celle-ci occasionne des difficultés quant à leur utilisation.

En raison de l'existence d'une bonne couverture végétale sur presque tous les bassins versants, les dégâts produit par les crues, sauf cas exceptionnels, ne sont jamais très importants.

La mer caspienne est une mer fermée; son niveau, malgré les apports à partir du territoire iranien ou celui de l'URSS (apport important par la Volga), est en baisse. La dégradation de la qualité des eaux de la caspienne est causée ces dernières années par le déversement des égouts domestiques et des eaux résiduaires industrielles ou agronomiques venant des territoires des deux pays riverains. L'exploitation du pétrole dans le nord de la caspienne menée par le gouvernement de l'URSS, est une source de pollution non négligeable.

La fragilité de l'équilibre écologique de la mer caspienne a attiré l'attention des gouvernements de l'Iran et de l'URSS qui ont la sauvegarde de cette mer et de son environnement.

Environ 3,5 millions d'habitants vivent sur les zones côtières iraniennes du sud de la caspienne, soit à peu près 10% de la population totale du pays. La densité y est de l'ordre de 60 habitants au km². L'accroissement important du nombre des residences secondaires dans cette zone, ajouté à l'augmentation régulière du nombre des touristes et vacanciers conduit à une certaine pression de l'espace.

UTILISATION DES RESSOURCES

On tire annuellement, environ 5 000 tonnes de poisson de la caspienne, une augmentation jusqu'à 7 000 tonnes a été prevue pour l'an prochain. L'utilisation de l'eau et du sol par l'agriculture dans les zones côtières se fait de facon intensive. La superficie actuellement cultivée (irriguée) est de l'ordre de 616 000 ha. Les eaux d'irrigation proviennent des eaux de surface auxquelles s'adjoignent dans la région est des eaux souterraines.

En dehors de l'utilisation des cours d'eau non régularisés, il y a une dizaine d'années que deux barrages reservoirs regularisent un volume de l'ordre de 3 230 m³ pour l'irrigation et la production d'énergie hydroélectrique.

Les principales cultures de la région sont le riz, le thé et l'olive à l'ouest, le coton et le blé à l'est. 89% du riz, 65% du coton et la majeure partie des agrumes produits dans le pays, proviennent de la zone côtière.

Les forêts de la région montagneuse de la zone caspienne ont une superficie de 3,4 millions d'hectares. 48% de ces forêts sont de type dense, les 52% restant étant constitués de bois plus ou moins détruits. Le volume annuellement exploitable est d'environ 4 millions de metres cubes. Une superficie de l'ordre de 2 millions d'hectares est consacrée à des pâturages qui sont les mailleurs du pays.

Les projets déjà mis en oeuvre pour l'exploitation et la sauvegarde des forêts de cette zone couvrent une superficie de 450 000 ha., l'objectiv à atteindre étant de 850 000 ha.

Les zones côtières de la caspienne en raison de l'existence de plaines en pente douce, du climat doux et de paysages naturels très agréables, attirent chaque année un nombre très élevé de vacanciers et de voyageurs. Dans le but d'attirer et d'intéresser davantage de touristes on a cree 5 parcs naturels d'une superficie totale de 4 200 ha.

Les zones côtières de la caspienne possedent 1 450 km de route asphaltée et 2 060 km de chaussée non asphaltée. Des projets permettant l'extension de ces voies sort en cours. La liaison entre la capitale et cette zone est assurée par une voie ferrée et 4 routes asphaltées. Dans cette zone, un seul port se consacre au transport maritime en relation avec l'Union Soviétique.

Il n'existe pas d'activités minieres importantes dans la région. Les industries développées sur le littoral de la caspienne sont essentiellement des industries alimentaires (7% du total du pays) et textile (9% du total).

LES CARACTERISTIQUES DES ZONES COTIERES DU GOLFE PERSIQUE ET DE LA MER D'OMAN

La partie sud de l'Iran est bordée par le golfe persique et par la mer d'Oman. La longueur des côtes y est de plus de 2 500 km. Cette zone littorale comprend une partie des quatre provinces sud du pays. D'un point de vue géographique on distingue trois régions très différentes :

- Les zones d'altitude qui s'étendent parallèlement à la mer. Elles sont dépourvues de couverture végétale importante. Il n'existe pas non plus de glaciers étendus ni de précipitations importantes, en consequence il n y a pas de cours d'eaux pérennes sauf a l'extrémité ouest de la région.
- Les plaines et mort-terrains qui se trouvent entre les zones montagneuses et le bord de mer. La largeur de ces plaines varient entre quelques kilomètres et 100 km. Les zones proches de l'embouchure des cours d'eau sont généralement marecageuses.

Du point de vue géologique les terrains côtiers sont de formation tertiaire. Dans certaines régions la remontée de nombreux dômes de sel d'origine cambrienne à la surface du sol est à l'origine d'une salure de ces terrains. Les cours d'eau superficiels passant par ces zones se salent et ne peuvent plus être utilisés. Les sols des plaines, dans les zones non-salées, sont argileux de texture fine. Dans les piémonts on passe à des dépôts sablo-argileux de texture grossière. Les sols dans les zones ou ils sont aptes a l'agriculture, sont souvent attaqués par l'érosion.

- Les îles du golfe persique sont en général disposées parallèlement a la côte; plus de 20, parmi celles-ci appartiennent à l'Iran; leur situation naturelle est semblable à celle de la zone côtière.

Les zones côtières du golfe persique ont un climat très chaud, il est chaud et humide en bordure et au fur et à mesure qu'on s'éloigne de la mer il devient plus sec. La température maximale des mois les plus chauds dépasse même 50°C. La température moyenne mensuelle du mois le plus chaud est environ 30 à 35°C et celle du mois le plus froid est de 18 à 20°C.

La moyenne des précipitations annuelles varie d'un point à l'autre de la côte entre 100 mm à 200 mm. La période de précipitation est très courte. Les ressources en eau de ces zones sont limitées tant des points de vue quantitatif que qualitatif. La salinité des eaux vient essentiellement du passage de celles-ci à travers des zones salées. En raison de la concentration des précipitations en un intervalle de temps très court le ruisellement est torrentiel entrainant des dégâts souvent importants.

Les conditions climatiques défavorables dans ces zones côtières du golfe persique ont été une raison importante de la faible densité de population sur cette partie du territoire iranien. Elle est en effet de [illegible] habitants par km² dans l'ouest, de 5,2 au centre et de [illegible] l'est. Si l'on compare ces chiffres avec la densité moyenne du pays et avec celle des zones caspiennes, (respectivement 16 et 60 habitants par km²) on se rend compte combien ces chiffres sont bas.

UTILISATION DES RESSOURCES DES ZONES COTIERES DU GOLFE PERSIQUE

Depuis des siècles la pêche constitue l'activité économique traditionelle dans le golfe persique. Celui-ci, en raison de sa liaison avec l'océan Indien et de la richesse des conditions biologiques possède des reserves importantes en animaux marins d'espèces très variées.

Les activités agricoles, en raison des ressources en eau limitée et de la pauvreté du sol ne sont pas importantes. Les cultures irriguées ainsi que les cultures sèches sont localisées dans des petites plaines loin de la mer ou les conditions climatiques particulières favorisent la production de primeurs.

Afin d'exploiter au mieux toutes les ressources en eaux de la région, des projets d'aménagement des eaux de surface et des eaux souterraines ont été mis en oeuvre; parallèlement on procède au dessalement d l'eau de mer avec une production annuelle qui atteindra en 1977, 23 M.M.C. Il faut ajouter qu'après l'installation des centrales nucléaires au bord du golfe persique la capacité de production d'eau douce à partir de la mer prendra une importance considérable.

La liaison entre la côte du golfe persique et les autres régions du pays se fait par des routes asphaltées ainsi que par chemin de fer (à l'ouest) et par voie aérienne. Etant donné l'immensité de la région, de nombreux projets sont prévus et mis au point pour la création des nouvelles voies de liaison.

Le golfe persique et la mer d'Oman ont une importance primordiale pour l'Iran dans le domaine des transports maritimes. Actuellement 5 principaux ports sont en plein d'activité. Il est prévu que la capacité totale de ces ports pour l'année 1977 atteigne 28 millions de tonnes (non compris le pétrole).

L'exploration et l'exploitation pétrolière, constituent l'essentiel de l'activité minière de la région. Rappelons cependant qu'il existe d'autres ressources minières exploitées tel le soufre et la cromite. L'exploitation du pétrole se fait en parts égales à l'intérieur de cette zone et sur le plateau continental dans les eaux du golfe persique. Sur le plan industriel en dehors des industries pétrochimiques très concentrées les industries légères sont dispersées. La création de nouveaux complexes industriels pétrochimiques et sidérurgiques (réduction par le gaz naturel) est prévue.

Actuellement le tourisme dans cette zone est peu développé mais il est prévu que certaines parties de la côte sont à même d'accueillir dans les années à venir un nombre élevé de touristes, surtout durant la saison d'hiver.

En raison des activités pétrolières dans les eaux du golfe persique (exploitation et transport) il y a danger de pollution marine. A cet égard les différents organismes intéressés et plus particulièrement l'organisation de la protection de l'environnement ont pris des mesures nécessaires afin de lutter contre les dangers de pollution et de sauvegarder le milieu naturel.

CADRES INSTITUTIONELS ET ADMINISTRATIFS

La mise en valeur des zones côtières de l'Iran se fait dans le cadre des plans de développement nationaux et régionaux. L'organisation du Plan et du Budget est chargé de la préparation des plans de développement. Les bureaux régionaux de l'O.P.B. dans chaque province sont chargés de préparer et de proposer les plans de développement regionaux.

En raison de la rapidité du développement des zones côtières de la caspienne, tout recemment un conseil superieur interministeriel a été charge de mettre en place les mesures necessaires pour la coordination de toutes les activités dans cette zone. Ce conseil supérieur en disposant de comités spécialisés veillera au développement harmonieux de la région.

Pour terminer nous devons rappeler que la récente création du centre National de l'Aménagement du Territoire et la mise au point d'un projet d'étude sur l'aménagement du territoire, résoudra les problèmes de mise en valeur des zones côtières de l'Iran à moyen et à long terme dans le cadre des objectifs nationaux.

THE ISRAEL MEDITERRANEAN COASTS

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GEOGRAPHICAL BACKGROUND

The Israel Mediterranean coast forms the South Eastern corner of the Levantine Basin, which itself forms the extreme Eastern part of the sea. The Israeli coast has relatively low relief, with only two mountains reaching the sea shore — the Carmel and the ridge of Rosh Haniqra. Elsewhere the foothills are separated from the sea shore by a coastal plain.

This plain is fairly wide in the South (up to 40 km), but narrows towards the North reaching a width of only a few hundred meters in the Carmel Plain. North of Haifa the coastal plain widens again, reaching an average width of about 10 km but narrows thereafter northward to Rosh-Haniqra where the mountains meet the sea.

THE SHORELINE

The Mediterranean shore of Israel forms a gentle curve, turning from an almost easterly to an almost northerly direction. The length of this shore from Rosh-Haniqra near the Lebanese border to Northern Sinai is about 230 km.

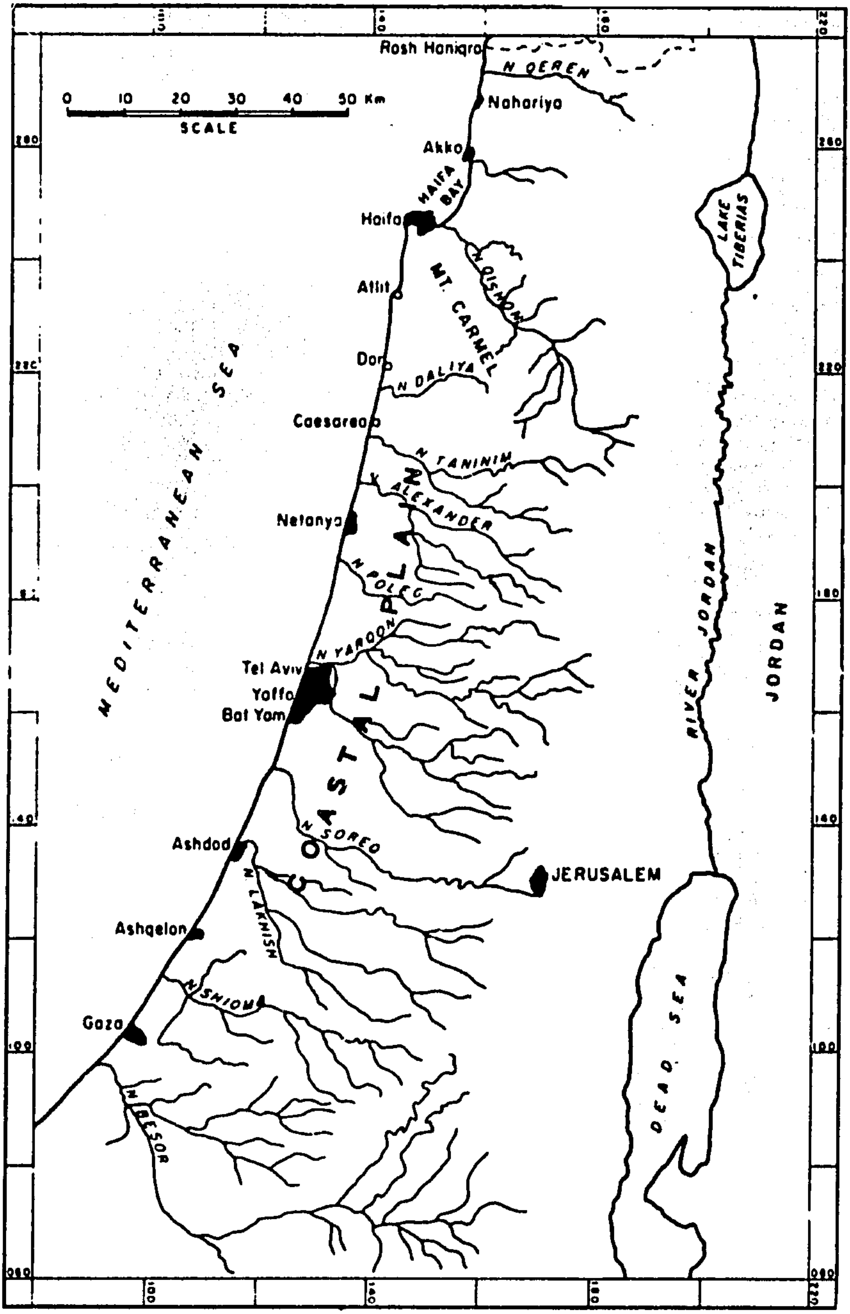
Active faulting is responsible for the shape and, to a certain extent, for the morphology of the coastline, which is characterized by small cliffs (Neev, et.al., 1973) and an abraded rocky platform mainly in the north.

The coastline region consists largely of Quaternary calcareous sandstone, known by the local name "Kurkar". Cenomanian limestone, dolomite and chalk are exposed at the northwest edge of Mount Carmel and at Rosh-Haniqra. The latter forms the Southern edge of the narrow and cliffy Lebanese shore.

The only important bay along the Israeil's coast is at Haifa. This is a morphological feature, directly related to the Carmel Mountain horst and the Zevulun Valley graben found north of it. Small bays a few tens of meters in length and usually rocky, occur in the Central and Northern parts of the shore, mostly between Dor and Atlit.

THE BEACHES

The Kurkar cliffs constitute a very distinct morphological feature along the Israel shores. Most of these cliffs are about 30-40 meters high and are very strongly abraded by the sea at the foot of the cliff and by rain water along



ISRAEL MEDITERRANEAN SHORES—LOCATION MAP its slopes.

Sand dunes cover relatively large areas along the coastal plain of Israel, although the majority of the dunes are located in the southern part, south of Tel Aviv. Dunes occur extensively in Northern Sinai along the beaches and further inland as well. Only around Haifa Bay an near river mouths however do these dunes form the edge of the shore zone.

The beaches of Israel are mostly sandy, with a few exceptions where local Kurkar or limestone pebbles are found. The sands are light in colour, white to light yellow, and are mostly composed of quartz grains. The Mount Carmel and the Akko-Rosh Haniqra beaches are an exception: here the sands are of local origin and are composed of calcium carbonate.

The origin of the quartz grains, which compose the bulk of the beach components, is as follows:

1. Nile derived sediments transported along the Nile delta, Sinai and Israel beaches by means of longshore currents and the counter-clockwise east Mediterranean current. According to Dornhelm (1972) the construction of the Port of Ashdod, with its main wavebreaker reaching a depth of 18 m, has interrupted about 80-100% of the annual northward transport of sand. He estimates that total annual transport reaches 50,000 m^3.
2. Erosion of Kurkar cliffs, composed of calcareous quartz sandstone layers (loosely to well cemented), with soft sand and Hamra (loam) layers.
3. Sediments transported by local rivers (wadis) which are active only during winter floods — a relatively minor source.

The sandy beaches are relatively wide in regions where cliffs are absent, reaching in some parts a width of 60-80 meters. In the cliff regions, the beaches are very narrow, reaching a width of only 10-20 meters in summer and 5-15 meters in winter.

Wave activity during winter, mainly during storms, has a considerable effect on the narrow beaches and the bases of the cliffs where undercuts (nips) are formed. Wind and wave conditions therefore accelerate erosion of the Kurkar cliffs, which, according to Nir (1973) have withdrawn on average about 200 meters in the last 6,000 years. That is at a rate of 3 cm/year. Relicts of these Kurkar strata are still found in the offshore waters, at depths of 2-8 meters.

Large quantities of beach-sand were quarried until 1964, with an annual yield 10 to 20 times larger than the sand replenishment each year. This quarrying produced a sand deficit along many beaches, which caused an accelerated erosion to the beaches and near-by cliffs.

BEACHROCK

Beachrock is found in the littoral zone all along the beaches, cementing in many cases Glycimeris shells to local beach sand. This beachrock forms a strip at the waterline, and thereby acts as a natural beach protector. In locations where the beachrock was either exposed and/or quarried, shore and cliff erosion is accelerated.

SEAWATER

Seawater salinity is one of the highest in the Mediterranean, reaching about 39.0 ‰. Small surface fluctuations existed prior to the damming of the Nile in 1964.

Surface water temperatures in the Mediterranean Sea off the coast of Israel are between 16-17°C in winter and 28-29°C in summer — a seasonal difference of about 12°C.

Tides are of low amplitude and never exceed 30 cm, although the maximal seasonal tide is moving between -40 to +40 cm.

Sixty percent of the total waves reach heights of less than 1 meter, and 20% are between 1 meter to 2 meters in height. Maximum wave heights are about 7.5 meters, but such waves are very rare. During the summer bathing period the average wave height is 60-120 cm.

RIVERS (WADIS)

Rivers are all small, both in water volume and in sediment supply to the sea. At present, because of the increased consumption of fresh water sources on one hand, and the weakness of antipollution laws on the other, these rivers are used as "natural" carriers for domestic and industrial sewage.

Water quantities during flood periods are relatively large, but there are actually no active flood-plains as the river channels can accommodate all the water that comes.

WATER SOURCES

Water for domestic and industrial uses is mostly pumped from the relatively shallow aquifers in the Kurkar sandstone, and from the few springs found at the foothills.

With an increased population and growing agricultural needs, some salinization has occurred in a few places where over-pumping took place. Special regulations to prevent over-pumping were made and the Water Planning for Israel Co. (Tahal), efficiently administers these rules. These growing needs for water in the Central and Southern Coastal Plain has developed a deficit. Therefore some of the water carried to Southern Israel through the National Water Carrier are being used here.

CLIMATE

The climate along the Israel Mediterranean coast is typically Mediterranean, with a rainy season in winter and hot summers. The summers are hot and dry, yet the relative humidity along the coastal plain is moderately high.

Average rainfall is 600 mm/yr North of Haifa, decreasing to 500 mm/yr in the central region and to about 350 mm/yr and less on the southern shores.

Average air temperatures usually range between 12-14°C in January which is the coldest month, and between 24-26°C in August — the warmest month. Summer winds are mostly light, while in winter more extreme winds blow, with storms reaching speeds of up to 80 km/hr or more. However periods with no wind at all are typical for winter.

NATURAL RESOURCES

SAND

Sand for construction purposes is the only exploitable material from these beaches, as no other minerals of economic value are known to occur. The growth of building from the late forties to the early sixties has enormously increased beach-sand quarrying. The total amount of sand quarried during that period is estimated to be 10 million m^3 a huge figure compared to the total amount of sand on the Israeli beaches and in the shallow sea. It is estimated that this region has 45 million m^3 of sand. Serious damage was done to the beaches, and steps were taken to prevent further quarrying. A special law to prevent sand quarrying in the beach and backshore region up to 200 m from shore was made in 1964. As a result, many beaches have partially recovered, and sand has started to accumulate once again.

As a result of the shortage in construction materials in Northern Israel, a study for offshore materials has been carried out. The purpose of this work was to examine the submerged Kurkar ridges for availability and dredgeability of construction materials there. It has shown that for certain construction purposes the offshore material can economically compete with the existing land sources.

FISHING

Fishing in the very shallow waters and along the beaches is mostly for sport, although there is some commercial fishing in very shallow water.

AQUACULTURE

Aquaculture is in its infancy, and no economic projects are planned yet. Some steps were recently taken by the construction of an artificial reef off Haifa.

POPULATION

About 2/3 of the population of Israel is concentrated in the Central Plain and along the beaches. Tel Aviv, Haifa, Gaza and Natanya are the four main cities situated here.

The ever growing population demands a vast construction activity. Therefore agricultural areas have been transformed into built-up areas, a well-known phenomenon in "booming" countries.

A good road network covers the entire shore region and connects it with the other parts of the country. A simple railway system runs parallel to the shoreline, connecting all the main coastal cities.

RECREATION AND TOURISM

One of the most popular leisure time activities in Israel during summer and autumn, is bathing. Particularly during the weekends large numbers of holiday makers gather on the 25 to 30 bathing beaches. Official figures show more than 1/2 a million bathers on these summer weekends, and the beaches are often overcrowded.

A few of the main beaches have been artificially enlarged by the construction of detached wavebreakers. Sand bodies, namely tombolos were formed, connecting the shoreline with the wavebreakers. Although the nearby beaches suffered an accelerated erosion due to this sand accumulation, beach size and capacity were increased.

Official national parks are still few in number along the beaches. Recently however some 15-20 coastal strips, each with its special morphology and natural features, were proposed as nature reservations.

Tourism in Israel is a very major industry, and more than 80% of the tourists stay in hotels near the sea shore. All main cities situated along the shore have developed a seaside colony of modern hotels.

MARINAS

Sailing and other marine sport activities are still not much developed in the Mediterranean waters of Israel. There are a number of small sail boats, but yachts are still rare. Tel Aviv has the only marina in Israel; its capacity is a few hundred small boats. Elsewhere old harbours are still used for both economic and sport activities. Due to present economic difficulties it seems that the number of yachts will not increase dramatically and the small harbours will therefore continue to function also as marinas.

PORTS

As the Israel Mediterranean shore does not have closed bays or large river estuaries, wavebreakers must be constructued for every port built here. Haifa Bay is, to a certain extent, an exception. The first modern harbour was therefore constructed there in recent times. The port of Yaffo, which had served as an open-sea harbour since biblical times, has declined since the fifties. At present it is used mainly as a fishing harbour.

A small port, which operated for about 25 years, was constructed in Tel Aviv in the mid-thirties.

A very large and modern port was constructed in Ashdod, and began its operation in the mid-sixties. As a result the Tel Aviv and Yaffo harbours declined and were actually closed.

There is also an open-sea port in Gaza, south of Ashdod, where two parallel groins function as port. This port can operate only during good weather conditions.

Fishing vessels are the main users of the Kishon harbour, which is adjacent to Haifa Harbour. They also use the small fishing port in Akko, and in fact utilize of all the shore ports.

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MONOGRAPH ON JAMAICA

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Introduction: Topography and Climate

Jamaica, an island of 11,344 square kilometers, is located in the Caribbean Sea between longitude $17^o41'$ to $18^o32'$ west and latitude $76^o15'$ to $78^o22'$ north. Much of the island is made up of rugged terrain with the main mountain ranges extending east and west across the island. About 50% of the island lies 300 m above sea level.

Broad coastal plains occur on the southern side of the island, but along the north coast, they are generally narrow. These plains are comprised of alluvial deposits and in part are covered by morasses and swamps. The island has 788 km of coastline which is irregular and indentured with many bays providing sandy beaches and protected harbours.

The island shelf is very narrow along the north coast and extends for 30 km off the central south coast. There are several cays and small islands rising from the shelf. A more or less continuous fringing coral reef occurs on the edge of the shelf along the north coast but the reefs on the southern shelf tend to occur as isolated patch reefs and barrier reefs. Extensive algae and sea-grass beds occur adjacent to the reef and along the coast in shallow waters.

Jamaica has a tropical climate with annual temperatures ranging between 20°C to 33°C at low elevations where the daily temperature variation is about 15°. Temperatures are 10° to 20° cooler in the highlands. Rainfall is seasonal being highest during May - June and September - October and the major dry period is from January to March. The average annual rainfall is 196 cm but its distribution is influenced by the terrain. Thus some southern coastal areas receive less than 127 cm per year. The island is subjected to regular north-easterly trade winds throughout the year. These are modified by the Blue Mountains (highest peak is 2256 m) so that winds blow from the east southeast along the eastern south coast. Land and sea breezes alternate daily and cold northerly winds occur during the winter season.

Coastal areas: Features, Status and Problems

The relatively small size of the island imposes acute spatial constraints on its ability to increase production in the face of mounting population needs. Due to its rugged interior highlands the major impact of development and exploitation has occured in the limited coastal zones.

In this paper, coastal areas are considered as being a part of an ecosystem comprising the actual coastal land and water basin as well as the adjacent shoreland and watershed. It is recognized that water is the major link between inland and coastal areas.

Jamaica has high rainfall and the resulting water is available from surface and underground sources. Although the supply is more than sufficient for the needs of Jamaica in the forseeable future, the problem of conservation, development and distribution of water exists and the areas of greatest water demand have the least abundant supply.

(a) Wetlands

The volume of fresh water supply governs the salinity of all coastal waters, their pattern of circulation and flushing and also the amount of dissolved and suspended materials in the water.

It has been estimated that there are about 20,000 hectares of morasses and swamps in Jamaica. These areas are found on the coastal plains especially near the sea and bordering rivers. They are permanently inundated in the deeper parts and periodically flooded along the shallower fringing zones. The wetlands have been formed on river flood plains, in which case, there are essentially freshwater, or enclosed behind coastal sandpits. Depending on the degree of enclosure and separation from the sea, the water may be fresh or brackish in the upper reaches and saline adjacent to the sea. The tidal range around the island is in the order of 30.5cm and thus the tide has relatively minor influence on the salinity regime.

Wetlands have traditionally been considered as wasteland and because of their location in flat coastal areas, they have been the prime targets for reclamation for agricultural and real estate development. In many areas, especially at higher elevations, much of the original wetland has been drained in the past to allow its use for growing sugar cane. More recently, wetlands have been reclaimed for the cultivation of rice. Swamps and morasses, in general, are extremely productive and have an important function in the natural ecosystem. This is briefly summarized below:

(i) Cleanse runoff waters.
(ii) Regulation of water flow.
(iii) Convert, store and supply basic nutrients to coastal waters
(iv) Stabilize shorelines.
(v) Provide habitat for specialized aquatic vegetation, waterfowl, crocodiles and other animals.
(vi) Provide nursery areas for certain fishes and shrimps.

This function is all the more critical in the Jamaican context in view of the island's limited size and resources and there is a need to conserve and manage these vital areas.

(b) Beaches

The island is well-endowed with beaches, especially those with white and yellow sands found on the north and western coasts. 47.5% on the entire coastline is suitable for bathing, and together with an amenable climate, these provide the basic attraction for the island's tourist industry.

The beaches derive their sediments from two basic sources. These are either river sands, which supply sediments to beaches via westward littoral drift, or coral sands derived from the destruction and breakdown of coralite from the adjacent reefs. Indentations and bays in the coast provide the sites for small pocket beaches which are usually isolated by rocky limestone headlands on either side.

At present, there is no serious problem of natural erosion of Jamaican beaches outside of normal periodic or random physical processes. However, the potential for future problems exists due to the destruction of reefs by sewage disposal in their vicinity, the construction of artificial harbours and beaches, physical encroachment on the foreshore and the illicit removal of beach sands. These factors tend to alter the foreshore dynamics.

Twenty-seven beaches with changing rooms, toilets, showers and parking facilities and 101 beaches without such facilities have been secured either by ownership or lease and are managed by the relevant government agency. In addition, there are twenty-two seaside parks. The total frontage of public bathing beaches so far reserved is over 23 km. There are 11 commercial bathing beaches under private ownership which are open to the public on a fee-paying basis and most hotel beaches are similarly accessible to the public for a fee. The total frontage of commercial and hotel beaches is about 13 km.

(c) Coral Reefs and Marine Grasses

Coral reefs are recognized as being one of the most productive and diverse of natural ecosystems. Typical of the Caribbean islands, coral reefs flourish around the Jamaican coast and particulary fine examples of deep fringing reefs are found on the north coast.

These reefs afford protection to the coastline, produce sediments that form beach sands and provide the basis of the island's fishing industry which heavily exploits the near-shore reef fish communities. A small but lucrative trade on the attractive branching types of coral and conch shells has developed near the tourist centres along the north coast. The effect of this removal of coral from the reef system has not yet been evaluated but the destruction of the reef habitat is a matter of concern as is the sale of juvenile conch shells from the marine grass-beds. A ministerial order prohibiting the removal of black coral is soon to be established and two areas of coral reefs on the north coast have been designated as marine parks.

Marine grass and algal beds are found in shallow waters such as protected back-reef areas and quiet estuaries. They attract a diverse and abundant biota and form an important component of the estuarine ecosystem by supplying food for grazing animals, adding nutrients and oxygen to the water, stabilizing bottom sediments and providing nursery areas for juvenile fishes and other aquatic animals. Marine grass-beds form the feeding areas of the sea-cow or manatee, a mamalian species that is rapidly becoming extinct throughout the Caribbean.

(d) Population centres and Harbours

With a total of approximately 2 million people, Jamaica has a relatively dense population averaging 5.7 persons per square kilometer. In rural areas, the population is highly dispersed except in areas of little agricultural value. Most of the important population centres are located around the coastal harbours including Kingston, the island's capital, which has a population of 3/4 million. The island's major exports, namely bauxite, sugar and bananas are shipped from the island's fifteen active ports. A transhipment port is also being constructed as a part of the Kingston Waterfront Development Scheme.

A feature in common with most of the harbour bays is that they are adjacent to the river exits bordered by mangrove swamps. These wetlands are increasingly being disturbed by reclamation processes for real estate development; in several cases leading to flooding problems during heavy rains. Another serious problem being experienced in the coastal areas with population concentration, especially in Kingston Harbour, is that of domestic and industrial pollution causing eutrophication and destruction of the quality of the aquatic environment.

The expansion of the city of Kingston has brought about the filling of extensive areas of mangrove swamps and tideland areas with corresponding modification of the water basin structure. Major redevelopment of the Kingston waterfront has concurrently taken place involving extensive dredging and land fill and a causeway has been constructed across the entrance of Hunts Bay. The latter has affected the natural water circulation pattern between Hunts Bay and the harbour basin. Similarly, physical alterations of the waterfront are being effected in Montego Bay and Oracabessa.

Resources and uses of Coastal Areas

(a) Agriculture

Almost one-half of the land area of Jamaica is used for agriculture and pastures. The three principal types of agriculture use are plantation crops grown mainly for export, food crops for local consumption, and pasture for beef and dairy cattle also used for local consumption. The two important export crops are sugar and bananas both of which are grown in the interior valleys and on the coastal plains. Large tracts of fresh water wetland have been drained in the past for growing sugarcane and in some areas the intrusion of saline water has curtailed the reclamation of more swamplands for this purpose.

The cultivation of rice has previously been unsuccessful largely because of the high production costs and inadequate water control. More recently, however, large-scale drainage and water control projects have been initiated primarily for the construction of rice paddies.

The important concern in regard to these water control projects is the possible disruption of natural water flow patterns which will ultimately affect the wetlands lower down towards the coast. Another matter of ecological concern is the discharge of "dunda", the waste fraction resulting from the distillation of spirits, and the more general effluent produced by the cane washing process and during factory cleaning operations at sugar factories. These untreated effluents are used for irrigation purposes and are discharged into rivers and canals and ultimately carried down into coastal lagoons, swamps and the sea. In some areas of the island, the degree of pollution during the crop season is sufficient to produce massive fish kills in rivers and lagoons.

(b) Fisheries

Traditionally, Jamaica's fishery has operated at a subsistence level and is largely based on canoe fishermen and the use of fish traps set on or near coral reefs. Fish are landed at fishing beaches and the marketing of fish is largely done through vendors. 70% of the annual fish landings are derived from reefs and, in addition, seine and gill nets are used for catching small inshore pelagic species and fishes feeding over marine grass beds. Apart from the near-shore fishery, an offshore fishery operates from the nearby cays, for example, Morant and Pedro Cays and banks near to the Central American mainland. Larger vessels are used for transporting fish, caught by fishermen based on these cays, to the island. The total annual catch of fish by the local fisheries has been estimated at 10,000 metric tons. This catch is insufficient to supply the demands of the island and approximately 18,000 metric tons of fish are imported. This is largely in the form of salted fish which comprises part of the national dish of 'saltfish and ackee'.

An initial increase in the production of fish followed a mechanization scheme introduced by the Fisheries Division in 1956. Outboard engines are made available to fishermen on easy credit terms with provision of tax free gasoline at several fishing beaches. About 7,000 persons are engaged in fishing activities and this industry supports about 75,000 people.

At present, the intensity of fishing effort is reflected by the impoverishment of the reef fish fauna and the almost complete absence of the larger carnivorous species. There is difficulty in assessing the reef fish stocks for the purposes of management due to the diversity of the catch and because no species forms more than 10% of the overall catch. As a first step towards setting up the basis for proper management of the fisheries, the Fisheries Division is in process of licensing all fishermen and their craft.

The illegal use of dynamite for killing fish occurs with alarming frequency especially in and around Kingston Harbour. This practice results in the loss of limb and life, destroys the aquatic habitat and does not discriminate between adult and juvenile fishes. A large portion of the dead fish also sinks rather than floats so that there is a considerable wastage of the catch. Pollution and the reclamation of nearshore shallow waters and swamps limit their use as nursery areas thus ultimately affecting recruitment to the fishery.

(c) Aquaculture

The practic of aquaculture has not established itself in Jamaica although it offers several avenues for development, either along lines directed towards the production of cheap protein to satisfy the island's acute need or for the high priced export market. Large areas of productive coastal wetlands have the potential for the development of fish and crustacean culture.

(d) Minerals

Offshore oil exploration has been conducted on the island's southern shelf but no deposits worthy of exploitation have yet been found. Black sands containing iron and titanium exist on the north and south coasts but recent evaluations have shown that only the south coast deposits have a potential for exploitation.

(e) Tourism

Tourism is not a new industry in Jamaica but it has increased significantly since the Second World War and has grown to become the island's second largest foreign exchange earner after bauxite and alumina. About 8,366 rooms are available for accommodation and the industry provides direct employment for some 8,500 people. The important hotel and resort areas lie on the north coast and in Kingston.

Although the recent world-wide recession, particulary that affecting the United States, has curtailed the expansion phase of the industry, long-term projections indicate the need for a total of 38,000 rooms and an employment potential of 65,000 by 1990. It may however be open to question whether the full impact of this projected development on the coastal resources and the environment has been fully appreciated. Excluding the social and physical problems associated with such development, an expansion of tourism, without due consideration to the ecological implications, can have an adverse effect on coastal resources. Areas of mangrove swamp have been destroyed for the construction of hotels and resort facilities. The attendant sale of conch shells and coral has been referred to before but further damage to the reefs is caused directly through collecting by tourists. Most, if not all, hotels located on the shoreline affect secondary treatment of sewage and such treated effluents are discharged in a manner prescribed by the relevant Government agencies.

Although at present there appears to be little pollution of coastal waters by hotel sewage, the increased amounts of waste matter produced by an expanding hotel industry will at some point exceed the capacity of the coastal waters to absorb and assimilate such wastes without causing eutrophication.

(f) Roadways

The island is relatively well provided with roadways throughout. There are major roads connecting the towns along the coast but in some instances, these roads have been improperly located and designed. There are cases where roads have been built in areas where they have impeded the natural flow of water, e.g., across swamps, and have caused changes to the ecosystem.

(g) Forestry Management

A relatively high degree of soil erosion occurs in Jamaica. This may be attributed to the steep-sided hills, heavy rainfall, fast-flowing rivers, and most importantly, poor agricultural practices. Conservation methods are being adopted which include afforestation of watersheds with useful trees and improved agricultural techniques.

(h) Waste Disposal

The problem of domestic and industrial waste control in Jamaica is critical. There are presently 56 sewage treatment plants in operation and in some cases these are operating inefficiently. Many industries do not provide for any treatment of their waste and this discharge includes caustic, oil and suspended solids. These effluents are either directly released in the coastal waters or reach the coastal waters by way of rivers and canals. Their deleterious effects include the deterioration of water quality and increase turbidity which affects marine life and the waters used for recreational purposes.

Institutions and regulations pertaining to coastal area management

Some of the major environmental problems facing Jamaica relate to soil erosion, urban runoff, flooding, pollution from agricultural, domestic and industrial sources and the destruction of ecologically sensitive areas. These problems reflect poor land use practices which in turn reflect the poor general understanding of the nature of land and the sensitivities of the resources. There is need for an improved awareness of the country's natural resources and the institution of a Development Control Procedure by which the normal functions of the physical planners will be strengthened by the addition of ecological skills.

It is important that there should be proper recognition of the ecological factors that comprise the island's ecosystems and of the limitations of its resources. This especially applies to the resources of the fragile coastal areas which suffer most heavily from the demands of population pressure and development. Jamaica's coastal resources include beaches, locations of scenic and cultural interest, black sands, estuaries, wetlands, marine grass beds, coral reefs and other marine organisms.

Legislation relating to the conservation of natural resources and environmental control has largely been made on an ad hoc basis. The laws governing the process of physical planning in Jamaica are:-

(i) The Town and Country Act of 1957 - which makes provision for the "orderly and progressive development of land, cities, towns and other areas, rural or urban, to preserve and improve the amenities thereof".

(ii) The local Improvement Act of 1914 - which relates to the subdivision of land and comes under the authority of the local Parish Councils but is over-ridden by the Town and Country Planning Act.

Each of these laws is administered by a separate Government agency resulting in inefficiencies in the planning and control of proper land use. A proposal has, however, been made for centralizing the development control organization under one Ministry.

The laws relating to flood water control and the protection of watersheds are:-

(i) The Flood Control Act of 1958 - which makes "provision for the construction, improvement, repair and maintenance of works for the control of flood-water, and for other matters connected therewith".

(ii) The Watersheds Protection Act of 1963 - which provides for "the protection of watersheds and areas adjoining watersheds and by that means to promote the conservation of water".

These acts are also administered by separate Ministeries.

Several other laws presently apply to the management of the coastal environment:-

(i) The Beach Control Act of 1955 - provides for control and regulation the use of the foreshore and the floor of the sea extending to the 12 mile (19 Km) territorial limit. The foreshore is defined as the area lying between the high and low tide marks but due to the small tidal range around Jamaica, it is relatively narrow. Thus, the development of beach projects requires the acquisition of adjoining beach lands. Commercial development along the foreshore and coast requires licensing under this act. The issuing of licenses for the exclusive use of beaches by resort operators has given rise to public pressure demanding more liberal access to the foreshore.

(ii) The Wildlife Protection Act of 1945 - makes it an offence to hunt in game sanctuaries and prohibits the hunting or taking of protected animals, gamebirds during close season, turtle eggs and immature fish. It makes it illegal to kill fish with dynamite or noxious materials and to pollute waters containing fish. The act allows regulations to be made controlling fishing seasons, hunting methods, bag-limits and provides for fish stocking and the establishment and control of fish sanctuaries and hatcheries.

(iii) The Fishing Industry Act of 1975 - deals with the regulation of the fishing industry. It prohibits fishing without a license and requires that fishing boats be registered and licensed and allows for the declaration of fish sanctuaries and close seasons.

(iv) The Public Health Act of 1974 - allows regulations to be made over air, soil and water pollution and to this end an environmental control division is presently being organized by the Ministry of Health and Environmental Control.

The traditional lack of a co-ordinated approach towards the management of the island's natural resources is changing towards a recognition of the need for the integrated and co-ordinated functions of agencies involved with management of the environment. As part of the strategy for conservation of the natural resources, including coastal resources, the Government of Jamaica established the Natural Resources Conservation Authority in 1975 by amalgamating the following agencies:-

- The Beach Control Authority
- The Watersheds Protection Commission
- The Wildlife Protection Committee
- The Natural Resources Planning Unit
- The Marine Advisory Committee
- The Kingston Harbour Quality Monitoring Committee

The N.R.C.A. currently operates under:-

- The Beach Control Act
- The Wildlife Act
- The Watersheds Act and
- The Flood Control Act

Steps have been initated to revise the existing laws and to draft a single comprehensive law for the Authority.

The plan for coastal management requires evaluation of sensitivities and classification of areas of environmental concern. Also it requires the definition of guidelines for the allocation of coastal space among competing uses. Considering the small size of our nation, its need for economic development in the face of an increasing population and the fragility of its ecosystem the N.R.C.A. is committed to the management of the limited coastal resources of the country for the benefit not only of the present but also the future generations. This will be achieved by:-

- increasing the public awareness and understanding of the Island's ecological systems;
- collecting, storing and distributing data and information on the development and conservation of the Island's coastal resources;
- determining the policy guidelines to be followed and standards to be maintained in the management of the Island's coastal resources of land, water, air, flora and fauna;
- promoting and ensuring the wise use of the Nation's coastal resources by the establishment of an ecological review procedure for all relevant development proposals;
- implementing programmes for the conservation and development of all coastal areas;
- developing coordination and cooperation between various government agencies dealing with development procedures.

KENYA

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AREA UNDER DISCUSSION

For purposes of this seminar the area under discussion here is that portion of the country which falls within sixty miles inland from the coastline of Kenya; also included is Kenya's territorial waters which is twelve miles from the coastline.

COASTAL AREA CHARACTERISTICS

Kenya has a coastline (480 km in total length) which is extended roughly in a North-East/South-West direction. It extends from the Somalia border about 1°45' South of the equator to the Tanzania border about 5° South of the equator.

Off the East African coast there is little or no continental shelf; the coastline is bordered by fringing reefs on the seaward side of which there is a steep slope, so that the depth of water increases to several hundred fathoms in a very short distance offshore.

The Coastal Plain is developed on sedimentary rocks and near the Western limit of the plain a series of steps or terraces lead up to the plateaus which occupy the greater part of Kenya.

CLIMATE

Climatically the coastal region of Kenya can be said to be an area of high temperatures and moderate to high rainfall.

Mombasa, the largest town in the area, receives an average of 48 inches of rain per year. The area experiences two rainfall seasons per year: the long rains from March to June during the Southeast Monsoons and the short rains from October to November during the Northeast Monsoons. Rainfall decreases steadily along the coast from south to north and also with increasing distance from the coast towards inland.

Temperatures are high throughout the year with highest temperatures being experienced in January and February and lowest temperatures in June and July, although variations in temperature are less marked along the coast than inland. Mombasa has a mean annual temperature of 80°F (26.7°C).

RIVERS

The most important rivers flowing into the sea all year round are the Tana and Sabaki in the North coast and the Umba and Mwachi in the South coast. Other rivers which are seasonal are Mwena, Ramisi, Cha Simba, Rare, Ndzovuni and Dedori.

The Tana River in the North coast has until recently caused floods in the Tana River District which lies in the lower river basin; these floods had a profound effect on the rhythm of life in that part of region. These floods have now been controlled by the construction of two dams, Kindaruma and Gtaru, in the upper river basin. The two dams are giant hydro-electric projects for Kenya'a power needs.

ECOLOGICAL SIGNIFICANCE

Unlike most areas in Kenya there are marked factors which have made the area under discussion unique in many respects. Some of these factors are its potential for tourism and wildlife development.

TOURISM AND WILDLIFE

Tourism in Kenya has become the third principal source of foreign exchange after agriculture and manufacturing. The coast of Kenya is endowed with natural tourist attractions comparable to any in the world. These have been developed and the area now offers many international tourist facilities along the whole of its length.

The Government's major investments have been in infrastructure, including airports (Mombasa Airport is now taking international flights), road networks on new tourist circuits, water schemes at the coast and in the systems of national parks and reserves.

Many international hotels are situated in the South coast (up to about 50 mi South of Mombasa) and in the North coast, all the way up to Malindi (about 70 mi North of Mombasa). Beyond Malindi, tourist hotels are found around Lamu. They provide holiday beach resorts for individuals, small groups and package tours from overseas, and most have swimming pools, shops and some game facilities. Water sports available include scuba diving, sailing, fishing, water skiing, goggling and deep sea fishing facilities.

The scope for further development of tourist facilities in the area is wide and although there is direct participation by the Kenya Tourism Development Corporation, partnership with other bodies such as County Councils is suggested. The development strategy for the beaches should cater for both overseas and local tourists and the whole linked to the conservation needs of the marine area and forest reserves. Planning and development should not be carried out in isolation, whereby one hotel chalet or camp is built here and another there without regard to the potential of the whole run of the beach, available water supply and the beach programmes. All concerned bodies should serve as a lever to organise and develop the tourism industry to ensure maximum domestic benefits.

Tourists are attracted to Kenya principally by its wildlife. It is the Government's policy to promote the development of both terrestrial and marine wildlife to ensure maximum benefits for both local inhabitants and the nation as a whole. The natural endowment of wildlife in the area is found in the sea. Although the rest of the country is famous for its terrestrial wildlife, the coast of Kenya gets added uniqueness from the existence of marine parks.

MARINE NATIONAL PARKS

The first marine parks in tropical Africa were opened to the public in 1968 by the Kenyan Government at Casuarina in Malindi and Watamu. The two are situated roughly about 60 mi North of Mombasa. Casuarina Marine Park covers an area of 1.5 mi^2 while Watamu Marine Park is about 3.0 mi^2. Since then another marine park has been established at Shimoni about 50 mi South of Mombasa. The latter park undoubtedly forms the richest and most beautiful part of the coastal environment. The area has a wide range of all types of marine tropical flora and fauna. The area on the seaward side of Wasini, out to Kisite and beyond is made up of extensive intertidal coral flats with scattered small islands and channels. At Kisite the coral forms a fairly deep slope running from the rich intertidal flats to a sandy bottom about 20 ft below. The parks attract tourists from all parts of the world and although they registered increased frequency of visits in the recent past, local Kenya residents' frequency is low and requires promotion to enhance the educative and aesthetic value of the marine parks domestically. The opportunity of using the marine parks for studies on marine biology by institutions of higher learning shall be particularly encouraged and exploited to the maximum.

TOLERANCE TO ALTERATION

After gazettement of the marine parks all forms of fishing were banned within the boundaries, causing quite an amount of ill-feeling amongst the local fishermen.

The main cause of ill-feeling was in the park boundaries endorsed areas which are sheltered during "kusi" (the Southeast Monsoons) by the various islands around the park areas. The fishermen argued that during "kusi" they would not be able to set their nets and traps in their traditional areas and would be forced to go out into rougher seas in their small traditional canoes. With the modernization of their fishing boats and gears this resentment is slowly dying away. It is interesting to note that the Fisheries Department records have not showed any appreciable decline in the weight of fish landed at Malindi, Watamu and Shimoni since the gazettement of the parks. On the other hand the gazettement has resulted in a general increase in the density of fish in those areas and has also led to the establishment of a relatively "tame" population, thereby increasing the level of attraction of the parks to visitors, both tourists and non-tourists.

OTHER WILDLIFE ENDOWMENTS

The development of the Kilifi Creek Bird Sanctuary, the Pangani and Chasimba privateland wildlife viewing will be put in line with tourism development. The construction of a road along the Sabaki River would in this respect, strengthen the game viewing and photographic block recently started in the area.

WILDLIFE DEVELOPMENT

The most immediate constraint on national planning for land and sea use in wildlife areas is inadequate data on range potentials, wildlife and domestic stock densities and wildlife migration patterns, as well as knowledge of the optimum mixtures of wildlife and non-wildlife enterprises in specific areas. The Government has undertaken to strengthen research and acquire this information. In addition, this policy will require re-training many existing staff members and employment of others with a wider variety of skills.

TRANSPORT AND COMMUNICATION

The major constraint in transport development is caused by difficulties of integration; railroads, air and maritime transport are largely administered by agencies of the East African Community whereas highway transport is the exclusive responsibility of the Kenya Government. This generates, both at the local and national levels, problems for the systematic and rational implementation of investment and policy measures. Deliberate steps are being undertaken to promote co-ordination among the different transport modes operating both locally and throughout the country.

The skeleton of a full transport system exists already. The main population, agricultural and commercial centres are now inter-connected by all weather roads. The thrust of the efforts in future will be to provide efficient connections to smaller centres and special attention will be devoted to the all-weather access between farming and market centres.

POPULATION

The coastal region is inhabited by the Miji-Kenda ethnic groups of tribes, the Pokomos and the Swahilis who are a mixture of Arab and African stock. Because the area being discussed is a geographical zone rather than an administrative unit, figures for total population will not be given here. However, population density figures range from 2 persons to the km^2 in some parts of the North coast to 382 persons per km^2 in some rural locations in Kilifi district. The 1969 census showed that Mombasa Municipality had a population of 247,000.

The national population growth rate as of 1974 stood at 3.5%. Population pressure is indeed a critical factor in agricultural planning for some parts of the region whereas under-population is likewise a critical factor in planning infrastructure in the northern part of the region.

There has been fairly significant population migrations within this region in the recent past. The focal areas of these population changes have been: Mombasa town, the various settlement schemes such as Shimba Hills, Mtwapa settlement scheme and Lake Kenyatta settlement scheme, Malindi town, Watamu town and Kilifi town. The actual extent of these population changes cannot be easily ascertained but it is evident in the new industrial and tourist growth centres around Mombasa, Malindi and Kilifi towns, and in the expanded settlement schemes all which have attracted considerable population.

RESOURCES

The resources found in this region are water, fisheries, agriculture, forests, minerals and electricity.

WATER RESOURCES

Water is essential for the continuation of all forms of life. The provision of water of satisfactory quality in sufficient quantities consistent with the minimum needs of life and social satisfaction of the people is a prerequisite in any development programme.

With the increasing concentrations and expanding distribution of human and animal life, the continuing use of natural water supplies alone has resulted in serious shortages along the coastal region of Kenya. If this is not controlled, it will lead to the lowering of levels of service to such a degree that water-borne diseases will become prevalent. Piped water supplies at various levels of service are one of the main aims of a programme on water that the Government has undertaken.

Work on this programme started in early 1971 when consulting engineers were appointed to carry out feasibility studies and to make recommendations on the solution of the Mombasa area's water problems. Many alternative schemes were investigated and from these a final selection was made. This selection was based mainly on economic grounds although other important aspects were also given close consideration.

To speed up water development, the Ministry of Water Development has been structured to operate on a functional system basis with a broader staff base than before, and it has employed the services of consultants and contractors to carry out design, construction and supervision of development projects.

The basic development goal of the water sector is long-term in nature. Summarily, it may be defined as bringing to the entire population the benefits of a safe supply sufficient to their requirements for domestic and livestock consumption. It has been the stated intention of the Government to achieve this by the year 2,000.

There are four main basic types of benefits to be derived from investments in water development. These are higher cash incomes, more secure subsistence, improved health and increased leisure. In each of these areas the realisation of full benefits depends upon the implementation of programmes and projects in other sectors such as fisheries, agriculture, forestry, health and transportation. To these programmes and projects water development stands in complementary relationship. Although this complementary relationship is essential to the fullest realisation of benefits, it must be noted that the grossly inadequate water supply facilities in many parts of the coastal region and the whole country at large means that a significant social benefit is attached to a water supply project even where complementary programmes are not well advanced. In recognition of this fact the strategy is for water development to proceed hand in hand with programmes and projects of other sectors so that a fuller realisation of potential benefits can be achieved.

It has become an axiom in the planning of water development that the fullest range of benefits is associated with the highest quality of service. The problem in Kenya is one of compromising this axiom to the extent required to prepare a development programme whose costs are within the capacity of people and Government to support. This effort, stimulated by a desire to spread the benefits as widely as possible and conditioned by final constraints and the fact of widespread rural proverty, is the context in which Government policies for standard services and for pricing have been formulated.

FISHERIES RESOURCES

The fisheries resources off the Kenya coast can be considered in terms of both coastal and oceanic resources. Up to now only the coastal fisheries are being exploited by artisanal (and sport) fishermen using simple canoes or dhows and simple fishing gear such as "Ozio" traps, "Malema" traps, Tata traps, shark nets, local beach seines known as Juya and line fishing. The Kenya annual yield of marine fish and associated products has varied between 5,125 and 8,883 metric tons in the last five years. There is evidence to suggest that the highest figure of 8,883 metric tons may not be substantially improved by increasing the fishing pressure on the coastal stocks; and therefore, that these waters may not be suitable for capital intensive investment planning.

The coastal waters already support a large number of artisanal fishermen whose economic welfare needs not only protection but improvement. A good example that can be referred to here is Japan. While the Japanese home island is quite a rich fishing ground (Chapman, 1969), fishing on these grounds has been reserved for small-scale fishermen. All large-scale operators can only fish outside all coastal waters around the Japanese Islands (Shindo, 1972).

The East African continental shelf is very narrow so that the fish stocks in coastal waters are likewise very limited (Kenya, Tanzania, E.A.M.F.R.O. Annual Reports). Extensive areas of this narrow shelf are covered by corals which may need special methods for effective exploitation of the available fish there (Morgan, 1964; Kambona, 1974). Ordinary modern fishing methods (e.g. trawling) cannot be applied intensively.

Unlike other coastal waters (Ivory Coast, Senegal, Namibia, etc.), the East African coast is relatively poor due to the interaction of currents and monsoon regimes producing downwelling rather than upwelling of the nutrients from below the photic layer (Newell, 1959; Cushing, 1968; FAO, IOFC/DEV/71/1; FAO, IOFC/75 Inf. 12;etc)

Inshore species diversity creates problems for marketir as the populations tend to run to large numbers of many small species (Kambona, 1974) and coastal fisheries are marked by numerous species with none in sufficient quantities to support a large-scale industry (Di Palma, 1969; Cushing, 1971).

These considerations demonstrate that coastal fisheries of the Kenya Coast are not suitable for capital intensive investment so that regional (i.e., East African Community) co-operative development planning would be well aspired if initiated beyond the continental shelf.

DEEP SEA FISHERIES

In considering the possibility of exploiting the resources of the high seas off the Kenya Coast a few probably digressive but significant points must be mentione at the outset.

The long standing notion that "exploitation of the resources of the high seas would be considered later on when enough funds are available" is very unfortunate. Neither the fish nor our Indian Ocean neighbours and other international "friends" will wait.

The living resources of the high seas being open to all, developing countries adjacent to them should have an economic advantage over distant countries in utilizing them for economic development. The proximity to the fishing grounds would limit the cost of running to and from the fishing grounds, and would reduce the time when a vessel in good condition is not earning by not fishing (Chapman, 1969).

The exploitation of the resources of the high seas can and should be used as a vanguard for economic development and as a source of the much needed protein in local markets in the coastal region.

AGRICULTURAL RESOURCES

Despite migrations to the towns the majority of people in the coastal region have continued to rely on agriculture as a source of employment.

HORTICULTURAL CROPS

Coconuts, mangoes and citrus fruits are the main horticultural crops grown in the region. Other fruits grown in smaller quantities include bananas, paw-paws, guavas and pineapples. Coconuts, which have traditionally been a major crop in the area, have been much affected by the rhino beetle insect. Currently an intensive programme of rehabilitation is in progress consisting of rhino beetle eradication and control, and coconut nurseries development to provide replanting seedlings to revitalise the coconut industry.

OTHER CROPS

Other crops grown are cashew nuts, sugar cane, maize (staple diet), sisal, oil crops such as sunflower, groundnuts and castor, and cotton.

The establishment of a K£ 2.5 million cashew nut processing plant at Kilifi is one of the largest agricultural processing industries at the coast. The value of marketed cashew nuts is expected to increase from K£ 0.6 million in 1972 to K£ 1.5 million in 1978 mainly due to the expansion and improved cultural practices in cashew nut farming. The coastal strip has vast potential for further development of cashew nuts into a major agricultural industry to cope up with the demand of the cashew nut processing plant at Kilifi both now and in the future. Other agricultural processing industries are cotton ginneries in Lamu and Malindi (North coast), the copra processing factory and maize milling factories in Mombasa and sugar cane factory in Ramisi in the South coast.

VEGETABLES

Vegetable growing is mainly centred on various minor irrigation schemes along the coast. Whatever vegetables produced are all consumed locally. Vegetables grown are tomatoes, onions, brinjals, cabbages, carrots and capsicum. Efforts are being made to step up production.

The principal constraints in agriculture are knowledge, technology and credit. Development strategy in the area therefore concentrates on extension services, training, research, credit, improved supplies of farm inputs, veterinary services, and markets and co-operatives. In addition, various experimental approaches to agricultural development will be continued through a Special Rural Development Programme operating in many parts of Kenya.

FOREST RESOURCES

Before the activity of man interfered with the ecology of the coastal region, the land was covered with a natural vegetation which varied directly with the climatic and geologic influences and combined with the forage activities of wild beasts and insects. Remunants that can be identified today are: "high forest" of the wetter areas, "lowland dry forest," "lowland rain forest," and "lowland woodland."

The mangrove forests of the coast are located in estuarine tidal conditions and have for centuries supplied poles for the construction of local houses and as fuel in the form of firewood and charcoal.

Under the Coast Forest Development Programme started in 1970, a Forest and Silviculture Research Project has been in progress at the Arabuko-Sokoke forest reserve in Kilifi district. The project is conducting trials in the drier areas considered marginal for agriculture aimed at determining the most suitable tree species and management techniques for developing large commercial plantations under the coastal ecological environment. If successful, the programme will then be extended to similar vast areas in Malindi and other areas which are considered marginal in agricultural potential.

The Rural Afforestation Programme started in Kilifi district in 1974 is in progress. The basic objective of the programme is to advise farmers on the importance of maintaining an adequate forest cover on their land and assisting them in the establishment and management of the woodlots.

Whilst the Forest Department is doing all within its present capacity to improve and conserve this vital resource, attention is drawn to the need for protection of non-gazetted areas along the coast and catchment areas inland, stricter control on charcoal burning and depletion of non-protected stands of timber, and closer co-operation by County councils and other departments with the Forest Department would materially help.

MINERAL RESOURCES

The extent of mineral deposits existing in the region is not yet fully known but initial investigations indicate that significant quantities are available for mining economically. Following a geochemical research which discovered silver, lead, zinc ore deposits in Kilifi district at Kinagoni, the Kenya Mining Industry was established over the period 1970-74 to exploit these minerals at Kinagoni about 25 mi North of Mombasa. The quantitative value of these minerals is estimated to be approximately K£ 15 million. The projected value of production from Kinagoni mines during 1974-78 is given as follows:

YEAR	1974	1978	1974-78 ANNUAL GROWTH RATE%
Production in K£	1,000,000	3,000,000	31.5

The Kinagoni Mines have an employment capacity of 800 workers and a production capacity of up to 300,000 tons of ore per year.

Another large scale exploitation of minerals in the coastal area is the production of cement by the Bamburi Portland Cement Company, Ltd. within Mombasa Municipality. The raised pleistocene coral is quarried for calcium; silica is obtained from the nearby jurassic clay/shale are. Gypsum is obtained at Roka in Kilifi district

Other smaller mining enterprises include the Doni Mines at Vitengeni, mining Barytes which is used in manufacturing paint, and the Fundisa Salt Works at Gongoni north of Malindi where sea water is trapped in shallow basins and is converted into sodium chloride (salt) by solar evaporation. Under certain conditions this procress also produces gypsum.

MANUFACTURING RESOURCES

The development of manufacturing industries since independence has been based primarily on import substitution, which has been encouraged through tariff protection of consumer goods. This policy has been highly successful to date. However, the long term objective is not to be completely self-sufficient in all manufacturing, but to achieve a high degree of economic welfare.

This is done by selecting those goods which this area by its resources and skills (both actual and potential) either can produce now or will ultimately learn to produce more cheaply relative to the rest of the world. These goods will initially be produced in substitution for imports and ultimately for exports. They include chemicals, processed and tinned foodstuffs, textiles, hardware industries, etc.

ELECTRICITY (POWER)RESOURCES

The East African Power and Lighting Co., Ltd.,a public company with the Kenya Government as a majority shareholder is responsible for generating and distributing electrical power in the coastal region. The demand for electricity has been growing more rapidly than gross domestic product. Increasing production of all kinds requires more power, while electricity is continuously being introduced into regions that have not had it before.

At present the thermal generating plant at Kipevu in Mombasa is being expanded. This power station is now linked by a 132 KV power line to Kindaruma Dam on the upper Tana and the power station can be used to supplement the capacity of Kindaruma so that the coast may at times import and at other times export power to other parts of the country.

Currently one major electricity grid system extends from Mombasa to Malindi and serves various points along the coastal strip whereas Mariakani and Mazeras are served from the Nairobi-Mombasa electricity. The demand for electricity is high and in some cases critical in respect of the operation of new industries within the area. Besides the proposed Mazeras-Kaloleni grid extension it is anticipated that the electricity will be extended to Baricho water works (intake point for the Mombasa and Coastal Water Supply project) via Jilore Kakokeni, Gongoni and Bamba. The Mombasa-Malindi electricity grid system will require increasing its capacity in view of the industrial and tourist developments taking place along the north coast as a whole.

Lamu Island in the north coast is supplied by diesel generators which were installed recently. There is no other public supplier in the area.

PLANNING, CO-ORDINATION AND IMPLEMENTATION

All planning for development in Kenya begins at the listrict level under the chairmanship of the)istrict Commissioner. Each district has a committee which .s responsible for the preparation and implementation of :he district development plans. This body is known as :he District Development Committee. To fulfill its 'unctions efficiently it must meet regularly, it must be serviced with carefully prepared agenda and supporting iemoranda and it must receive regular reports of the 'ollow-up action from the District Heads of operating linistries. The minutes of the committee will constitute n effective management record of the progress of the istrict development plan. The full co-operation of all he heads of departments is essential to the committee's iccessful operation. The District Development Officer .-ordinates district planning work and the implementation : approved projects, thereby strengthening the effective-:ss of the District Development Committee. The members of this committee are:

District Commissioner - Chairman
District Development Officer - Secretary
Provincial Planning Officer
All District Heads of Department
All members of Parliament from the District
All District Officers
Chairman and Clerk to County Council
District Chairman ruling the National Park (K.A.N.U.)

The activities of the District Development Committee are co-ordinated by a Provincial Development Committee under the chairmanship of the Provincial Commissioner. The Coast Province Development Committee in this instance co-ordinates all the management and development projects in the area.

KUWAIT

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GENERAL CHARACTERISTICS OF THE ARABIAN GULF

The Arabian Gulf covers an area of 239,000 km^2 and the coastline is about 3,000 km. Kuwait lies Northwest of the Arabian Gulf and has a coastline of 140 km.

The Arabian Gulf is generally shallow, having a mean depth of 35 m, the deepest area ranging from 70-90 m around the middle of the Gulf and along the Iranian coast. The sediment in the area and the shallow area of Shatt Al-Arab is soft mud and clay brought into the Gulf by rivers and sand storms from the desert.

The bottom of the shallow southern coast is sandy, along with coral, shell and gravel, interspaced with numerous coral reefs.

The formation of the coastline of Kuwait is oolitic lime stone, slightly cemented. The coastline is mostly sand beach extended from the desert.

The coastal water of Kuwait has temperatures ranging from 15°-30°C during the year, and it is lowest in January and highest in July, according to a hydrographical survey. During January to March the salinity ranges from a low reading of 32‰ to a high 38 ‰ during July through September. The highest record of over 40‰ is also experienced during Summer. The concentration of disolved oxygen is measured at 4 to 5 cc/l throughout the year.

The air temperature at Kuwait City ranges from a mean high of 35°C in June, July and August to a low 14°C in January. A typical desert climate, the rainfall is extremely low in the months of December through February with the maximum of 80 mm or so in January. During the rest of the year there is no precipitation or it is negligible.

WATER MOVEMENT

WATER MOVEMENT IN THE ARABIAN GULF

The hydrology of the Arabian Gulf is extremely complex. The main parametres affecting the water movement in the Gulf area are the Gulf flow system, the tidal movements and wind induced currents.

1. The Gulf flow system consists of an anticlockwise flow, starting at the Strait of Hormuz, then passing up along the Iranian coast and thereafter down on the other side of the Gulf.

2. The tidal movements are irregular and oscillate offshore. The tidal currents set north on the flood and southeast on the ebb with velocities up to 1.5 m per second and less in the shallow areas.
3. Wind currents are dependent on the wind speed and the distance of travel of the wind on the water. However, waves are rarely higher than 1.5 m and these concur with the North-Northeast wind blowing along the Gulf.

The water movements in Kuwait territorial waters consist of secondary coastal tidal currents varying in direction and magnitude in the different places (0.1 m/sec to 1.0 m/sec). However in the Kuwait Bay there is a clockwise main tidal current with the flood and an anticlockwise with the ebb with a speed of 0.4 m/sec to 0.6 m/sec.

In general, sea water depths are shallow along the shoreline. The gradients of the sea bed of the western part of Kuwait Bay are more steep up to the contour line of -1.0 m and becoming more soft between the contour lines of -1.0 and -2.0 m from Ras Ajuza extending along the eastern part of the shore of Kuwait City, and up to Al She'eb, the gradients of the sea bed are more gentle. From this point and up to the Salmiya these gradients change gradually and become quite steep reaching a depth of 15 m within a distance of 200 m from the present coastline.

Basically, the geological structure of the coastal area belongs to Neogene-Pleistocenic formations, "Gatch" of consolidated marine deposited sand, gypsiferous and calcareous, yellow or pinkish.

Along the western coastal area there is a strip of pleistocenic formations of medium grained porous sandstone with varying amounts of oolitic components. These formations are exposed along the shoreline at Salmiya, due to the sea water erosion and become obvious during the ebb.

Parallel to the above formations, as well as partly on the eastern part of the coast, there is a strip of sub-recent to recent formation consisting of stratified soft calcareous shelly sandstone (coral rock). The same formations, covered with a dead body, spread North of Shuwaikh Port.

The sea bed along the shore from Shuwaikh Port to Ras Ajuza is covered with muddy sand and scattered rocks, presenting a very ugly view during the ebb. From Ras Ajuza to Al-She'eb, the sea bed is more sandy. From there on and up to Ras Al Ard in Salmiya, it becomes almost rocky.

LEVEL OF BACTERIAL POLLUTION ALONG THE SHORE OF KUWAIT

The level of bacterial pollution (Table 1), has been done by taking water samples from specific parts and indicating the numbers of coliform organisms. The number is an indication of semage pollution. The measurements on which the count exceeded 800 organisms/ml are shown

Table 1

The level of bacterial pollution along the shores of Kuwait City, 1974.

Point No.	Locality opposite	Number of samples		Percentage exceeded
1	North of Shuwaikh Port	11	9	81.8
2	Opposite Shuwaikh Port	20	9	45
3	Salam Beach	12	4	33
4	Sheraton Hotel	12	2	16.7
5	Old Port	20	4	20
6	Sief Palace	24	5	20.8
7	Amiri Hospital	20	7	35
8	Television Station	12	1	8.3
9	Immigration Dept.	12	0	0
10	Saudi Embassy	24	4	16.7
11	Abdulla Salem Sec. School	20	0	0
12	Salmiah Clinic	24	1	4.2
13	Shaikh Nasser Palace	20	3	15
14	Salmiah Beach	24	0	0
15	Beeda Circle	20	0	0
16	Kuwait Airways Club	12	0	0
17	Messeila Beach	24	1	42
18	Fintas Beach	8	0	0
19	Mangaf Abu-Halifa	12	0	0
20	Fahaheel Beach	7	0	0
21	Different Streets	36	2	5.6

as percentages of the total samples. The highest was reported in the area extending from north of Shuwaikh Port to Al-She'eb. This is expected because of sewage discharge from the populated area and the hospitals present there.

The pollution of the sea water along the coast is due to the following factors:

1. Industrial pollutants
2. Domestic sewage discharge, either treated (in the Biological Treatment Plant), or untreated
3. The normal cargo traffic to and from the Shuwaikh Port
4. Pollution from oil tankers.

The chemical properties of the water offshore are considered among the important factors for the enjoyment of the beaches. However, few measurements were done for the chemical properties of the water about 7 mi offshore the Shuaiba Industrial area (Table 2).

Table 2

Chemical analysis of water samples taken from a point 7 miles off Shuaiba Port.

Type of Analysis	Surface	Middle	Bottom
pH	8.45	8.55	8.55
Turbidity	5	5	2
NH_1 ppm	0.374	1.156	0.867
H_2S	Nil	Nil	Nil
Alkalinity (T) ppm	120	140	140
Chlorium ppm	27200	28200	32800
Nitration ppm	0.5	0.9	0.8
Hardness ppm	9300	9300	9500
Phosphate	0.08	0.12	0.22
Sulphate	2250	2125	1875
Copper	0.14	0.2	0.19
Lead	Nil	Nil	Nil
Nickel	-	-	-
Chromium	0.02	0.03	0.035
Zinc	0.02	0.02	0.03
Iron	0.04	0.04	0.04

There are two separate general drainage systems in Kuwait. One is for the collection of sewage effluent and a second one for the collection and drainage of the storm waters.

The sewage network operates through gravity collector mains and a service of pumping stations and pressure mains, transferring almost the whole of the sewage effluent into a biological sewage treatment plant. Sixty percent of the so treated effluent is discharged without prior chlorination through a storm water sewer directly into the sea at a point west of Shuwaikh Port. The balance is used for irrigation purposes.

Although there is a collection of all the sewage effluent from residential and other areas into the main sanitary sewer system, there remains a number of sewers along the coastal area discharging directly into the sea without prior treatment, and this is causing considerable pollution to the shore.

All sewage pumping stations are equipped with extra diesel generators which pump untreated sewage effluent into the nearest storm drain in cases of emergency. This also causes periodically a temporary pollution of the shores at points of discharge.

The existing storm water drainage network operates by gravity and satisfactorily serves the whole area. There are no storm water flooding problems anywhere in the city. Nevertheless there is a programme underway for the completion of the general drainage system. All the storm sewers discharge at the seashore. This is the cause of increased sea turbidity along the coastal area during intense rainfall.

The countries bordering the Arabian Gulf are rich not only in "black gold" (oil), but also in fish and shellfish, especially shrimp. Several Arabian Gulf countries have developed fishery industries with some success as an additional source of income to oil. The State of Kuwait, Saudi Arabia, Iran and Baharain provided by modern techniques and methods, have made a successful fishery development of shrimp fishing and its export.

For the State of Kuwait the fishery industry is one of economic activity, and fish and shrimp may be interpreted as the valuable, available natural resources which have been exploited despite their economical value being lower than that of oil. Fishes have been exploited for local consumption and the shrimp mainly for export. The people of Kuwait in their eating habits have depended mainly on land animals as the source of protein. These people of half a million are not fish eaters, and per capita domestic consumption of fish is estimated less than 20 kg a year, indicating this point clearly. Shrimp fishing with more than 100 shrimp trawlers, has developed technically to world standard, while other fishing activity remains at a small scale.

Fishing is practised throughout the year except during the winter season, December and January, when the wind direction is not favourable for operation and navigation.

The fishing grounds extend from local shore water to the offshore waters off the Iranian coast and Saudi Arabia depending on the types of gear employed and the species of fish sought. The catch is landed at the harbour of Kuwait City, then transferred to the market within the city. A considerable amount of catch is also landed at the market of Al-Fahaheel Town.

The shrimp trawlers operate during the year except during the months of May, June and July; and the peaks of the catch are observed twice a year, the first in February and March, and the second from September to November. Its grounds extend from Kuwaiti shore water to Qatar, southwardly, and to Iranian offshore waters eastwardly, especially around Bushire and Queshm Island. Many trawlers also leave the Gulf for shrimp fishing operations. The catch of shrimp is transferred from the trawlers to the carrier boats for freezing in offshore water, and they are not brought back to the harbour for landing. Fish caught together with shrimp are dumped into the sea, and only those species of higher value are brought back to the harbour for marketing or as subsistence for the crew.

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MONOGRAFIA DE MEXICO

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I. Características de la zona costera

La República Mexicana cuenta con 10,760 kilómetros de Litorales, de los cuales 7,939 pertenecen al Océano Pacífico e Islas, y 2,821 kilómetros a las costas del Golfo de México, Mar Caribe e Islas. La plataforma continental tiene una superficie de 500,000 kilómetros cuadrados, lugar donde se localizan los principales bancos de peces, así como yacimientos mineros y petrolíferos.

El Total de la superficie de lagunas litorales con que cuenta el país es de 1,567,300 hectáreas, de las cuales corresponden a la región costera del Pacífico 892,000 hectáreas. La región del Golfo de México cuenta con 587,200 hectáreas y la región del mar Caribe con 83,300 hectáreas.

Al crearse la zona económica exclusiva hasta 200 millas, los recursos naturales se incrementarán notablemente en una superficie marina calculadas en 2,000,400 kilómetros cuadrados (superficie ligeramente mayor a la del actual territorio nacional).

En el litoral mexicano figuran como principales entrantes: la notable brecha del Golfo de California. Como salientes de mayor consideración deben mencionarse: en Jalisco el Cabo Corrientes, en la Baja California, Punta Eugenia y el Cabo San Lucas y en Yucatán el Cabo Catoche, que marca la línea divisoria entre el Golfo de México y el Mar de las Antillas.

No obstante la uniformidad del contorno en su conjunto, los detalles del mismo presentan alguna variedad: el litoral del Golfo es bajo, plano y arenoso, con frecuentes islotes, escolleras, bancos y arrecifes; el del Mar Caribe es alto y recortado, especialmente hacia el sur; y el del Pacífico, sin dejar de mostrar en algunos lugares cierta semejanza con el del Golfo, es elevado y abrupto en la Baja California, sinuoso y escarpado desde el Colorado hasta el Cabo Corrientes y bravo y peñascoso desde este punto hasta el Suchiata, alternando la playa con el acantilado.

Las bahías y los buenos puertos son mas frecuente en el Litoral del Pacífico, pués en el Golfo abundan el cordón litoral, las albúferas, los bancos, los arrecifes y las barras, las que de preferencia se forman en las desembocaduras de los ríos.

Junto al litoral mexicano se encuentran más de 260 islas, que en su mayoría son islotes, escollos, arrecifes y bancos de arena, inútiles en su mayor parte, y que por estar esparcidas frente a las costas, constituyen un serio obstáculo para la navegación.

En cuanto al clima, las costas y las regiones bajas situadas al sur del Trópico de Cáncer, tanto en las entidades del Golfo como en las del Pacífico (Veracruz, Tabasco, Yucatán, Quintana Roo, Chiapas, Oaxaca, Guerrero, Michoacán, Colima, Jalisco y Nayarit), son de régimen térmico "caluroso regular". Las costas situadas al Norte del Trópico (Tamaulipas, Sinaloa, Sonora y el Sur de Baja California), son de régimen térmico, "caluroso medio", es decir, caliente con oscilaciones térmicas bastante sensibles. El noroeste de Sonora y la mayor parte de la Baja California, son de régimen "extremoso".

Por las condiciones de su latitud, el territorio mexicano se encuentra influído por el centro de las Bajas Presiones Ecuatoriales y por el de las Altas Presiones de la latitud de 30 grados norte. Además, su situación en relación con los mares, la posición y orientación de sus relieves y su cercanía al Mar de las Antillas y al Golfo de México, lo exponen a la influencia de los centros ciclónicos y anticiclónicos, los que frecuentemente lo recorren marcando a los viendos, direcciones y rumbos distintos e imprimiendo variedad a los climas.

La humedad disminuye gradualmente de las costas a la Altiplanicie, en la que es notable la sequedad. Esta variación de la humedad originada por la altura y por la cercanía de los mares, determina diversos grados de precipitación pluvial, ocasionando en algunas regiones serias inundaciones en determinadas épocas del año.

En la mayor parte de la República domina el régimen "tropical", con lluvias de convección en verano y parte del otoño (junio, julio, agosto y septiembre) y con un largo período de tiempo seco durante el resto del año. En términos generales son más lluviosas las costas del Atlántico que las del Pacífico, pués las primeras reciben la infuencia directa del alisio, cuya dirección es perpendicular a las cordilleras que borden el Golfo.

De acuerdo con la latitud y los climas, la República Mexicana comprende zonas de selva, de sabana, de estepa, también varia de acuerdo con la zona, predominan los suelos de calcificaciones: de regiones subhúmedas, de regiones áridas, así como también regiones de escasa humedad y regiones en condiciones hidrológicas locales que les dan características de pántanos.

La población se acumula en las mesetas o valles centrales y se hace más y más escasa en las estepas y desiertos del norte y en las costas. Estas, a pesar de su fertilidad, por ser regiones calurosas, húmedad y malsanas se ven abandonadas por el hombre, que prefiere las zonas templadas y frías del interior. En términos generales, la densidad de población es mayor en las mesetas que en las costas. En México no existe el problema de escasez de espacio en las costas, existe una escasez de recursos humanos.

II. Recursos y usos de la zona costera

La zona costera mexicana es propicia para el cultivo de cereales, productos alimenticios, textiles, estimulantes. Asimismo, México cuenta en sus costas con numerosas salinas de las que se extrae la sal marina o cloruro de sodio. En cuanto a energéticos, la zona general de producción petrolera y sus derivados, se encuentra en las proximidades del Golfo de México. En el sureste de la República, con excepción de Yucatán, y en las fajas costeras, desde Sonora y Tamaulipas hacia el sur, abundan las maderas finas. En las costas de México los recursos pesqueros son de una riqueza muy considerable. La pesca proporciona variados productos que se consumen en los mismos lugares en que se obtienen o se expenden en algunos mercados del interior. La explotación de minerales se realiza principalmente en el interior de la República, sin embargo, hay algunas zonas costeras aún inexplotadas, principalmente en la Península de Baja California. Se han localizado nódulos de magnesio, que encontrándose aún sin explotar, en un futuro muy próximo permitirán extraer de ellos cobre y níquel.

Los cereales, especialmente el arroz, encuentra las mejores condiciones para su desarrollo en casi todas las zonas costeras, lo que explica por las condiciones del clima y por las características del suelo.

Entre otros productos alimenticios que se producen en las costas tropicales del país, figura la caña de azúcar que es una fuente de riqueza agrícola directamente relacionada con la fabricación de azúcar y alcohol. El cacao, desarrollado bajo condiciones climáticas favorables, es de gran importancia en la fabricación de chocolates.

En cuanto a frutos, el plátano se produce en regiones de clima subecuatorial o tropical, principalmente en las costas de Veracruz, Chiapas, Tabasco, Oaxaca, Jalisco y Nayarit.

En la economía mexicana, los textiles como el algodón y el henequén son de considerable importancia, ambos se producen en algunas regiones de las costas.

México es muy rico en productos estimulantes, que abundan en las costas tropicales, algunos de los cuales desempeñan importantísimo papel en la economía general del mundo, por haberse extendido su uso a todos los países del mundo. Entre estos productos destacan principalmente el café y el tabaco.

Los hallazgos petroleros en los Estados de Chiapas y Tabasco y el reciente descubrimiento de otras áreas potencialmente productoras de petróleo en los Estados de Veracruz, Tamaulipas y la Plataforma Continental de Campeche, hacen pensar en una adecuada disponibilidad de hidrocarburos para un futuro inmediato.

El volumen de la explotación pesquera nacional ha venido aumentando consistentemente en los últimos años, llegando a 392,942 toneladas en 1974. La población dedicada a las actividades pesqueras en México representan aproximadamente el 0.4% de la población económicamente activa.

La pesquería que ha tenido un mayor desarrollo ha sido la del camarón, debido básicamente a la aceptación de este producto en el mercado norteamericano. Esta actividad ha absorbido, durante muchos años, capital y recursos humanos que podrían haberse empleado en otras pesquerías.

En lo que se refiere a otras especies, su baja productividad y su subexplotación se debe a la falta de autonomía de las embarcaciones y al hecho de que muchas de ellas no han sido construídas específicamente para la pesca de una especie en particular. La incorrecta localización y falta de estrategia en la operación de la flota afecta también a las instalaciones fijas en tierra, tanto industriales como portuarias. La capacidad ociosa de las instalaciones industriales obedece, entre otras cosas, a la falta de planeación.

Las instalaciones industriales, las cuales se dedican principalmente a la refrigeración, el enlatado y el secado de los productos del mar, operan generalmente con tecnología atrasada, lo que lleva a señalar la necesidad de combinar estas técnicas con otras más productivas.

En lo que se refiere a comunicaciones, el litoral del Golfo de México es poco favorable para las comunicaciones por mar, pués es bajo y arenoso, carece de buenos puertos naturales y, origina gastos muy considerables para el acondicionamiento de los puertos artificiales; y aunque se ha tratado de establecer los puertos en las desembocaduras de los ríos, como éstas son también bastante arenosas, requieren el constante dragado. Además, los nortes que frecuentemente soplan en esta región son otros factores desventajosos para las comunicaciones marítimas. Solo la vecindad de los Estados Unidos, la mayor población de la zona del Golfo y la presencia de la industria petrolera, han favorecido el tráfico marítimo en las costas del Golfo.

En el Pacífico, no obstante sus buenos puertos y las bahías naturales con que cuenta, y a pesar de que la extensión de su litoral es tres veces mayor que la del litoral del Atlántico, el tráfico marítimo se reduce casi a la mitad. Influyen en ello tanto la dificultad de comunicaciones con el interior, a causa de la posición de las elevadas Sierras Madres, como la menor corriente comercial con los países asiáticos y la apertura del Canal de Panamá.

Como puertos de primera importancia en el Atlántico figuran: Veracruz (puerto marítimo en que se realiza el mayor movimiento de pasaje internacional y entrada a la Ciudad de México); Tampico, Túxpan, Coatzacoalcos y Puerto Lobos (centro de exportación petrolera); Progreso (puerto marítimo que sirve de entrada a la Ciudad de Mérida y que a la vez es el centro del comercio del henequén) y Frontera (puerto fluvial de gran importancia en la exportación platanera). En el Pacífico: Guaymas, Mazatlán, Manzanillo, Acapulco y Salina Cruz, son los puertos en que se concentran el movimiento comercial y las comunicaciones marítimas. Todos estos puertos se encuentran comunicados con el interior del país, por medio de carreteras y algunos de ellos por ferrocarril.

México no cuenta con un sistema fluvial que, por su situación, su conveniente distribución y el volumen del caudal de sus aguas, fuera la base de una inmensa red de comunicaciones entre diversas zonas del territorio, como sucede en otros países. Los ríos del país son todos de escaso caudal, de pequeñas proporciones, de corta extensión y de fuerte pendiente; recurren de las sierras hacia el mar o hacia el interior sin que constituyan un eslabón de comunicación entre la parte central y las regiones litorales; y casi todos son navegables cerca de su desembocadura o en pequeños tramos de su curso medio.

En lo que se refiere a turismo, se ha tratado de eliminar los problemas que entorpecen la actividad, tales como: la falta de coordinación en las inversiones turísticas; la carencia de incentivos fiscales y monetarios; la falta de proyectos selectivos de inversión y la necesidad de una infraestructura básica. Hasta ahora, son unos cuantos los centros turísticos que han recibido gran impulso. En el Golfo de México y Mar Caribe caben destacar los siguientes: Tampico, Veracruz, Coatzacoalcos, Cancún, Isla Mujeres y Cozumel. En el litoral del Pacífico destacan: Acapulco, Zihuatanejo, Puerto Vallars, Manzanillo, Mazatlá: La Paz, Cabo San Lucas, Ensenada y Tijuana. Todos estos centros poseen una infraestructura básica, que le ha permitido atender tanto al turismo nacional como extranjero.

En todos los puertos del país, se han tomado las medidas necesarias para evitar hasta donde se pueda, la contaminación de las aguas, generalmente producida por actividades turísticas y de recreo, por combustibles en las aguas, o por desechos industriales que son arrojados al mar, por vía fluvial.

III. Marco institucional y reglamentario de la ordenación de la zona costera

En el artículo 27 de la Constitución Política de los Estados Unidos Mexicanos, se encuentran contenidas las disposiciones para el dominio de los recursos de la nación. A partir de esta Ley suprema, emanan las leyes reglamentarias que se encargan de cada uno de los diferentes aspectos, en cuanto a la administración de los recursos nacionales se refiere. Son las diferentes Secretarías de Estado, las encargadas de llevar a la práctica la ley de su competencia. Así por ejemplo, la Secretaría de Industria y Comercio y través de la Subsecretaría de Pesca, es la encargada de hacer cumplir las disposiciones en materia pesquera, para tal fin, existen leyes entre las que caben destacar: Ley Federal para el Fomento de la Pesca, Ley de Impuestos y Derechos y la Explotación Pesquera y algunas otras leyes y reglamentos relacionados con la actividad. La Secretaría del Patrimonio Nacional, es la encargada del control de los bienes de la nación. La Secretaría de Marina lleva a cabo la vigilancia de las costas. La Secretaría de Recursos Hidráulicos en lo que se refiere a acuacultura o al control de las aguas. La Secretaría de la Reforma Agraria en cuanto a la creación de Cooperativas Pesqueras Ejidales. Existen algunas otras dependencias que tienen injerencia en las zonas costeras, como para el cobro de impuestos, salud pública, educación, seguridad social, agricultura, ganadería, etc.

Por otra parte, en la mayoría de los estados litorales existen planes para el Desarrollo y la Explotación de la Fauna y la Flora en Aguas Litorales, los cuales contemplan tres aspectos básicos: construcción de obras hidráulicas; estudios ecológicos, económicos y sociales en lagunas litorales y plataforma continental adyacente; y tecnificación de la explotación de la Fauna y Flora acuática en lagunas y litorales.

El Gobierno Federal, actualmente impulsa un Programa Nacional de Ciencia y Tecnología para el Aprovechamiento de los Recursos Marinos. Entre los objetivos de este programa destacan:

1. Fomentar el desenvolvimiento de las ciencias del mar e incorporarlas dentro de una política nacional como elemen-

tos del desarrollo económico y social.

2. Elaborar un programa en el cual se logre la formación de personal docente, científico y técnico que requiere el país a todos los niveles, y el conocimiento de los mares y zona costera mexicana por el óptimo aprovechamiento de sus recursos minerales, hidrocarburos y bióticos, así como de su mejor uso con fines portuarios, turísticos, industriales, de navegación, protección de costas, etc.
3. Establecer la debida articulación, coordinación y optimización de los esfuerzos de las instituciones nacionales con el debido respeto de sus atribuciones y autonomía.
4. Promover el fortalecimiento o creación de los servicios de apoyo requeridos para las necesidades del programa.
5. Procurar la consolidación de la infraestructura científica y tecnología de las instituciones, promoviendo proyectos específicos de investigación y desarrollo y proporcionando fondos extraordinarios a fin de consolidarla y contribuir así al mejor conocimiento de los recursos marinos.
6. Asesorar al Ejecutivo Federal y al Consejo Nacional de Ciencia y Tecnología en lo relacionado con el mar y sus recursos.
7. Proponer acciones tendientes a optimizar los aspectos de cooperación internacional que competen al mar y sus recursos.

MOROCCO

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INTRODUCTION

La mise en valeur des ressources régionales pourrait constituer un atout inestimable non seulement pour parer au désiquilibre économique géographique d'un pays comme le Maroc où il existe des régions riches et des régions pauvres mais permettrait aussi un développement global et harmonieux tenant compte à la fois de l'économique et du social.

En effet l'évolution de la planification au Maroc a d'abord connu une étape où l'accent a été mis exclusivement sur la rentabilité des investissements. Cette étape s'est caractérisée par le renforcement des disparités économiques existantes entre les régions.

C'est pour remédier à cette distorsion structurelle que les pouvoirs publics ont édicté un certain nombre de textes instituant une nouvelle technique de la planification fondée sur la régionalisation.

L'institution en particulier du fonds du développement régional a eu pour effet de décentraliser au niveau de la région les moyens humains et materiels pour faire face aux besoins des régions les plus déshéritées afin que celles-ci prennent au même titre que les régions riches le train de développement.

Parmi ces régions ayant pris un retard certain figure la zone côtière méditerranéenne marocaine et son hinterland que l'on se propose d'étudier dans la présente monographie.

Aussi la demarche que l'on va suivre consiste dans une premiere approche, à dégager les caractéristiques de cette zone.

Dans une seconde on examinera ses ressources et leurs utilisations. Enfin dans une troisième, on traitera des cadres institutionnel et administratif pour la mise en valeur de la zone ainsi définie.

Tels sont les trois axes de reflexion autour desquels les développements suivants vont évoluer.

LES CARACTERISTIQUES DE LA Z.C.M.M.

La mise en valeur et la gestion des ressources des zones côtières s'avère une nécessité impérieuse. Cette nécessité n'est pas spécifique au Maroc. Elle est valable pour tous les pays en voie de développement riverains.

Aussi l'analyse de la question nous conduira à dégager les données à la fois physiques et humaines de la zone considerée

LES CARACTERISTIQUES PHYSIQUES DE LA ZONE COTIERE MEDITERRANEENNE MAROCAINE

Elles peuvent être envisagées à deux niveaux :
- au niveau maritime d'une part
- au niveau terrestre d'autre part.

Les caractères physiques de la partie maritime

Les caractéristiques physiques de la Méditerranée comprennent des éléments positifs et des éléments negatifs.

- En ce qui concerne les élements negatifs la méditerranée est tout d'abord une mer fermée. Elle ne communique avec l'océan Atlantique que par l'étroit Détroit de Gibraltar, ce qui explique l'hydrologie de cette mer caractérisée par ses faibles taux d'échange et la réduction de l'apport des sels nutritifs dans les couches superficielles où se forment les premiers chaînons des ressources vivantes.
- Ensuite, l'existence d'un courant profond au Détroit de Gibraltar dans le sens Méditerranée-Océan-Atlantique draine avec lui une partie des sels nutritifs des couches d'eau profondes.

Cette perte est compensée par des sels nutritifs ramenés par la masse d'eau superficielle qui passe continuellement de l'Atlantique en Méditerranée. Par consequent, la faiblesse de la teneur des eaux de la Méditerranée par rapport à celle de l'Atlantique et la concentration des ressources halieutiques le long de la côte rendent leur exploitation vulnérable aux alternations entrainées par les differents types de pollution.

Enfin, la zone côtière Méditerraneenne se caractérise par un plateau continental étroit.

Quant aux éléments positifs on peut signaler que le climat de la zone est particulièrement favorable. L'absence d'upwelling à certaines époques (février par exemple) occasionne un rechauffement des eaux cotieres. D'autre part des zones de peuplement peuvent apparaître notamment aux points de déversement par les fleuves des sels nutritifs d'origine terrigene, ce qui est particulièrement le cas de l'embouchure de Oued Laou, où l'on rencontre des chinchards.

Ceci explique que dans leur ensemble les eaux côtières sont plus riches que les eaux du large. Cette richesse permet la concentration des ressources halieutiques au-dessus de la plate-forme continentale. Ce qui entraîne une exploitation intensive des ressources.

Pourtant cette exploitation, comme on le verra ci-dessous ne se traduit que par une faible production.

La question qui se pose serait de savoir quels sont les caractères physiques de la partie terrestre de la zone considérée.

Les caractères physiques de la partie terrestre

Les conditions physiques de base de cette partie peuvent être envisagées à un triple point de vue :
- du point de vue géographique
- du point de vue relief
- du point de vue climat et pluviométrie

Situation géographique

Géographiquement cette zone se situe au nord du Maroc entre le 2ème et le 6ème meridien ou plus exactement entre le Cap Milonia et Ceuta et s'étend sur 600 km environ. Cette zone se caractérise par un arc montagneux parallèle au littoral qui va du Cap des Trois Fourches à l'est jusqu'à les centres importants de cette région peuvent être groupes en trois sous-régions :
- la région : M'diq - Martil - Oued Laou - qui relèvent territorialement de la province de Tétouan
- la région : Al Hoceima (province d'Al Hoceima)
- la région : Nador, Ras Kebdana (Province de Nador) et Saïdia (qui dépend de la province d'Oujda).

Le relief

Cette partie terrestre dela zone côtière méditerranéenne marocaine se caractérise par un relief très accidenté et inhospitalier, un défrichement abusif et une érosion intense.

Le versant Nord de cette zone se décompose un vallées et en crêtes perpendiculaires à la mer, ce qui rend l'installation des infrastructures extrêmement coûteuse.

Une route ou une voie ferrée serait une succession de ponts de tunnels de viaducs.

Le versant surd forme ce qu'on appelle la nappe refaine qui elle-même se prolonge sur la plaine du gharb par des guirlandes prérifaines.

A l'est de la chaîne rifaine, la montage finit par des plateaux qui viennent mourir dans la plaine de Trifa (plaine de la Moulouya). Au morcellement du relief correspond bien sûr une extrême variété des sols et des climats.

Le climat et pluviométrie

Le climat comme pour le reste du Maroc est de type méditerraneen; c'est-à-dire que le nombre de jours ensoleillés par an est élevé.

La pluviométrie est variable. Elle est par exemple très forte dans la région des Jbala où elle oscille entre 400/1700 m/m par an. Plus on descend vers l'est elle devient irrégulière et insuffisante pour les cultures.

Dans la région de Nador par exemple la pluviométrie moyenne annuelle varie entre 350 m/m au Nord et 100 m/m au Sud.

Les écarts de température sont également variables suivant les saisons.

Après cet aperçu, on peut conclure que cette zone est très défavorisée aussi bien sur le plan du relief que du climat. Qu'en est-il sur le plan humain? C'est ce qu'on examinera dans le paragraphe suivant.

CARACTERES HUMAINS DE LA ZONE COTIERE MEDITERRANEENNE MAROCAINE

Les caractères humains peuvent être analysés sur un plan structurel et fonctionnel.

Sur le plan structurel, la population présente les caractéristiques suivantes :

La population dans cette zone est très concentrée par rapport au reste du pays. En effet, sur une superficie représentant près de 5 % de la superficie totale du Royaume s'implante près de 10 % de la population marocaine.

Cette constatation est confirmée par la densité de la population au km² que l'on rencontre dans cette région, soit un peu plus de 85 habitants/km².

Taux largement superieur à la moyenne nationale qui est de l'ordre de 35 habitants/km².

Le tableau N° I met en relief par centre les différentes données.

TABLEAU N° I

PROVINCES	SUPERFICIE en km²		POPULATION			DENSITE AU D'HAB/km²
	Régionale	% (2)	TOTAL	U en %	R en %	
Tétouan	10.060	2,2	920.000	32,60	67,40	92
Al Hoceima	3.555	0,8	259.000	7,30	92,70	72
Nador	6.132	1,9	510.000	5,90	94,10	83
TOTAL	19.747	4,9	1.689.000	15,27	84,73	85

(1) Les chiffres sont de 1973.
(2) Colonne montrant le pourcentage de la superficie régionale par rapport à la superficie totale.
U Urbain
R Rural

Sur le plan fonctionnel la population est essentielle-concentrée dans le secteur primaire. L'analyse du tableau N°II est assez éloquente.

TABLEAU N° II

SECTEURS D'ACTIVITE	TETOUAN	AL HOCEIMA	NADOR	MOYENNE
Agriculture	75,30	86,50	74,80	78,87
Industrie	7,50	3,80	5,70	5,67
Commerce	17,20	9,70	19,50	15,46

La conclusion que l'on peut tirer après ce tour d'horizon se résume dans les points suivants :

C'est une région très peuplée, à faible taux d'urbanisation (5 % environ) dont la préoccupation principale est l'activité d'autosubsistance. Ce sont là des traits qui caractérisent l'économie fermée et à faible échange.

Dans ces conditions, une mobilisation des ressources et la fructification des richesses potentielles s'avèrent une nécessité impérieuse pour cette zone. C'est l'object de la deuxième partie de cet exposé.

RESSOURCES ET UTILISATIONS DE LA ZONE COTIERE

L'analyse de ces ressources ainsi que leur utilisation va nous amener à passer en revue d'une part les ressources naturelles et d'autre part les ressources infrastructurelles.

LES RESSOURCES NATURELLES

Elles peuvent être envisagées au double niveau maritime et terrestre.

Les ressources naturelles de la partie maritime

Ces ressources peuvent être regroupées à leur tour en deux catégories, d'une part les ressources biologiques dont l'exploitation est traditionnellement pratiquée et d'autre part les ressources potentielles dont la mise en valeur serait souhaitable.

Les ressources biologiques

On peut dire que la zone côtière renferme des espèces animales démersales, pélagiques et océaniques avec des variations dans le temps et dans l'espace. Cependant les prises des pêcheurs le long de ces côtes sont faibles et ne représentent que (13%) du total des captures au Maroc.

Ces chiffres sont fort probablement sous estimés pour deux raisons.

- D'abord par l'existence des Presides de Ceuta et Melilla qui absorbent une grande partie de la production des pêcheurs marocains et par conséquent qui échapent aux statistiques.
- Ensuite, dans certains centres de pêche (Jebha, Oued Laou...) une grande partie des prises n'est pas comptabilisée, soit parce qu'elles font l'objet de vente directe soit du fait de l'inexistence d'un service administratif approprié.

Quoique réduites en quantités, la valeur du poisson est exceptionnellement élevée dans la région. Le prix moyen du kg dans cette région est supérieur de 38 % par rapport à l'ensemble du pays. Cette constatation n'est pas propre à la côte méditerranéenne marocaine, elle est valable pour tout le bassin mediterraneen. Il est suivant la FAO* cinq fois plus élevé que celui que l'on observe dans la plupart des autres régions du monde.

Ce prix exceptionnellement élevé s'explique par les quatre facteurs suivants :

- le poisson est considéré comme aliment de base
- la fraîcheur du poisson due aux courtes marées des bateaux
- l'existence de certaines espèces très recherchées (langoustine, mérou, mulet...)
- le grand développement du tourisme ne fait que renforcer cette tendance.

En tenant compte de cette valeur marchande, un accroissement de la production ne serait que très bénéfique pour le développement de la région.

<u>Les ressources potentielles</u>

Parmi les ressources potentielles on peut citer l'aquaculture et les ressources minérales.

L'aquaculture est une activité historiquement très ancienne dans les côtes méditerranéennes. La côte marocaine offre des conditions favorables pour l'implantation et l'expansion de cette activité, et notamment dans la MAR-CHICA qui a une superficie de 114 km^2. Cependant plusieurs entraves existent parmi lesquelles on peut citer l'incompatibilité de cette activité avec d'une part le développement de l'urbanisme et des industries côtières et d'autre part le risque de conflits sociaux du fait que les riverains exercent une activité séculaire dans cette mer.

L'aquaculture ne constitue donc qu'un type d'utilisations parmi tant d'autres des eaux côtières. Beaucoup de ces types d'utilisations sont antagonistes et de plus en plus intensifs.

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* Conseil général des pêches pour la méditerranée n° 54, 1974 - p. 33, para. 3.

Quant aux ressources minérales maritimes, si elles sont considérables ailleurs - 1/5 de la production du pétrole en 1973 provient de la production off-shore ; 30% de la production japonaise du charbon et une grande partie de la production française du ciment sont d'origine maritime - la zone côtière marocaine concernée ne fait jusqu'à présent l'objet d'aucune exploitation minière.

La partie terrestre

On peut distinguer deux types de ressources :
- les ressources naturelles traditionnelles
- les ressources de type moderne.

Les ressources naturelles traditionnelles

Il convient d'abord d'envisager ces ressources avant d'examiner les problèmes sur lesquels elles butent.

En ce qui concerne les ressources, on notera la prépondérance du secteur primaire. En effet le revenu principal provient de l'agriculture entendue au sens large du mot aussi bien dans la province de Tétouan que dans celles d'Al Hoceima et de Nador.

L'exploitation des ressources forestières rentre pour 26 % du revenu à Tetouan, 32 % à Al Hoceima et 22 % à Nador.

La production vivrière fournit respectivement 15 % à Tetouan, 14 % à Al Hoceima et 23 % % à Nador. Dans les trois provinces le cheptel constitue un appoint non négligeable.

La mise en valeur des potentialités agricoles bute sur un certain nombre de problèmes ce sont : le problème de la terre, le problème de l'eau et le problème forestier.

Tout d'abord cette zone se caractérise par une exigüité des terres à vocation agricole. Cette limitation est aggravée par l'érosion occasionnée par des précipitations irrégulières et brutales.

Ensuite l'irrégularité pluviométrique, on l'a déjà vue, empêche des cultures d'été surtout dans certains centres comme Nador.

Enfin l'incorporation de la forêt dans le domaine public a été un facteur de limitation des revenues des populations qui habituellement exploitaient cette forêt (charbon, pâturage...).

Qu'en est-il des ressources de type moderne?

Les ressources de type moderne

Les zone côtières ont vu se developper durant les dernières décennies une activité touristique qui est encore jeune mais qui ne cesse de prendre de plus en plus d'ampleur.

Les zones côtières marocaines offrent à cet égard un meilleur exemple. En particulier, la zone côtière méditerranéenne bénéficie d'une série de conditions favorables qui devraient lui permettre mieux que d'autres, de brûler les étapes et d'assurer un développement éminemment souhaitable.

Parmi ces conditions il y a lieu de signaler la proximité de l'Europe et un ensemble incomparable de sites et de plages attrayants et captivants qui attirent un flot de plus en plus nourri de touristes.

Les conditions d'accueil ont été assez développées dans la région. C'est ainsi qu'au terme du plan 1968-1972 la capacité hôtelière de la région a été de l'ordre de 3.399 lits repartis comme suit :

- Tetouan : 1.557
- Al Hoceima : 1.530
- Nador : 312

Il a été prévu de porter cette capacité à plus de 7.000 lits.

L'activité touristique - ou l'industrie touristique - semble être prometteuse dans la mesure où en plus de l'hôtellerie cette industrie développe des activités connexes telles que les loisirs (station de ski, peche sous-marine et la plaisance).

Il convient de noter à ce sujet que Saidia du Kiss (frontière algéro-marocaine) constitue l'une des meilleures stations balênaires de l'oriental du Royaume.

Cependant la aussi les problèmes ne manquent pas. On peut citer en premier lieu le problème infrastructurel.

C'est ce que l'on se proposera d'examiner dans le paragraphe suivant :

Les donnees infrastructurelles

Elles peuvent être examinées au double point de vue, maritime et terrestre.

Du point de vue maritime

L'infrastructure est insuffisante. On peut dire que deux ports drainent tout le trafic de la région et monopolisent même la majeur partie de l'activité de la pêche. Il s'agit des presides de Melilla et Ceuta. Le port de M'diq récement construit ne constitue qu'un abri pour les petites embarcations de pêche. Il en est de même du petit port de la lagune de la Mar-chica. Quant au port d'Al Hoceima il n'a qu'une portée locale et est loin de repondre aux besoins, puisque ses caractéristiques sont assez limitées (3 quais dont la longueur est de 500 m; la profondeur varie de 3 à 9 m).

Par ailleurs, entre Ras - Kebdana et la frontière algéro-marocaine il n'y a aucun port, ni même possibilité de port.

En revanche, l'existence de 70 ha. de la basse Moulouya irrigués par le barrage Mohamed V d'une part, et de projet siderurgique de Nador d'autre part, nécessitent la construction d'un port en eau profonde à Nador. Ce port est maintenant en train de se réaliser.

Du point de vue terrestre

On note là aussi un retard frappant caractérisé par l'absence de réseau ferroviaire et l'insuffisance du réseau routier. Ce dernier ne compte tout au plus qu'environ 760 km de route principale.

Il faut noter qu'il n'existe aucune route longeant la côte de cette zone. Par ailleurs, les communications inter-centres ne sont possibles qu'au prix de détours assez longs, ce qui explique un quasi-isolement de ces centres entre eux d'une part, et par rapport au reste du pays d'autre part.

Quant aux liaisons aériennes, assurées par la Royale Air Inter, elles sont encore embryonnaires.

D'après ce tableau, il apparait que le développement économique et social de cette région n'est possible que dans la mesure où il existe une infrastructure appropriée. Cette infrastructure est déterminante pour la mise en valeur des ressources et partant pour assurer le développement régional et lier cette région au reste du pays pour faciliter les échanges et les communications.

Le développement régional est d'ailleurs a l'ordre du jour dans la planification marocaine.

Il est perçu par les pouvoirs publics dans sa veritable dimension.

Deux questions meritent d'être posees :

- Quels sont les cadres institutionnels et administratifs prévus a cet effet pour la mise en valeur de cette zone ?
- Comment pourrait-on développer ces dispositions ?

Telles sont les deux questions auxquelles il nous faudra rechercher une réponse dans la 3 ème partie de cette étude.

CADRES INSTITUTIONNEL ET ADMINISTRATIF DE LA MISE EN VALEUR DES RESSOURCES COTIERES

La mise en valeur des ressources et leur gestion s'integrent dans la planification. Cette technique introduite au Maroc déjà par le protectorat a connu un caractère national à partir de 1960 avec le plan quadriennal 1960-1964. Cette planification a été appliquée sous sa forme classique c'est-à-dire une planification globale jusqu'en 1973. Le dernier plan quinquennal 1973-1977 applique la planification régionale.

Il reste à voir dans un premier point le cadre legislatif de cette planification régionale avant d'envisager dans un second point le cadre administratif.

<u>Le cadre legislatif</u>

La planification au Maroc a été consacrée par la constitution du 14 décembre 1962 ainsi que par celles de 1970 et de 1972.

En effet cette dernière constitution institue (titre IX, articles 90 a 93) un conseil supérieur de la Promotion Nationale et du Plan. Le dahir portant loi organique du 10 avril 1973 organise ce conseil.

Dans une première phase cette planification avait un but essentiellement matériel. Elle avait pour seule préocupation la rentabilité économique des investissements.

Dans une seconde phase la planification marocaine se fixe objectif un développement aussi bien économique que social. C'est dans ce but que le décret royal du 6 août 1968 a institué un comité interministériel pour l'aménagement du territoire.

Par la suite, le dahir du 16 juin 1971 vient compléter cet édifice en créant des régions qui constituent "un cadre d'action économique dans lequel des études seront entreprises et des programmes réalisés en vue d'un développement harmonieux et équilibré des différentes parties du Royaume".

De ce fait, ce texte est considéré comme l'élément fondamental de la politique de développement régional.

Cette nouvelle politique économique a trouvé son application dans le plan quinquennal 1973-1977. L'institution du fonds de développement régional en 1975 ne fait que renforcer cette politique.

Les textes ci-dessus indiqués ont crée un certain nombre d'organes administratifs. C;est ce qu'on verra dans le paragraphe suivant.

<u>Le cadre administratif</u>

On distingue deux types d'organes administratifs : les organes de coordination et d'administration et les organes de préparation et d'exécution.

<u>Les organes de préparation et d'exécution</u>

Ces organes sont situés au niveau de la région économique. Ils comprennent :

- Une assemblée régionale consultative
- Un secrétariat permanent
- Une délégation régionale de l'autorité gouvernementale chargée du plan et du développement regional.

<u>Les organes de coordination et d'administration</u>

Ces organes sont institués au niveau central, ils comprennent :

- Un comité interministériel pour l'aménagement du territoire
- L'autorité gouvernementale chargée du développement régional
- Un comité national du développement régional.

CONCLUSION

Depuis l'indépendance, la région considérée a été l'objet d'une attention particulière de la part des pouvoirs publics pour supprimer les disparités existantes entre cette zone et le reste du pays.

En particulier, au cours des années 60 qui coincident avec la "Décennie du Développement" decidée par l'Assemblée générale des Nations-Unies, un programme individualisé a été conçu et exécuté dans cette zone avec l'aide bilatérale (Allemagne, Belgique, Canada) et multilatérale (FAO - PAM - FSNU). Ce programme est connu sous le nom de projet DERRO (Développement Economique et rural du rif occidental). Ce projet poursuit deux objectifs principaux :

- Un premier, d'ordre socio-économique qui est d'augmenter le revenu annuel de la population.
- Un second, d'ordre bio-physique qui est de lutter contre l'érosion des sols.

Quant à la nouvelle technique de planification elle permettrait d'assurer un développement économique et social intégré sur un plan vertical étant entendu que les provinces de Tétouan, Al Hoceima et Nador sont respectivement intégrées dans les régions économiques suivantes : la région du nord-ouest, la région du centre-nord et la région orientale. Cette intégration se justifie par des motifs d'ordre géographique, économique et social.

Il faut donc attendre la fin de la période quinquennale pour mesurer l'efficacité de cette nouvelle technique de planification.

NIGERIA

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COASTAL AREA CHARACTERISTICS

The physical environment of the Nigerian coastal area features a relatively regular 800 km coastline with a few navigable bays and inlets. The continental shelf is quite narrow varying from 18 nautical miles off Lagos to about 40 nautical miles off Calabar.

The shoreline is bordered by extensive low lying swampy land varying in width from a few kilometres off Lagos to 96 km in the Niger Delta which covers 10,000 sq mi with about 230 km of shoreline.

The coastal condition of the beach off Lagos to about 100 km eastwards is sandy and features moderate to high surf. From about 130 km the beach becomes muddy due to the deposition of silt. The siltation is intensified towards the Niger Delta owing to lack of strong tidal currents; the tidal range along the coastline is small, usually about 1.5 m.

The water column appears to comprise principal water marks of the South Atlantic. The movement of the deep waters are relatively slow but very large volumes are involved. In the Bight of Benin the thermocline was found by Berrit to lie between 20 to 35 m. The upper limit of the thermocline is very strongly defined often virtually 90°. Below this level the temperature falls rapidly reaching almost 1°C per metre at times. The lower level of the thermocline in the Gulf of Guinea appears to be generally between 40 to 50 m.

The anomalous salinity situation of the Bight of Benin seems to suggest that its origin is under the influence of southern currents as oppored to the western equatorial counter currents. The distribution of surface salinity depends upon the distribution of precipitation and on the effluents from rivers - thus, the greatest dilutions occur in connection with Niger/Benue effluents. Salinity cycles around Lagos show two minima correlating with the two rainfall maxima occurring in May/June and August/September. Data becomes scanty east of Lagos and a section from Lagos to Calabar, around the Niger Delta, worked by HMNS Nigeria, showed an abrupt decline to the west of Benin River from about 34.9‰ to a minimum of 27.1 ‰. The oxygen concentration was close to the saturation values of 5.05 m/l. The phosphate contents are generally low as typical for tropical seas. From a marine ecological point of view, studies relating the distribution and ecology of marine fauna to the oceanographic regime have been in progress for a couple of years - studies on the distribution of demersal fish on the continental shelf have revealed that the thermocline and oceanographic frontal zones of approximately 14°N and 14°S form very important faunal boundaries for the demersal fish population.

The sea along Nigeria's coastline is endowed with a number of natural resources. The exploitation of these resources contribute to the vast number of human settlements all along the entire 800 km coastline. Little information can be provided on the actual numbers of coastal settlements and population. However, based on available fragmentary data and extrapolation, it is assumed that there is a 2.5% per annum growth rate in the population. The total human population along the Nigerian coastline is about 1,500,000, out of which 969,000 or approximately 65% are fishermen; most of the remaining 35% engage in farming and exploitation of coastal trees, including coconut and mangrove for food production and canoe construction.

With regards to protection, Nigeria possesses a 30 km territorial limit and is in favour of the 320 km jurisdiction zone.

RESOURCES AND USES OF THE COASTAL AREA

Nigeria's coastal area is endowed with a number of natural resources including crude oil, gas, trees (such as red mangrove and coconut) and fish.

The position occupied by the petroleum industry in the Nigerian economy is indicative of the importance of crude oil resources, and the ever increasing demand for fish and fish products clearly signify the need for greater fish and shell fish exploitation to boost production.

Nigeria's fisheries potential is found to be low. Nigeria's coastal area is for obvious oceanographic reasons not very rich in fisheries resources.

The present structure of Nigeria's coastal fisheries may be broadly divided into (a) inshore trawl fishery, (b) canoe fishery, and (c) brackish water fishery. The inshore fishery can be sub-divided into general fishing and shrimp fisheries with a modern fleet of over 40 vessels having an over-all length range of 42 ft - 75 ft. The coastal canoe/brackish water fishery constitutes the artisanal sector which is characterised among other factors by low productivity. Table 1 gives the fish production pattern per sector. The breakdown of domestic fish production figures shows that under the industrial sector, coastal production accounted for 6.4% while under the artisanal sector, coastal/brackish water efforts yielded 64% of production. Over-all coastal fish production amounted to 64.8% of total domestic fish production. This level of production is a measure of the types of fishing gear and the available technology.

Table 1

Domestic Fish Production, 1974

SOURCES	PRODUCTION (thousand metric tons)
INDUSTRIAL	
Distant water	71.4
Coastal trawlers	5.0
Shrimp	1.0
ARTISANAL	
Coastal and brackish waters	404.0
Rivers and ponds	167.5
Lake Chad	56.0
Kainji Lake	3.0
TOTAL	707.9

The data supplied by the Food and Agriculture Organization (FAO) in 1970 on artisanal fishermen indicated that 5,000 seagoing canoes, 48,000 river and lake canoes, using different kinds of gear, landed 12,500 tons of marine fish and 16,500 tons of freshwater fish, respectively. From this, it follows that 9% of the fishermen who fished from the seacoast landed 65% of the catch at a rate of 2.0 tons/year/canoe, while inland fisheries yield was 0.3 tons/year/canoe.

The need for increased domestic fish production in Nigeria has resulted in concerted efforts by implementing various fisheries development projects, aimed at aiding artisanal fishermen so as to increase their catch, to improve their boats and working conditions, and to adopt modern fishing gear and techniques. The problem of technology transfer in artisanal fisheries is also recognised. In programming the improvement of activities in this sector, caution is being taken to proceed at reasonable steps. The target for an increased coastal fish production (Table 2) has brought to attention the need for improved fisheries activities, particularly in the curtailment of spoilage, poor processing methods and inefficient handling procedures. The aim is to optimally utilize Nigeria's coastal fish stocks produced by artisanal fishermen. The efforts to increase domestic fish production and seafood supply involve the eradication of the numerous and complex economic, sociological, political and legal restraints hampering technological development and frustrating coastal fishing efforts, and also the provision of basic infrastructures at coastal fishing terminals.

Table 2

Target for coastal fish/shell production (TMT per annum)

SECTOR	1970	1975	1980	1985
Coastal trawlers	5.0	12.5	18.0	18.0
Shrimps	1.0	2.1	22.7	3.0
Coastal and brackish waters	404.0	543.0	607.0	630.0

At the present stage of fisheries development, aquaculture is mostly carried out at a subsistance level and is regarded as a part-time occupation of farmers. Brackish water aquaculture is still in its infancy, the activities being restricted mostly to surveys, experimentation and test production of fish species such as mullets (Mugilidae), Tilapia (Cichlidae) and oysters (Ostreidae). Development potential is considerable according to available information and results. Thought may be given in the near future to the development of recreational fisheries.

INSTITUTIONAL AND REGULATORY FRAMEWORK FOR COASTAL DEVELOPMENT

In order to protect Nigeria's coastal resources from over-exploitation, there are various regulations in line with the 1958 Geneva Convention on the Law of the Sea.

Formerly, Nigeria had 3 nautical miles of territorial waters and in 1967 this was extended to 12 nautical miles. By 1971, a decree was promulgated extending further Nigeria's protected waters to 30 nautical miles.

With regards to regulatory measures in preventing oil pollution, there are adequate regulations prohibiting discharge of oil into Nigerian waters and ordering the installation of equipments to prevent oil pollution. Facilities are also provided at harbours for the disposal of all residue.

The collection of statistical information at scattered settlements along the coast is being organised by the

Federal Department of Fisheries in conjunction with the Federal Office of Statistics.

To ensure the proper development of available shoreline, inter-ministerial co-ordination exists in the planning of coastal area development and usage, including port expansion to cope with the forecasted tonnage as indicated in Tables 3 and 4.

Table 3

The 1980 and 1990 tonnage forecast for the Port of Lagos (in thousand tons)

HANDLING METHODS	1980		1990	
	IMPORTS	EXPORTS	IMPORTS	EXPORTS
General cargo - conventional	1,226	481	1,568	247
General cargo - containerized	320	230	1,000	800
Dry bulk via silo	171	513	340	660
Liquid bulk via pipeline	-	168	-	405
Midstream loading	-	50	-	15
TOTAL	1,937	1,442	3,301	2,127

Table 4

The 1980 and 1990 tonnage forecast for Port-Harcourt (in thousand tons)

HANDLING METHODS	1980		1990	
	IMPORTS	EXPORTS	IMPORTS	EXPORTS
General cargo - conventional	600	366	602	85
General cargo - containerized	-	-	260	185
Dry bulk via silo	60	15	110	48
Dry bulk via grab	110	-	196	-
Liquid bulk via pipelines	-	416	-	450
TOTAL	770	797	1,168	768

MONOGRAFIA DE LA REPUBLICA DOMINICANA

Andrés Aquino Camarena
Arquitecto

Características de la Zona Costera

La República Dominicana ocupa las dos terceras partes de la isla de Santo Domingo, geograficamente insertada en el mar Caribe, cuya superficie es de 72000 km^2: 48442 km^2 que ella ocupa y 23,558 para la República de Haití. Por estas características nuestras zonas costeras son importantes, pues nuestra población se encuentra intimanente ligada al litoral.

La población urbana más dinámica y moderna se ha desarrollado en las 27 ciudades costeras del país con respectos a las 67 cuidades restantes que forman la población total (estos datos son tomados del Censo Nacional de Población y Habitación de 1970).

El área de acción de las ciudades costeras se manifiesta en 1500 km de litoral y 9000 km^2 de plataforma insular.

Ahora bién, un factor que tiene necesariamente que tomarse en cuenta por la ubicación geográfica de la isla es su clima, pues presenta una variación insignificante por pequeña: 25°C promedio durante el año, oscilando entre 18°C y 26°C. Este clima nos permite un disfrute de uno de nuestros recursos naturales durante todo el año.

La localización de 27 ciudades en la costa está determinada por el patrón de desarrollo utilizado por los españoles en la época de la conquista de América. Esta distribución urbana les proporcionaba más facilidades en la conquista de la zona mediterránea y además uno o más puertos que le comunicaran directamente con Espana.

La población urbana localizada en el litoral de la isla mantiene una alta tasa de crecimiento en comparación con las demás ciudades mediterráneas porque las absorve. La razón se explica en el fuerte flujo (existente actualmente) de interrelaciones condicionado por su red de carreteras, en vista de que por la dimensión del territorio otros medios de comunicaciones resultan antieconómicos. Prevalece, pués, una función básica que se desarrolla en la costa al igual que en la organización espacial para obtener un maximum de aprovechamiento de los recursos nacionales.

Es entonces cuando, esta actividad básica, como un complemento de ella misma, se plantéa el desarrollo dos Sector Turismo, que puede llegar a ser en nuestro medio de vital importancia por lo que la República Dominicana puede ofrecer de los recursos naturales.

Recursos y Usos de la Zona Costera

La isla de Santo Domingo, fisiograficamente se cáracteriza por ser montañosa, hecho por el cual en el idioma taino (1) se le llamó Haití, que significaba tierra alta o montanosa.

Sobre los accidientes de relieve, el profesor Felipe Parra Pagan nos dice:

El acomodamiento de los rasgos topográficos del relieve a las condiciones geológicas, tanto estructurales como tectónicas y estratigráficas, ha hecho que cioncidan en los terrenos sedimentarios que cubren la mayor parte de la superficie de la isla, las montañas con los anticlinales y los valles con los sinclinales, no presentándose ejemplos de relieve invertido de volumen semejante.(2),

Las playas de nuestro litoral tambien presentan diferentes tipos de arena por los antes señalado: cantos rodados en las zonas montañosas y arena blanca y fina en las áreas de valles.

De manera que podemos dividir los recursos principales en Terrenales y Marítimos; en el promero se destacan los recursos humanos (recuérdese que dijimos que son los más desarrollados del país), con toda su infraestructura económica básica, como consecuencia de estas actividades urbanas se desarrollan las agropecuarias complementarias de las localizaciones humanas con productos para el mercado interno y el de intercambio internacional.

Los recursos de explotación minera no se desarrollan en la costa, (salvo la extracción de la bauxita y de la sal marina ambas explotadas en su estado virgen, sin ningún tratamiento especial), sino en el interior des país.

Las costas Dominicanas han sido dedicadas en los ultimos años para el desarrollo de una infraestructura turística y con esto aprovechar las condiciones ecológicas preponderantes en nuestro medio con el fin de captar el turismo de playa que se mueve en el área des Caribe.

Con este fin se han progamado y se realizan las inversiones en infraestructura necesarias para captar los flujos turísticos hacia el área del Caribe. Ofreciéndole en forma adicional las tradiciones de nuestra Ciudad Primada de las Americas, primera Ciudad fundada en el nuevo mundo.

Un estudio realizado por la UNESCO señala 4 zonas Turísticas para la Republica Dominicana: la primera se denomina Santo Domingo y en un primer orden de prioridad partiendo del hecho de que a todo lo largo de casi un centenar de kilometros desde la capital hacia el Este de la Isla, se puede desarrollar una zona Turística bajo la gran influencia que ejerce la cercanía de la Capital, sus servicios y el patrimonio histórico que ésta ofrece.

UNESCO designa como la segunda prioridad para el desarrollo del Turismo la zona Norte en la Costa de Puerto Plata ("Costa de Ambar") reglamentada ya por Decreto Presidencial para dotarla de la infraestructura Turística necesaria.

En una tercera prioridad quedo situada una zona costera desarrollada en la parte Nor-oriental de la isla, llamada Macao, indicando que esta zona era verdaderamente excepcional y que sin lugar a dudas, entre las mejores playas del mundo. Entonces debían incluirse también las de la zona de Macao.

La cuarta zona prioritaria designada por UNESCO es la costa de Barahona en el Sur de la Isla.

Un estudio posterior realizado por EDES-MENDAR estimó adecuado cambiar el orden prioritario de dichas áreas en cuanto a las prioridades 2 y 3. Y manteniendo las prioridades 1 y 4. Arguyendo que el cambio recomendado en sus prioridades no implicaría que las zonas indicades tengan algun impedimento para que sean realizadas simultáneamente. Señalando además que es indudable que la zona de Puerto Plata, tiene mejores playas que la zona primera (Santo Domingo) y que existe en el área un mínimo de infraestructura que no existe en la zona de Macao, que es la mejor zona desde el punto de vista de recursos naturales.

Recursos Maritimos

A pesar de pertenecer a una isla, de tener una riqueza icticola comprobada y un indice tan alto de km. de litoral/ sobre km^2 = 31, es lamentable que no se hayan explotado, en forma adecuada, los recursos maritimos con que contamos, pues en estas aguas templades del Caribe el volumen del consumo del pescado en nuestra dieta diaria es muy bajo y no se tiene costumbre de su consumo. La pesca es menor de 1% en el PBI agropecuario, por lo que se encuentra marginado de la cocina dominicana. El Estado ha señalado su interés en la conservación de la productividad de los recursos del mar y lo ha manifestado con la promulgación de la Ley No. 186 del 6 de septiembre del 1967, en la cual se declara de interes nacional la conservación y mantenimiento de los bancos de Plata (Silver Bank) cuyo centro es localizado en LAT 32.5'N Long. 69°42' y el Banoo de la Navidad (Navidad Bank) cuyo centro es Lat. 20° OI'N, Long. 68° 51'W.

Existe una gran cantidad de puertos en condiciones de servicios y muchas de nuestra comunicación interna se realiza a través de estos puertos.

La pesca deportiva se ha incrementado y las competencias de pesca son de importancia internacional. Las competencias internacionales ligades al turismo, atráen una gran cantidad de pescadores, tras el Marlin y el Guatapanal, asi como la captura de Tiburón en competencias de sub-marinistas.

Por las condiciones expresadas anteriormente de tener una gran población habitando en nuesta costa, ha sido preocupación de nuestras autoridades el control de los desechos en el mar y la contaminación de los mismos, existe una presión de la ciudadania para impedir la contaminación de las aguas costeras, base de nuestro futuro desarrallo turistico. El problema que se confronta con más frecuencia es el de los barcos cargueros de petroleo que lavan sus bodegas en el canal de la Mona llegando residuos de petroleo a nuestras playas.

Marco Institucional y Reglamentación

En vista de nuestra intensión de aprovechar las costas en base al desarrollo del Turismo, se han tomado variadas medidas de control sobre las áreas costeras y muy especificamente sobre nuestros polos de Desarrollo Turistico.

El estado Dominicano ha señalado que el Desarrollo Científico del Turísmo es altamente prioritario para lograr el bienestar económico de las comunidades que cuentan con dichos recursos y en base a ésto ha tomado una serie de medidas para favorecer el desarrollo Turístico de esas áreas.

Para ello la ley No. 305 del 30 de abril de 1968 que modificó el art. 49 de la ley 4733 del 1º de agosto de 1957, para que la fajo de terreno, denominada Zona maritima que forma parte del dominio público fuera de 60 Mts. a partir de la línea de marea, y para el litoral sur esa franja se establece en 75 Mts., en sustitucion de los 20 Mts. indicados antes.

Adicional al anterior se determina una faja de 1 km. en el litoral Polo I y de 10 Kms. en el litoral Polo 2 (el Banco Central es quien ha sido designado para la creación de toda la infraestructura básica necesaria de la zona). El estado Dominicano se vió entonces en la necesidad de declarar de Utilidad Pública dichos terrenos con los fines de controlar el desarrollo de dichas áreas.

Estas áreas de Desarrollo Turístico quedan encomendadas por el Senor Presidente de la República, al Banco Central de la República Dominicana, la Dirección General de Turismo y el Secretariado Técnico de la Presidencia, para que sean planificadas y se les dote de las infraestructuras básicas de servicios.

Aspectos Humanos

Como se puede apreciar an la localización de la población de nuestro país, la programación de los aspectos humanos en general se desarrollan en la periferia del territorio a lo largo de su litoral, por lo que la programación de estas actividades deben estar ligadas al aprovechamiento de los recursos de nuestra fauna marina teniendo que programarse las actividades básicas de tierra y de apoyo en los recursos marinos, en una forma integral, de manera que permita su mejor aprovechmiento.

Notar:

1) Aborigenes que habitaban la Isla de Santo Domingo antes del descubrimiento.

2) Regionalización de la República Dominicana, plandes 23, Oficina Nacional de Planificación, 1975.

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SPAIN

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The contribution of the Government of Spain to the seminar held in Berlin (West) is based on a series of publications relating to various aspects of planning of the coastal area in Spain.

From this extensive documentation we are presenting a synthesis of two studies: firstly, Sanitation Infrastructure Plans for Tourist Areas of the Mediterranean and, secondly, the Indicative Plan for Uses of Publicly Owned Coast between Torredembarra and Cambrils.

The orientation of this study is the result of an analysis of the coastal resources, artificial as well as natural, since man can change existing resources. Likewise, he can create new resources which will permit new uses to meet demands whose foreseeable development in space and time, in turn, requires both the remodelling and possibly the creation of resources.

SANITATION INFRASTRUCTURE PLANS FOR TOURIST AREAS OF THE MEDITERRANEAN

The rapid increase in the number of tourists visiting the Spanish coast during the 1960's was particularly noticeable all along the Mediterranean shoreline.

This presented the Spanish Government with a number of immediate problems to be solved on a long-range basis. The main objective is to meet the pressing need for drinking water, sanitation and treatment of the sewage created in certain areas by crowds of tourists and holiday makers.

It is essential to prevent an undesirable degradation of the natural surroundings which are intrinsically very special and attractive. The ecological balance of the tourist areas continues to be threatened by the large concentration of people, and tensions have arisen because the tourist structure has adapted quickly to the demand whereas the available infrastructure cannot change so fast.

Hence, the emergence of the so-called Sanitation Infrastructure Plans for tourist areas, which in principle are limited to the Mediterranean and Balearic coasts, although they were extended recently to all the areas which have proved to be particularly popular among tourists.

Administratively speaking, once they have been formulated by the Ministry of Public Works, the plans are treated like extraordinary Provincial Plans which are submitted to the Government for approval by the Inter-Ministerial Commission for Provincial Plans. The subsidiary departments of the General Waterworks Directorate draw up the basic documents for the Plan in close collaboration with provincial and local authorities. The Plans have three basic aspects:

drinking water supplies, and the evaculation and treatment of sewage.

When the Plans are formulated, the first step is to draw up an inventory of requirements and of existing installations and to describe and evaluate the works needed. A comparison of the two sets of data indicate what the Plan must include.

Depending on present and foreseeable needs, the solutions vary according to the characteristics of each specific case. Plans fall into two types:

(a) Those consisting mainly of isolated solutions for each nucleus;

(b) Those consisting mainly of collective solutions serving all the nuclei of a coastal area.

The factors determining which of the two is the optimum solution include such factors as population conditions or facilities for obtaining water resources and for drainage.

The rates form the economic basis for the exploitation. They must be sufficient to cover both financial charges stemming from loans and the cost of maintaining and operating the facilities. At the same time, they should facilitate the creation of economic conditions which will enable the service to finance future expansions on its own, so that needs may be dealt with as they arise, thus obviating a recurrence of any lag between the time a need is identified and the time when it can be met.

In all there are 24 plans at the present time, 12 of which relate to the Mediterranean coast and cover the ocean from the Costa Brava to the Costa del Sol, including the Balearic Islands.

INDICATIVE PLAN FOR USES OF PUBLICLY OWNED COAST FROM TORREDEMBARRA TO CAMBRILS (TARRAGONA) INCLUSIVE

The General Directorate of Ports and Maritime Signals of the Ministry of Public Works, through the Office of Coasts and Ports of Cataluña, has requested INTESA to prepare an indicative planning study of the uses of publicly owned coast from the demarcation line separating the municipalities of Torredembarra and Creixel up to La Riera de Riudecañas separating the municipalities of Montroig and Cambrils.

The total area under study is approximately 45 km long and includes in the centre the urban area of Tarragona, its growing industrial pole and its important commercial port. It includes Salou, a well-known tourist centre in the minicipality of Vilaseca.

The stretch of coast under study is mainly used for tourism and recreation except for the port zone of Tarragona and some other less important zones. The study consists of two parts. The first is a description of the current state of the coast and the uses for which it is intended. This part covers the following subjects: description of the physical aspects of the coastline and its lithological composition, current uses of the publicly owned land, population distribution on the coastal fringe and further inland, access to the coast from public vehicular roads and promenades and an inventory of beaches. First, each of these items is examined together with a study of the dynamics of the coastline and an analysis of the current condition of that stretch with respect to the capacity of the beaches and existing installations for pleasure craft.

A distinction has been made in the population studies between the permanent population and the transient population and between the coastal population and the inland population, which has a direct impact on this stretch of coast.

In evaluating the beaches capacity and current needs, the first 10 m have been considered as the active area and the next 30 m of beach as the resting area. The remainder is the back portion of the beach not included in the above categories, which can be used only for setting up a large part of the beach facilities.

Information has been requested regarding the main ports and shipping companies in the stretch under study. The data concerning pleasure craft have been compiled with a view to using them subsequently to estimate future needs for mooring.

The second part of the Indicative Plan for Uses of Publicly Owned Coast is the master plan for future uses and needs of the coast covering the following subjects: forecasts of uses, necessary access roads to the various sectors of the coast, new promenades, new shipping facilities or extension of existing facilities, beach protection, regeneration, creation and improvement.

Throughout this second part account has been taken of the three phases of planning defined as follows:

- Immediate, which corresponds to work that should already be completed and in operation.
- Medium-term, which is set at four years, in other words, 1979 coinciding with the completion of the Fourth Development Plan.
- Long-term, which corresponds to 1985, since that year was adopted in some General Development Plans.

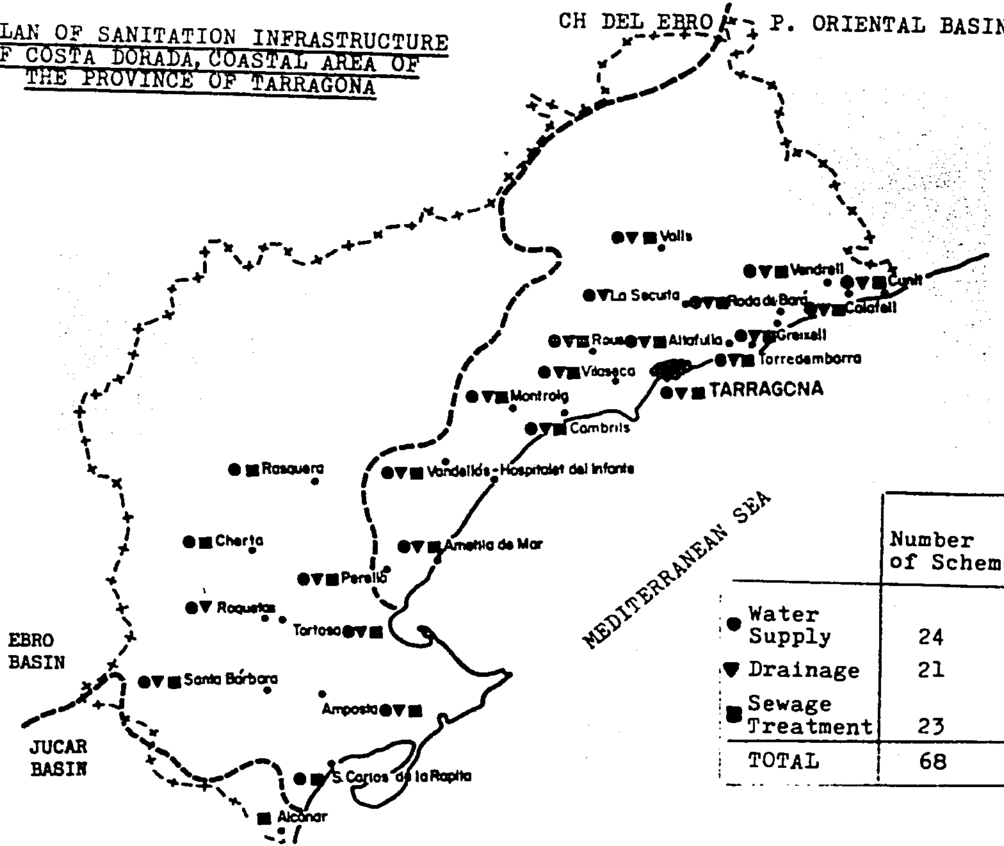
Owing to the special circumstances of the tourist sector and the lack of forecasts on which to base planning more than 10 years in advance, no later target date was adopted.

In planning future uses of the coast, an attempt has been made to observe the current uses and trends in the various sectors of the stretch of coast under study and to protect wooded areas and beauty spots.

The various uses planned for this stretch of coast are as follows:

- Tourist and recreational: this is the predominant use. In sectors already devoted to this purpose there has been no change and others currently described as having "no specific use" have been earmarked for this purpose.
- Industrial: this use is limited solely to the industrial zone situated south of the port of

PLAN OF SANITATION INFRASTRUCTURE OF COSTA DORADA, COASTAL AREA OF THE PROVINCE OF TARRAGONA



	Number of Schemes	Investments (millions of pesetas)
● Water Supply	24	419,2
▼ Drainage	21	403,7
■ Sewage Treatment	23	735,5
TOTAL	68	1.558,4

Tarragona, which is scheduled to include the beaches of Rio-Cla, La Canoja and part of the Playa de la Pineda, as far as Cape Salou.
- Port: currently, there is only one commercial port, Tarragona, a recreational port, Salou, and another fishing and recreational port, Cambrils. There are plans to expand the port of Tarragona as far as Salou; the ports of Cambrils and Salou will be kept and two further recreational ports along the coast are planned. To supplement the recreational ports, various marinas have been planned for small pleasure craft.
- Zones for free use or development: in order to encourage private initiative, several zones have been left for free use or development.
- Natural reserve: it has been deemed advisable to leave these zones in their wild state because of their beauty. A number of new access roads to the publicly owned coastal zone, 13 in all, have been planned; these, together with the existing access roads and the planned improvements, will mean that the coastal strip will be adequately served.

The data concerning the current population in the first part of this study and the forecasts in the orientation plans for the various municipalities have been used to project the permanent population the next few years. This has been done for the target year 1985 as well as for the four-year medium-term, namely, 1979. The new beaches needed have been calculated in three phases or degrees of priority: immediate needs, medium-term needs (1979) long-term needs (1985). Consideration has been given to potential beaches, in other words, areas where there is no beach as yet or where the beach is very narrow, whose natural features make it possible to create or regenerate a beach by means of new works, with or without having to bring in sand. In view of the demand for beaches in the stretch under study, the current condition of some of those beaches and the fact that it is estimated that nearly all of the remaining beaches will soon be saturated, this improvement is necessary in order to obtain better and greater utilization.

THAILAND

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COASTAL AREA CHARACTERISTICS

The coastal areas of Thailand include the Inner Gul, the Northern Outer Gulf, the Southern Outer Gulf, and the Andaman Sea, a total of 2,650 km of coastline. The sea area is about 120,000 km^2 along the coast and the continental shelf is approximately 350,000 km^2.

The marine environment is characterized by high temperature, low oxygen concentrations, great variations of salinity and high levels of dissolved and suspended materials. Productivity levels are generally high due to consistently high water temperature, abundance of sunlight and replenishment of nutrients by outwash from the land.

The bottom of the coastal areas of the Outer Gulf and of the Inner Gulf is muddy while the central parts of the Outer Gulf are mostly covered with very soft mud. However, soft corals can be found almost everywhere, except on the east side of the Outer Gulf where stony and calcareous corals are frequently found.

There are 1,393 fishing villages situated along the coast composing of approximately 38,700 fishery households. Most of those living along the coast are small-scale fishermen, having their own vessels and hiring less than two fishery employees. Nevertheless, the marine fishery production provides about 90% of the total fishery production of Thailand (Table 1). In addition, some 60,000 rais or 10,000 hectares of coastal tidal and estuarine areas in Thailand have now been developed into ponds for aquaculture of the highly valued shrimp species as well as some fin fish. The country also abounds with long areas of mangal swamps, tidal flats and estuaries that are still available and suitable for development of aquaculture and other industries. It is estimated that there are at least 150,000 hectares of such area along the 2,650 km stretch of coastline of Thailand.

RESOURCES AND USES OF THE COASTAL AREAS

BEACH AND RECREATIONAL ASPECTS

There are many beach resorts along the coastline of Thailand that have become world-famous and have thus stimulated interest in developing recreational areas along the beach. The success of Thailand's first major venture into an international beach tourist business at Pattaya, on the eastern coast, led to an appraisal of other potential areas elsewhere in the country. Many excellent

Table 1

Annual Fish Landings in Thailand, 1960-1874 (in metric tons)

Year	Marine	Inland	Total
1960	146,500	40,000	186,500
1961	233,300	49,000	282,300
1962	269,700	61,000	330,700
1963	323,700	70,500	394,200
1964	494,000	82,700	576,700
1965	529,500	83,600	613,100
1966	635,200	85,200	720,400
1967	762,200	85,300	847,500
1968	1,004,000	85,200	1,089,200
1969	1,180,000	90,400	1,270,400
1970	1,335,000	113,000	1,448,000
1971	1,470,000	117,000	1,587,000
1972	1,548,000	131,000	1,679,000
1973	1,538,000	141,000	1,679,000
1974	1,352,000	159,000	1,511,000

potentials were recognised; for example, the coastal zone south of Pattaya to the Cambodian border at Trat, the western gulf zone near Hua Hin and Songkla, and the beaches of the island of Phuket. There appears to be ample opportunities for progressive development of beach and recreational areas in Thailand.

FORESTRY

There are mangrove forests along an inundated muddy shore of the coastline. This type of forest is well-distributed along the eastern coast of the Gulf of Thailand. It also appears along the western coast of the peninsula, southward to the Thai-Malaysian border.

From the economical point of view, mangrove forest is an essential source of fuel wood and charcoal. This type of forest covers an estimated area of about 3,681 km^2 in which an area of about 1,671 km^2 is controlled by the Royal Forest Department. The annual yield of the forest in recent years has been about 757,054 m^3.

FISHERIES AND AQUACULTURE

The fishery resources in the coastal areas of Thailand may be divided into two categories, i.e., marine and brackish waters. In the first category, the Indo-Pacific mackerel (Rastrelliger spp.) is the most important pelagic fish. Other important fishes in the marine catch are the anchovies (Engraulis spp. and Stolephorus spp.) the Spanish mackerels (Scomberomorus spp.), pomfrets (Pampus sp. and Stromateus sp.), mackerel scad (Megalaspis cordyla), threadfins (Polynemus spp.), baracudas, groupers, snappers, lizard fish and flat fishes, squids, shrimp (Penaeus spp. and Metapenaeus spp.) and swimming crabs are the most abundant invertebrates in the coastal zone.

Many brackish water species are used in aquaculture forms along the coast, particularly in the Inner Gulf of Thailand. These species include: (1) finfish, such as sea bass (Lates calcalifer), milk fish (Chanos chanos) and mullet (Mugil spp.); (2) crustaceans, such as shrimp (Penaeus and Metapenaeus spp.) and mangrove crab or blue crab (Scylla scerata); and (3) molluscs, such as arkshell clam (Anadara granosa), mussel (Mytilus smaragdinus), and oyster (Crassostrea spp.). Among these, the culture of shrimps and molluscs is done extensively. The areas used for shrimp farms have been increased from 44,704 rais in 1970 to 75,576 rais in 1974, resulting in a substantial increase in shrimp production (Table 2). On the other hand, mollusc production from 1971 to 1973 declined rapidly (Table 3). Water pollution, particularly in the Inner Gulf areas was cited as one of the main causes for the decreased yield.

Fish is an important source of protein in the regular diet of the Thai people and the projected demand and supply of fish production in Thailand for the period 1973-1980 has been calculated by using the equation used by

Table 2

Shrimp farms and their production during 1970-1974

	1970	1971	1972	1973	1974
Total number	945	1,200	1,154	1,462	1,518
Areas used (rais)	44,704	59,914	56,602	71,668	75,576
Production (tons)	975	954	1,450	2,060	2,926
Shrimp	-	911	911	1,365	1,775
Fish	-	43	459	695	1,151
Value (/ 10^6 Bahts)	-	-	-	37.4	48.3
Shrimp	-	-	-	35.3	43.2
Fish	-	-	-	2.1	5.1

Decreased due to flooding.

Table 3

Mollusc production from the Inner Gulf of Thailand, 1971-1973 (In Metric Tons)

SPECIES	1971	1972	1973	1974
Oysters	2,294	941	1,100	-
Mussel	208,918	70,991	10,710	-
Arkshell Clam	10,461	2,706	3,920	-
Others	38,122	26,209	25,630	-
TOTAL	259,795	100,847	41,410	-

Russek (1971), as shown in Table 4.

Table 4

Projected demand and supply of fish production of Thailand, 1973-1980
(In Metric Tons)

Year	Estimated population (million)	Projected demand	Supply of edible fish			
			Marine	Inland	Aqua-culture	Total
1973	39.7	795,014	100,759	100,759	39,716	915,962
1974	41.0	832,254	780,000	100,000	55,128	935,128
1975	42.2	912,049	800,000	100,000	67,370	967,370
1976	43.5	954,770	800,000	150,000	80,780	1,030,780
1977	44.8	999,493	820,000	160,000	94,195	1,074,195
1978	46.3	1,046,310	850,000	170,000	107,610	1,127,610
1979	47.7	1,095,322	850,000	180,000	120,975	1,150,975
1980	49.2	1,146,555	900,000	190,000	143,240	1,233,240

It is anticipated that marine fish production for human consumption will not exceed one million metric tons in 1980, although inland fish production could be increased. It is projected that aquaculture production from inland and brackish water sources could be increased from 40,000 metric tons in 1973 to an estimated 143,240 metric tons in 1980. The estimated production includes freshwater species such as catfish (Clarias spp.), Pangasius spp., Chinese grass, silver and bighead carp, common carp, and Tilapia spp.

OFFSHORE MINERAL EXPLORATION AND EXPLOITATION

Although oil exploration in the Gulf of Thailand and in the Andaman Sea is being conducted by various oil companies and evidences of oil deposits were reported in some areas, oil exploitation is not at present being made. However, tin mining in the coastal areas, particularly in Ranong, Phanga and Phuket, has become an increasing problem. Tin mining conflicts with the mangrove industry. After an area has been mined, the land generally becomes useless and it would take a considerable long time before the land is turned to its original forest. The tin mining operations on the bottom of the coastal sea also present a serious problem on the deterioration of the benthic environment. Measures to control such operations are being discussed.

INSTITUTIONAL AND REGULATORY FRAMEWORK FOR COASTAL AREA DEVELOPMENT

At present, there is no single governmental agency which is responsible for coastal area development and management. Each "resource" is under the authority of the corresponding department. For example, the fishery resources are protected and managed by the Department of Fisheries while the Royal Forest Department takes care of the mangrove areas. Ports and shore facilities are under the jurisdiction of the Harbour and Marine Department. Only when a conflict of interests occurs does an inter-departmental co-operation come to action.

With the growing use of sea lanes for commerce and the use of coastal areas for industrial development, the threat of pollution and other deterioration of the coastal areas become more acute. Various tanker disasters such as the Santa Barbara oil well seepage, and other accidents have demonstrated the harmful effects that can arise in coastal waters and on beaches. Utilization of coastal land for industrial or community development have led to a deterioration of the ecosystems and have adversely affected the yields from the fisheries and aquaculture projects. However, knowledge on the various coastal ecosystems is still inadequate at present. Attempts have been made by the National Economic and Social Development Board (NESDB) of Thailand in 1975 to identify environmental criteria and policies for coastal zone management and to develop a detailed guideline for regulating new development in the coastal zone of Thailand. As a result, a proposal was made in which three major coastal zones, i.e., preservation, conservation and development were being considered.

Another proposal was made recently by the Harbour and Marine Department of Thailand on the establishment of a Central Pollution Control Center to co-ordinate and direct the governmental agencies, governmental enterprises and private sectors concerned in handling pollution cases, particularly oil spill. This proposal however is still in the drafting stage although it is very likely that it will be accepted by the National Environment Board in the near future.

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TOGO

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Le Togo, avec une superficie de 56.600 km^2, abritaient une population de 2 millions d'habitants en 1970 dont 12 % habitaient la zone côtière qui représente à peine le 1/10ème du territoire national.

Le pays épouse la forme d'un corridor et s'étire sur une distance d'environ 600 km entre le 6° et le 11° parallèle latitude nord avec 53 km de côte. Il est limité au nord par la Haute-Volta, à l'est par la République Populaire du Bénin, à l'ouest par le Ghana et au sud par l'Océan Atlantique.

CARACTERES PHYSIQUES ET PROBLEMES DE L'ENVIRONNEMENT COTIER TOGOLAIS

La zone côtière togolaise est formée par deux unités morphologiques bien distinctes :

- le cordon littoral d'une largeur de 2 à 3 km avec un système lagunaire et lacustre, d'une part et
- la partie méridionale du Plateau de la "terre de barre" du Continental Terminal, d'autre part. Le Plateau tombe en abrupt sur le cordon littoral.

L'ensemble est arrosé par trois cours d'eau côtière : le Zio, le Haho et le Mono de direction nord-sud formant des plaines alluviales correspondant aux dépôts fluvio-lacustres.

Le cordon littoral et lagunaire proprement dit forme une bande de largeur variable (2 à 3 km) au relief estompé entre le bord de la mer et la lagune intérieure dont fait partie le Lac Togo (450.000 m^2) situé à 32 km à l'est de Lomé, la capitale du Togo.

Le côte marin du cordon littoral est une zone de dépôts sableux alors que le côté lagunaire est formé de sols salins argileux ou stratifiés, sable sur argile ou argile sur sable.

Le cordon littoral constitue un sol à cocoteraie par excellence. Par contre, du côté lagunaire, les sols forment des pâturages naturels qui sont inondés périodiquement pendant les saisons pluvieuses.

Le zone côtière togolaise est caractérisée par une anomalie climatique qui se traduit par une sécheresse relative et la disparition de la forêt dense. Lomé ne reçoit que 841 mm d'eau par an alors que d'autres stations ouest africaines situées à la même latitude que la région côtière togolaise enregistre une moyenne pluviométrique annuelle d'environ 1.500 mm d'eau. Ceci entraîne une pénurie d'eau pour la population locale.

Il se pose actuellement dans la région côtière togolaise les problèmes majeurs ci-après :

L'EROSION DE LA COTE TOGOLAISE

La côte togolaise est actuellement soumise à une action intensive d'érosion marine à la suite de construction du port de Cotonou (Bénin) datant de plus de 10 ans et de celle du port de Lomé il y a 8 ans.

La construction de ces ouvrages artificiels ne sont pas les seuls responsables de cette érosion. Il y a d'autres facteurs naturels qui font partie de la génèse des cordons littoraux ouest africains. Il s'agit :

1. Des agents marins constructeurs tels que :

- la houle du sud-ouest dont le déferlement sur nos côtes est à l'origine de phénomène de la "barre".
- la dérive littorale qui charrie constamment vers l'Est, tout le long de la côte d'énormes quantités de sable, dérive renforcée par un courant dit de Cotonou qui serait issu du cap Saint-Paul.

2. Des envahissements brusques du littoral

Selon Marc Donnel et Stwart dans leurs études préliminaires à la construction du port de Takoradi en 1920, la cause ce ces attaques naturelles de la côte serait due a "l'existence sur l'equateur à 1300 miles à l'ouest de la Gold-Coast, d'un centre de pertubation où les tremblements de terre produiraient des vagues anormales".

C'est ainsi que par ce phénomène, le wharf de Lomé et la ville d'Accra ont éte détruits en 1911 et en juillet 1862. Les villes les plus touchées dans le Golfe du Bénin sont celles de Grand-Popo en 1921 et 1944 et celle de Kéta (Ghana). Constamment battues par les vagues, ces deux dernières villes ont périclité. La mer continue à les ronger et il ne reste pour chacune qu'un mince lambeau que lagune et mer se disputent.

3. Une petite et lente transgression marine

Certaines études sur la côte togolaise ont conclu à un rapprochement sensible de la mer. L'observation du littoral de Lomé à Cotonou le prouve. Les populations riveraines et le usagers de la route internationale Lomé-Cotonou l'ont témoigné.

Une partie de cette route est complètement décapée par la mer dans le secteur d'Agbodrafo (Porto-Seguro) où la mer avancerait de 6 m par an. Il a fallu procéder à un autre tracé de cette route. Sous l'influence de la mer, des cocotiers ont été déracinés. Certains pêcheurs sont obligés d'abandonner leurs hameaux.

Ces actions de l'érosion de la côte sont lourdes de consequences.

La superposition des photographies aériennes datent de 1961, 1965 et 1970 donne une idée précise des modifications de la côte. On assiste donc, après la construction des ports de Cotonou et de Lomé à l'ébauche d'un nouveau profil littoral. Ceci se traduit par la disparition de la belle plage sablonneuse à certains endroits faisant place à l'apparition de petits golfes. Les beaux sites touristiques du littoral se trouvent ainsi menacés.

Le dragage (prélèvement de sable) sur la côte pour la construction des maisons en dur contribue à aggraver la situation.

Jusqu'où ira cette évolution progressive de la côte togolaise. Pour l'instant aucun remède n'a encore été trouvé à ce problème d'érosion.

4. Les inondations

Elles sont fréquentes en période de saisons pluvieuses et sont dues au débordement des lagunes, du lac Togo et des embouchures des trois cours d'eaux cotiers : Zio, Haho, Mono, causant des dégâts importants aux riverains notamment les habitants des quartiers limitrophes des lagunes de Lomé et d'Aného qui heuresement sont actuellement en voie d'assainissement.

Par ailleurs, l'irruption de l'eau de mer dans celle du lac Togo a rendu cette eau salée. La desalinisation de cette eau à des fins agricoles a été prevue.

5. Le manque d'eau douce

La population du cordon littoral togolais souffre du manque d'eau douce. La nappe phréatique qui est a une faible profondeur, communique directement avec l'eau de mer rendant ainsi cette nappe d'eau complètement salée. L'eau douce n'existe que dans les nappes d'eau souterraine du Plateau du Continental Terminal mais cette eau est menacée par l'influence marine.

6. La pollution

La pollution dans la zone côtière togolaise bien qu'elle ne soit pas chronique, retient de plus en plus l'attention. Cette pollution se presente sous deux formes : d'abord au niveau de la capitale, ensuite sur tout le long du littoral de Lomé jusqu'à Aného.

Les éléments de cette pollution se presentent comme suit :

- l'existence encore à Lomé de tinettes due a l'absence d'un réseau d'assainissement adéquat et de fosses sceptiques. Ces tinettes polluent littéralement l'atmosphere urbain au moment des vidanges.
- la présence du wharf à vidange à 24 km de la route Lomé-Aného compromet l'utilisation de la plage à des fins touristiques.

- le rejet directement dans la mer des résidus de l'exploitation de l'usine phosphatière de Kpémé pollue l'eau de mer de Kpémé à Aného provoquant ainsi la mort des poissons.
- la proliferation des moustiques dans les eaux saumâtres et stagnantes des lagunes compromet gravement l'environnement social de la côte.

DONNEES DEMOGRAPHIQUES

La zone côtière togolaise est caracterisée par une forte concentration humaine. La population, essentiellement composée de trois principaux groupes ethniques : EWE, Mina, Ouatchi, vite surtout de cultures vivrières et de commerce.

Quelques chiffres tirés du recensement de la population du Togo en 1960 et 1970 suffiront pour donner une idée claire de cette concentration humaine sur la côte.

Population du Togo en :

1960 : 1,5 millions d'habitants
1970 : 2 millions d'habitants

Avec un taux d'accroissement moyen de 2,8 %, cette population aura atteint 3 millions d'habitants en 1985 par extrapolation de la période 1960-1970 et sous réserve de modifications du taux de croissance dans la période actuelle.

Population de la zone côtière

ANNEES	POPULATION URBAINE (Lomé und Aného)	POPULATION RURALE	TOTAL
1960	97.000	172.000	269.000
1970	211.000	210.000	421.000
1985	780.000	290.000	1.070.000

La part de la population de la zone côtière dans l'ensemble du Togo se présente comme suit :

1960	18 %
1970	21 %
1985	35,6 %

Il se dégage de ces quelques données démographiques que d'ici 10 ans, c'est-à-dire vers 1985, un Togolais sur trois résidera sur la zone côtière.

L'essentiel des activités : industries, administrations, commerce, service, enseignement, tourisme et des infrastructures qui sont déjà concentrées dans la région littorale seront davantage renforcées, alors que cette zone littorale ne représente que 2 % de la superficie totale du territoire togolais (56.600 km^2).

L'urbanisation rapide de la côte togolaise envahit progressivement l'espace rural et les milieux naturels si bien qu'il manque de plus en plus d'espace.

La population de Lomé qui était de 250.000 habitants en 1975 avec un taux de croissance de 9,8 %, aura triplé en 1985 (environ 750.000 habitants).

Lomé couvrait déjà en 1975, 12 km de côte ; soit : 25 % des 53 km de la côte togolaise.

Le souci du Gouvernement togolais est d'organiser au mieux la région côtière pour une meilleure distribution de la population des activités, des équipements et des infrastructures necessaires pour protéger les sites naturels en vue d'établir un meilleur équilibre entre l'espace rural et l'espace urbain.

RESSOURCES ET UTILISATIONS DE LA ZONE COTIERE

AGRICULTURE

Elle est fondée essentiellement sur la production vivrière surtout le maïs et le manioc qui constituent la base de l'alimentation de la population côtière. Les cultures maraîchères ce sont sensiblement developpées ces dernières années dans les banlieues de Lomé.

La seule culture industrielle de la zone côtière est celle de cocotiers. Les cocoteraies qui couvrent dans cette région 600 hectares, fournissent du coprah destine à l'exportation.

Cette culture qui était florissante autour des années 1935 constituait une véritable source de revenu pour les populations de la côte composées surtout de l'ethnie Mina. Aujourd'hui, une bonne partie de ces cocoteraies est ravagée par une maladie dite "maladie de kaïncopé" à laquelle on n'a trouvé aucun remède.

La pêche est importante dans la zone côtière togolaise ou est pratiquée d'une façon traditionnelle, la pêche maritime et la pêche lagunaire et lacustre par les riverains et les saisonniers venus du Ghana et du Bénin.

Les poissons abondent dans les fonds marins sablo-vaseux qui représentent, près de la côte, 50 km^2 et aussi dans les fonds vasosableux, situés un peu plus loin, et couvrant environ 150 km^2. Ces fonds marins meritent d'être protégés et utilisés rationnellement pour empêcher leur depeuplement.

Mais ces conditions naturelles ont leurs limites. Ces fonds marins susceptibles d'être utilisés par les chalutiers ne sont pas assez etendus. Le Plateau Continental est encombre de coraux à partir de 55 m de profondeur et contient peu de poissons.

La pêche lagunaire et lacustre est pratiquée par les agriculteurs pour qui elle constitue une activité d'appoint.

Tout au long du littoral, il existe des villages de pêcheurs. Leur habitat est assez original. Il est fait de branchage de cocotier.

L'INDUSTRIE

Les activités industrielles qui sont encore embryonnaires au Togo sont concentrées à Lomé et dans la zone côtière. La plus importante de ces activités est celle de la CTMB (Compagnie Togolaise des Mines du Bénin) qui exploite d'importants gisements de phosphates, l'un des plus riches du monde, situés à 32 km de la côte à hahotoe et dont les réserves sont estimées à plus de 50 millions de tonnes. La production annuelle dépasse 1 million de tonnes et est acheminée à l'exterieur par le port phosphatier de Kpémé.

Des indices de gisements de pétrôle ont été decouverts au large de Lomé. Des études sont en cours pour les confirmer.

LES INFRASTRUCTURES DE COMMUNICATIONS

Les voies de communication sont denses dans la région côtière togolaise qui se trouve de ce fait privilegiée par rapport au reste du pays.

Les réseaux de communication sont constitués par un système parallèle rail-route au départ de Lomé dont le réseau Lomé-Aného longe litteralement toute la côte.

1. Les routes

Elles sont pour la plupart bitumées et en excellent état. La route du littoral est attaquée par l'érosion marine ce qui a obligé les autorités à tracer une nouvelle route qui reprend en partie l'ancien tracé.

La densité du réseau routier dans la région côtière n'exclut pas un relatif enclavement de l'arrière-pays immédiat au cordon littoral, enclavement dû au système lagunaire et au lac Togo qui constituent de véritables obstacles de liaison entre ces deux unités morphologiques.

Le projet d'autoroute Inter-Etat Abidjan-Lagos passant au nord de Lomé est un nouvel élément structurel à prendre en compte dans l'aménagement rationnel de la côte.

2. Le chemin de fer

Les trois lignes de chemin de fer de la région qui ont été construites par l'administration coloniale allemande avant la première guerre mondiale, sont assez vétustés et méritent d'être renouvellées. La voie ferrée côtiere sera renforcée pour le transport d'engrais phosphate dans la zone portuaire de Lomé.

Dans le cadre du projet régional de la CIMAO (Ciments de l'Afrique de l'Ouest), ou prevoit la construction d'une ligne de voie ferrée à partir du parcours kilométrique 19 de la ligne du centre Lomé-Blitta jusqu'à Tabligbo en vue du transport de clinker en destination du port de Lomé.

3. Le port de Lomé

Le port de Lomé qui a été construit par les Allemands et inauguré en avril 1968, constitue l'élément principal de développement du pays. C'est un port en eau profonde autour duquel se développe actuellement une zone industrielle bloquant ainsi la croissance de Lomé vers l'est.

Le port de Lomé sera utilisé par les pays continentaux africains enclavés tels que la Haute-Volta, le Niger et le Mali pour l'écoulement de leurs produits.

Des accords à vocation de coopération regionale ont été conclus en septembre 1975 entre les gouvernements du Togo et de ces trois Etats en vue de la réalisation rapide de ce projet. La Haute-Volta a déjà réservé des terrains dans la zone portuaire de Lomé pour la construction des hangars et des entrepôts.

4. Le tourisme

Le Togo connait ces dernières années un début de développement touristique. Mais cet effort n'est réellemen senti que dans la zone du littoral qui constitue en fait le principal potentiel touristique.

Il n'existe pas actuellement de véritable politique de promotion touristique fondée sur l'aménagement systématique des sites. Au contraire, on assiste à une politique de développement d'infrastructures hôtelières destinées à assurer l'accueil des touristes étrangers.

Cependant, dans le cadre du projet d'aménagement intégré de la zone côtière togolaise du troisième Plan de développement (1976-1980), on prevoit l'aménagement des sites pittoresques du lac Togo et de la côte, notamment celui d'Aného, mais aussi des forêts sacrées de Bè, d'Asseme et de Glidji qui sont des reliques des anciennes forêts de la côte.

SCHEMA INSTITUTIONNEL ET REGLEMENTAIRE POUR LE DEVELOPPEMENT DE LA ZONE COTIERE TOGOLAISE

Il n'existe pas encore de règlements particuliers concernant l'utilisation de la zone côtière togolaise. Mais l'ordonnance n° 12 du 6 février 1974 temoigne de la volonté du Gouvernement togolais de se pencher sur l'organisation rationnelle de la zone côtière du pays.

Les articles 15 et 16 du chapitre III section I, de la dite ordonnance définissent, d'une façon générale, les domaines publics naturel ou artificiel de l'Etat et des collectivités publiques. Ces articles sont ainsi libellés :

Article 15 : Font partie du domaine public naturel : le domaine public maritime et le domaine public fluvial.

<u>Le domaine public maritime se compose</u> :

1°/ des rivages de la mer jusqu'à 100 mètres à l'interieur des terres à partir des plus haute marées.
2°/ des rives des embouchures des cours d'eau subissant l'influence de la marée jusqu'à la limite des plus hautes marées.
3°/ les lacs, étangs, lagunes dans les limite déterminées par les niveaux des plus hautes eaux avant débordement avec une zone de protection de 100 mètres de largeur à partir de ces limites sur chaque rive extérieure et sur chacun des bords des îles.

<u>Article 16</u> : Font partie du domaine public artificiel :
a) les ports maritimes, militaires ou de commerce avec dépendances nécessaires (diques, jetées, bassins, écluses, etc...) ainsi que les ports fluviaux, les canaux de navigation et leurs chemins de halage, les aqueducs exécutés dans un but d'utilité publique, ainsi que les dépendances de ces ouvrages.

Sur la base des règlements généraux sur le domaine maritime de cette ordonnance, une règlementation spécifique concernant l'utilisation de la zone côtière togolaise est en voie d'elaboration.

Au terme de cette étude, il convient de souligner que, face aux nombreux problèmes ci-dessus mentionnes, il existe actuellement une volonté politique du Gouvernement togolais visant à ces resoudre. C'est ainsi qu'a déjà été inscrit dans les programmes du troisième Plan quinquennal de développement économique et social (1976-1980), un projet d'aménagement intégré de la zone côtière togolaise.

Par ailleurs, certains problèmes côtiers peuvent être résolus dans le cadre d'une coopération régionale ou sous-régionale. C'est le cas du phénomène d'érosion marine de la côte togolaise, ghanéenne et béninoise qui peut faire l'objet d'un programme d'action commune pour ces trois pays côtiers ouest africains : Bénin, Ghana, Togo.

UNITED REPUBLIC OF TANZANIA

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INTRODUCTION

The coastline of Tanzania is approximately 800 km (500 mi) long and includes the islands of Mafia and a number of small offshore islands. Dar es Salaam, Lindi and Mtwara are natural harbours, none of which has been developed as an up-to-date fishing port. River Rufiji discharges into the sea through a complex delta system opposite Mafia Island, while the Ruvuma, Ruvu, Wami, and Pangani have important estuaries along the coast. The coast is characterised by a narrow continental shelf with a width varying from a minimum of 6 km to a maximum of 64 km at the area around Mafia Island and Zanzibar. Fishing by conventional trawling methods is difficult along a great proportion of the continental shelf because of coral formation.

The climatic conditions on the coast are influenced by the East African coastal current, which is a northerly branch of the South Equatorial current dividing off the north tip of Malagasy Republic. Hydrobiological studies indicate that the ocean water is deficient in the growth of plankton and fish species, which affects the chain of marine foods and consequently the distribution of marine resources that can be exploited.

The greater length of the coast is protected by coral formations which reduce the effect of heavy winds. Fishing villages are developed all along the coast and fish receiving facilities have been planned/installed to preserve the catch.

TOPOGRAPHY OF THE COASTLINE

In general the continental shelf is in most places narrow and characterised by coral formation. Pemba Island does not form part of the continental shelf and is separated by a deep channel 56 km wide and 800 to 1000 m deep. The coastline topography can be classified as follows

1. The inshore reefs and islands

The general coastal pattern of Tanzania is that of an elevating fringing reef. Most areas have a continuous chain of small offshore islands presumably formed by fragments of the elevated crest of a previous reef. Between the small islands and the coast are extensive Acropora sp. coral beds. This type of pattern is observed on a large scale in the main island channels of Zanzibar and Mafia

Islands. The bulk of the demersal fisheries is concentrated on these sheltered areas which essentially can be analogous to lagoons. The main outer reef face is probably little fished owing to the strong currents and the steepness of the reef face itself.

The exposed reef flat is exploited for octopus (a highly priced food item); for shells formerly eaten, now usually sold to tourists; for small oysters and clams, usually boiled, then smoked; for bêche-de-mer, exported for seaweeds similarly exported for agaragar and for bait used for other fishing operations. Stake traps are sometimes placed on sandy areas but are very often placed in estuarine and sub-estuarine conditions.

In the "Acropora" coral areas the most frequently used fishing equipment is the "dema" trap and the handline. The "dema" trap is a hexagonal basket work structure and is usually placed on smooth sandy bottoms close to coral growths. The handline is used from small boats anchored over the coral growth areas. Most "dema" trap fishermen also employ handlines and it is difficult to make a separation between catches from the two methods.

2. Sand and grass beds

Between the coral outcrops, mainly in the channel areas, are found extensive areas of sand bottom, clothed to a greater or lesser extent with turtle grass beds. The areas close to coral outcrops seem to house populations of Lethrinus sp. in great variety but most particularly Lethriums chaerorynchus. "Dema" traps set in the grass beds away from coral with weed as bait seem to catch exclusively Siganus oramin. Use of bottom longlines has been tried with moderate catches of small sharks and marine catfishes (EAMFRO Annual Report 1972). In general the areas are too broken up by coral heads to be trawable.

3. Estuarine and sub-estuarine areas

In these areas coral growth is suppressed by silt and brackish water and constitute the suitable areas for trawling on the coast. The main areas are off the Rufiji and Sabaki rivers and smaller areas off Bagamoyo, Sadani and Pangani. It could be mentioned that catches from trawling consist of 50% marketable table fish and the remainder can be converted to fishmeal or sold as "soup fish". Plans are in the pipeline to catch and process the small size species for human consumption. A substantial amount of prawns is also caught when trawling (data from MV Mwenye Busara and MV Mbudya, 1972, 1973 and 1974). Bruce (1972) reports the extension of prawn fisheries in much deeper waters than was previously suggested.

4. The submerged reefs

The submerged reefs are in a series of banks found mainly at the mouth of the Zanzibar and Mafia channels. The banks are extremely rocky and rise up from sandy bottoms. Although the submerged reefs are rich in a variety of fish species, the only suitable exploitation method is handlining. Yields are generally in the excess of

10 kg/line/hour (EAMFRO Annual Report 1972).

5. The continental slope and shelf areas below the thermocline

The deeper water areas (below 50 fathoms) are characterised by an extremely rich gorgonian coral and sponge fauna. These areas are located off south Zanzibar and Shimoni. There is a variable amount of fish species but there is no commercial means being utilized to exploit these species at the moment.

Area of the shelf fronting Tanzania on the Western Indian Ocean (from Moiseev 1969)

Area	Shelf (0-200 m)	Upper slope 200 m-1000 m
TANZANIA/KENYA	10,000 km^2	160,000 km^2

Source: The Fish Resources of the Oceans, J.A. Gulland.

COASTAL HYDROGRAPHY

1. Currents

The characteristic feature of the ocean currents in the Indian Ocean (which influence the coastal climatic conditions) is the reversal observed in the northern parts (Arabian Sea and Bay of Bengal) which is brought about by the changes in the wind system with the monsoons.

The current system in the southern Indian Ocean which washes the Tanzanian coastline is similar to those of the Pacific and Atlantic. The south equatorial current flows westwards at around 10° S dividing as it approaches the East African coast. The northwards flowing arm forms the East African coastal current which washes the coastline.

In the northern Indian Ocean, during the southwest monsoon (April-September), the Somali current flows northwards along the east coast as a swift and narrow current; and speeds as high as seven knots have been reported (Swallow, 1965). The Somali current reaches as far north as 12° N latitude. The water leaves the coast and flows an easterly direction as the monsoon current south of 10° N latitude.

The northeast monsoon (October-March) brings about considerable changes in the circulatory pattern, especially in the northern seas. The Somali current reverses direction and flows southerly from December through February.

2. Stratification (upwelling)

It may be noted that although zones of upwelling have been discovered in various locations throughout the Indian Ocean, no record is available to indicate that these are available along the Tanzanian coastline. The East African coastal current is poor in nutrients and this deficiency delimits high level of biological activity. A high standing crop of plankton is evident only in the northern part of the cold water area in the area close to Cape Guardafui.

RESOURCES OF THE TANZANIAN COAST

As mentioned elsewhere the difficult topography of the coastline limits effective exploitation of the available species by trawling. The coastal water is deficient in nutrients which delimits the quantities of plankton growth and consequently affects the chain of marine foods. The waters seem to have a large variety of species but not in sufficient concentrations to ensure that a fishing enterprise of a commercial nature can take enough fish to make a reasonable profit. Fishing is still carried out mostly in non-motorised boats with simple gear. The low yields per unit effort can be attributed to the low level of fishing effort and the use of inefficient gear typical for subsistence fishing. Tanzania's annual marine fish production is estimated at under 30,000 tons per year (1972) and is mostly confined to the immediate coastal waters. At present the fish species exploited include sadinella, seerfishes, sharks, and a variety of demersal fishes and seasonal runs of migratory pelagic fish over a wide area of the coast presents a potential for large-scale exploitation.

Plans for expanding the fishing effort are being worked out by the Tanzania Fisheries Corporation (TAFICO) in collaboration with District Development Corporations and Ujamaa fishing villages. It is realised that only marginal improvements can be achieved with the non-motorised fish craft now in use. Improved fishing boats (between 32 and 40 feet) are now being designed by the Fisheries Corporation to be used for fishing in waters on the continental shelf. Due to the absence of upwelling and the presence of a deep thermocline in the East African Coastal current (Bell, 1969), relatively unproductive waters stretch for considerable distances offshore (80 to 320 km). Beyond this belt a possibility exists for a tuna line fishery for scombroid fishes, particularly yellow fin tuna, albacare, bigeye tuna and billfish. Due to the distance from the shore to the fishing grounds and the need to preserve the catch on board the fishing vessel, larger vessels than the ones under consideration for the continental shelf, will have to be designed and constructed. A tuna fishing fleet developed on the coast would increase the fish supply to a considerable extent. Sardines are presently being exploited by light attraction in combination with purse seine and dipnet.

Table 2 Comparable data on potential demersal resources of the continental shelf of the western Indian Ocean

Region	Area Km^2	Density Kg/ha/year	Potential tons/year
South Africa E. of 30°E	140,000	25	350,000
Mozambique	120,000	25	350,000
Malagasy Republic	210,000	25	525,000
Tanzania/Kenya	10,000	10 - 20	10,000 20,000
Somalia 2°S....5°N	50,000	10 - 20	50,000 100,000
Somalia North of [illegible]N	70,000	50	350,000
Arabia and Gulf of Aden	80,000	50	400,000

Source: The Fish Resources of the Ocean, J.A. Gulland.

Table 2 Comparable Marine Fish Production in Tanzania
(Fisheries Division Annual Report 1973)

Product	Annual fish production in metric tonnes					
	1968	1969	1970	1971	1972	1973
Fish	20,900	15,374	17,492	20,904	27,563	22,187
Crustacea	507,507	597	585	391	330	273
Bêche-de-mer	105	130	277	202	147	35
Seaweed	260	205	252	135	195	112
Seashells	533	769	478	479	696	492
Total production	22,305	16,975	19,084	22,111	28,679	22,187
Value of catch (T. Shs.)	34,389,300	28,653,600	25,779,000	32,796,598	46,886,528	46,563

Table 3 Average yearly fishing effort and yield (1970-1972)

	Regions considered				
	Tanga	Coast	Lindi	Mtwara	Overral
Number of fishermen	2523	2679	1381	1248	7831
Number of km^2 of continental shelf per fisherman	0.9	3.0	1.1	0.25	1.5
Number of fishermen/ km of coastline	21	7	5	19	9
Total fish landings in 1000 metric tonnes	5310	6420	8900	1350	21980
Metric tonnes landed per fisherman/year	2.1	2.4	6.4	1.1	2.8
Metric tonnes landed per km^2 of continental shelf per year	2.4	0.8	5.7	4.3	1.8
Number of canoes and other craft	912	835	779	385	2911
Number of fishermen per fishing craft	2.8	3.2	1.8	3.2	2.7
Metric tonnes landed per fishing craft per year	5.8	7.7	11.4	3.5	7.5

Source: Fisheries Division Statistics Reports 1970-1972.

USE OF COASTAL AREAS

1. Port terminal facilities

Historically the coast attracted ancient mariners because of trade in ivory and other natural resources, and at a later stage slaves, and the good natural harbours with deep water and protection from violent waves as is the case with Dar es Salaam. Along with these settlements sprung up along the coast, the East African Harbours Corporation, established in 1969, taking charge of the trading ports of Dar es Salaam and Mtwara. In addition, the following ports are also important for minor coastal trade: Mikindani, Kilwa Masoko, Kilwa Kivinje, Lindi, Mafia Island, Bagamoyo and Pangani. The main ports of Tanga, Dar es Salaam and Mtwara handle exports and imports of Tanzania, Rwanda, Burundi, Zambia and Zaire (portly) with a total population of over 40 million. To avoid the destructive effect that port development may have on marine life, the United Nations Development Programme (UNDP) has financed a project to ascertain the effect of port development on the marine environment in the ongoing Dar es Salaam Port Development study.

2. Pollution of coastal areas

In general, coastal towns usually dump their raw sewage into the sea for economic reasons. The large volume of water assists in diluting the wastes and the salt content of the sea acts as a natural sterilizing compound. For moderately populated towns, dumping may not have a deleterious effect on the marine life but with growing populations, action has to be taken to safeguard marine life and to continue to attract bathers on the beaches. The types of wastes associated with coastal areas are:

i) The human environment sewage disposal;
ii) Industrial wastes - toxic and other solid wastes dumped into the sea from different installations;
iii) Port development - operations of cargo during loading and unloading can pollute the harbour area and ultimately the port surroundings;
iv) Oil spills and the dumping of chemicals at sea pollute coastal areas through action of waves and tides.

While pollution may not be a great threat at the moment, emphasis should be placed at making a proper study of the environment around the coast. The launching of the United Nations Environment Programme (UNEP) and the establishment of the FAO/SIDA proposed Regional Laboratory on Aquatic Pollution Control show the great emphasis being placed on controlling the dangers expected out of pollution. The East African Marine Fisheries Research Organization (EAMFRO) has been collecting data on oil pollution on the coast as a basis for preserving the environment. The studies to be undertaken by any organization should be directed to solving problems connected with rapid urbanization on the coast, anticipated port development, industrialisation and the preservation of marine ecology and fishing industries.

3. Coastal and estuarine aquaculture

The long coastline has many important rivers which create conditions ideal for development of estuarine aquaculture, especially for high valued species like prawns, lobsters and oysters. Besides the fact that the resources of the ocean both pelagic and demersal remain under-exploited, mariculture can be initiated to utilise the vast areas of swamps which are at present fallow and unproductive.

Presently there is no study that has covered the role of aquaculture development in the fisheries of the country. A survey by a Japanese team (1973), comprising Drs. Yamachita, Taki and Kawahara, recommended strongly the possibility of starting aquacultural research at Udofu creek near Tanga and Mzinga creek at Dar es Salaam.

a. Areas suitable for aquaculture

Based on the topography of the coastline, potentially suitable areas for aquaculture can be grouped to include all estuaries and their vicinities (exception being given to the exposed ones, e.g., the Pangani); all mangroves and creeks, leeward shores with extensive shallow waters, lagoons and shallow bays. Areas of the above nature are in plenty along the coastline. Some suitable areas (e.g., the Rufiji delta) are not easily accessible. The vast areas of mangrove swamps which are presently unproductive can be converted into ponds suitable for mariculture. The ideal soil conditions suitable for culturing the high valued species (e.g., prawns) have to be established. Other factors to be investigated may include tidal range, salinity, freshwater inflow, pollution and the availability of juveniles for culturing in adequate quantity over a long period in a year.

b. Suggested suitable species

The species that could be cultured could be classified as edible seaweeds, molluscs (oysters, clams, etc.), crustaceans (prawns, lobsters and crabs), sea cucumbers and high valued fishes. The basic requirements of the organisms could be considered under general headings of zonation (depth) substrate, water quality, food supply and reproduction. The species to be cultured will have to command a profitable exploitation where factors like rapid growth to marketable size, selection of species with resistance to diseases and parasites, and other environmental conditions will have to be considered. The undertaking should guarantee reasonable production costs and high market value.

Since prawns are presently rated highly as a foreign exchange earner, emphasis can be placed on prawn culture. Investigations conducted by the East African Marine Fisheries Research Organization (Zanzibar) have established the existence of various species of prawns. They are _Penaeus indicus_ _P. monoceros_. _P. indicus_ dominates commercial landings while _P. japonicus_ is available in commercial quantities at irregular intervals. A study of Kunduchi creek (near Dar es Salaam) confirms the existence of *P. latisulcatus* in the continental shelf.

4. Establishment of marine national parks (marine reserves)

Way back in 1967 an idea to set up marine national parks to protect and conserve marine flora and fauna was initiated. With assistance from the United States based foundations and the United Nations Educational, Scientific and Cultural Organization (UNESCO), expert surveys have been undertaken to identify suitable areas for marine park (marine reserves). Initial areas identified for marine reserves are the reefs around the islands lying close to Dar es Salaam and the coastal tourist hotels, and the area around Mafia islands and Maziwi Island. The Fisheries Act of 1970 emphasizes the need to establish marine reserves and the need to develop marine parks in a co-operative effort between the Fisheries Division and the National Parks. The Fisheries Division would be responsible for the management and conservation of the whole coastline while the National Parks would take measures to protect and develop specified tourist areas. The Fisheries Act also stresses the use of proper fishing methods, enforces a total ban on spear gun fishing, use of destructive fishing methods (e.g., dynamite) and bans collection of live shells and corals.

5. Development of Ujamaa fishing villages

Based on the national policy of socialism ("Ujamaa"), fishermen have been organised all along the coast into Ujamaa fishing villages where the Government assists by providing relevant facilities like fish receiving facilities (e.g., cold room, ice making machines, etc.), training in the use of improved gear and craft and organised bookkeeping. The villages are able to make good use of experts attached to the village by the Fisheries Division. Through these villages other social facilities (e.g., electricity, portable water and schools) have been introduced as observed at Moa Ujamaa fishing village. Initially, the villages also received a financial subsidy from the Government through the Regional Development Fund (RDF). Well-established development corporations can also be observed all along the coast (e.g., Pangani Development Corporation, Dar es Salaam Development Corporation, Mtwara Development Corporation, etc.). The corporations utilise modern fishing gear and craft and are catching substantial quantities of fish and prawns. The corporations are financed through the Regional Development Fund and have access to loans from the Tanzania Rural Development Bank. Besides fishing, the development corporations may be involved in other commercial activities (e.g., running of butcheries, etc.).

INSTITUTIONAL AND OTHER REGULATORY FRAMEWORK

Presently EAMFRO (Zanzibar) is responsible for co-ordinating all the marine biological research under the auspices of the East African Community. The research scientists also gather data on marine pollution for advisory purposes. Plans are under way for EAMFRO to establish a sub-station at Kunduchi (near Dar es Salaam) to cater the Tanzania coast. The University of Dar es Salaam (Zoology Department) and the Fisheries Division also have infrastructure at Kunduchi and besides training activities, research is undertaken to gather relevant data for the coastal area development. The complex to be formed when EAMFRO establishes the sub-station will form the basis for scientific investigations on the whole coast. It has been mentioned elsewhere that FAO/SIDA and interested countries have plans to establish a regional laboratory on aquatic pollution to be erected at Mombasa, Kenya and to cater the East African region.

The Fisheries Division has a Fisheries Diploma Institute at Kunduchi and a Fisheries Certificate centre at Mbegani near Bagamoyo. Mbegani is also involved in the construction of modern wooden boats for fishing on the coast. Mbegani is destined to play an increasingly important role in the development of coastal areas as a result of the NORAD/TANZANIA Coastal Fisheries Development Project, which is planned to set up a full-fledged modern fishing harbour and to undertake an exhaustive resource survey, boat building programme and training. Hand in hand with this development is the establishment of the Tanzania Fisheries Corporation (1973) to handle all commercial fisheries activities. The Corporation's major concerns at present are commercial fishing, marketing and boat building. The Corporation has plans to expand the boat building yard at Mikindani and to set up a new boatyard at Dar es Salam to provide suitable boats for exploiting the coastal resources. The Fisheries Division's major concerns are therefore administration, staff development, research, management and law enforcement. The National Cold Chain Operation (NNCO) has established facilities for handling, processing, storage and marketing of fish and fishery products and it is planned to expand its activities along the coast with the expansion of the industry.

CONCLUSION

Any programme to develop and manage the coastal resources of Tanzania has to take into account the topography of the continental shelf (that makes it difficult to exploit the resources), the existing infrastructure and the laid down policy of socialism for self-reliance.

There is a need to carry out full-scale resource investigation to collect data on the shore and reef resources. While present investigations by EAMFRO, Fisheries Division and the University of Dar es Salaam emphasize (a) improvement of fishing through better design and use of good quality material; (b) modernization of local fishing gear and craft; (c) fishermen training to give fishermen required knowledge on use of modern fishing equipment; (d) planning for improved port terminal facilities for processing, storage and distribution of the catch, the response has been slow. There is also an urgent need to study the social economic problems of the fishing community so that these may be considered with economic planning.

The existing institutions should be encouraged to co-operate in collecting research data and utilizing the available manpower and equipment. The fishing community should be made to take an active part in utilizing research findings to ensure optimum output from the scarce funds being invested.

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III CONTRIBUTIONS OF RESOURCES SPECIALISTS

COASTAL RESOURCE MANAGEMENT AND ECONOMIC DEVELOPMENT

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The United Arab Emirates (UAE) is embarking on a program of comprehensive coastal zone planning.* This new program recognizes the importance of the valuable coastal resources of the UAE and the need for logical long-term resource planning that will assume the viability and wise use of these resources.

The UAE has taken a leadership role in examining the need for establishing effective coastal resource planning programs. This paper presents some of the concepts that are part of the UAE effort in this area.

The desire and need for economic growth in the many nations of the world has brought a new focus on the resources of the coastal zone and the development potential they possess. These development potentials may be found in direct resource utilization, such as offshore oil production, fisheries development, recreation development; or they may be indirect, supportive development activities, such as ports, power plant sites, etc.

As in any activity involving development of resources, there is an intuitive belief that some form of coastal resource development planning and management will produce more benefits than an unplanned, unmanaged development process will.

What then is the relationship between the need for economic development and the use of coastal management programs to govern the use of coastal resources? Before we can address this question, it is helpful to consider what we mean by coastal zone management. This topic will also be covered by other speakers at this symposium so we will not deal at length but rather consider it only briefly.

It is instructive to consider coastal zone management as a process. This process involves the setting forth of objectives, policies, and standards to guide and regulate private and public uses of the lands and waters of the coastal zone.

* Appendix A, describing some of the planned UAE work, is attached to this paper.

In developing coastal resource management programs countries will need to carry out a number of tasks:

1. The development of basic goals and objectives for the use of coastal resources.
2. Development and utilization of procedures and programs to comprehend and define the coastal zone as a natural and social system in terms of its resource attributes and its capacity to assimulate the impacts associated with various potential or existing uses.
3. Formulation of basic policies by which various proposed uses of coastal resources can be evaluated, with respect to national goals and objectives.
4. Adoption of necessary rules, regulations, and organizational arrangements to implement policies which control and guide development of coastal zone resources.

The coastal zone policies that a country formulates and implements will serve a number of purposes:

1. They may help guide the selection of coastal uses that a nation wishes to pursue.
2. They may assist the nation in establishing priority of potential uses by clarifying the preference ranking of the various uses.
3. They can help determine the degree to which the adopted coastal objectives can be met.
4. They can help in the design of the organizational structure necessary to implement the policies by determining the types of manpower and resources required.
5. They can help identify those coastal areas requiring special attention by determining impacts or resource protection issues in specific geographical areas.

Thus we see that the process of establishing and implementing a coastal zone management program is a complex problem requiring that a nation view its coastal zone as a complete system of interconnected natural, social, and economic elements. A change in one element will have direct and indirect impacts on the other elements, e. g., the modification of natural components of the coastel system will have long- and short-term effects on the economic attributes of the coastal zone.

Each of the above listed steps that a country must take in establishing a coastal resource management program have economic ramifications: the establishment of coastal zone boundaries will determine what economic uses will be included in the management program; the establishment of priority uses will have a differential impact on the various potential economic units in the coastal zone; the type and intensity of impacts that various uses cause will have a direct economic significance; the type of rules, regulations and organizational structure adopted will determine the cost of implementing the country's coastal management program. This latter is an important element in considering the economic effects of coastal resource management.

In order to better understand the economic effects of coastal management one must consider several of the relevant coastal management factors in greater detail, particularly as they relate to economic development factors.[1]

Impact of coastal resource use

Impact significance is generally associated with the extent or degree of change which results from an action, including:

- an action that results in degradation of the quality of the environment;
- an action that curtails the range of beneficial uses of the environment;
- an action that serves short-term, to the disadvantage of long-term environmental goals; and
- an action which may have both a beneficial and detrimental effect, even if on balance the net effect is deemed to be beneficial.

Other guidelines to determine or to identify significant impacts might, for example, use categories, such as:

- actions having both beneficial and detrimental effects even if, on balance, the net effect is deemed to be beneficial;
- the expected environmental impact of precedent-setting actions;
- the expected environmental impact of individually small but cumulatively large actions; and
- actions which are likely to be highly contreversial.

Figure 1 shows a two-place matrix which differentiates among the four combinations of impacts discussed above. Each country must decide whether to adopt a narrow or a broad interpretation of what constitutes a direct and a significant impact. With this interpretation as a basis, the country can then adopt specific indicators and measures for the characteristics of its coastal resources as well as specific categories of impacts (to determine impact significance).

For example, consider an estuary and its associated watershed within which a country must define a coastal zone. Pressures from representatives from different factions might result in conflicts, either real or anticipated. A recreation area (including a marina, beaches and swimming areas, and fishing piers) might well be located there. The area might also be under pressure for residential development with

IMPACT MATRIX

	DIRECT	INDIRECT
SIGNIFICANT	Those situations where an action modifies the identified characteristics of a state's coastal waters and the attendant impact falls within one of the categories of impacts that a state uses to determine significance.	Those situations where an action may modify the identified characteristics of a state's coastal waters, but the modification is caused by some secondary reaction as opposed to the primary action even though the resulting impact might fall within one of the categories of impacts that a state uses to determine significance.
INSIGNIFICANT	Those situations where an action modifies the identified characteristics of a state's coastal waters, but the attendant impact does not fall within one of the categories of impacts that a state uses to determine significance.	Those situations where an action does not modify the identified characteristics of a state's coastal waters, nor does the action result in an impact that falls within the categories of impacts that a state uses to determine significance

FIGURE 1

CONFLICTING USES IN COASTAL ZONE MANAGEMENT

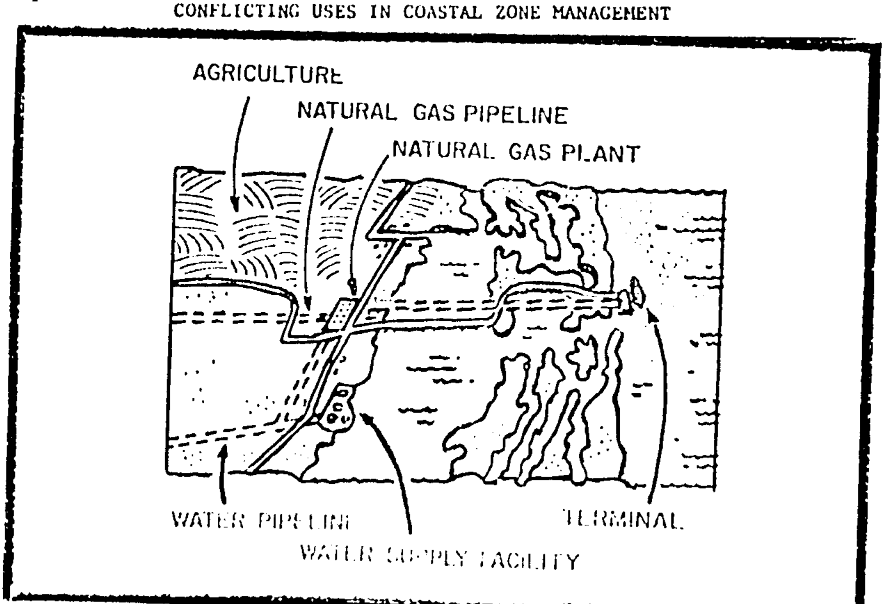

FIGURE 2

proximity to the recreational facilities. Planners might also anticipate pressure from commercial development associated with the residential and recreational uses (e. g., shopping centers, boatyards). Conservation interests might maintain that the area should be conserved as a natural system. Finally, industrial developers might bring pressure to take advantage of the coastal location and the potential labor force residing there.

A country confronted with a problem like this will have to determine which of these uses will have a significant impact on the coastal resources and which will therefore require the associated shoreland managed appropriately. The economic gain of the various development mixes must be compared.

Figure 2 shows an estuary being impacted by a variety of uses. The effluent from the water supply facility could have a direct and significant impact on the coastal waters of the estuary. The same could be true of the impacts resulting from the natural gas plant and its associated pipeline and terminal facilities; a somewhat simplified example of a complex system composed of many components. Finally, the runoff from the agricultural area might also cause direct and significant impact on the estuary.

In resolving which uses to include in defining its coastal zone, the country should identify all systems the components of which cause direct and significant impacts as in the natural gas operation shown in Figure 2. Once such systems are identified, countries should determine to what degree the entire system should be included within the defined coastal zone.

For discussion purposes, consider three categories of use-conservation, recreation and induatry:

First, conservation use of the area might be an alternative: maintaining or enhancing its natural resource characteristics or attributes. A country will need to determine when such a use could adversely alter the coastal resource system (e. g., enhance the biological characteristics beneficially, or cause eutrophication) or curtail other beneficial uses of the area or if the use could result in a direct and significant impact on the coastal waters.

Second, additional recreation use of the area might be a possibility when the natural resources' attributes could offer users a variety of recreation experiences. The coastal country will need to determine which of the specific recreational uses will have a direct and significant impact on coastal waters, based on its adopted criteria.

Third, industrial use of the area could broaden the economic base. The country will need to apply its impact criteria carefully here or adopt performance standards to ensure that any impacts resulting from the development will not be direct and significant to an unacceptable degree.

Table 1, listing impact types and criteria, is based in

TABLE 1: IMPACT TYPES AND CRITERIA

Impact of environment on use

Type of impact	Criteria	Measure
floods	.magnitude	.height above mean sea level
	.damage	.dollars
	.frequency	.events per X number of years
seismic events	.magnitude	.extent of movement
	.damage	.dollars
	.frequency	.events per X number of years
landslides	.magnitude	.tons and area of movement
	.damage	.dollars
	.frequency	.events per X number of years
coastal erosion	.magnitude	.tons and area loss
	.damage	.dollars
	.frequency	.rate per year

Impact of uses on environmental and socioeconomic conditions

Type of impact	Criteria	Measures
hydrologic	.ground water quality and quantity	.ppm of salts, volume
	.surface water quality and quantity	.ppm of dissolved oxygen, flow rate
atmospheric	.air quality	.ppm of bases or particulates
	.climate modification	.temperature, precipitation
geologic and soils	.erosion	.erosion rate, volume
	.soil quality	.fertility index
biotic	.vegetation type	.decrease or increase in acres
	.species	.population size, species diversity
aesthetics	.visual quality	.ranking of scenic prominence
	.acoustic quality	.decibels of noise
	.smell	.standard comparison index
access and circulation	.highway access	.traffic levels, trip generation
	.public access	.access ways per mile of shoreline
use of public services	.water supply	.water consumption
	.sewage service	.gallons per day
	.recreation	.user days
historic	.historic sites	.visitor days
	.architectural monuments	.visitor days
economic	.regional income	.dollars
	.employment	.percent employment
	.tax base	.appraised value
	.net tax revenue or deficit	.dollars
social	.socioeconomic mix, social structure	.percent of socioeconomic groups
	per capita income	.dollars
	.employment opportunities	job diversity
energy	.energy consumption	.fuel burned

part on environmental and socio-economic considerations. This table is meant to illustrate the scope and nature of criteria that countries could consider and to give en example of the factors used to express impact.

The most evident and direct means of evaluating the adverse or beneficial nature of a measured change in criteria (e. g., a ppm sediment increase) is by comparing the potential impact with relevant government standards where these exist. The adverse/beneficial nature of impact would be based on the degree of compliance or conflict with government standards, e. g., air quality, water quality, traffic flow, noise, marine mammals protection. However, no measurable standards exist for many of the potential impacts associated with coastal uses, among these, aesthetic degradation or a country's socio-economic mix.

If countries are to use existing standards to evaluate coastal use impacts, they should be aware of at least three potential problems:

1. The reasonableness of the standard. Does scientific evidence support the standard? Does the standard take into account geographic variations in the environment?

2. The costs and benefits of achieving these standards. Do the benefits derived by maintaining environmental impact criteria within limits of the standard more than offset the costs of meeting these standards? For example, a power plant may have to spend eight million dollars in water cooling and diffusion equipment to meet a standard that requires a discharge water temperature not to exceed 4^{o} above ambient water temperature. But if the discharge water standard was set a 10^{o} above ambient water temperature, the cost of required cooling and diffusion equipment might be reduced to two million dollars. Do the environmental and social benefits gained from a 6-degree decrease in effluent temperature equal or outweigh the six million dollar cost of additional cooling and diffusion equipment? The impact assessment process may indicate that government standards should be modified.

3. The problem of somewhat arbitrary standards. If an impact just exceeds the level set by the standard, it does not mean that the adverse effects will be any greater than those produced by an impact that was just below the level set by the standard. Here again, in trying to deal with this problem, countries may find that existing standards might best be modified.

Cumulative Impact Assessment and Methods

Countries should be aware that they can consider impacts from at least two perspectives: individual and cumulative. Individual impacts are changes that actions of one event produce. Cumulative impacts are changes that two or more events (simultaneous or sequential) produce.

Impact assessment, as it is currently practiced, is largely an incremental exercise in the sense that the assessment is usually focused on analyzing the added increment of impact that a proposed project may generate, e. g., a housing development that would add 600 more vehicle trips to a coastal highway's traffic load. The cumulative impact on the coastal highway system's traffic capacity by permitting past and future housing projects with similar generation is usually not considered, or if it is considered, it is analyzed inadequately.

Because impact assessment is conducted as an incremental exercise, the assessment will usually fail to comprehend the threshold where many apparently insignificant environmental condition changes will reach a cumulative level that will result in the irreversible degradation of a coastal system. More simply, we do not know our capabilities until we have exceeded them. For example, a housing development of 25 units on 10 acres may not cause a significant change in the sediment load entering as estuary. However, if all property owners were permitted to construct similar density housing on all lands in the watershed areas with similar site characteristics, they might build 10,000 units. The sediment load resulting from the construction of 10,000 units could far exceed the thresholds of estuary water quality and circulation necessary to maintain oyster production, productive waterfowl habitats, navigation channels, and fish nursery areas.

To assess cumulative impact accurately, one must consider not only the adverse effects, but also the various measures available to mitigate these effects. To mitigate erosion and sediment impacts, for example, one could build settling ponds or check dams, or recontour the area. The obvious problem lies in determining how much housing (with mitigating measures) can be allowed before the sediment load exceeds the desired thresholds of estuary water quality and circulation.

Suitability Analysis

Suitability or resources analysis is one form of location theory planners commonly use to evaluate potential sites for commercial and industrial developments. Suitability analysis is based on the geographic location of environmental or socio-economic attributes that attract or constrain particular coastal uses. Examples of attributes are:

- direct access to deep draft channels or potential deep draft channels for port facilities;
- adjacency to port facilities for tank farms, refineries, bulk processing;
- nonliving extractable resources-oil, gas, sand and gravel, mineral deposits;
- coastal climate influence on crop production for coastal specialty crops;
- coastal lands with exceptional scenic qualities for recreation and residential development;
- coastal waters with high waste water assimilation

capacity for thermal and sewage outfalls;

- coastal airsheds of high pollution assimilation capacity for highways and heavy industry; and
- buildable sites-favorable slope, soil, absence of geologic hazards-for residential, industrial, and commercial structures.

One particular advantage of suitability analysis is that it will provide a geographical overview of the intensity of potential conflict. Analyses should identify areas where competition is intense (hot spots) versus areas of low or no conflict. Given limitations of time and funding, countries may consider concentrating the research and information collection on the hot spot areas, rather than expending effort evenly throughout the coastal zone. Maps and conclusions developed by suitability analysis are particularly relevant to determining geographic areas of particular concern.

Coastal Dependency and Inland Alternatives

Within recent years the concept of a use's dependency on coastal resources has emerged as a possible criterion for choosing among competing coastal uses. The concept appears to have been initiated in the criterion of the San Francisco Bay Plan that stated users seeking to locate on or immediately adjacent to the Bay should demonstrate that they require a waterfront location for their activities. The state agency responsible for coastal zone planning (COAP) extended the Bay Plan's waterfront requirement concept to its own criterion that uses permitted within the coastal zone must be substantially dependent on the resources of the coast for their existence. Michigan recently considered using dependency as a means of setting priorities among proposed uses. The underlying rationale of dependency is that noncoastal dependent uses' denial or removal of coastal dependent uses will raise the price and lower the quality of coastal goods and services available to the public.

One direct means to measure dependency is the calculation of opportunity costs. Usually the opportunity costs will be a combination of the extra investment needed to create inland the particular coastal zone attributes used in an operation and the extra operating costs associated with an inland operation, such as transportation and equipment operation. Essentially, the higher the opportunity cost of moving inland, the higher the coastal dependency. COAP set four levels of dependency based on the percentage difference between the costs of inland and coastal location. The California Advisory Commission on Marine and Coastal Resources outlined a number of problems associated with criteria of dependency COAP presented.

If a country uses the dependency concept to force non-dependent uses inland, it should consider both the inland and coastal impacts. What would be the variety and mix of coastal land uses if only coastal dependent uses were allowed? The coastal zone might be a continuous strip of marinas, ports, and bathing beaches if the state were to apply dependency criteria rigidly. If uses are displaced from the coast, where will they locate and what may be the environmental and socio-economic costs associated with the inland location? A country should determine whether environmental and/or socio-economic impacts of the coastal use displaced to an inland location will be greater or less than the net impacts that would occur if the use were allowed to locate on the coast.

Input/Output Analysis

One of the more sophisticated methods of determining interaction (specifically, economic,interdependence) among coastal uses is input/output analysis (sometimes called "interindustry analysis"). Basically the input/output analysis shows the inputs (materials, labor) to each industry from other industries and sectors; and how the output (product) of each industry is distributed among other industries and sectors of the economy.

Identifying areas of concern

Identifying areas of particular concern has an important bearing on the economic aspects of coastal zone management. Areas where concern is high may be areas where economic development potential is high and in conflict with other potential uses.

Countries should give priority in their coastal zone planning to identifying the three kinds of areas of particular concern: (1) areas with significant natural values; (2) (2) transitional areas where further development or restoration are called for; or intensely developed areas where modifications may be necessary; and (3) areas which are threatened for various reasons or are already scarce.

Areas with Significant Natural Values

These are areas in which the nature of the resources, their present or potential uses, and their relative abundance are particularly susceptible to the timing of potential changes or irreversible commitments to one use over another.

A country can only determine the significant natural value of a given area after it has made a thorough iventory of the nature of the area's resources and analyzed their abundance.

Designating an area with significant natural values may require expert evaluation and perhaps lengthy studies. For these reasons, it may be advisable or necessary tentatively to define characteristics of areas or even entire areas on the basis of overestimations of significance. Later studies may enable the country to classify these tentatively designated areas more accurately.

As examples of the complexity of factors wich can enter into the designation process, consider the following:

1. If it were known that a given square mile of eel grass beds supported large numbers of wild geese (brant) moving back and forth on a flyway, this would give the acre of grass a certain natural value. If the grass beds were the only ones, or the bulk of those present in the country, they would take on a particular and higher significance. And if filling or reclamation were proposed for that area within the next few months, the grass beds would attain yet a higher level of significance.

2. If the plants or animals in an area are rare or endangered, then the value of that area would be higher than those surrounding it. Or if an area supported animals economically valuable to man, that would raise its value. For example, an area that supported commercially desirable scallops would be of higher value than one which supported primarily marine worms and tunicates.

3. Barrier beach systems and tidal flats serve as lines of defense that dissipate wave energy which attacks the shoreline - an important natural value. Imminent developments which were to threaten to modify that capability would increase the significance of the resource under discussion as an area of particular concern.

Transitional and Intensely Developed Areas

Transitional areas are areas in which change is actively and perceptibly taking place. Intensely developed areas are those areas subject to the pressure of major multiple use conflicts.

Identifying transitional or intensely developed areas of particular concern should be based on need or demand consistent with areawide objectives. Within this category of delineation, countries should designate areas for restoration and reclamation. Circumstances that countries should consider when they identify these areas include:

1. Areas where physical alterations will enhance or improve the quality of the resource base. This would include areas of deterioration or blight - decaying waterfront facilities, areas of environmental degradation that could benefit from man-induced changes like water circulation to control eutrophication, areas that require shoreline expansion open space, or offshore space when allowed within the bounds of environmental impact, and is in the public interest.

2. Areas where the exercise of regulation, control, and other management skills can interrupt a trend or a transition to an undesirable state by providing services, or by modifying zoning to control visual appearances, population density, and other similar activities.

Intensely or Potentially Intensely Developed Areas

Planners frequently encounter a basic conflict in identifying these areas - whether to have continued commitment and greater local impact or commitment of a new areaand lower but wider spread impact. The first frequently results from intensifying uses within an area. It may also result in economies of scale and decreased transfer costs. The second is characterized by the developer who seeks uncluttered or aesthetically pleasing areas for his expanded activities or by the decision-maker's need to consider safety as a factor in dispersing pipeline corridors across the coastal zone rather than concertrating them in one area.

Methods and rational for locating intensive development outside the management zone, for example, will frequently depend on the economic tradeoffs inherent in transportation costs, tax costs, and the costs of services.

Methodologically planners could analyze user requirements for coastal zone resources, examine traditional site preferences, examine the effects of clustering on use types, and identify alternative means for accomplishing the use objectives.

The rationale for making a choice between intensive and extensive development would probably depend on results of considering factors like the amount of resources available, the assimilative capacity of the resources for relevant kinds of impact, and economic considerations similar to those described above. The extent of environmental damage, availabilty of resources, dependence upon coastal zone resources, and societal considerations must all enter into the selection process. Three examples may help put these factors in perspective:

1. Much less damage may result from expanding an existing refinery than from building a new one in a pristine area because of areal requirements, effluent loads, and intensity-of-use effect.

2. Intensive development for power generation may have entire different (and less severe) impacts than intensive residential development.

3. Recognizing the need for access may facilitate defining areas particularly suitable for establishing transportation corridors to nonurban areas. In this case, development would spread over a wider segment of the nonurban areas.

Generally, the feasibility of intensive development should be carefully examined for environmental impact on the coastal zone because of the susceptability of such areas to the loss of public access and open space.

Priority of Use

The question of use priority and establishment of so-called permissible uses bear directly on the relationship of coastal zone management and economic development. The ranking of uses and the defining of permissible uses will determine the economic potential of future coastal resource development programs. This section discusses the question of use priority and setting of permissible uses.

If a country finds an area of particular concern because of its recreation value, it would logically follow that the priority use of that area would be recreation. Relating the area of particular concern to specific geographic areas assumes that these areas have approximately the same boundaries.

The reason a country might designate a given geographic area as an area of particular concern is based on the inherent suitability or unsuitability of potential or proposed uses. For example, areas of substantial recreational value have recreation designated as a top priority use (inherent suitability); areas that would have significant hazards if developed have residential uses as lowest priority (inherent unsuitability).

The uses associated with an area of particular concern often overlap. When this is so, there may or may not be conflict among uses. As an example of no conflict, a wetland area may be of particular concern because of waterfowl production, and an overlapping area may be of particular concern because of scenic qualities.

However, if an estuary is an area of particular concern because of its fisheries, and an overlapping area is of particular concern because of its value as a unique source of mineral deposits, there may be a degree of direct conflict.

Where the areas of particular concern overlap and their associated uses conflict, a country must give one use priority over the other. For example, a country could decide to give fishing priority over mineral extraction in the area where the estuary overlaps mineral resource deposit because of the potentially greater economic returns from utilizing a renewable resource on a continuing basis.

Examples of several high and low priority uses are:

- areas of unique, fragile, or vulnerable natural habitat:
  . high priority use - scientific, educational, recreation
  . low priority use - intensive public recreation, residential
- areas of high natural productivity or essential habitat:
  . high priority use - fish and wildlife refuges, fishing
  . low priority use - refineries, warehouses, power plants, residences on fill
- areas of substantial recreational value:
  . high priority use - public beaches, resort developments
  . low priority use - pulpmills, steel plants, sand and gravel extraction
- areas where developments and facilities are dependent upon utilization of, or access to coastal waters:
  . high priority use - marinas, ports, fish unloading

facilities

- . low priority use - residential housing, shopping centers, small industries

- areas of unique geologic or topographic significance to industrieal or commercial development:
  - high priority use - port facilities (direct access to deep water channel and land transportation modes), extraction of oil, sand, and other minerals
  - low priority use - warehouse, residences

Control of Surrounding Land Use

Any priority use designation of a specific area should consider that activities on surrounding locations may adversely affect the priority use. Designating priority uses should consider whether the use can be maintained over a period of time. Long-term maintenance of priority uses in this specific area depends upon controlling the impacts from uses in surrounding areas.

For example, if an estuarine water body is designated as a specific area for a wildlife preserve, the use of the surrounding area would have to be controlled to ensure that sediment runoff would not degrade the preserve's environmental conditions.

This suggests that many areas with special values may have to have adjoining "buffer" zones to protect them from adverse impacts. The country may choose to expand boundaries of the specific geographic area to include the buffer zone, or may work out organizational arrangements with other agencies to regulate activities within the buffer zone for the purpose of protecting the area with a designated priority use.

Impacts of Use on Surrounding Areas

Designating a priority use in one area should consider the effects of that use on locations outside of the area. For example, designating a park may lead to traffic congestion and increased littering outside the park boundaries, thus placing a burden on local public service systems like the police and trash collection. In determining designations for priority uses, countries should consider the physical, economic, and social capacities of the surrounding areas to absorb these impacts.

Analyzing consequences of impacts outside the specific area if the country does designate a priority use may require altering the priority use or adjusting the uses the country will permit. Furthermore, the country's coastal zone management authority may recommend or provide facilities required to absorb the spillover impacts into the adjacent areas. For example, determining an area as low intensity public recreation may generate significant adverse impacts outside the area - trailer parks, compgrounds, picnic areas. But if the country changes the use designation to high intensity public recreation, the campgrounds, trailer parks, and picnic areas may be accommodated within the park, thus reducing the adverse impacts in the surrounding areas.

Scarcity and Uniqueness

A specific geographic area which possesses a unique attribute is likely to have fewer options for alternative uses than areas which have less unusual attributes. For example, coastal wetlands are relatively scarce in some areas and are therefore highly regarded for scientific and educational purposes, whereas, coastal wetlands in other areas are quite common and, therefore, the loss or degradation of one wetlands system may not be as serious as it could be in other areas.

Inventorying coastal resource characteristics is a standard method for delineating scarcity and uniqueness.

Irreversible Commitments

Nations must evaluate very carefully those uses which irreversibly change the resources, whether through consumption (e. g., sand, oil, gravel) or through landform modification (e. g., filling, dredging, excavation). An approach they may use would seek to determine if there is another better location or a possibility of substituting for the desired resource (e. g., compacted, burned solid waste residues for paving materials; geothermal steam instead of fossil fuel power plants), thus avoiding impacts that may cause irreversible change. Since irreversible commitments lead to a reduction in future options for resource utilization, this consideration will be especially important in designating priority of uses.

Few of the activites mentioned have impacts which are truly irreversible if cost is not a factor. However, activities which result in the loss of a species certainly lead to commitments which are truly irreversible, regardless of the costs. Countries must weigh the short-term gains against possible long-term losses. For example, port development may result in an immediate increase in local employment and income, but in the long term, it may result in an overall reduction in the fishery harvest on a regionwide basis.

A marsh may be filled now, and eventually this might lead to extinction of a species which may have considerable scientific, sport, or commercial value.

Dependency

Countries should ask to what extent does the proposed use need to be located on the coast? How dependent is the proposed use upon coastal resources for its existence?

With this approach, uses which could be accommodated at a location other than in the coastal zone would have a lower priority than uses which required some feature of the coastal zone to exist.

Countries could modify the dependency concept to another approach which would be to compare the costs and benefits of alternative inland locations versus coastal locations. In this case, one of the costs could be the preemption of water-dependent uses.

Countries must examine the consequences of relocating a use from the coast to an inland location. This relocation may be called the "displacement effect". Certainly countries proposing to relocate a use should determine the environmental and economic impacts of this relocation as a basis for the comparative evaluation of the coastal versus inland impacts.

Economic Efficiency

Nations should ask whether priority use designation will increase the economic efficiency of commercial and industrial enterprises. Will increases in economic efficiency lead to lowered production costs and lower product costs to the consumer? For example, locating power plants inland may increase the costs of electrical power which ultimately may be reflected in higher production costs in industries with large electrical consumption.

Countries may also consider using priority use designation to cluster industrial activities to minimize transportation and communication costs and/or achieve economies of scale (e. g., clustering oil refineries with chemical, plastic, or paint industries; locating a fish processing plant with fertilizer and pet food plants; locating power plants with desalination facilities).

Of course, concentrating industrial activities may significantly increase adverse environmental impacts (i. e., water pollution, noise, air pollution). However, where industrial activities are clustered, they may be able to share the high cost of joint facilities for advanced treatment of wastes.

Designating priority uses must also consider the needs for ancillary uses. If the priority use is agriculture, countries must consider the same or adjoining areas for agricultural processing, fertilization, warehouses, farm workers' housing, water supply, and other support activities. Another example is the requirement that ports have for support industries (e. g., a ship chandlery, welding facilities, metal supplies, and linkage with land transportation systems).

If a coastal use does not have ancillary facilities in close proximity, it may incur substantial transportation and communication costs and therefore may operate at an inefficient economic level.

Regional Benefits and National Interest

One of the more difficult determinations a country must make in establishing priorities lies in assigning benefits and costs at the various levels.

In an advanced industrial economy, it is extremely difficult to identify the economic flows and to establish the geographic boundaries of economic systems (i. e., local, substate region, state, and multistate region). In a developing economy this may be more easily done if adequate data exists.

Regional benefits may be especially important when several countries share a common resource. These may include benefits of employment or of production. Another example is an electrical power generating plant located in one small local may provide economic benefits directly to locals over a wide area which supplies workers or services or products to the facility. Recreation facilities - beaches or national seashores - provide beneficial uses to people over extremely wide areas.

Determining Permissible Uses

In determining permissible uses as one of the first steps in developing its coastal planning program, a country has at least two possibilities:

First, it may categorically exclude certain uses from the country's entire coastal zone; basing this exclusion on potential impacts, the use would generate on the existence of suitable inland alternative locations. (A county might define these uses as nonpermissible.) A country could determine categorical exclusion several ways; among these,

- A use's potential impacts cannot comply with performance standards, in particular, with air or water quality standards. New oil refiniries unable to meet existing coastal zone air quality standards could be one example.
- A use's potential impacts cannot comply with geographically defined standards or policies in all areas where the type of use seeks to locate. An example would be wetlands law that protects all potential sites for small boat harbor development from dredging and filling activities necessary for constructing these harbors.
- A use could be located inland because it is not dependent on a coastal location, and inland locations exist that would provide higher net social benefits than if the use were located on the coast.

Second, a country could categorically exclude certain types of coastal uses from types of coastal environments or specific geographic areas that occur within a country's coastal zone. Different types of coastal environments reoccur within the coastal zone - wetlands, dunes, bluffs, flood plains, etc. Specific geographic areas would be areas like San Francisco Bay, Florida Everglades, etc.

A country could base exclusion on the potential impacts a use could generate or on its degree of dependency on the type of coastal environment ("environment" in this context is broadly defined to include natural, physical, and socio-economic situations) or specific geographic areas the use seeks.

For a country categorically to exclude a use under this second possibility would involve determining that:

- The expected net adverse impact on an identified type of coastal environment or specific geographic area would exceed desired levels. Examples would be excluding residential and tourist commercial development from wetlands; and prohibiting residential development on fill in San Francisco Bay.
- A use's potential impact cannot fully comply with standards for a type of coastal environment or a specific geographic area.
- A use is not dependent on an identified type of coastal environment or specific geographic area, or conversely, the inherent suitability of the coastal environment type or geographic area would conflict with specific types of coastal use. Residential development does not depend on wetland locations and wetlands do not have an inherent environmental suitability for residential development. For example, proposed development on or adjoining San Francisco Bay would have to demonstrate that its planned activities are waterfront related.

A country seeking to determine categorical exclusions in this second category should consider as well "designation of priority uses within specific geographic areas throughout the coastal zone".

Economic Values

Countries will have to weigh th economic and social costs of regulating coastal land and water uses against the overall values they will derive from implementing the proposed coastal zone management programs. For example, nations should base their determinations that oil refineries are a non-permissible use of wetlands environment, at least in part, on the finding that protecting wetlands is necessary to maintain or to increase specific economic and social values; among these, commercial fishing, sport fishing, waterfowl hunting, research and education activities, and coastal tourism.

Identifying the values of coastal land and water environments usually does not present a problem. In most cases identification is simply a matter of relating the particular land or water environment to the uses which benefit from its resources. Coastal lands with a view of the ocean are valuable for tourism, recreational activities, and second home or other residential development. Similarly, estuaries with rare species or rich in specis diversity are valuable for educational and resea·ch uses.

The two significant problems in determining value are measuring and estimating how values will change with changes in land or water environments. For this, monetary value is the most common and best understood measure.

The estimated annual monetary value of estuaries for the current level of shellfish and sport fishing on the Georgia coast was $ 33.7 million (or, estuaries/acre/year value was $ 108). If the $ 108 / acre figure is interpreted to be the annual "rent", the property value of the Georgia wetlands would be approximately $ 1,250 / acre (assuming rent represents an 8 percent return on investment). Two other examples of measuring the monetary value of environments are provided by studies on estuary water quality and migratory waterfowl. Many qualities of coastal land and water environments do not lend themselves to monetary evaluation. In these cases, states may use nonmonetary measures (e. g., intensity of use, number of people who benefit, scarcity/uniqueness, willingness to travel, diversity indices, and direct public expression).

Once the value of the coastal environments are measured, the problem is then to estimate how the situations those measurements represent may change if the coastal environment is altered by future development proposals. If a commercial fishery is worth X million dollars per year, will the construction of a petrochemical complex on one estuary substantially reduce the dollar value of that fishery? And even if it is determined that the dollar value of the fishery will not be substantially reduced, will the nonmonetary considerations (e. g., aesthetic impacts or change in community life-style) outweigh the potential benefits of industrieal development?

Ideally, countries should develop the capability to estimate the relative social values and costs that will accrue from managing coastal environments at different levels of system maintenance. For example, countries could determine one level of values and costs for maintaining an estuary in near pristine condition, as well as other levels of costs and benefits that would be associated with different types and intensities of development and corresponding levels of estuarine degradation.

Inventory and mapping programs can describe the dynamics of environmental and social impact. Physical properties, environments and biologic assemblages, current land use, mineral and energy resources, active natural processes, manmade features and water systems, rainfall discharge and surface salinity, and topography and bathymetry can be mapped. These nine maps, and especially the environmental geology map, can serve as the base for the land and water resource capability units. Activities of various coastal uses in terms of compatibility with the environmental characteristics that make up the land and water capability units can be described.

There can be drawbacks to this technique of inventory and mapping. One basic problem of inventorying and mapping programs is that much of the information these programs develop turns out to be marginally relevant to the resolution of issues confronting the management program. Countries that embark on inventorying and mapping programs should be aware of five other reasons these programs may not be useful: researchers collect the wrong type of information; they do not collect certain "key" types of information; they use too gross a scale; they base the inventory on marginally accurate or inaccurate data; and they choose too small a geographic area to be useful.

Monitoring

Monitoring programs involve the collection of time series data. Most coastal states have several extensive programs monitoring environmental and socio-economic phenomena. Common subjects for monitoring programs are water quality, air quality, stream flow, sediment transport, fish and wildlife census, traffic counts, recreation user days. Often the time series data being collected has little or no application to coastal zone management (or any other form of resources management). Often the reason for collecting time series data is that the particular phenomenon happens to be measurable over time, not that there is a demonstrated need for this information. The dual intent of monitoring programs for coastal zone management should be developing descriptive models that simulate the interrelationships within and among coastal land and water environments (coastal systems); and predictive models to estimate the probability, duration, degree, and spatial dimension of a use's impact.

A country may improve substantially its capability to predict impact by monitoring environmental and socio-economic phenomena. Common subjects for monitoring programs are water quality, air quality, stream flow, sediment transport, fish and wildlife census, traffic counts, recreation user days. Often the time series data being collected has little or no application to coastal zone management (or any other form of resources management). Often the reason for collecting time series data is that the particular phenomenon happens to be measurable over time, not that there is a demonstrated need for this information. The dual intent of monitoring programs for coastal zone management should be developing descriptive models that simulate the interrelationships within and among coastal land and water environments (coastal systems); and predictive models to estimate the probability, duration, degree, and spatial dimension of a use's impact.

A country may improve substantially its capability to predict impact by monitoring the environmental and socio-economic condition before, during, and after construction of coastal projects. The data it derives from monitoring these projects can help the country develop improved pridictive models.

Economic Costs and Benefits of Coastal Management

The discussion presented above have dealt primarily with some important aspects of coastal zone management and related economic considerations. This section is presented to provide the seminar participants information regarding the specific economic impacts that arise when coastal zone planning is formulated and implemented. Examples are drawn from a specific program in the United States and some conclusions drawn from these examples for the developing nations who may have an interest in coastal resource planning.

The most obvious cost of comprehensive resource planning and management policy is the cost of planning, instituting, implementing, and monitoring the management program.

Assembling existing land and other natural resource use information, collecting new information, codifying and analyzing data, and developing an efficient monitoring system will require expenditure of funds. There have not been many significant studies done on the costs of implementing coastal zone planning/management programs. However, for total land use programs in the U.S. (planning for land use throughout a state) it has been estimated that the data collection and "start-up" costs for a land use program would be between \$ 3.0 and \$ 5.0×10^6 in a state the size of Colorado or Florida. To administer such a program and carry on continuing monitoring programs could cost as much as \$ 3.0×10^6 to \$ 4.0×10^6 per year in states of that type and size.

Ecological and environmental data, usually not presently available will have to be collected for particular areas of concern. A variety of analyses, including those of economic and fiscal effects, will have to be performed.

In certain cases, depending on the nature of land ownership in a country, land or water use rights may have to be purchased in order to secure adequate management power. Sometimes this will be in areas where prices are at a premium because of the location or uniqueness of the property. Also, this type of cost to the government may be highest in the early years of a coastal management program because the first lands to be acquired may be where development pressure is the strongest.

As mentioned in several of the above sections cost savings may be realized from planning higher density developments with adequate spacing between as opposed to sprawling type developments that sometimes occur in uncontrolled development. This will be discussed further in a subsequent section. In essence, it has been shown that logical patterns of controlled development at efficient densities are cheaper in terms of providing public services, as compared with poorly-controlled development. Economies in the provision of sewerage, streets, fire and police protection, and other services are immediately apparent.

In a recent study carried out in the U.S.[2] several of these financial and economic effects are analyzed. While the results obtained were primarily for the State of California, parallels can be drawn with other coastal zone management situations. In the study the California Coastal Plan (CCP) was analyzed as to its economic aspects. Three economic impact areas were studied: (1) public investment in facilities and services (with and without the plan), (2) the effect of the plan on land values, and (3) impacts on economic development through such indicators as employment, business investment, and construction activity.

In the study it was stated that "Potential economic benefits of the coastal zone plan policies can have the following attributes:

- They can be 'one-time only' or 'recurring'.
- They can cause net increases in economic activity or merely shift its benefits among individuals or groups.
- Costs may be incurred in their attainment - e. g., expenditures shoreline restoration or pollution control.
- Secondary 'spin-off' effects may be felt - both positive and negative, depending on the nature of the policies and the economic activities affected.

The following list of benefits of coastal zone planning and management was presented and is similar to the benefits of most state and local planning activities:

- Reduced cost of new development.
- Reduced cost of transportation.
- Better preservation of natural environment.
- Better preservation of existing buildings.
- Less pollution.
- Less congestion.
- Higher quality development.
- Better utilization of sunk investments.
- Better fit of supply and demand.
- Greater awareness of needs and opportunities.
- Less uncertainty regarding future potentials.
- Improved possibilities for effective actions based on understanding and consensus regarding goals."

The study showed that "Potential economic benefits can appear as increased productivity, more jobs, greater demand for facilities and services, increased property values, reduced or stabilized consumer prices, and heightened satisfaction with one's physical environment. Prudent coastal zone planning, therefore, was claimed to result in a balance between conservation of irreplaceable natural resources and the needs - job creation, housing, recreation, and shipping - of an expanding population/economy." The authors claimed that while some coastal zone actions will result in net gains or net losses for the local economy, in most instances the short-term effects of the plan are redistributional. The report also stated that "Planning stabilizes erratic 'swings' in expectations because it results in less uncertainty in future prospects of land investment. While there may be short-term lags as the economy adjusts to changes induced by the Plan, long-run benefits are likely to balance or exceed costs. For example, some industrial plants may not be built in the coastal zone, in part because environmental protection regulations may make them financially infeasible. They would yield an inadequate rate of return on equity when compared to alternative opportunities. However, that same development proposal may be equally unattractive outside the coastal zone.

Moreover, lower financing costs or improved marketing outlook could result in a decision to ultimately go ahead with a deferred project despite the cost of complying with coastal zone regulation. These same regulations will result in heightened opportunities in coastal dependent economic activities - tourism, recreation, agriculture, fisheries, and forestry."

Public Investment With and Without the Plan

Here the study found that the California Coastal Plan held a promise of considerable savings in governmental capital investment and maintenance costs for roads, utilities, and other public facilities. "If adopted, new development would be encouraged to make maximum use of available system capacities within existing communities, or locate adjacent to already built-up areas." They also showed that "Fewer miles of new pipeline and urban roads would be extended into rural areas. In a recent study for three federal agencies prepared by Real Estate Research Corporation, entitled The Costs of Sprawl, more compact development was estimated to save as much as $ 1,700 per dwelling unit or more in public infrastructure investment over conventional low density sprawl, as shown in Exhibit 1."

Impact of the Plan on Land Values

The study found that "The key determinants of land values include:

- Natural site characteristics and environment.
- Man-made site characteristics and environment.
- Community image.
- Demand for particular land uses.
- Access.
- Utilities.
- Public facilities and services.
- Taxes.
- Land use and development regulations."

It was estimated in the study that, in general, "about 55 percent of land value is attributable to government action, with the balance resulting from the actions of the property owner, his or her neighbors, and the general public. Governments influence land values through use or design regulations, improving access, providing public facilities and services, preserving favorable "images", and through its tax rates and policies. Exhibit 2 shows the different types of government action that impact property values, and their relative importance in determining the overall net effect of coastal zone regulations on land value. Restricting land use options will lower land values of subject properties, but will also transfer any unsatisfied demand to other competitive sites not subject to use restrictions. Regulations requiring mitigation of adverse environmental impacts result in higher development costs but also result in more attractive, desirable sites. Improved access and public facility provision generally

EXHIBIT 1

INFRASTRUCTURE SAVINGS ATTRIBUTABLE TO BETTER PLANNED, MORE COMPACT DEVELOPMENT

	Community Development Prototypes Presented in The Costs of Sprawl	Net Density	Capital Cost per Unit Publicly Provided Infrastructure (collector and arterial streets, utility lines)
I.	Planned Mix (planned new community with single-family homes, townhouses and apartments)	6.9 units/acre (40% single-family detached)	$ 900
II.	Combination Mix (part conventional development and part PUD -- same housing mix as in I)	6.9 units/acre (40% single-family detached)	$2,789
III.	Sprawl Mix (conventionally developed suburbs -- same housing mix)	6.9 units/acre (40% single-family detached)	$3,796
IV.	Low Density Planned (planned new community of single-family homes)	4.3 units/acre (100% single-family detached)	$ 998
V.	Low Density Sprawl (suburban single-family development)	3.3 units/acre (100% single-family detached)	$4,468
VI.	High Density Planned (planned community -- mainly apartments)	13.6 units/acre (10% single-family detached)	$ 835

Sources:

Real Estate Research Corporation, The Costs of Sprawl: Case Studies and Further Research, Table 15. Prepared for the Council on Environmental Quality and Department of Housing and Urban Development. Unpublished. Data have been updated to reflect 4th quarter 1975 costs.

EXHIBIT 2

IMPACT OF GOVERNMENT ACTION ON PROPERTY VALUES

Type of Action	Impact on Values of Subject Property	Impact on Values of Neighboring or Competitive Properties	Net Effect on Property Values	Relative Importance of Specific Actions in Determining Impacts
Restrictions on land use	Value declines	Value rises	Redistributional	Very important
Developer required to make improvements or pay fees	Value declines	Value rises	Slightly negative	Unimportant compared to other public actions
Resource amenities protected or restored by government action	Value rises	Value rises	Slightly positive to very positive	Very important
Shore access by the public maximized and protected	Value declines	Value rises	Slightly negative	Less important than use restrictions or amenity protection
Concentrating development in existing communities	If still undeveloped, value declines; if already improved, value rises	Value rises	Positive	Very important
Providing infrastructure, public facilities, and services	Value rises	Values unchanged	Positive	Important
Tax reduction or deferral for regulated, restricted, or encouraged uses of coastal properties	Value rises	Values unchanged	Slightly positive	Less important than use restrictions or amenity protection

Source: Real Estate Research Corporation.

impact positively on land values; however, access improvements can have negative effects-noise, air pollution, or reduced privacy".

Economic Development Impacts

The study reported that "The Plan's impact on employment and other business investment will vary for major industry sectors. The construction industry will suffer from reduced opportunities along the shoreline and in infrastructure development. It will gain from public investment in housing rehabilitation, provision of on-site recreation, higher quality design and amenity requirements, and more intense use of in-city parcels. Investment and employment potential in agriculture, fisheries, forestry, tourism, commercial recreation, and mass transit facilities will be enhanced through government incentives and regulatory policies. The long-range viability and security of these industries in the coastal area will be protected and encouraged, but the costs of doing business in the coastal zone may go up for some industries which must purchase more expensive sites and install costly energy conservation, pollution control and design amenities. This added investment stimulates other businesses, but it might also make certain business development or expansion programs financially infeasible. Some industries may therefore choose not to locate in the coastal zone as a result of higher costs, but others will be drawn there because of the attractiveness of the physical setting. Exhibit 3 summarizes various types of economic development impacts likely to occur for different sectors. Although California residents and business consumers may have to bear higher costs as buyers, renters, or purchasers of goods and services - because of higher land costs (due to reduced availability of developable sites) and greater production costs (because of regulations requiring greater on-site amenities and environmental protection devices) - they would benefit from stabilized productivity (and price stability) for wood products, agricultural produce, and seafood, as well as reduced energy consumption.

Consumers would also enjoy heightened recreational opportunities in an attractive, uncongested atmosphere. Scenic, historic, and ecologically significant areas would be preserved for future generations of California residents and visitors.

Overall, the economic benefits of coastal zone management in California will, at a minimum, offset noncomensated losses in land values or business opportunity. The positive effects of a more attractive, secure physical environment, combined with greater efficiencies attained from elimination of urban sprawl, with outweight these losses overall."

EXHIBIT 3

POTENTIAL ECONOMIC DEVELOPMENT EFFECTS
OF SELECTED COASTAL PLAN POLICY ACTIONS

Primary Coastal Plan Policies	Primary Affected Sectors of the Economy	Potential Economic Effects: Employment (non-construction)	Potential Economic Effects: Construction Activity	Potential Economic Effects: Other Business Investment/Profitability	Benefits/Costs to the Consumer
Remove outmoded plants from beach area (50)	Energy development	Negative until replaced with new facility	Positive - will mean new construction elsewhere	Increased investment in equipment for replacement facilities	Return beach to recreational use; greater production efficiency at lower cost
Institute energy conservation measures for new development (72)	Housing and urban development; commercial and industrial development	Nominal	Slightly positive	Positive	Higher cost of housing or commercial/industrial buildings, lower operating costs
Establish siting and design criteria for power plants, petroleum development, refineries, tanker terminals, LNG facilities, and other industrial uses (55, 56, 63, 79, 83, 85, 92, 95, 96, 97)	Recreation and tourism; commercial fishing; commercial and industrial development; energy development	Probably nominal net effect; negative only if regulations force plants to locate outside the coastal zone altogether	Slightly positive, given more costly design requirements; negative if plants must go outside the zone	Positive, given more investment in safety equipment; negative if plants must go outside the zone or if profitability is severely reduced	Minimize adverse effects of heavy industrial development on recreation potential; preserve fishing opportunities
Prohibit mining in fragile, valuable or highly scenic natural environments (41)	Mining; recreation and tourism	Negative	Nominal	Negative	Protect areas for public use; higher cost and less availability of mineral resources
Allow mining elsewhere in the coast only if there is no long-term adverse effects on coastal resources (41)	Mining	Slightly negative	Nominal	Positive -- investment in buffers and site restoration	Higher cost of mineral resources
Protect mineral reserves from urban encroachment (42)	Mining; housing and urban development	Positive	Negative	Positive	Lower cost of mineral resources

References and Credits

1. In preparing this section the authors relied heavily on information contained in various sections of Coastal Zone Management: The Process of Programmed Development.
   Published by CZMI, Sandwich, Massachusetts, 1974.

2. "Business Prospects under Coastal Zone Management". Prepared by the Real Estate Research Corporation, Chicago, Illinois under contract to the U.S. Department of Commerce, March, 1976.

APPENDIX A

OUTLINE OF COASTAL DEVELOPMENT PLANNING STUDY
UNITED ARAB EMIRATES

I. Plan Development Outline

Introduction

Background and Need for Study

- provide advice to UAE in formulation of national goals and programs for development and management of coastal resources,
- provide advice and guidance to individual municipalities and emirates in the development of their own planning and development programs,
- provide the various national ministries a unified and comprehensive view of coastal resource systems and problems.

The study will coordinate closely with existing plans and development programs that each emirate and municipality has or may evolve.

Chapter 1 - General Findings - The Existing System

Physical and Socio-economic Characteristics of the Coast Area

- fishery resources
- agriculture
- industry/commerce
- urban land use
- tourism
- recreation
- topographical geophysical inventories

Existing Use Patterns in Each Category

Environmental Characteristics

- water quality
- aesthetic quality
- unique resource status
- impact projections

Preliminary Existing Critical Area Identification

Chapter 2 - Nature of New Development in the Coastal Area- General Overview

Goals and Objectives for Coastal Area Resources

- national
- emirates
- municipalities

Projected Demands in Categories

Coastal Village and Towns, Changing Role and Scale of Development

The Effects of Tourism

The Effects of Shipping

New Industry (e. g., nuclear power plants, desalinization systems)

Critical Areas of the Coast (redefined)

Chapter 3 - An Analysis of Tourism/Recreational Needs

Needs of Resident Population for Coastal-Based Recreation Opportunities

Concepts for Tourism/Recreation to Resource Conservation Concepts.

Landscape Design Concepts

Chapter 4 - Analysis of Fisheries/Agriculture Needs with Respect to the Coastal Zone

The Continuing Importance of Native Fisheries - Food Supply

The Role of the National Fishery Corporation

Needs for Aquaculture, Preliminary Design of Potential Programs for Shellfish- Use of Creeks for Aquaculture Projects

Effects of Pollution - Oil Shipping, Port Development, Refineries, etc. on Coastal Fisheries

Role of Agriculture in Coastal Areas - Irrigation, New Technology in Desalinization

Chapter 5 - Industry, Commerce, and Urban Land Use in the Coastal Area

Development of Port Facilities for Attainment of Economic Growth Objectives. Designation of Geographical Areas of

Opportunity.

Refineries and Their Relationship to Coastal Resource Systems

Integrated Residential, Commercial, and Industrial Development Programs for the Urbanized Areas (Possible use of development "clusters" and "modules" for attainment of open space and citizen recreation opportunities).

Chapter 6 - Alternative Coastal Development Schemes

Reserved Areas Based on Critical Resource Identification

Preplanned Industrial, Recreational, Tourism Areas - Zones of Use

Preliminary Concepts for Regional and Subregional Coastal Activity Centers

Transportation Needs of Coastal Development Programs

Chapter 7 - Analysis of Alternative Coastal Development Programs

Relationship to Environmental Impacts - Research, Education Opportunities

Economic Impacts

Coastal Management Options (e. g., use zones, permits, reviews, etc.)

Specific Recommendations for a Phase I, Five-Year Coastal Development Program (e. g., family of projects of high priority)

Chapter 8 - Development of a Coastal Planning Methodology

Processes for Selection of Preferred Development Patterns (objectives)

Recommendations for an On-Going Information and Data Gathering Program

Design of a Coastal Development/Management Organization including:

- review process concepts (process for formal presentation and discussion of coastal area development proposals)
- resource impact assessment process (formal means by which to analyze impact of each proposed development)
- provision for maintenance of a set of general coastal

- development maps showing status of various projects, recourse background information, etc.
- formal coordinative mechanisms for ensuring on-going communications among ministries, municipalities, and other appropriate groups
- interaction with other groups in Gulf region

II.A Coastal Resource Technical Assistance Program (Advisory Services)

Utilization of the coastal resources of the UAE is varied and not presently carried out in a planned manner. Several important stepr should be taken to ensure wise use of the coastal resources. In addition to the specific projects listed in Items I-IV above, further assistance efforts are needed. Two of these are discussed here.

Even with all of the above projects accomplished, it will still be necessary to make sure the information flowing from them is available to the various groups in the UAE that need the data and information.

What is proposed here is the establishment of a technical information and assistance program, e. g., "an advisory services services program". This program will have as its objective the gathering, dissemination, and application of information regarding problems of the coastal area of the UAE.

The project would involve the use of a small resident staff of individuals trained in several basic areas. For the first phase of this project two such staff positions are envisioned.

One would be a coastal planning information specialist. This person would be responsible for coordinating the above proposed projects and would act as an advisor to the various ministries and groups in the UAE. His primary function would be of coordination and communication to ensure that proposed developments in the coastal area were planned in an orderly logical way and that all of the various appropriate groups in the government were aware of each development and of any information regarding it.

This individual would also seek out information from other countries and from the literature concerning coastal problems and would be responsible for disseminating it to various groups. He would also conduct workshops and seminars on certain key problems of coastal development, environmental quality, resource planning, and other related topics.

The second type of individual would be a marine resource information and technical assistance specialist. His duties would be to provide information and assistance to groups and individuals as various marine and aquatic resource problems such as pollution problems, fishing techniques, boat repair and design, net design and repair, processing storage, marketing, etc. He would work closely with the various villages in the country and provide information in a very applied manner to those who would benefit from it.

Both of these individuals would necessarily have unique talents. They would not need to have advanced degrees, but they would have to possess some technical training. They would have to be creative and innovative and would have to have the ability to work with many different types of individuals and groups.

MINERAL RESOURCES IN COASTAL AREAS

Harald Bäcker
Preussag, AG
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Mineral Resources in Coastal Areas

Development of a coastal area generally includes improvement of agriculture and fisheries, city and port construction, road building, industrialization and possibly creation of tourism facilities. For most of these activities natural resources have to be mobilized. Sea connections facilitate importation and distribution of raw materials. For some most important basic requirements, such as water, energy, fertilizer, cement, sand, steel, asphalt, and glass the relation between product cost and transport cost would become prohibitive in the case of a long transport.

The development of a coastal zone should therefore provide the basic industries for production of these items.

The raw material might be present within the coastal area or not far away in the hinterland. There might be as well a total or partical lack of most resources on land. During the development there will be also a growing interference between mineral exploitation and other uses of the area, such as recreation, tourism, or city expansion.

In such cases the planning authorities should look to the sea. Many of the needed raw materials may be present there. Since a few years ago, mineral exploration has gone beyond the shore lines and important resources are already identified. Specially oil, gas and sand production from the seabed is rapidly expanding. But also fertilizer raw material and metal ore have been found. The predominance of volcanic rocks on land e.g. generally excludes the presence of raw materials needed in a steel mill and a cement plant. But there might be iron sands derived from volcanic rocks as well as carbonates for the cement production in the beach area or on the sea bottom nearby.

Fig. 1 shows an example of the city development in an arid coastal environment. A few low cost raw materials are required to produce the basic construction materials concrete, asphalt and glass, and to provide some other items, essential for a city development, such as energy, freshwater, salt, detergents. The raw materials in this case are seawater, carbonates, clay, oil or gas and sand.

The output include those materials immediately needed for the development of the coastal area as well as some additional products which can be sold on the world market, such as magnesia and some chemicals.

Geological background

The mineral resources of a given area are directly dependent on the geological history and the past and present

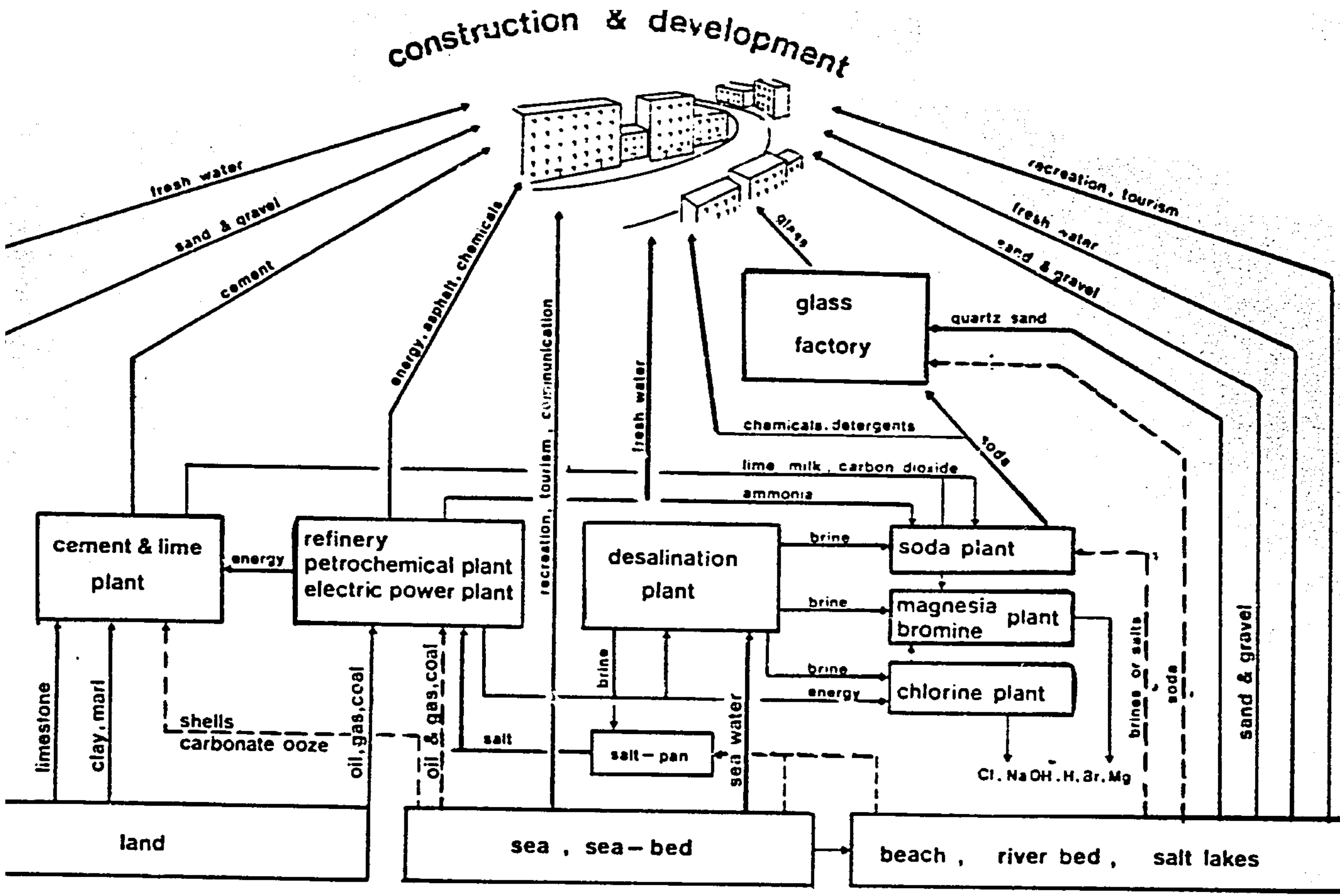

Fig. 1: City building in a coastal area. Provision of raw materials for the basic requirements from local sources.

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structure of the area and its hinterland. This means that detailed knowledge of this background is essential for locating any resources not visible on the surface. Besides the location and size of the resources, the definition of their quality is essential. In the case of the glass production e.g. not any sand but a special pure quartz sand quality is needed. Coastal areas may have the same geological background as the land they belong to, with the additional opportunity offered by the sea connections. In this case also the possibility of finding hidden natural resources are the same in the coastal zone as in the hinterland. Such resources may extend far beneath the waters of the continental shelf.

Parts of the shores of the world ocean, however, are real boundaries between the continental and the oceanic earth crust. They show special geologic features such as volcanism and frequent earthquakes.

Specially abundant in coastal plains, valleys, hills, or dunes are the so-called alluvial resources. These are unconsolidated fine to course grained detritals derived from disintegrating rocks in the mountains and transported and redeposited by rivers, wind and waves.

The continental margin beneath the sea can generally be subdivided into a flat continental shelf of about 200 m water depth and a continental slope which leads to the deep-sea bottom below 2.500 m. Mineral exploitation in the shelf area is now generally considered as being under jurisdiction of the coastal state.

There are considerable climatic influences on the resources and development possibilities of coastal areas. A tropical climate may lead to a lateritic weathering of rocks and to the formation of potential resources of aluminium or nickel. Locally an extensive reef or mangrove growth restricts the development of a coastal area. On the other hand cold upwelling water favours the formation of a rich fish fauna and possibly of phosphate deposits.

At arid tropical coasts there is generally a severe shortage of freshwater. If cheap energy is available sea-water can be destilled to produce freshwater. Natural evaporation in closed basins of such areas may locally lead to important brine or salt resources.

Past climatic conditions may also have influenced the present distribution of the resources. During the ice ages, the sea level was considerable lower than at present. Consequently resources, which orginally were deposited on the beaches or in the riverbed near the coast are now hidden under some tenth of meters of water.

Volcanism active in many coastal areas represent certain hazards and disadvantages for such zones, e.g. earthquakes and lava flows. On the other hand it may provide cheap material for road and harbour construction and possibly geothermal energy and mineral deposits.

Fig. 2:

Possible mineral resources in coastal areas. Panorama and cross-section.

A Seawater, possible source for freshwater, brine, salt, magnesia, bromine.

B Natural and artificial saltpans, possible source for brine, salt, magnesia, bromine, soda.

C River bed, possible source for freshwater, gravel, sand, locally certain minerals, such as tin, gold, and precious stones.

D Fossil river bed, same resources as C.

E Submerged river bed on the shelf, possible source for sand, gravel, tin, gold, and precious stones.

F Dunes and beach sands, possible source for sand, gravel, and placer minerals (iron, titanium, and refractory sands).

G Submerged dunes and beach sands, on the shelf, with same resources as F.

H Porous and permeable rocks, underneath the coastal plain and the continental shelf. They may contain gas, oil, or water.

I Stratiform minerals in the rocks underneath the coastal plain and the continental shelf, such as coal or iron.

K Carbonate rocks (limestone), raw material for cement and lime production. Alternatives are carbonate shells or sands on the shelf or carbonate ooze on the continental slope.

L Clay or marl, raw material for cement and brick production.

M Volcanic rocks, for road and port construction, volcanic ashes for the production of concrete and artificial stones.

N Volcanic activity as a possible source for geothermal energy.

O Hot mineral springs for carbon dioxide and mineral water production and the creation of bathing establishments. Submarine thermal springs as a source for metalliferous sediments (iron, manganese, copper, zinc, silver, sulfur).

P Phosphorite nodules on the continental slope as raw material for fertilizers.

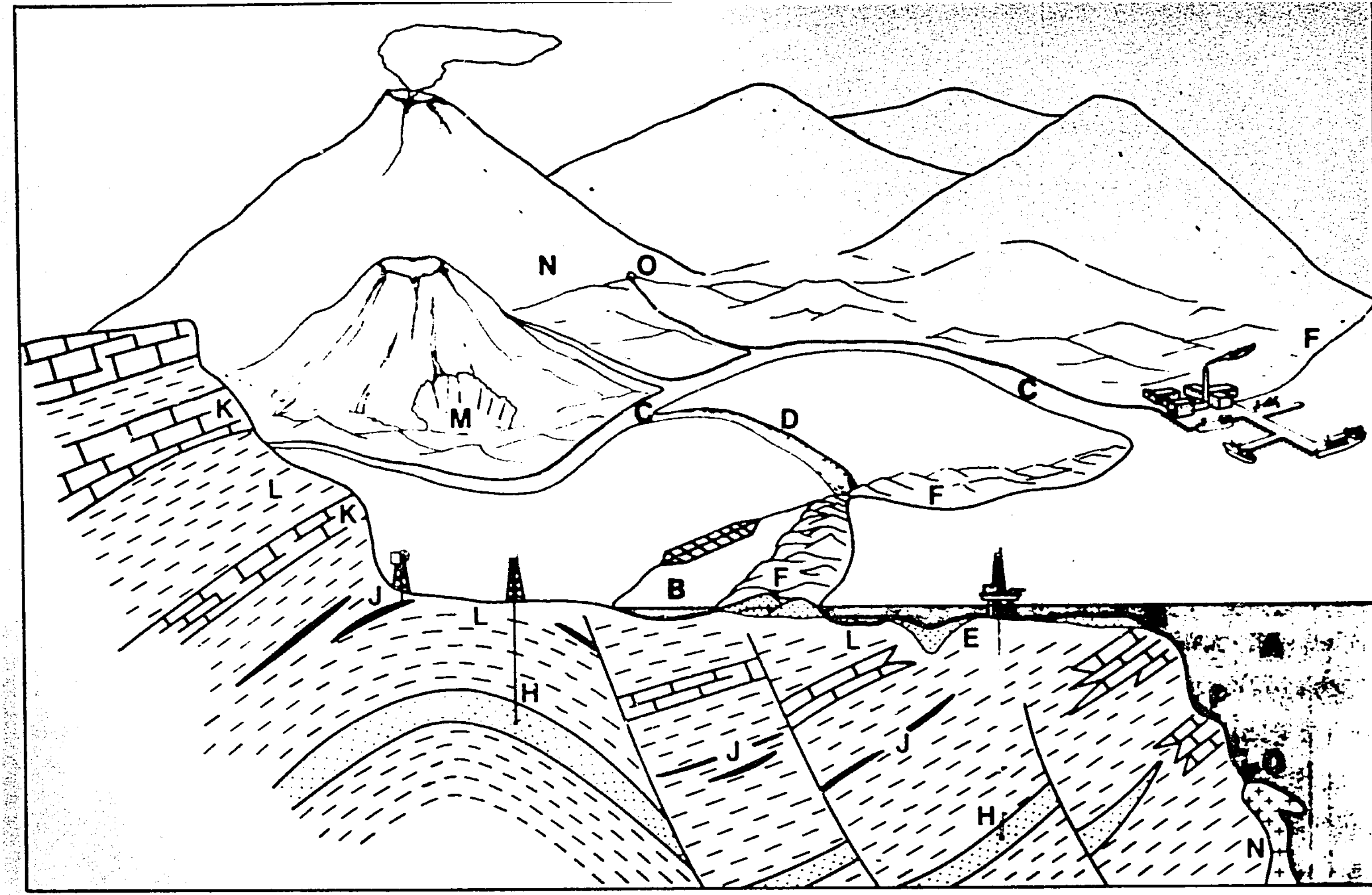

Fig. 2

Alluvial deposits on land

This is the most important group of potential resources available in coastal areas. The materials originate in the mountains adjacent to the coastal area and were transported into the plains mainly by the action of water flow. Where they reached the sea they were additionally subjected to the action of wind and waves. During this way a sorting took place according to hardness and grain size. The main resources of this kind are gravel, sand, clay, and mineral placers, such as ilmenite, rutil (titanium), iron sands and precious stones. River beds are the best places to find the coarse sands and gravels. Since rivers in coastal plains tend to change their direction from time to time, ancient river beds should be considered as well. Fine sands and placer deposits can mainly be found near the coast. In arid areas the bottom of former coastal lakes may contain additional resources such as salt, soda or diatomite, which serves as an important isolating compound. in volcanic zones black ashes can replace sand.

Subsurface deposits

The existance of minerals and rocks in the subsoil of coastal zones depend largely on the general geologic background of the area in question. This is not the place to enumerate all possible mineral resources on land. The main interest should be focused on those raw materials which are essential for the development of the area: oil, gas, coal or geothermal energy; limestone and clay for the provision of cement, bricks, lime; hard rocks for road construction; iron deposits for a steel plant. If there is a well developed shelf in front of the coastal area deposits like oil and gas may well continue under the sea or be restricted to the offshore areas. There are now several mines operated under the sea bottom, and offshore oil production represents already a considerable part of the world energy output.

Water and dissolved minerals

The provision of freshwater is essential for any large scale developments. Apart from the general per capita consumption considerable quantities of water are needed by industries, ports and agriculture. If there is a shortage of water, the first steps to secure a continuous provision are to collect seasonal waters by dams and to look for water in the subsoil. Even dry tropical coastal areas show generally water resources within old river beds and other alluvial sand bodies. In most cases this water is recent or subrecent rain water from that area or from neighbouring mountains. In some extremely arid zones at least fossil water retained in porous rocks some hundred meters deep may be made available. If this water supply is not feasible, and the energy costs within the area are low, freshwater can be produced from seawater. Such plants are now working along the Gulf coast and on many oceanic islands. The brine produced during such operation may be used for the production of several compounds contained therein. Besides these artificial brines the products of salt lakes can be used as well. Such lakes are common in many coastal plains or can easily be constructed on flat water shoals. The main material produced from brine is common salt, which can be used for soda and chlorine production or for domestic use, where it fetches a much better price than the rock salt. Other compounds presently produced predominantly from seawater or brines are magnesia and bromine.

Sea bottom deposits

The possibility to find some raw materials on the sea bottom should thoroughly be studied specially in the case of the development of a coastal area.

There are several resources which may be found also on land, others are restricted to the marine environment. Sand or gravel are widely distributed along certain coasts and in river estuaries. Some coastal areas get already a considerable part of their sand supply from offshore areas (England, Sicily). Sand is not only required by the building industry but also for road construction and the establishment of artificial beaches. Carbonates required for the cement production can be dredged from the continental shelf, where they occur as shells or carbonate sands. Such a production is known e.g. from Iceland. Relatively pure carbonates are known also from limited areas of the deep ocean bottom, where they are formed by the shells of planktonic micro-organisms. Mineral sands with ilmenite, rutil, zirconium, gold or iron sands have already been located in some offshore areas, mainly near the mouth of big rivers. Tin placers are dredged from drowned river vallsys on the Sunda Shelf. For some time even diamonds were dredged offshore the Orange River mouth.

On the Baltic coast, where hard rock is missing on land, blocks and boulders are collected from the seabottom.

Other possible resources on the seabottom near the coast are phosphorites and metalliferous sediments.

Phosphorites occur in the form of nodules, sand or mud in about 40 - 400 m water depth at the edge of the continental slope or on the shelf in those parts of the ocean, where upwelling nutrient-rich water creates a high biologic activity. Phosphates are an important compound of fertilizers which are essential for any kind of agricultural development. After the enormous rise in phosphate prices during the last years local phosphate resources become increasingly important especially for the developing countries.

Metalliferous muds are connected with submarine volcanism and hot springs. The most important material which can be produced from such muds are copper, zinc, lead, silver and sulfur, and in the case that no better deposits are available on land, iron and manganese.

Exploration methods

A systematic development of a coastal area should include a general geological survey during the first stages of such development. In this way most negative interferences between the utilization of the resources of the subsoil and the seabottom with other uses of the area can be avoided. The main objective of the survey is the location of all resources, including minerals, rocks, energy and water. In addition valuable information concerning the soil mechanics of the potential construction areas and the improvement of agriculture can be collected in this way. The first step of a general survey is mapping. Reliable charts which are the base for any further planning can now more easily and quicker be made using satellite and air photos. The use of these new methods is specially advisable in coastal areas to delineate coastlines, mangrove swamps, and reefs. The seabottom morphology cannot be charted from the air. This is done by echo-sounding from ships. After finishing the geographic maps which show only surface morphology, geologic surface maps have to be prepared. Such maps are based on collected surface samples of rocks and sediments. On land geologic mapping and sample collection is generally done by a group of geologists using cross-country cars and, in mountainous areas, helicopters. The instruments commonly used for sampling of the seabottom are graps, dredges, gravity corers, box corers, and piston corers. The collected samples are subsequently analized in laboratories. During this second step of the survey apart from the preparation of the geological map those deposits exposed to the air or the seawater should be localized. Most deposits, however, are hidden in subsoil and can be traced only indirectly by geophysical or geochemical methods or directly by drilling. The later is very expensive and is therefore applied only on structures or anomalies found by the indirect methods. The most common geophysical mehthods are seismic, gravimetry and magnetometry. They can be applied on land as well as on sea. These methods do not detect the deposits but they give a good impression of the subsurface structures of the rocks and sediments. If a certain structure indicates the possibility of the existance of a mineral deposit, special geophysical methods may be applied to the structure. Such methods, e.g. geo-electric, radiometric or detailed magnetic measurements may already indicate character and size of the deposit. Simultaneously with those geophysical measurements geochemical investigation takes place In this case soil or water samples are collected and analized. An elevated percentage of certain elements in a sample indicates that an ore body may be present underneath or nearby. Geochemical investigations can be made on land and at sea. The final proof of the existence of hidden ore bodies and the determinations of their quality and size can only be given by drilling. The normal procedure of systematic resource exploration is presented in Table 1. In some cases parts of two steps can be combined to save time and money.

STEPS	METHODS LAND	METHODS SEA	RESULTS
A) Geographic mapping	satellite photos air photos survey	echo sounding side scan sounding	geographic maps bathymetric maps physiographic diagrams
B) Geological mapping	profiling air photos sampling rock determination shallow drilling	sampling coring sea bottom photographs sediment determination	geological map detection of surface deposits rock characteristics
C) Geophysical survey	air magnetometry land magnetometry gravimetry seismic	air magnetometry sea magnetometry gravimetry seismic sub bottom profiling	location and delineation of structures, certain rock characteristics layering of sediments
D) Geochemical survey	Soil sampling water sampling rock sampling trace element analysis gas analysis	sea water sampling sediment sampling trace element analysis gas analysis	indication of hidden ore bodies
E) Specific geophysical investigation	magnetometry geoelectrical measurements radiometry	magnetometry radiometry temperature measurements resistivity measurement	location of hidden ore or water bodies, certain rock or sediment characteristics
F) Drilling	Shallow drilling for water or alluvial deposits, ore drilling, shaft sinking, deep oil drilling	shallow sediment drilling (vibro coring, geotechnical drillship) deep oil drilling (platform, drillship)	proof and delineation of deposits
G) Evaluation and Feasibility	Pilot phase investigation	Pilot phase investigation	investment decision

Table 1: SYSTEMATIC RESOURCE EXPLORATION

Interaction between mining and other activities

The availability of cheap raw materials facilitates considerably the development of an area. Positive side effects are long-term occupation of man power and possible royalties and taces. Such income can spe ially be axpected from the exploitation of metal and energy resources. Any mining activity needs a certain infrastructure, such as roads, ports, water provision, houses, schools and hospitals for the workers. In this way, discovery of ore bodies alone leads to a certain development of an area. In former time evolution often stopped at this point. When the resources were exhausted the mining site was abandoned and the area fell back into poverty. Today mining activity should lead to a certain industrialization of the zone, at least to the creation of other activities more or less connected with mining.

The negative influences of the mining business are commonly very exaggerated today. Modern mining generally takes all environmental factors into account, and respects nature and the people who have to live in the area. This is especially important for those areas, which are already developed to a certain extent or where tourism is an important or potential economic factor. The emission of tailings into rivers and air can be reduced to a minimum using modern recycling methods. Quarries, open pits and rubble dumps respresent unwanted changes of the natural environment for some people. In monotonous areas they can represent as well a welcome change of the enviromment.

After mining these new structures can be used for other purposes, such as artificial lakes, waste disposal or reforestation.

Good examples for successful resterations of huge surface mining areas are known from the placer deposits of Eastern Australia and the lignite district in West Germany.

SOCIO-ECONOMIC DATA

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Introduction

The practice of some form of management of one or more coastal resources has existed for many centuries. It has not been until the past decade however, that comprehensive coastal zone management has begun to emerge as a concept. This change, can be attributed to an ecological awakening supported by a burgeoning population and its insatiable demand for the resources of the coastline and contiguous waters. The importance of a suitable socio-economic information base to facilitate Coastal Zone Management is reflected in the nature of some designations of geographic areas of particular concern because of direct effects (i.e. rapidity of change; urban redevelopmen limited access) or because of response to externalities and multi-use conflicts (OCS activity; offshore terminals; etc). It is the need to quantify the characteristics of population and their economic environment that creates the need for establishing a suitable socio-economic information base. But socio-economic information is frequently more difficult to acquire because it is less precise than technical information, not as amenable to scale simulation, and more difficult to interpret as a function of boundary designation.

It is not unusual, for example, for erstwhile stable areas to be faced with the instabilities of multiple use conflicts that can only be described in terms of common denominators such as social and economic impact. Therefore, it is not surprising that there are many diverse circumstances in which socio-economic considerations relate to the process of coastal zone management program development. This paper will identify some of them, and assess their implications with respect to the problems of satisfying information needs. The approach to be taken will start with a description of the program development process, illustrated in Figure 1, and proceed then to more detailed consideration of data organization and finally to a brief description of some of the models or approaches to modeling that are employed for this purpose.

General Factors to Consider in Data Base Construction

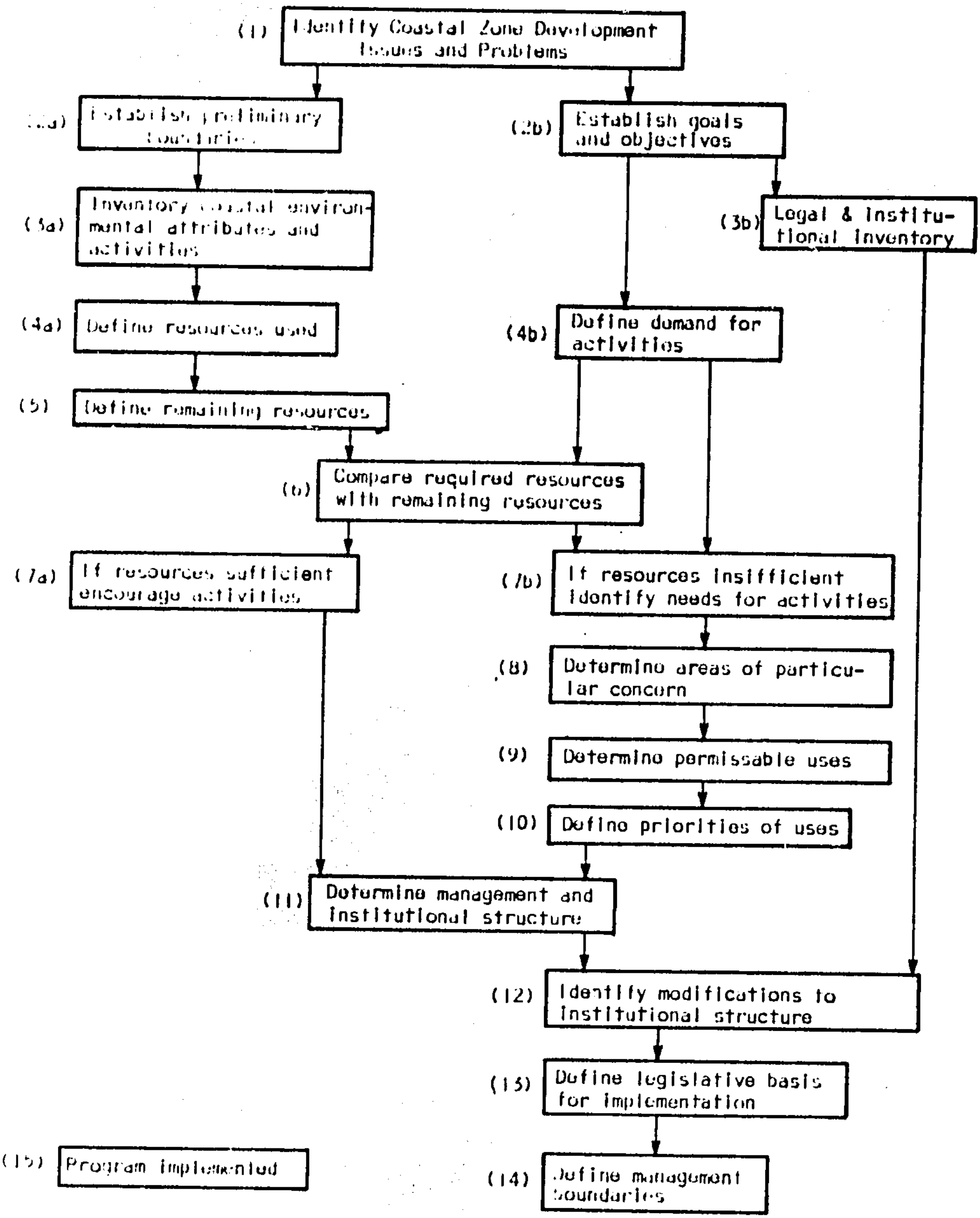
There are a number of general factors that require comment before proceeding with the specific types of information that are needed in order to progress through the process of program development. These include:

(a) The subject of boundaries and how they may effect the collection of information.

(b) Accuracy

Figure 1

Program Development Process



(c) The significance of perspective in the interpretation of data.

(a) Boundaries

(1) Political: The acquisition of data for any purpose has associated with it, collection boundaries. At the grossest level of aggragation one can think of the natural boundaries that define continents or the political ones that define States. There are frequently smaller aggregation units for political subdivisions within nations - variously defined as provinces, states, districts, regions, counties, etc. and also urban units such as villages, towns and cities. Demographic and economic data are usually collected in accordance with political boundaries because the offering of many governmental services is based upon the distribution of people and wealth.

(2) Natural: In comparatively recent time there has been increasing recognition that environmental phenomena do not respect political boundaries. It's so obvious that this fact hardly warrents saying - but institutional and political means to cope with this fact have not kept pace with the realities of nature. The river basin is an excellent example of a natural unit whose well-being has long been intimately related to the distribution of people and economic activity; yet it is only quite recently that information has begun to be aggregated in a way that provides a rational, national or international data base for decision makers. The Delaware River Basin (Figure 2) of the United States illustrates the point, as does the Rhine River Basin, and the soon-to-be-studied Senegal.

(3) The Coastal Zone: A more difficult problem by far is that of boundary definitions for the Coastal Zone. While the seaward extent of the boundary may be easy to define, the determination of upland limits and of transitional areas such as estuaries and bays is likely to be much more difficult on both a national and international basis. The disaggregation of data organized along more traditional lines can become a very significant problem requiring either area specific surveys or an adjustment of Coastal Zone boundaries to avoid the problem. As a case in point, in Figure 3, the primary coastal zone of the State of Delaware is defined by natural criteria as shown by a solid line - this would require difficult and costly data disaggregation. The dashed line on the other hand shows what the boundary would look like if ease of data accumulation were used as a criterion.

The presense of international boundaries and differences in approach by adjacent nations can, of course, add further confusion to an already overly complicated problem.

(4) Diminishing Sphere of Influences: One more aspect of boundaries as it relates to socio-economic data bases deserves comment before moving on to the next topic. One of the principal uses of a socio-economic data base is assessment of the impact of management options on demographic and economic factors. It would be very unusual for there to be a step-wise change in effect associated with and internal or naturally derived boundary - what

Figure 2

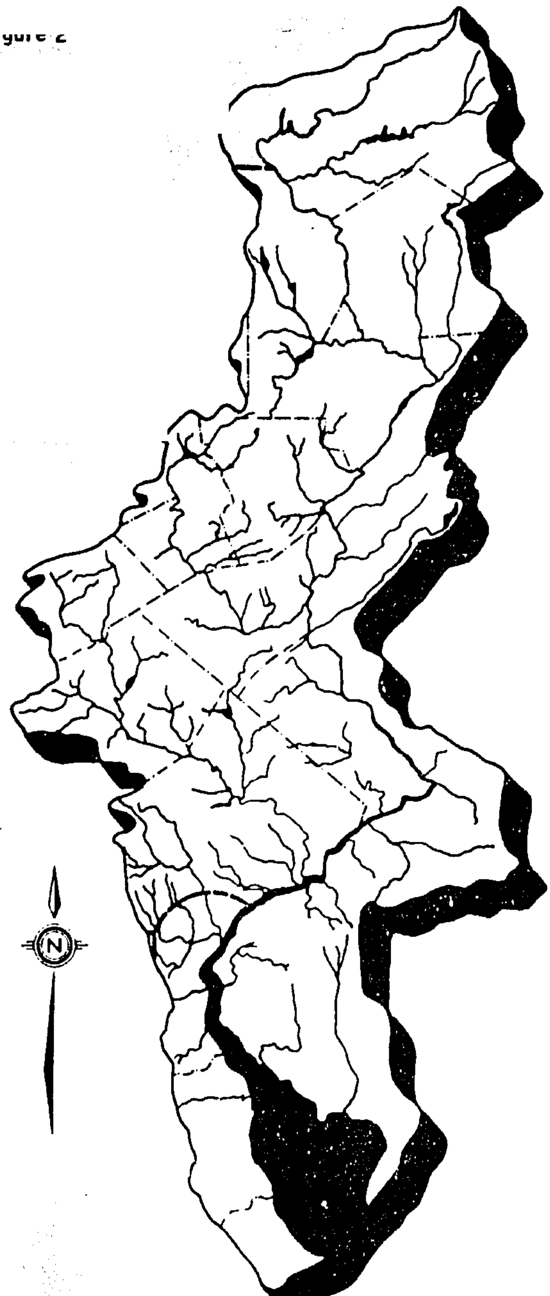
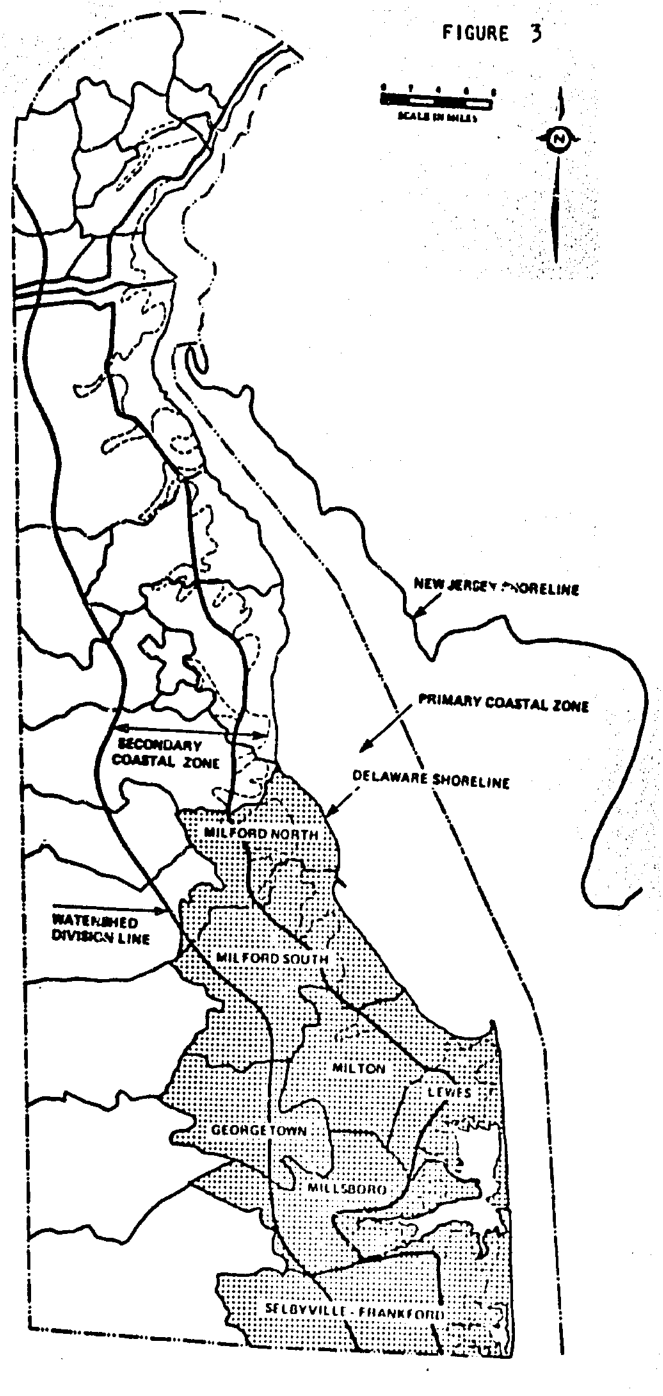


FIGURE 3


SCALE IN MILES
N
NEW JERSEY SHORELINE
PRIMARY COASTAL ZONE
SECONDARY COASTAL ZONE
DELAWARE SHORELINE
MILFORD NORTH
WATERSHED DIVISION LINE
MILFORD SOUTH
MILTON
LEWES
GEORGETOWN
MILLSBORO
SELBYVILLE - FRANKFORD

is more likely is a diminishing sphere of influence. This would be typified by an industry, for example, that has significant effect on a local economy but that may have little or not effect on a regional economy - as a matter of fact, it conceivably might not even show up in regional data. It can be argued therefore that the quality of information (discrimination or accuracy) necessary to evaluate management programs need not be as great as one moves further away from the area of direct impact. The full significance of this argument however, in the absence of 1/0 models, is not intuitively clear, particularly when one also considers the prospect of cumulative effects.

(b) Accuracy

A number of factors enter into the consideration of accuracy as far as socio-economic information is concerned. As already noted, accuracy might be permitted to vary as a function of the diminishing sphere of influence, and also as a function of the scale of estimation, e.g. the ability to discriminate (or requirement to discriminate) differences between two alternative conditions changes significance as the characteristics of the area being investigated change from say urban to rural. Second, accuracy should be expected to vary as a function of prediction period - a socio-economic data base should be able to be extrapolated, since most uses include some assessment of future conditions. But the reliability of the estimate generally decreases rapidly with time. On the basis of statistical arguments, accuracy can also be expected to vary as a function of the sample size used to develop estimating relationships; a model based on a large sample size should yield more reliable estimates than one derived from a small sample.

(c) Perspective

The last general factor to be mentioned before proceeding to a more detailed discussion of data needs is the influence of perspective on the selection of socio-economic information.

The selection of parameters to be included in the socio-economic data base should be predicated on the value of the data to the management process and on the ability of the manager to explain the impact of decisions on two user groups, - those already present in an area and those wishing to be present. What generally differs between the two is perspective - the local inhabitant may be motitivated by grossly different considerations then the newly arriving, and both interests should be served. The importance of this factor increases as the potential for multiple use or life style conflict increases. The data necessary to develop arguments for evaluating the intrusion of industrial development on a recreational/retirement environment, for example, should include a factor such as age distribution because from one perspective it facilitates the evaluation of the social impact of life stage difference and from another the economic impact of newly created needs.

Specific Data Requirements

(a) General Considerations

As noted in the introduction, specific socio-economic data requirements can be identified to each of the numerous steps required to develop a coherent and rational coastal zone management program.

The extensive variability of information type, and depth of detail necessary to support the aforementioned processes and models can be illustrated by the following example

Consider the various economic characteristics of an activity located in a coastal zone, any activity. At the grossest level of detail and in a broad sense of the word economic, any activity can be defined by its:

> Land use requirements; acreage, geographic location.
>
> Process characteristics; use of water, energy effluents, transportation services, etc.
>
> Establishment characteristics; number of participants, units of output, capital assets, etc.
>
> Measures of effectiveness; units of output per participant, units of output per unit of input resource.

As one focuses on a more specific site/activity relationship it may be advantageous to define economic characteristics in greater detail Thus more detailed definitions for those items specified above could include the following:

> Land use requirements defined in terms of zoning designation, acres devoted to buildings, areas devoted to parking, linear feet of shoreline for piers, etc.
>
> Process characteristics defined in terms of gallons of water/day of a given quality, etc.
>
> Establishment characteristics defined as number of employees by skill category, output by model type, capital assets by class, etc.

It becomes readily apparant that data requirements can become extravagant so early consideration should be given to the development of data selection criteria such as utility to user, effect on accuracy, availability of common substitute (or proxy variable) and the like.

In the interest of controlling the cost of data bank development, a consolidation of individual requirements should be effected, so that where possible, a number of process requirements can be satisfied by one data set.

Data Needs of the Program Development Process

The discussion of the diverse data requirements for each type of process will start with the Program Development Process. Looking first at Step 1 of the Process. (Figure 1), "Identify Issues and Problems of the Coastal Zone", it is likely that subjects such as extent of resource development, life style, and economic growth will be high on the list of items identified. Factors such as these are not generally directly measurable either because they are not sufficiently well defined or because they are composites of a number of variables which are themselves socio-economic parameters, Life style, for example, would be a multi-dimensional construct derived from age distribution, income distribution, population density, housing unit type and distribution, land use distribution and other factors. Similarly, economic growth and resource development should be characterized by a number of different parameters. In an ongoing, interdisciplinary team research project led by the author, the ecological concepts of diversity and productivity have been applied to industrial, recreational and conservation activities in order to provide a basis for defining the parameters of interest. Included in the list of socio-economic parameters are:

As Measures of Productivity

(1) Total Employment
(2) Employment Stability
(3) Proportion of Employment - Which is Local
(4) Wage Level
(5) Size of Input Base
(6) Productive Process
(7) Multiplier Effects
(8) Capital Ownership
(9) Effects on Land Values

As a Measure of Diversity

(1) Industry Mix

A recently completed compendium of industrial characteristics, a more restrictive activity classification, includes the following socio-economic parameters:

Employment Characteristics	Income Generated	Support Industry Requirements	Other Requirements
a) Professional	a) Average Income per Employee	a) Forward Linkage	a) Energy requirements
b) Skilled	b) Relative income level	b) Backward Linkage	b) Proximity to markets
c) % Female		c) Concentration Dependence	c) Land Use
d) Average jobs/plant		d) Urban Orientation	d) Water Use
e) Seasonal fluctuation			

These are readily recognized as characteristics that are examined when industry location descisions are made.

Even at this fist step then, it becomes apparent that there are probably a very large number of socio-economic parameters that should be taken into consideration when formulating a Coastal Zone Management Program, and that there is a certain universality of data needs whether considering the general question of economic growth potential, the coastal zone or any other aspect of socio-economic impact.

program goals and objectives, Step 2b, will unquestionably also include socio-economic elements. It is quite likely that the parameters defined as measures of the problems and issues of Step 1, will be the goals and objectives of this step. In order, therefore to determine whether or not goals and objectives are reached, it is necessary to include their measures in the historical data base; income per capita, employment, recreational opportunities per capita are examples. Continuing through the process, as noted in Step 3a an inventory of coastal activities is also required. Such an inventory would contain socio-economic data of the grossest type, data pertaining mostly to the establishment characteristics as described earlier. In Step 4a the establishment characteristics data base would be expanded to include exogenous resources required to support the socio-economic activity. These include characteristics such as water needs, effluent streams, energy needs, etc. and also land use requirements. The types of data that define the demands for activities of Step 4 will probably include extrapolations of existing activities such as those identified in 3a, as well as totally new ones for an area that may derive from the examination of analogs or from future studies. The ability to deal adequately with the remainder of the steps of the process will depend to a great extent on the data developed in the earlier steps with only few exceptions.

No unique data will be required to facilitate completion of Steps 5 through 7 if an adequate data base has been established for the proceeding steps.

The same can be said for steps 8 through 10 except that the data necessary to support the functional requirements also depends to a great extent on the selection criteria used to accomplish the purposes of these steps.
Measures of the rate of economic and social change are suggested in Step 8. The rationale among criteria suggested for delineating "Areas of particular concern" for this selection is predicated on immediacy of need providing a focus. Appropirate socio-economic characteristics of rate of change would be population or worker migration, land use shifts to the industrial sector, and other similar parameters. These are not unique requirements and would therefore not require additions to the data base.

Factors to consider in determining permissible uses (Step 9) include criteria and measures to assess use impacts. Economic criteria and the related measures would include:

Criteria	Measures
Regional Income	Currency of the realm
Employment	Percent employed
Tax Base	Appraised value
Net Tax Revenue	Currency of the realm
Per capita income	Currency of the realm

Social criteria and measures would be:

Criteria	Measures
Socio-economic Mix	Percent by group
Net Affect on Population	Numbers of people
Employment Opportunities	Job density

These, too, are not unique in light of previously defined requirments.

In order to establish priorities of uses, as suggested in Step 10, there are a number of socio-economic factors that should be taken into consideration. One such factor is the maintenances of "diversity" or, in the case of cultural diversity, pluralism. Another is "economic efficiency" which might be measured by the cost of providing services, land-use per unit of production and other similar measures of effectiveness. Social equity is still another factor measurable, at least in part, by opportunities per capita within social groups. Regional benefits, national interest, and fair share of social responsibility are yet others with strong socio-economic implications.

The data requirements implicit in these factors, as indicated below are really no different than those described earlier; what differs is historical precedent and analytical perspective.

Factor	Measures
Cultural Diversity	Interest group affiliation and associated age, education, income, ets. distribution by affiliation.
Economic Efficiency	Distributions of service costs, land use, employment, tax benefits, etc. per unit industrial capacity.
Social Equity	Extent of recreational and aesthetic resources and distribution of opportunities per capita as a function of proximately, cost per use, etc.
Regional Benefits & costs	Change in employment, production, secondary economic effects, recreational resources, land use, etc.
National Interest	Land in government use, net inter-regional transfers
Social Responsibility	Production from undesirable uses per capita.

Some of the remainder of the steps in the process, 11-15, may require the collection and analysis of socio-economic data particularly that related to tax receipts (amounts and services) and expenditures (items, amounts, etc) and land use modifications.

The persistent recurrence of the same generic data needs from step-to-step should not be surprising. What makes the data problem very difficult to manage however, is the numerous different specific situations which must be covered. There are dozens of affiliations, hundreds of industries and land use categories, and numerous other groupings to consider. Data organization is therefore an important factor to consider in establishing a socio-economic data base.

Data Organization

The data organization problem requires consideration of two factors. First, the establishment of an information hierarchy. This identifies the relationship between data types, including causality where possible and facilitates the selection of proxy variables if it is too costly or otherwise impractical to collect the desired data.

Second, and related to the first, is the problem of weighting if indexes are constructed to relate non-commensurable data. The weighting problems frequently result from incomplete accountability.

A number of studies of Coastal Zone activities in the United States have created hierarchal listings of socio-economic parameters that should be considered in establishing an adequate data base. Table 1 & 2 illustrate the types of structures utilized. The first of these, Table 1 illustrates, in the first 5 levels, the tremendous number of groupings under which the remaining data may be organized. Table 2 illustrates a different type of structure, one which incorporates a weighting scheme that permits 26 'effect' variables to be included based upon only six causal socio-economic factors: The inter-relationships are defined subjectively, the weightings are subjective and the determination of whether the relationship is direct or inverse is intuitive. The parenthetical notations for noise and pop density exemplify logical differences of opinion that should be expected.

A considerable depth of detail can be incorporated into this type of display limited only by the practicality of data accumulation. Since one of the purposes of this type of display is organization for accountability, the primary concern should be with completeness and then only with practicality.

Some Concluding Considerations

In closing, I want to mention briefly some of the considerations that should enter into establishment of a socio-economic data base supportive to the needs of the decision maker for modeling and problem delineation tasks.

As has been noted in earlier discussion, a particularly important aspect of Coastal Zone Management Program development is the ability to evaluate the socio-economic impact of management decisions. This is of particular concern in the resource allocation process with which the decision maker ultimately establishes areas of particular concern, permissible uses and priorities of uses of the Coastal Zone.

In order to assess impact, a methodology must be employed that utilizes some form of a data base that is compatible with whatever modeling technique is selected by the user organization. First it is necessary to establish a baseline situation and then to forecast activity for the same time periods with the appropriate Coastal Zone programs included. The types of economic variables that would be considered are tabulated in Table 3.

Table 1

Cataloguing Hierarchy

LEVEL 1	2	3	4	5	6	7	8	INFORMATION ELEMENT
x								Perspective (Historical, Contemporary, Planned)
	x							Geographical Bound (Shoreline, Coastal, Hinterland)
		x						Sphere of Influence (Local, Regional, Super-Regional)
			x					Role (Cause, effect)
				x				Environmental Regimes (Natural, Social, Economic)
					x			A. Industrial and Commercial Activity
						x		1. Fishing
						x		2. Tourism and Recreation
						x		3. Port Activities
						x		4. Shipbuilders
						x		5. Heavy Manufacturing
						x		6. Minerals, Materials, and other
							x	1. Plant locations, where industry will likely move
							x	2. Logistic support activities
						x		3. Location of areas of exploration interest
						x		4. Petrochemical plants and locations
					x			B. Demography
						x		1. Population
						x		2. Income and employment
						x		3. Education and job skills available
					x			C. Land and Water Use
						x		1. Land ownership maps-private, State, military, Federal, Indian, etc.
						x		2. Urban-Industrial
						x		3. Agricultural
						x		4. Conservation/Preservation
						x		5. Recreation/Historical/Archeological
						x		6. Present land use controls and constraints and projections therefor
						x		7. Other appropriate features

TABLE 2

Area	Year	Total Earnings Absolute	Total Earnings %	Total Employment Absolute	Total Employment %	Per Capita Income Absolute	Per Capita Income %	Per Worker Earnings Absolute	Per Worker Earnings %	Total Personal Income Absolute	Total Personal Income %	Total Population Absolute	Total Population %
Region	1980	7,439,872	17.5	768,900	15.3	223	6.2	154	1.9	9,302,592	17.0	1,054,666	7.6
	2000	15,056,912	15.0	929,528	13.6	515	7.6	185	1.3	19,298,144	14.8	1,211,376	6.6
	2020	23,158,560	10.1	857,859	9.4	656	5.5	166	0.7	30,198,784	10.0	1,098,992	4.6

ASSESSMENT OF ECONOMIC AND SOCIAL EFFECTS OF ALTERNATIVE D 1 WEIGHTED SCORES

EFFECTS	WEIGHTING FACTOR	EQUIVALENCY	REGION 1980	REGION 2000	REGION 2020	
Employment, Income, & Earnings	30					
Total Employment	x .20	6	92	82	56	Total Employment
Income Distribution	.20	6				Omit
Per Capita Income	.20	6	37	46	33	Inc./Capita
Total Personal Income	.20	6	102	89	60	Total Per. Inc.
Earnings/Worker	.20	6	12	8	4	Earnings/Worker
Population	20					
Displacement	.40	8				Omit
Density	.40	(D) I 8	-61	-53	-36	Total Population
Mobility	.20	D 4	61	54	37	Total Population
Housing	5	D 5	-38	38	27	Total Population
Educational System	5	D 5	-38	38	27	Total Population
Health	5	D 5	-38	38	27	Total Population
Business & Industrial Activity	5	D 5	88	75	50	Total Earnings
Agricultural Activity	5	5				Omit
Transportation	5	D 5	-38	38	27	Total Population
Land Use	5					
Level of Use	x .40	D 2	35	30	20	Total Earnings
Displacement of Agri. Land	.20	1				Omit
Property Values	.20	D 1	17	15	10	Total Earnings
Undeveloped Land	.20	I 1	-18	-15	-10	Total Earnings
Government	5					
Revenue (taxes)	.50	D 2.5	43	37	25	Total Revenue
Public Facilities & Services	.50	D 2.5	-19	19	19	Total Population
Recreational Opportunities	3	D 3	-23	23	16	Per Capita Income
Community Cohesion	2	2				Omit
Cultural Opportunities	1	D 1	17	15	10	Total Earnings
Noise	1	(D) I 1	-18	-15	-10	Total Earnings
Esthetic Value	1	I 1	-2	-7	-5	Total Population
Historic Value	1	1				Omit
Archaeologic Value	1					Omit
Total		100	205	555	382	

Table 3

Economic Impact Variables

- Employment level
    - by industry
    - by occupation
- Output
- Income level & distribution
    - by type
        - wages and salaries
        - property
    - by family income level
- Resources required
    - land use
    - energy
    - water
    - capital
    - labor
    - material

Demographic Impact Variables

- Population and population trend
    - by geographic division
    - by political division
- Work Force and Work Force trend
    - by sex
    - by political division
    - by geographic division
    - by age group
- Migration patterns and trends
- Minority group participation
    - in work force
    - in industry
    - earned income proportion

One particularly useful tool for this analytical purpose is the I-O model which records the flow of goods and services between segments of an economy considering effects of employment levels, technological state-of-the-art, and other exogenous factors such as environmental and energy policy.

Another tool, useful as an adjunct to an I-O model, is the econometric model which summarizes the activities of an economy in a series of equations. One difficulty with constructing such a model is that the coefficients for the equations's variables can only be estimated from time series data, whereas the extension of an existing I-O model only requires data for a single point in time. The fundamental instability of such models when pushed more than a year or two into the future argues against dependence on them.

The expedient of impact synthesis from unit trends derived from program element analogs is probably the least desirable but most pragmatic way of developing an impact assessment. The basis for developing such models, for example, could be the calculation of estimating coefficients for a known type of activity in a relevant region where data is gathered and then applying them to a potentially new activity in the same or a new region. This approach is, of course dependent on the availability of data from analogous regions - it does not preclude the need for information. It simply shifts the collection site. In a manner similar to the treatment of data requirements for the economic aspects of impact assessment, demographic data is necessary in order to determine sociological impact. The type of information collected is also illustrated in Table 3.

The sole reason for this brief discourse on socio-economic impact assessment and evaluation has been to gain further insight into data requirements, and serves to point out the strong interdependence between methodology (or technique) and data base. The process of methodology development and the establishment of data needs are, however, an iterative process with feedback between the activities based upon the desired predictive value for the methodology.

The concluding thought that I would like to leave with you concerns the general role of data in the impact assessment process vis-à-vis analytical techniques and decision making.

It is important to think of Coastal Zone data, socio-economic and other, in the context of two functions.

(1) As a device for defining an appropriate methodology to be used in a decision making process.

(2) As an input to a methodology that will yield information which a decision maker can then employ in his decision making process.

Socio-economic data should therefore be considered as a building block in a methodology scheme - it is, as a matter of fact, the keystone of any methodology and the decisions that arise from it.

MANAGEMENT TECHNIQUES

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I. Introduction

In order to place the subject of management techniques in proper perspective, I would like to start this paper with a few definitions.

First, as the title denotes, I will deal with TECHNIQUES. The term is defined as:

"The mechanical or formal part of an art; the manner of artistic execution or performance in relation to formal or practical details."

It is not uncommon to hear the term "Methodology" used in the same context as technique. A commonly accepted definition for methodology is:

"A treatise or dissertation on (method)...
... a special form of procedure adopted in any branch of mental activity whether for the purpose of teaching, exposition or for investigation and inquiry.
... a way of doing anything according to a defined and regular plan; a mode of procedure in any activity."

In practice, therefore, our techniques may utilize methodologies for dealing with certain aspects of management activity.

The number of active Coastal Zone programs in the United States and elsewhere in the world has led to the development of a large number of approaches for handling the management process reinforcing the thesis that we are in fact dealing with an art form when we deal with the function of Coastal Zone Management. The causes for differences between programs are many and in some cases are attributable to Cite specific factors which, on an international scale may include:

- Political traditions and processes
- Degree of environmental consciousness or awareness
- The available information base, and
- Program objectives

On examining these many approaches however, one finds the frequent recurrence of certain phenomena and characteristics. These are the few generic management concepts and techniques that are found to underlie the management process. It is some of these that I will discuss in this paper.

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II. Terms and Jargon

Before going further a brief digression may be beneficial in order to explore some additional terms and jargon that are likely to emerge in later discussions about techniques.

Common to most Coastal Zone Management situations is the necessity to allocate limited resources to a variety of uses (including sometimes conflicting uses). Among the several rational ways in which this can be done are those based on ....

... carrying capacity, i.e., allocations governed by limitations on the capacity of certain resources to absorb impact, (3,000 visitor days per year per campsite, 8 septic tanks per square mile).

... intensity of demand, i.e., allocations governed by the socio-economic forces of supply and demand. Proportional allocations as a function of demand and supply/demand differences are examples. (Ten percent of the land for industrial use -- 20 miles of beach for recreation.)

... performance criteria, i.e., allocations based on impact limits for the system, derived from modifications made to resources within the system. Instead of controlling ground water recharge by the allocation of residential use, control the aquifer recharge rate by run-off contraints; instead of controlling conversion of land to agriculture, control the allowable sediment load contribution by a watershed. (Non-point source run-off of no more than 500 tons of sediment/year; a population density no greater than an average of 3oo/square mile.)

The differences between these statements are large in principle. In the first case, the resource variable is controlled by controlling the <u>level</u> of activity involved. In the second case, the resource variable is controlled by controlling the <u>type</u> of activity involved. In the third case, the resource variable is controlled by the way in which use of the resources contributes to the state of the entire resources system and may have an extensive number of permissible uses if technology can influence (ameliorate; mitigate) the impact -- the parenthetic terms are part of the jargon.

Frequently when discussing technique and methodology, questions and comments arise concerning <u>policy</u> level <u>"guidelines"</u>, implementation <u>guidelines</u>, implementing <u>"regulations"</u>, etc. The terms "policy", "guidelines", and "regulations" require clarification if there is to be common ground for the discussion. For this purpose, therefore, these terms are defined as follows:

"Policy" - Any plan or course of action adopted by a government, political party, business organization or the like, designed to influence and determine decisions, actions, and other matters.

"Guidelines"- A statement of a course of action, guiding principle or procedure considered to be expedient (appropriate to the purpose at hand) prudent (wise in handling practical matters) or advantageous made by a person or group of persons having authority over an activity.

"Regulations" - Principles, rules, or laws (or governmental orders having the force of laws) to control or govern behavior.

I also feel certain that during the course of this discussion, a number of organizational entities will be identified that are created to support the evaluation of suitable management techniques. Committees, Task Forces, and Commissions, for example, frequently are called on to assist the Executive Branch of government. There are many reasons that can be offered for doing this, but perhaps most importantly it is done in order to:

(1) Spread the responsibility for decisions and improve their credibility.

(2) Bring special expertise to bear that is not otherwise available to the governing body.

(3) Broaden the governing body's perspective with respect to the interdisciplinary nature of coastal zone issues.

In general then, these appellations as used in this paper refer to bodies of persons appointed or elected for some special business or particular function or piece of work in connection with program development.

III. Some Concepts that Affect Technique

Moving on to the next aspect of the question of techniques, we find that underlying the development of Coastal Zone Management there are some percepts for constituency involvement and resource allocation that can have significant impact on the evolution of both technique and methodology. In order to make my point in both situations I will use arguments at the extremes of what may in reality be a continuum of solutions.

A. Constituency Involvement

In defining the spectrum of constituency involvement, at one extreme we would find Dictatorial or Autocratic Development. A program that evolves in this environment would probably not involve the public in the process of program development, thus there would probably be no provisions in the technique or methodology for review of any type. An option involving a higher degree of constituency involvement could be classified as Reactive Development. In this situation the program would be the product of the technician but would make provision for a wider base of reaction to the program with some assurance of responsiveness on the part of the originator. Under these circumstances, the methodologies evolved would probably make provision for review hearings and program development reiterations prior to implementation. At the other extreme of involvement there is Participatory Development. In this option the methodology must make provision for representatives of constituency groups to help in the process of both program evolution and review.

In summary, with respect to the differing roles of constituencies, the principal impact on technique and methodology will be in the provisions made for participation in program formulation, review, and reiteration (or feedback).

B. Resource Allocation

With regard to the approach to resource allocation, there are a number of factors that should be considered simultaneously to arrive at the range of options that will affect methodology and technique; several hundred options exist. These are individually summarized in the following statement of attitudinal factors:

> Can the attitude of the nation toward use of the coastal zone be considered exploitive or conservative?
>
> Does the government exercise leadership or controllership; are they more likely to induce cooperation or prohibit deviation, anticipate needs or regulate demand; provide service or permit services to be supplied?

The factors add up to an attitude with respect to management philosophy that can cover the gamut from strongly positive or negative toward development or conservation. The most negative attitude is controllership through prohibitive regulation of demand with only permitted services for both exploitive and conservative uses. Conversely, the most positive attitude would be reflected by a government that exercised leadership by inducing cooperation and providing services in anticipation of needs.

IV. Coastal Zone Management as a Process

A. Introduction

The practice of some form of management of one or more coastal resources has existed for many centuries. It has not been until the past decade however, that comprehensive Coastal Zone Management has begun to emerge as a concept. This change can be attributed to an ecological awakening reinforced by a burgeoning population and its insatiable demand for the resources of the coastline and contiguous waters.

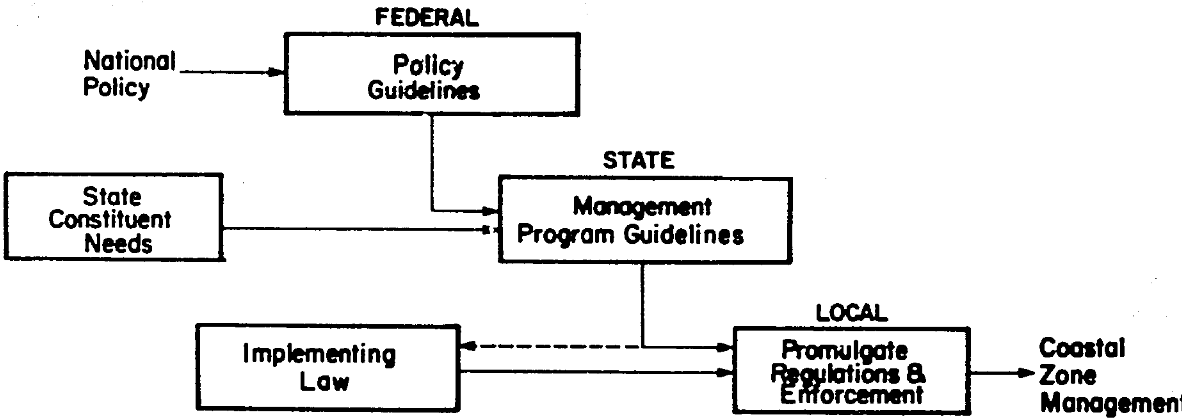
The management concept as it has evolved comprises a sequence of activities each of which can be accomplished in any of a number of alternative ways. It is an explanation of these various approaches to performing the sequential steps that comprises the body of this section of the paper.

B. The General Concept

As a process, it is convenient to think of a coastal zone management program, as a means for allocating limited resources to satisfy recognized needs. <u>What and whose needs</u>, <u>what resources</u>, <u>whose allocation</u>, and <u>how allocated</u> are the most significant questions to be answered. Under any implementing situation, policy must be declared, guidelines and constraints specified, standards and regulations specified, and enforcement begun.

As noted in the beginning of this paper, the answer to many of these questions will depend upon the operating characteristics of the implementing states. Thus, in the United States, with its hierarchal form of democratic government, the process explained in its simplest form will probably involve at least three levels of government which can be graphically portrayed in Figure 1.

Figure 1



Adaptec from the Water's Edge, Structure of Management and Planning, Goodman _et al_., 1972.

If the form of organization is less complex then, as illustrated in Figure 2, the process simply moves into a single tier arrangement but possibly still differentiated departmentally.

As might be expected there are numerous internal activities included in each of the major elements portrayed in Figure 1. The formulation of a "National Policy" for example, as illustrated in Figure 3 will probably have contributions derived from special publics, the various branches of government (whatever their place in the hierarchy), and advisors (both technical and user oriented).

The "Policy" may then be defined as a program and interpreted as guidelines for those expected to take it the next step in the sequence. This task may well be accomplished by an organ of government.

The promulgated guidelines together with more specific information as to local needs and objectives (probably determined with the help of publics, advisors, and government officials), then becomes the bases for the next stage of program development - the promulgation of regulation implementation guidelines.

Once regulations become law and implementation guidelines are developed, it then becomes logical to establish permit and appeals processes, standards for performance and monitoring systems to assure the compliance of proposed projects, and to accomodate alterations to the system if necessitated by changes in policy or needs.

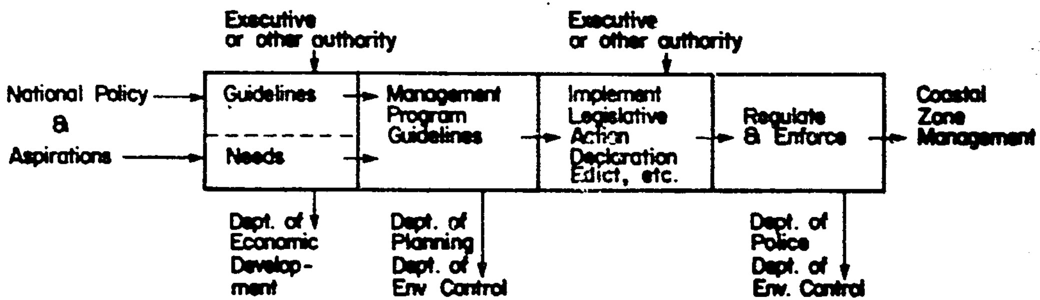
At each step along the way the potential should exist for comparing the product of that step with the goals that were sought to be accomplished. These are the feedback loops in the system that facilitate adjustment of the system to meet the initial objectives and also provide a basis for evaluating the modifications.

C. A More Detailed Review of Concepts

As this review of technique and methodology unfold, the term "model" will sometimes appear. It is a term which is frequently associated with mathematical approaches to problems, however, in the context of this paper the term is used to describe any flow of thought or logic which can be depicted by any of a number of system analysis tools such as flow diagrams, information matrices, equations, etc.

Models can satisfy a number of purposes when used for describing a comprehensive interdisciplinary situation such as Coastal Zone Management. First, it can quickly identify the activities required for a program to proceed. Second, it helps to develop thought processes by organizing activities into a logical pattern of development. Third, it helps identify the outputs of a process and fourth, it helps identify data requirements.

With the above mentioned factors in mind, and moving further away from the gross generalities of the institutional model described in the previous section, there are a number of more detailed approaches to organizing and analyzing Coastal Zone Management program activities that should be explored.


Executive
or other authority
Executive
or other authority
National Policy
&
Aspirations
Guidelines
Needs
Management
Program
Guidelines
Implement
Legislative
Action
Declaration
Edict, etc.
Regulate
& Enforce
Coastal
Zone
Management
Dept. of
Economic
Develop-
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Dept. of
Planning
Dept. of
Env Control
Dept. of
Police
Dept. of
Env. Control

FIGURE 2

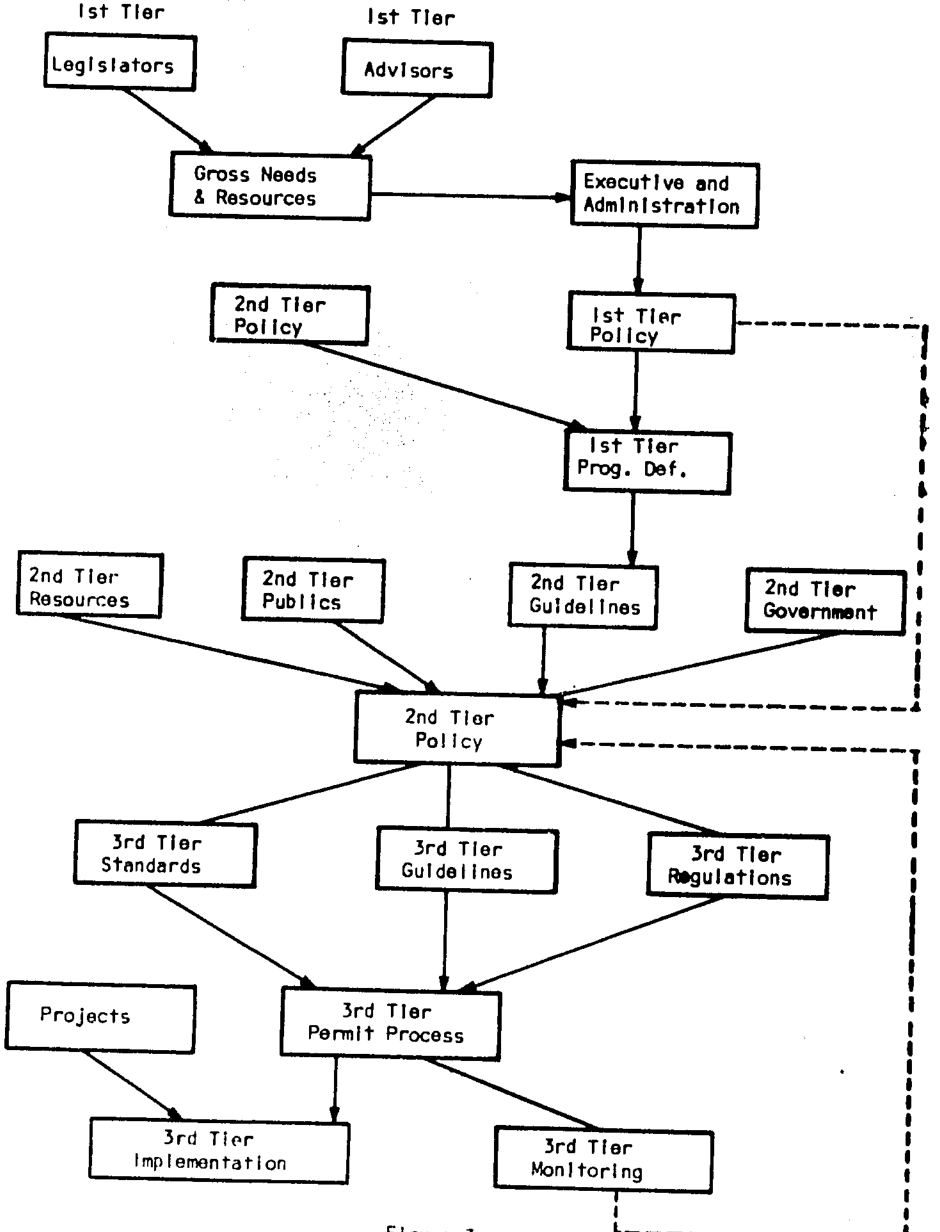


Figure 3
Program Policy Formulation

Adapted from the Water's Edge, Structure of Management & Planning, Goodman, et al., 1972.

The most comprehensive of these describe policy development processes, planning processes and program development processes. These all appear to be parallel constructions that reflect the disciplinary perspective of their advocates or are special cases that reflect a prejudgment as to the desired form of an institutional structure.

For ease of presentation flow charts will be used to describe the processes.

The program development process as a whole is depicted in Figure 4.

In Step (1) it is necessary first to identify, by some means, the issues and problems related to Coastal Zone resource development. In some instances there may already exist some historical perspective of the general problems that relate to a State's shoreline and contiguous land or water bodies. In other cases it may be necessary to conduct surveys or employ other devices to develop a sense of the concerns.

The determination of "what resources" requires several steps in the process. First, in step (2), preliminary boundaries are established and initial program goals and objectives are defined. Both are of a preliminary nature simply because it is easier to reiterate a solution than to work with an unbounded problem. The boundaries though preliminary, should not be arbitrary. They should relate to some natural or physical constraint or to some hitherto recognized political jurisdiction.

Next, in step (3), a variety of inventories are called for -- in brief, with respect to environmental attributes and activities, one must know what's there before logical recommendations for development action can be made. Similarly, one should be aware of the existing legal and institutional framework before considering new or modifying actions.

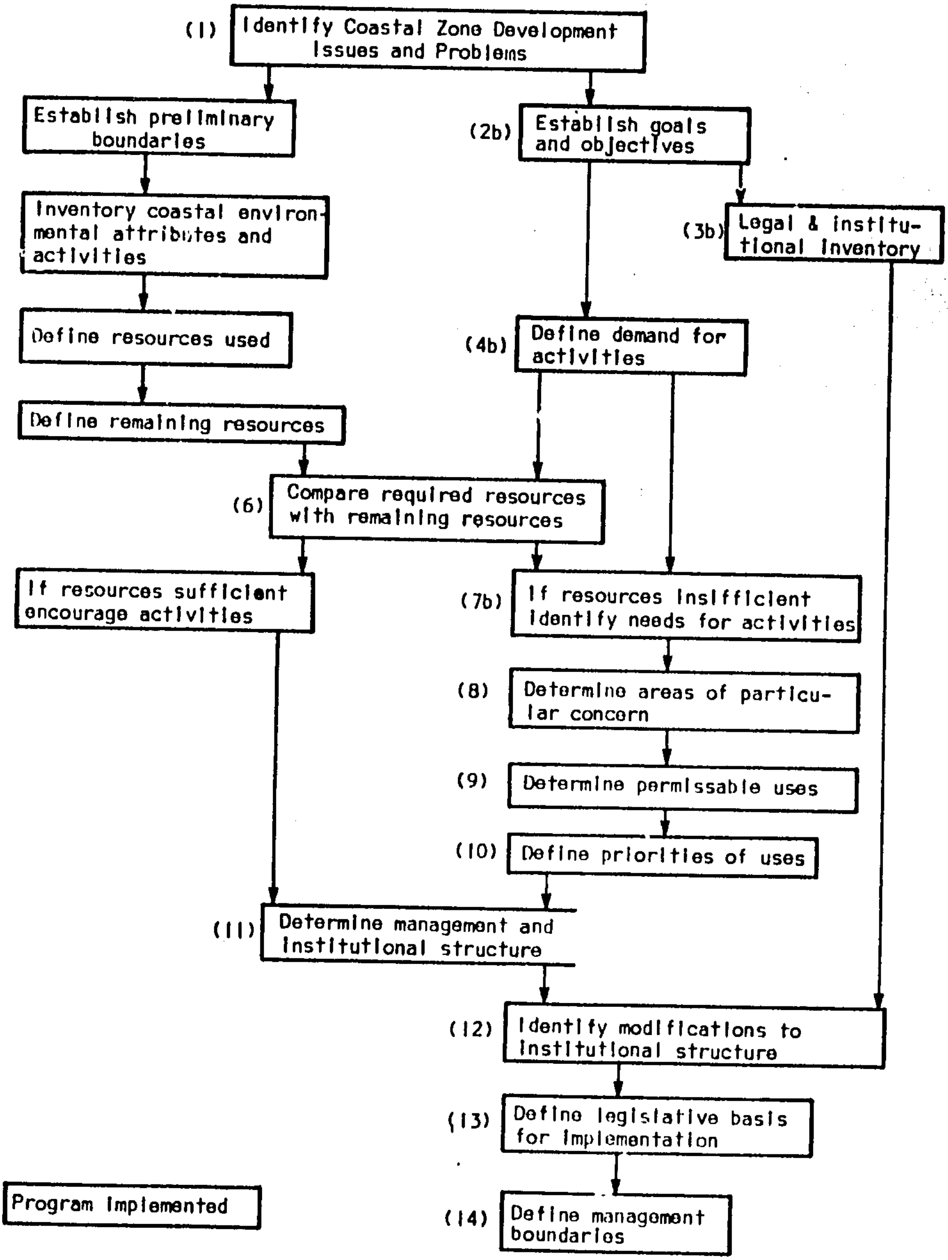
Finally, in step (4), resources used are identified and their capabilities stated. Also in answering the question "whose allocation?", in step (4) demands for activities are assessed based upon various types of projections such as population, economic growth, demographic characteristics, etc.

It is important to note the differentiation between "needs" and "demands". Given a limited resource, it is entirely possible that demands may outstrip needs, and their reconciliation can provide a basis for voluntary rationing of particularly scarce resources.

Lastly, in answering the question "how allocated?", in step (5) remaining resources are defined in terms of their physical attributes and cpabilities. Then in step (6) these remaining resources are compared with resources requested to satisfy demands. If the re-resources are sufficient then as indicated in step (7a) it is reasonable to encourage the activities at the level demanded. Sufficiency of resources as used here relates not only to physical extent and attributes, but also the ability to absorb the impact resulting from its use for a particular activity or set of activities. If the resources are insufficient then in step (7b) "needs" must be identified, either as a subset of demands or in response

Figure 4

Program Development Process



to modified goals and objectives. (It is apparent then, in this process flow simplification, that feedback loops have been eliminated for clarity.) When considering the allocation of "needs" it is important to realize that a process of joint negotiation is at least implicitly taking place.

In the first place, it can be reasonably premised that current human demands will always exceed needs -- but unsatisfied demands can be a source of both real and imagined grievances. Second, physical and capability resources limits may modify the relative priority of even satisfying human needs, by introducing non-human and/or long range needs. Thus steps (8)-(10) are required to complete the allocation process.

Step (11) results in the determination of the management and institutional structure deemed necessary to implement the program. When in step (12) this is compared with the existing structure, then the legislative (or executive) basis for implementation can be defined in step (13) and finally boundaries defined and the program implemented.

In more conventional form, Figure 5 shows the implied feedback loop (dashed line) and location of steps (8)-(10) in the process.

D. Second Tier Models

A second tier model is one which identifies task requirements in a specific rather than conceptual sense, and which usually treats only a protion of a process.

One such model, a resource allocation process, was created to assist the State of Delaware develop its Coastal Zone Management program and is illustrated in Figure 6. The creation of the model itself was an interesting display of technique at work as exemplified by the interplay between the Program Development Agency, a Citizens Advisory Group and the Contractor.

A quick comparison of this model with the one describing the Program Development Process shows that the former describes in greater detail steps (3)-(10) in the latter. As the explanation proceeds it will become apparent that even at this stage of development some processes, and detailed methods and techniques are still not well specified.

Items (A_1), (A_2) and (A_4) are inventories. A number of classification schemes for differentiating areas on the basis of natural characteristics and form of use have been developed. Whatever the scheme selected, it should be consistent with the capability of survey techniques and level of required discrimination for management purposes. Left undefined at this point, are the characteristics of the survey techniques employed and of the resource units. Some of the methodologies proposed will be described in the next section.

Item (A_3) in the process pertains to determining perceived future desires for land and water use by parochial

Figure 5

Schematic Program Development Process

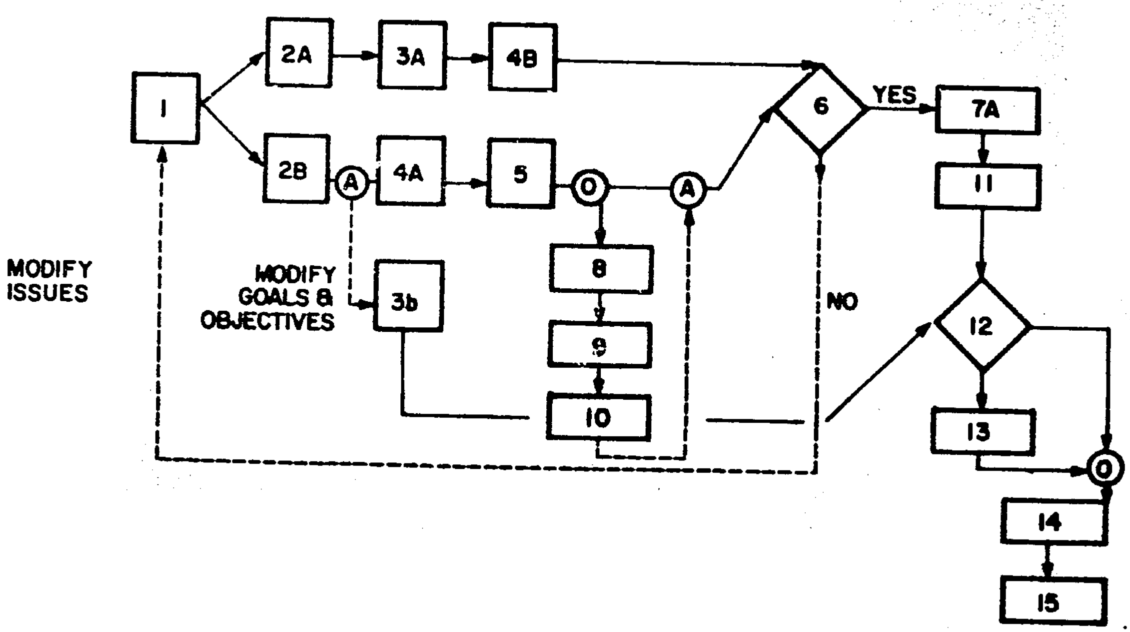
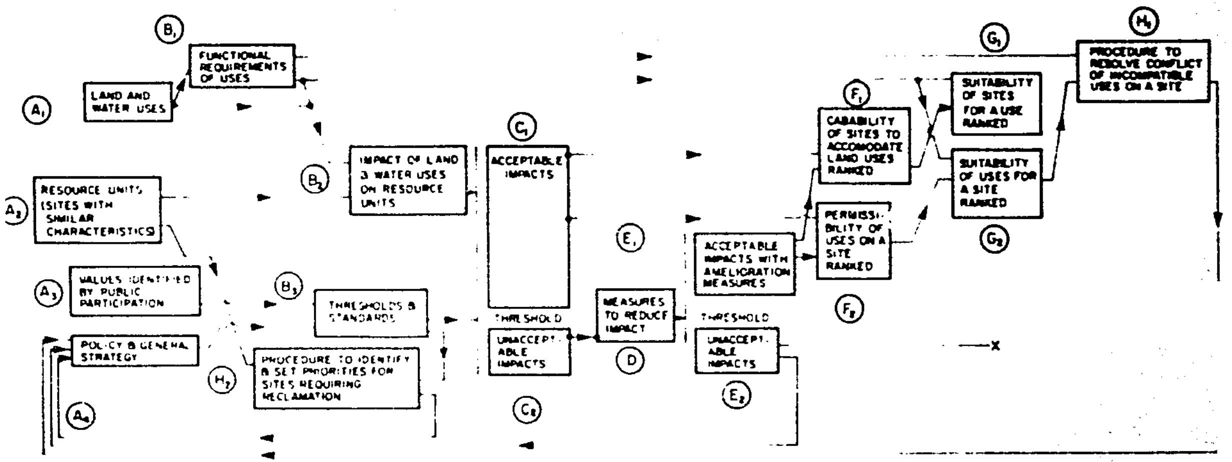


FIGURE 6



LAND AND WATER USES
FUNCTIONAL REQUIREMENTS OF USES
RESOURCE UNITS (SITES WITH SIMILAR CHARACTERISTICS)
VALUES IDENTIFIED BY PUBLIC PARTICIPATION
POLICY & GENERAL STRATEGY
IMPACT OF LAND & WATER USES ON RESOURCE UNITS
THRESHOLDS & STANDARDS
PROCEDURE TO IDENTIFY & SET PRIORITIES FOR SITES REQUIRING RECLAMATION
ACCEPTABLE IMPACTS
THRESHOLD
UNACCEPTABLE IMPACTS
MEASURES TO REDUCE IMPACT
ACCEPTABLE IMPACTS WITH AMELIORATION MEASURES
THRESHOLD
UNACCEPTABLE IMPACTS
CABABILITY OF SITES TO ACCOMODATE LAND USES RANKED
PERMISSIBILITY OF USES ON A SITE RANKED
SUITABILITY OF SITES FOR A USE RANKED
SUITABILITY OF USES FOR A SITE RANKED
PROCEDURE TO RESOLVE CONFLICT OF INCOMPATIBLE USES ON A SITE

interests, i.e. what are the citizens perceptions of the importance of as yet undeveloped areas for various uses from their parochial viewpoint. Nonquantifiable factors such as aesthetics, aspirations, hopes, etc. are included in this process. This step together with (A_4) comprises current constituency constraints -- the publics and the government. A number of methods for obtaining citizen input are available and will be briefly described later in this paper.

In Item (B_1) the previously defined uses are described in terms of functional requirements that place demands on resource units -- i.e. area of ground occupied, channel water depth for navigation, amount of water withdrawn for processes, amount of water discharged, temperature of water discharged. This information together with that of (A_1) and (A_2) allows an assessment to be made of the impact of the various uses on the resource units.

Item (B_1), thresholds and standards derived from statutes and perceived values, is the basis for differentiating impacts between those that are or are not acceptable (C_1) and (C_2). Those that are unacceptable may be subjected to ameliorative actions (D). Those that remain unacceptable, (E_2), are either discarded or recycled through a change in policy, (A_4), possibly a legislative initiative, edict, or similar governmental action.

The acceptable use-site combinations are then subjected to a capability/suitability analysis (F_1, F_2, G_1, G_2) from which are derived the following resource rankings:

(1) The relative capability of <u>all sites</u> to accommodate <u>each use</u>.
(2) The relative capability of <u>each site</u> to accomodate <u>all uses</u>.
(3) The relative suitability of <u>all sites</u> for <u>each use</u>.
(4) The relative suitability of <u>each site</u> for <u>all uses</u>.

Finally, steps (H_1), (H_2), and (E_2) feedback to step (A_4) so that the basis for reconciling conflicts such as unacceptable impacts, incompatible uses and reclamation proceedings may be reappraised in light of policy and the general program strategy (goals and objectives of the original process description).

A number of situations requiring the simultaneous display of many parameters will likely arise in the analysis or development of a Coastal Zone program. In these situations it is frequently beneficial to use the information matrix as a means for communication and to facilitate evaluation. Under most circumstances these matrixes are <u>not</u> designed to be manipulated by the rules of matrix alegbra -- their purpose rather is information display and integration. Some of the situations in which they might be useful are:

(1) In order to assure that adequate consideration is given to all impacts of a use, matrices have been developed that relate uses to casual factors

and subsequently to initial and consequent impact conditions and finally to effects (Figure 7). This then is a tool for accountability.

(2) In order to qualitatively evaluate the relative merits of various activities on the relative vulnerability oı various resources based on a comparative assessment of the impact of the activities.

The degree of discrimination attainable and degree of independence between evaluation criteria (or its corollary - interdependence) are major factors to consider in developing such a matrix.

Using Figure 8a as an example, in its original form, one could discriminate three levels of effect, undesirable (X), possible problem (0), and a blank for no effect. On that basis one could confidently but subjectively argue that "Well Development" while a more undesirable Coastal Zone use than "Construction of Offshore Platforms", was nowhere near the problem associated with the subsurface or shallow disposal of untreated liquid wastes. If instead, a binary criterion had been used, i.e. undesirable or not undesirable then the table would have appeared as in Figure 8b, and the selection could have gone the other way. Note however that construction of "Offshore and Bay Platforms" would have still appeared to be a more desirable option.

In a similar manner, reading across the matrix one would expect to assess the relative vulnerability of different kinds of resource capability units. The high vulnerability of the Salt Water Marsh is clear in either case, but in the case of the Point-Bar Sands and the Enclosed Bay Area, the relative metits of a site selection are clouded for two reasons with onaly binary criteria. First is the loss of discrimination between an undesirable effect and only a possible problem. The second is the lack of discrimination even at the three criteria level of the relative importance of the types of use; with respect to Enclosed Bay Area for example, uses 1, 2, 4, 5, 7, 8 (essentially Waste Disposal and Coastal Construction) acceptable -- unanswered is the relative importance based on either need or demand for either of the two uses. The ultimate in discrimination is the use of some form of numerical index system. The use of such a system, however, implies equivalency between factors or activities with the same numerical rating. This usually entails a series of value judgements such as those identified in Step (A_3) of Figure 6.

Figures 9 and 10 illustrate two other versions of matrices indicatingthe diversity of information that can be displayed. In once case, the author, Dr. Howard Odum has commented on some of the shortcomings that he perceives in the use of the matrix as an analytical and evaluative tool.

Figure 7

Impact Matrix Format

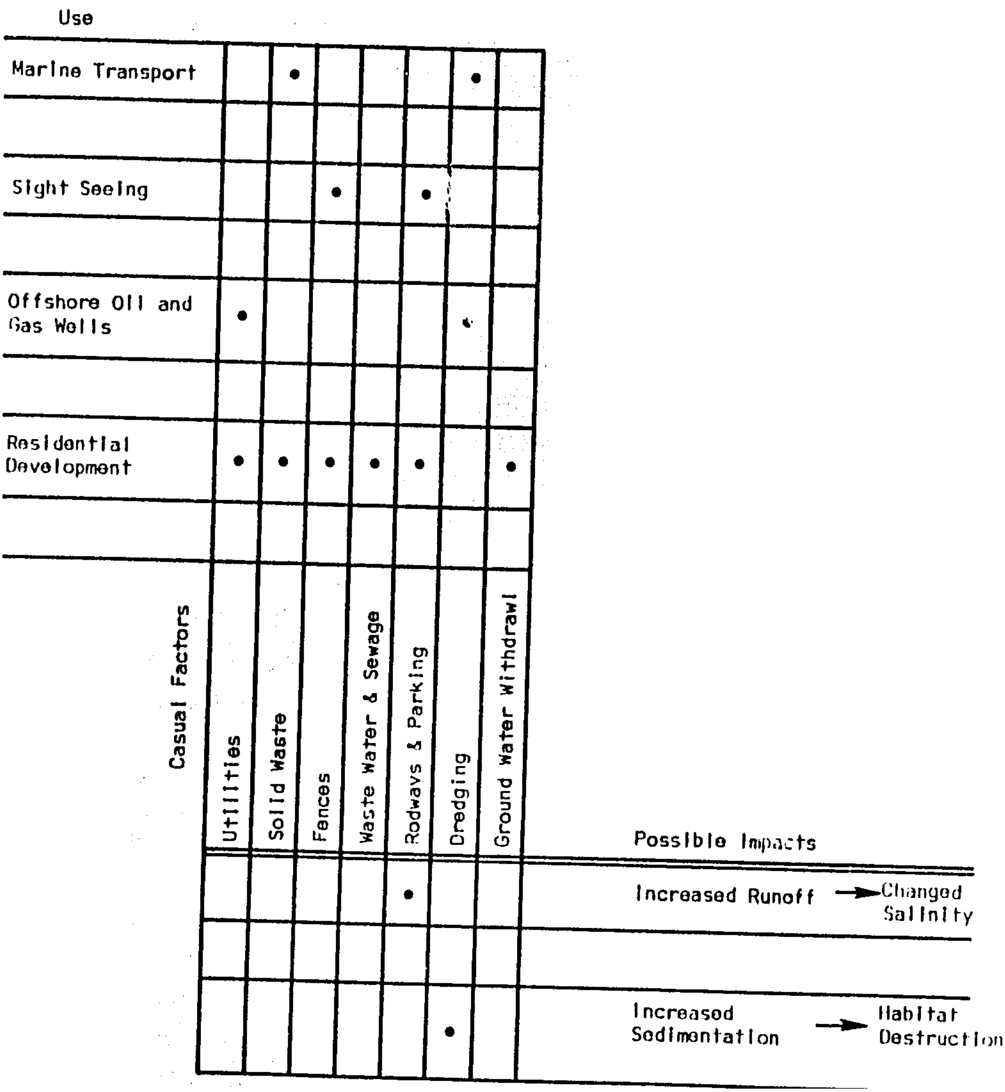


Figure 8a Coastal Zone Resource Units - Use/Capabilities   Fig. 8b

Activity groups: Liquid Waste Disposal (1–3); Solid Waste Disposal (4); Coastal Construction (6–8); Inland Construction (9–12). Fig. 8b: Liquid Waste Disposal (21).

Activities: 1 = Surface Disposal of Untreated Liquid Wastes; 2 = Disposal of Untreated Liquid Wastes, Subsurface, Shallow; 3 = Maintenance of Feed Lots; 4 = Disposal of Solid Waste Materials; 5 = Construction of Offshore and Bay Platforms; 6 = Construction of Jetties, Groins, Piers; 7 = Construction of Storm Barriers and/or Seawalls; 8 = Placement of Pipelines and/or Subsurface Cables; 9 = Light Construction; 10 = Construction of Highways; 11 = Heavy Construction; 12 = Flooding (through dam construction); 13 = Dredging of Canals and Channels, and Spoil Disposal; 14 = Excavation (includes extraction of natural materials); 15 = Filling for Development; 16 = Draining of Wetlands; 17 = Well Development; 18 = Devegetation; 19 = Traversing with Vehicles (marsh buggies, air boats, dune buggies, motorcycles); 20 = Use of Herbicides, Pesticides, Insecticides; Fig. 8b: 21 = Disposal of Untreated Liquid Wastes, Subsurf, Shallow; 22 = Construction of offshore Area Bay Platforms; 23 = Well Development

Resource Capability Units		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Water Capability Units – Bays, Estuaries, and Lagoons	River Influenced Bay Areas Including Prodelta and Delta Front	X	X		X	O	O	X	O					X		X		O				O	O	O
	Enclosed Bay Areas	X	X		X	O		X	O					O		O		O				O	O	O
	Living Oyster Reefs and Related Areas	X	X		X	X	X	X	X					X		X		X				O	O	O
	Dead Oyster and Serpulid Reefs and Related Areas	X	X		X	O	O	X	O					X		X		O				O	O	O
	Grassflats	X	X		X	X	X	X	X					X		X		X				O	O	O
	Mobile Bay-Margin Sand Areas	X	X		X	X	X	X	X					X		X		O				O	O	O
	Tidally Influenced Open Bay Areas	X	X		X	O	O	X	O					X		X		O				O	O	O
	Subaqueous Spoil Areas	X	X		X	O	O									O		O				O	O	O
	Inlet and Tidal Delta Areas	X	X		X	X	X	X	X					X		X		O				O	O	O
	Tidal Flats	X	X		X			X	X	X	X	X		O	X	X		O				O		O
Land Capability Units – Coastal Wetlands	Salt Water Marsh	X			X	X		X	X	X	X	X	X	X	X	X	X	O	X	X	X		O	O
	Fresh-Water Marsh	X			X			X	O	X	X	X	X	X	X	X	X	O	X	X	X			O
	Swamps	X			X				O	X	X	X	X	O	O	X	X	O	X	O	X			O
Coastal Barriers	Beach and Shoreface	X	X		X		X	O		X	X	X		X	X			X		O		O		O
	Fore-Island Dunes and Vegetated Barrier Flats	X	X	X	X			X						X	X			O	X	X	X	O		O
	Washover Areas	X	X	X	X		X	X	X	X	X	X		X		X		X				O		O
	Blowouts and Back-Island Dune Fields	X	X		X				O	X	X	X		X				X				O		O
	Wind Tidal Flats	X	X		X					X	X	X		O		X		O				O		O
	Swales	X	X		X					X	X	X		X	X	X	X		X		X	O		
Man-Made	Made Land and Spoil	X	X	X	X							O							X			O		
Coastal Plains	Highly Permeable Sands	X	X	X	X									O	X			O	X		X	O		O
	Moderately Permeable Sands	X	X	X	X									O	X			O	X		X	O		O
	Impermeable Muds	O							O	O	O	O						O			O			O
	Broad Shallow Depressions	O								X	O	X						O			O			O
	Highly Forested Upland Areas												X					O	X		X			O
	Steep Lands, Locally High Relief	X			X					O		O			X				X		O			
	Stabilized Dunes	X	X	X	X						O			X	X			O	X	X	X	O		O
	Unstabilized, Unvegetated Dunes	X	X		X				O	X	X	X		X				X				O		O
	Fresh-Water Lakes, Ponds, Sloughs, Playas	X			X									X		X	X	O			X			O
	Mainland Beaches	X	X		X		X	X		X	X	X		X	X	X		X	O			O		O
	Areas of Active Faulting and Subsidence	O	O		O				X	O	O	X						O				O		O
Major Floodplain Systems	Point Bar Sands	X	X	X	X					O				X				O			X	O		
	Overbank Muds and Silts	X	X	X	X				O	O	O	O	O								O	O		
	Water	X			X								O	X							X			

4-X-Ø
5-0-9
11 11

16-X-Ø
1-0-17
3 3

7-X-Ø
2-0-9
11 11

24-X 1-0 A(1) A(2) 5-X 5-0 7-X A(3) 22-0 25-0 A(0) A(6) A(5) 10-0 29-0

X Undesirable (will require special planning and engineering)

O Possible problem(s)

Source: L.F Brown, Jr.; W.L Fisher; A.W. Enleben; & J.H. McGowen
Geol circ 71-1 Resource Capability Units - U of Texas, Austin
1971

FIGURE 9 MARINE MEADOWS MATRIX

MARINE MEADOWS MATRIX

System Properties / Development Actions	Roads, Parking, and Buildings	Vegetation Clearing and Logging	Irrigation	Ground Water Withdrawl	Chemical Pesticides	Fertilization	Drainage Improvements	Septic Tanks	Sewage Outfall	Solid Wastes	Plowing and Cultivation	Channels	Boats	Boat Docks (fuel)	Causeways, Bridges	Dredge & Fill	Thermal Wastes	Commercial and Sport Fishing
Phosphorus	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Nitrogen	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Turbidity	+	+	+	O	X	+	+	+	+	+	+	+	+	+	+	+	+	+
Attached Algae	±	±	±	−	−	±	±	+	+	±	±	−	±	−	±	−	±	−
Turtle Grass	±	±	±	±	−	±	±	±	±	±	±	−	−	−	−	−	−	−
Plankton Algae	±	±	+	X	+	+	±	+	+	±	±	+	+	+	+	+	+	−
Toxic Residues	+	+	+	O	+	O	+	X	+	+	+	+	+	+	+	+	+	+
Organic Matter	+	+	+	−	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Small Fish Food	X	+	+	±	+	+	X	+	+	±	+	−	±	−	−	−	±	+
Larvae	X	X	X	+	−	X	−	X	−	−	X	−	X	−	X	−	−	−
Shrimp, Mullet	X	X	X	±	−	−	−	X	−	X	X	−	−	−	X	−	−	−
Sports Fish	−	X	−	X	−	−	X	X	−	+	X	±	−	+	+	±	−	±
Salt Water (salinity)	−	−	−	+	O	O	−	−	−	+	−	+	O	O	−	±	−	O
Circulation	O	O	+	−	O	O	+	+	+	−	+	+	+	−	−	±	+	O
Oxygen Variation (range)	+	+	+	−	+	−	−	−	−	+	+	−	+	O	+	−	−	+

\+ Stimulant

− Depressant

O No Effect

X Further Study Needed

GENERAL NOTES:

It is very difficult to represent the energy network diagram by the use of the matrix. This matrix is a lineal tool and lends itself to describing only limited kinds of systems. The energy network diagram however, if modeled on the analog computer identifies the interactions of all components of a system, including secondary, tertiary, and indirect effects of the model.

A plus, or stimulant, to any system (or component) may not be a positive value to that system. Over stimulation may have long term adverse affects to a system, subsystem, or cause negatives elsewhere.

Source: S.W. Florida Coastal Area Study; Howard T. Odum 1971

On the positive side however, it is difficult to think of an alternate mechanism for displaying such a wealth of information.

Figure 10. Estimated distribution of functions among several governmental levels with relation to the coastal zones. Letters indicate the location of present attention. Boxes show where Panel 2 felt that primary responsibility should be centered, although participation at other levels bay be desirable and necessary.

P - Planning (including coordination)
R - Regulation
S - Service (including research)
M - Management

Function	Local	State	Federal
Commercial Fishing	RS	PRSM	PS
Outdoor Recreation	PRM	PRSM	PRSM
Biological Productivity	R	PRSM	PS
Navigation		P?	PRSM
Port Facilities	PRSM	PM	PRS
Dredging and Filling	PM	PRSM	PRSM
Hurricane Protection	PRM		PSM
Public Land Use	PRM	PRSM	PRSM
Private Land Use	PR	PRS*	PS
Waste Management	PRSM	PRS**	PRS
Transportation	PM	PRSM	PRS
Aesthetics	PR	P	P
National Defense	j	P	PRSM

* Limited to situations in which there is demonstrated effect on resources and values beyond local jurisdiction.

** Management by the state is under consideration in Maryland.

E. Microstructure

From a methodological viewpoint problem and issue identification can be approached a number of ways somewhat dependent upon the constituencies who contribute to the process. At one extreme, if an autocratic form of government exists, defining issues and problems can be as simple as an executive proclamation. At the other extreme one might resort to the public referendum. Seldom is either extreme likely, One will probably find instead, that both extremes move toward the middle ground of at least committees of experts or at most organizations of concerned citizens who probably include representatives of the communities political, social, and economic power structure.

The actual process of defining problems, issues, and opportunities through direct participation, has been the subject of much study. Techniques sometimes used include personal interview, mass survey by questionnaire, interactive group conferencing (Delphi technique), small group interacting workshops and finally, the least structured technique of public forum. These techniques are equally appropriate to programs which encourage participation in the development process or those that simply seek reaction to an already prepared program.

This discussion of technique and methodology would not be complete without at least a few comments about data, information and systhesis.

The function of management is data and information dependent. Decisions can only be made after data and information are acquired and analyzed. The more sparse the information, in general, the greater the risk of an erroneous decision. But in spite of that fact, there are times when decisions must be made on the basis of the best available. information. Every program therefore must utilize techniques assuring the acquisition, storage, and display of as much information as possible to facilitate decision making.

In this context, previous descriptions of the process have identified the need for knowledge, classification schemes, surveys and display techniques in order to provide information in a suitable form for use by the decision maker. In so doing, knowledge gaps will also be revealed and this in turn can lead to the research or monitoring programs necessary to expand the information base.

The determination of impact, assessment of resource and site capability, and determination of use and site suitability are likely to suffer from the most significant knowledge and information gaps. It is in these areas of assessment that the scientist, planner, and administrator mustwork closely in order to minimize the risk of wrong management decisions.

Finally, if sufficient information of suitable quality can be obtained it may be come possible to exploit some of the sophisticated methods of simulation modeling (management games) in the Coastal Zone Management process. It is argued by some that techniques such as these are still in the realm of the scientist plaything. Considering the state of knowledge of the coastal environment and the lack of understanding of human values, it is not likely to become a useful Coastal Zone Management tool in the foreseeable future.

V. Summary

To briefly summarize this paper, I think it important to first note that the development of Coastal Zone Management Programs is a multi-step process that is strongly dependent upon human relations as well as technical information. Much is non-quantified and some even unquantifiable at our present level of understanding of both man and the Coastal Zone environment. The techniques available for handling the program development process are varied -- ranging from nonquantitative logic discriptions as detailed in the functional flow diagrams of system engineering to sometimes sophisticated simulations.

Behind the general process there are a number of analyti-

	Social Interaction					Models				
	Interview	Survey	Delphi	Small Group Dynamics	Public Forum	Functional Flow Diagram	Descriptive Matrix	Analog	Math	Gaming
(1) Issue/Problem Identification	X	X	X	X	X					O
(2) Information Base	X	X		O						
(3) Supply/Demand Analysis		O					O		O	
(4) User Requirements	O	X	O	O		O	X			X
(5) Impact Determination				X		X	X			
(6) Impact Assessment				X	X		X	O		O
(7) Suitability/ Capability Analysis				X			X			O
(8) Institutional Process	O			O	O					
(9) Implementation Process						X		O	O	O
(10) Overall Process						X	X	X	X	X

FIGURE 11

Summary of Techniques

cal techniques which must be employed and information requirements which must be fulfilled in order to implement the overall process. Several of these have been described and discussed. The crosses in Figure 11 identify the applications discussed in this paper -- the circles identify those either alluded to or those that are reasonable extrapolations. Undoubtedly new techniques will be identified as the field of Coastal Zone Management continues to grow, particularly as opportunities arise to develop programs in different environmental and political situations.

RAW MATERIALS POTENTIAL AND THE GEODYNAMICS OF THE COASTAL ZONES

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The coast is for the geologist a coincidental feature, both in a geological and sedimentological sense. Continents rise, crustal fragments subside. Deltas bring the detritus from the landmasses into the sea and elsewhere waves erode cliffs. The wind carries shoreline sand over coastal marshes and peat lands and it migrates back to the sea as dunes. Corals form reefs while waves erode algal banks and form offshore bars and banks of the calcareous detritus. In short, there is a continuous give and take in the zone called the coast. This zone is characterized by the effects of positive and negative changes in position of the strandline whose momentary position marking the coastline can hardly be important in light of its changeability through geologic time.

The person who may have to protect this coast and build breakwaters, dams, and dikes, sees the coastal processes from a different viewpoint. For him, the coast is a battle line and he tries to maintain it by science and art. That this effort must not be against nature but must exploit nature's hydraulic and meteorological laws and that geologic factors such as coastal subsidence, sand movements, and compaction exist are known to the hydraulic engineer and the hydrographer. Nevertheless, management of the position and form of the coast in a manner satisfactory to human planning is commonly considered to be only a question of technical and financial effort. However, only a stormflood is needed to show the planner what energy is released by geologic processes and how weak the effort and methods we have set against nature are.

The management of the coastal zone requires knowledge of basic geologic laws; not applying this knowledge is deliberate risk-taking.

The economic geologist sees the coast in another way. It represents a boundary line whose crossing mostly (but certainly not always) involves a cost increase because of the change in technology from dry to wet, that is, from the continental to the marine environment. The nature and form of offshore occurrences and deposits of raw materials and their technological parameters are not always different from those of inshore deposits. However, the methods of extraction and processing are usually much different and especially, the costs higher.

As a result, the coast also appears for our generation, which has been shaken by energy and raw-materials crises, recognizes the limits to resources and the potential of the natural environment, and is economically stressed, to be a barrier behind which the price for urgently needed raw materials increases sharply.

Even though the exploration for and exploitation of deposits in littoral and fully marine areas require great technical and financial effort, the costs of exploration for these deposits particulary in the near-shore area, approach those for the diminishing onshore deposits. For this reason and also because prospective geology (LÜTTIG, 1975) must think 20 to 30 years into the future, the geological investigation of littoral deposits is presently of great interest.

As a result, those involved with coastal management view littoral sand, for example, not only as material that influences the quality of a beach positively and the navigability of a harbour negatively. The unconsolidated deposits present along the coasts are no longer considered to be only material to be used for dikes or to be dredged from shipping channels. Primarily the exploration for hydrocarbons has increased the realization that, in the future in the coastal and shelf areas, there will have to be increased exploration for and exploitation of the deposits that can provide raw materials for industry. These deposits include:

- mineral containing rare earths,
- mud valuable for balneotherapy,
- submarine bauxite,
- heavy-mineral sands and other sandy ore concentrations,
- diamond-containing sands,
- quartz sand and kaolin sand,
- sand and gravel for the construction industry,
- gravels with flint pebbles, used for special purposes,
- enrichments of shell-hash,
- deposits of ore and coal which extend from onshore beneath shallow cover,
- hydrocarbon occurrences, and
- other economically important occurrences.

In the following are some examples to substantiate the importance of this almost untouched and, nevertheless, major part of the earth's surface for the raw-materials sector.

a) In the classic tin region of the United Kingdom, placer deposits have long been exploited in the Cornwall operations. Interest has revived in submarine mining and the placer reserves are estimated to be 0.55×10^6t. (MEDFORD, 1969). That would fulfill the needs of the U.K. for 25 years. Also, the commercial viability of offshore hard-rock reserves is increasing. Of course, this is also true for the tin mining regions of, for example, Indonesia and Thailand where the production from placers is about 25,000 and 6000 t/yr, respectively. The world production is about 230,000 t/yr.

The strong demand for phosphate and the high costs of transport to Europe and North America from mostly overseas deposits have awakened interest in offshore deposits. Unlike the findings off the east coast of Mexico, however, there is no indication of offshore phosphate deposits in Europe. It is possible that they may be found by more rigorous investigation of parts of the European shelves, particularly in the Mediterranean area.

The mining of rutile (TiO_2), ilmenite ($FeTiO_3$), zircon ($Zr(SiO_4)$), monazite ($Ce(PO_4)$), and other heavy minerals that are important strategically and for the pigment industry already concentrates on coastal placers. This concentration will increase in proportion to the decreasing availability of these important industrial minerals. In the Western World, out of a yearly production of 3.5×10^6t of ilmenite, about 80,000 t are produced from coastal placers in Sri Lanka (Ceylon), 100,000 t in India, 930,000 t in Australia, and 140,000 t in Florida.

The yearly production of zircon in the Western World is about 430,000 t of which about 400,000 t come from the east coast of Australia. About 95 % of the Western World's yearly production of rutile (320,000 t) also comes from Australia.

Particulary successful in recent years has been prospecting for placers offshore from Mozambique and Sierra Leone (BEIERSDORF, 1972; SCHOTT, 1974).

The production of diamonds from coastal placers is limited to southwest Africa and, according to MERO (1965) and CRUIKSHANK et al. (1968) has been 221,500 cyd of sand which contained diamonds with a value of about $ 10 million.

Elevated uranium contents have been found in diatom ooze offshore, for example, of southwest Africa (K.MEYER, 1973). Consequently, it is likely that greater attention will be paid during prospecting to those coastal areas where such sediments might occur.

Of great importance for the construction industry is the production of littoral sand and shelf-sea sand and gravel because, for example, the reserves of gravel in Europe have a limited lifetime (LÜTTIG, 1973, 1975). A significant amount of marine gravel is already being used in the USA and Great Britain (JOLLIFFE, 1971). About 12 % of the total gravel used in Great Britain is marine gravel. In the German part of the North Sea offshore, a study initated by the author found large gravel occurrences which will be exploited. Because of the shortage of gravel on land, such measures are also necessary in other countries of Europe such as Belgium and the Netherlands (OELE, 1973). Elsewhere, in the Mediterranean area (Greese, Cypress, and Spain), for example, such studies are of pressing urgency because of the increasing destruction by quarrying for building materials of the limestone hills that are important for tourism, archeology, and water supply.

I wish to briefly touch on one additional problem greatly affected by the innovations of the geosciences, that is, on the problem of waste deposition and disposal. The relevant companies and governmental authorities increasingly look towards the coastal regions in response to the increasing restrictions on land and the often hysterical demands for environmental protection. They do so because the offshore dumping and disposal of waste appears to be simpler and to raise fewer problems. For anyone working on the coasts, however, it is apparent that the coastal biotope is very sensitive and that thoughtless disposal of sewage or waste can have serious consequences. It should not be overlooked that with our demands on industry for a high living standard, we must care for the other side of production, namely, the resultant waste. It approaches schizophrenia when people, who themselves participate in the generation of waste, become indignant about this problem.

Nevertheless, one chance should not be overlooked because of this critical warning about overestimating the possibilities of the coastal area for waste disposal. This concerns the coastal region of Northwest Germany in which salt stocks are present in the shelf area (as well as on land). Salt stocks offer good and safe possibilities for disposal because of their geologic structure and technical characteristics. Caverns can be formed in the salt by solution and the disposal of the resultant brine, which cannot be drained into rivers on land, is not all dangerous in the coastal regions. Greater use (for the disposal of radioactive waste, for example) should be made of the offshore salt stocks because it involves no unsolvable difficulties. Solving these problems on land, and solved they must be, becomes more difficult just on security grounds.

The, in part, greatly limited lifetime of particular raw materials onshore will undoubtedly contribute to an intensification of the exploration for littoral deposits. The onshore production prices will increase so much that production in marine areas can and must be begun. This is true particulary for the following materials or deposits containing raw materials with low dynamic lifetimes:

rutile,

ilmenite,

zircon,

gold,

cerium (and other rare earths),

construction sand and gravel,

and, of course, hydrocarbons whose increasing production in shelf areas must be increasingly considered in coastal management because of the installations involved (pipelines, refineries, and oil and gas terminals, for example).

It should be noted that, for future considerations, it is unimportant whether the expert has estimated the lifetime of a particular element or raw material correctly or not. Even an error of ± 100 % is tolerable because it is only significant for the short-term price and supply situation to know if the material will become rare in 20 or, instead, 40 years. For technology, it is important in such cases if substitutes or other procedures and methods must be found. Because this requires time, it is of primary importance that the raw-materials expert simply warns of the impending shortage and less essential what urgency he attaches to this warning.

It is certain that the search for raw materials will exert considerable pressure on all decisions regarding the coasts. Even though one demand on the environmental potential of our earth, in this case the coasts, is emphasized here, this demand cannot be made without consideration of the needs of mankind. This is apparent in that this emphasis is from a geoscientist, that is, someone from a profession which cooperates significantly in all phases of coastal protection and coastal research such as geological and morphological research and the determination of basic data on sedimentology, facies, paleobiology, soils, and hydrogeology. This knowledge is the basis of the initially expressed requirement that geologic factors must be considered in all coastal management questions and geologists must be involved in all decisions.

It is necessary to mention in this regard the commonly onesided attitudes towards the coasts of other interest groups such as the tourist and recreation industries, the conservationists, the marine biologists, and the transportation industry whose dominant public representation is as dangerous as the overemphasis of energy and raw-materials viewpoints.

Our earth is no longer an idyll; neither one nor the other interest group can claim innocence and blame all of the others. This is particulary true for the coasts. The potential of the natural environment is limited and shrinking and is in many ways misused. The demands of all peoples for improvement of the living standard cannot be overheard by the planners and results in, among other things, their planning of greater use of the geopotential.

If we and our followers do not wish to obstruct the path into the future, we will have to plan better with better balancing of all interests. As formerly stated, however, proper management of our natural environment is not possible without the inclusion of the geosciences, that is, the sciences of energy and natural resources.

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MARINE METEOROLOGICAL SERVICES TO COASTAL ACTIVITIES

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General

Coastal preservation and the economic uses of the coast have always been the concern of marine nations. The development of many forms of coastal activites depends to a large extent on weather conditions. Serious limitations to these activities are often caused by weather phenomena near coastal areas. More than a century ago one of the basic motives for the establishment of Meteorological Services in several countries was to help coastal navigation and other marine occupations by providing weather forecasts and timely warnings. It is no surprise, then, that the first International Meteorology Conference in 1853 concerned itself largely with maritime meteorological co-operation. Systematic collection of basic marine data through naval and merchant ships on a world-wide bases was considered essential to describe and understand the behaviour of the oceans.

Interests in special fields such as agriculture, aviation and shipping have influcenced the growth and pattern of Meteorological Services. However, the present status of development of national Meteorological Services differs from one country to another depending on national requirements and available resources. Nevertheless, the countries afflicted with natural disasters like cyclones, tides and floods, are fully conscious of the value of efficient weather services for mitigation of the recurring damages. Experience in different parts of the world has shown that improved meteorological services based on modern facilities and techniques can bring about enormous savings. The WWW Planning Reports, numbers 4, 17 and 27, published by the World Meteorological Organization (WMO) provide a wide range of useful information on the economic benefits of meteorological services.

Marked widening of interest in coastal development has become manifest in many ways. Apart from the development of seaside towns, there have been several other demands on the coastline such as inshore shipping, harbours, off-shore mineral explorations, installation of nuclear power stations etc. Fishery operations are a traditional economic pursuit of many countries. Coastal plains provide the favourable terrain for agricultural development and drilling of artesian water wells. Petroleum and natural gas formations in coastal belts are of great economic value. Other coastal deposits of economic importance include sulphur, phosphate, lignite, uranium etc. In recent years the coasts of many countries have become popular as places of holiday resorts. Demands for marinas and small boat recreational facilities are increasing more and more. Many housing areas have also sprung up in coastal areas. All these increasing activities imply improved transport and communication facilities.

While such activities add to the economic potential of countries, there is also the danger of pollution of coastal waters by wasteful and sometimes poisonous discharges of the coastal industries. Further, the possibility of a disaster such as that of the tanker "Torrey Canyon" should not be ruled out. Even though the source areas of pollution may be far removed at sea, under the influence of winds and currents the effects of pollution will be considerably felt in coastal waters. Combat operations against pollution are therefore part of coastal activities.

All the operations mentioned above, and there may be others, are greatly affected by weather conditions in the adjoining seas. Weather damages or losses due to discontinuance of work are usually so great that it is of economic advantage to have an efficient marine meteorological forecast and information service. National Meteorological Services should therefore be equipped to be able to develop suitable forecasting techniques as necessary, and their personnel should be adequately trained. There should also be regular consultations between the meteorologists and those conducting marine operations. In order to ascertain that an adequate organization is developed and that the personnel are trained well in advance, National Meteorological Services should closely follow economic and technological development of coastal zone activities and anticipate requests for specialized meteorological and related oceanographic forecast services.

In planning and conducting coastal zone development it is therefore very important that governments strengthen their National Meteorological Services so as to enable them to render adequate meteorological support to various development projects.

Programmes with special reference to marine meteorology

Before an analysis is made of the various meteoroligical factors that affect the coasts and the meteorological services provided to coastal activities, it is worthwhile to have a quick glance at the role of WMO in co-ordinating the functions of National Meteorological Service under various programmes, with special reference to marine meteorological services to coastal activities.

Education and training programmes

WMO has a well-established programme to assist developing countries in assessing their education and training needs in the field of marine meteorology and the subsequent traning and technical assistance required.

Syllabi for education and training of all categories of meteorological personnel in the field of marine meteorology have been prepared and published by WMO. These are being used in the Regional Meteorology Training Centres established in Africa with WMO assistance as well as in the meteorological training courses introduced in some of the universities of Latin America. Suitable lecture notes and training manuals are prepared within WMO.

For promotion of marine meteorology especially in developing countries, assistance is provided by WMO under different aid programmes such as the United Nations Development Programme (UNDP), WMO Voluntary Assistance Programme (VAP), in the following forms:

- training of experts;
- training courses;

- preparation of training manuals and compendia;
- fellowships.

Short-term expert missions are arranged under WMO/UNDP aid programmes to assist developing countries in the evaluation of national requirements for marine meteorological services. The short-term surveys are followed, as required, by long-term expert mission to assist the countries in the establishment or expansion of marine meteorological services.

Marine Meteorological Services System

The marine meteorological services are essentionally provided by the Members and co-ordinated by WMO. Under this system, weather and sea information is provided to meet requirements for navigation, rescue operations, fisheries, off-shore mining and drilling, coastal area development, port services, recreational boating as well as for operations combatting water pollution. Details of the system are given in the "Guide to Marine Meteorological Services System" under preparation for the benefit of National Meteorological Services.

Basically, the system consists of the preparation of meteorological forecasts and related information by Member countries for their respective sea areas (including coastal waters) and the dissemination of this information by radio and other means according to internationally-agreed procedures. Analyses and forecast charts are also disseminated by several Members. The forecasts include storm warnings which are issued when necessary, for which the form and content as well as the criteria are laid down by WMO. In addition, visual storm warning signals are displayed at ports; an international system of Visual Storm Signals has been established by WMO. Details of the broadcasts and storm warning signals are included in a WMO Publication and updated periodically.

World Weather Watch (WWW) Programme

The World Weather Watch (WWW) programme of WMO is a world-wide system composed of the national facilities and services provided by individual Members, co-ordinated by WMO. The primary purpose of WWW is to make available to each Member, within the limits of the agreed system, the basic meteorological and other related environmental information it requires. The essential operational elements of the WWW are (a) the Global Observing System (GOS), (b) the Global Data Processing System (GDPS) and (c) the Global Telecommunications System (GTS).

The purpose of the GOS is to produce observational meteorological and related environmental data from all parts of the globe as required by Members for operational and research aims. It includes observational networks on land and at sea, aircraft, meteorological satellite systems and other observational devices such as automatic land and marine stations.

The purpose of the GDPS is to make available to all Members the basic processed data for real-time and non-real-time applications. This is achieved through an integrated system of world, regional and national centres equipped to the maximum degree possible with modern processing facilities including high-speed computers. Under this system, primary and derived data are stored by the centres, including in some cases selections of specialized data.

The primary function of the GTS is to collect and distribute basic observational data from the Global Observing System and to distribute the output products of world and regional centres. The GTS consists of a global main trunk circuit and its branches, the regional telecommunication networks and the national telecommunications networks. Modern telecommunication facilities are employed at the centres to ensure high-speed transmission of data.

Global Atmospheric Research Programme

Oceans constitute nearly three-quarters of the world and the weather systems generated over the oceans contribute largely to global atmospheric circulation. For a better understanding of the dynamic processes involved in the general atmospheric circulation, a Global Atmospheric Research Programme (GARP) has been set up jointly by the WMO and the ICSU. The First GARP Global Experiment (FGGE), the operational phase of which is planned to take place in 1978 and 1979, will include two observation periods over the entire globe. The major objectives of the experiment are i) to obtain a deeper understanding of the atmospheric motion for the development of more realistic models for extended range forecasting, ii) to assess the ultimate limit of predictability of weather systems, iii) to develop more powerful methods for assimilation of meteorological observations and, in particular, for using non-synchronous data as a basis for predicting the largescale motions and iv) to design an optimum composite meteorological observing system for routine numerical weather prediction of the largescale features of the general circulation. The results of the experiment are expected to lead to improved forecasting techniques including those for shipping and other coastal activities.

Long-term and Expanded Programme of Oceanic Exploration and Research (LEPOR)

This programme, co-sponsored by WMO under UN Resolution 2414 (XXIII), aims at co-ordination of ocean-oriented scientific programmes of several international organizations. WMO is concerned, among other topics, with the studies on upwelling including ocean-atmosphere interaction. Coastal upwelling and movement of fertile water are of great importance to the fishing industry, as fish productivity and migration depend largely on these processes.

Meteorological phenomena affecting the coasts

Besides the largescale systems there are other mesoscale phenomena of oceanic origin which have profound influence on coasts and, as a consequence, ultimately affect the coastal operations. Weather processes extend over a greater area both sea-ward and land-ward of the coastline. Hence, any consideration of coastal weather should take into account a somewhat larger area than the actual sea-shore and also changes in the sea level.

The development and use of advanced technology in coastal shipping, rescue operations, fisheries, oil-drilling, off-shore terminals and other construction works are limited to an extent by abnormal weather conditions. Operations which are highly efficient and technically safe under normal environmental conditions are no longer the same when certain threshold values of weather and sea are exceeded. Strong winds, waves, currents, surges and sea temperatures are particularly relevant in this connection. When these elements do exceed certain values, they give rise to hazardous phenomena. Information on and warnings of such hazards constitute the general requirments for meteorological support. In addition, many special requirements exist and these will be dealt with later.

Waves, tides and surges

Wind-generated ocean waves occur in large systems and are defined in relation to the wind field producing the waves. They travel across deep oceans with practically no loss of energy, but as they approach shallow waters their dimensions, except for the wave period, undergo changes due to frictional influence of the sea floor. Wave height and steepness increase rapidly and wave length is shortened. Eventually the waves collapse on the coastline as surf or breaker It is in this surf zone that nearly all the wave energy is expended. The collapse is immediately followed by a powerful onrush, or a surge, of a huge mass of turbulent water on the beach. When the body of water retreats after the force of the upsurge is exhausted, the return flow, or the backwash, is retarded by the frictional force of the sea bed. This makes the water pile up on the shoreline. In times of storms, when enormous waves break involving movement of huge masses of water, the surges result in rapid erosion of coastal structures.

Tides are the rhythmic rise and fall of sea level due to lunar and solar effects. They are dependent on the changing attractive forces of moon and sun on the rotating earth. The spring tides are the highest when earth, moon and sun are in alignment and the nip tides are the lowest when lunar and solar effects cancel each other.

A surge composed of high tide and the meteorological effect from wind stresses in a transition zone of deep to shallow water is generally considered a hazard when it reaches a certain level above the normaltidal height. The effects of changing water level and the currents set in motion are of major importance to coastal processes. When aided by high tides the storm waves reach great heights especially during hurricane or storm surge conditions. The North Sea surge in February 1953, which brought havoc on the Netherlands coast was caused by a combination of gale force winds during the passage of a deep depression and a high spring tide. The widespread devastation, flooding and loss of life caused by the surge are well-know. This led the government of the

Netherlands to plan and execute a new Delta project. The flood disaster in Hamburg in February 1962 was induced by the unusually long duration of gale force winds, exceptionally violent gusts and an extreme surge from the North Atlantic.

Of equal interest is the need to predict meteorologically-induced lowering, instead of a rise, of sea level in areas near the coastline. This is known as the negative surge and a surge of this type, exceeding a metre in shallow water, could spell disaster for big ships like fully loaded tankers or bulkers which cannot reach the port. A meteorological prediction of a negative surge is therefore equally important for shipping management.

In this context it would be necessary to emphasize the importance of an adequate network of tide-gauges along the coastline. This is necessary not only for a verification programme for surge predictions, but is also important for rise evaluation against storm surges. In most developing countries the network of tide-gauges is deficient.

Realizing the adverse effects of storm surges, a few countries are now developing national programmes for insurance against damage or destruction by storm surges. The two basic aims of the programme are (a) to find out, from climatological records, the worse that has happened over a coastal area and (b) to assess the probability of the worst happening again in the future.

Cyclones

Cyclones are revolving wind systems with steep pressure gradients, especially in their troughs or near their fronts, the winds often reaching speeds from 120 to 200 km/hour or even more. The most powerful and destructive cyclonic storms are the tropical cyclones, otherwise known as typhoons or hurricanes depending on the geographical areas where they occur. Their importance lies in their tremendously destructive effect on islands and coastal installations. Widespread destruction of cities and their inhabitants has been reported on many occasions. Damage and flooding in coastal areas can be limited by effective storm warning systems.

The tropical cyclone that occured in the Bay of Bengal in November 1970 is one of the worst national disasters in history. It took a toll of 200.000 human lives according to official estimates, with unofficial estimates as high as 500.000. An enormous storm surge, with its height variously estimated from 3 to 9 meters, accompanied the cyclone and swept over the offshore islands and low-lying coastal belt causing severe inundations, widespread damage and heavy loss of life.

Much damage was recently caused in Australia by cyclone "Tracy", which struck Darwin on December 25, 1974. A mean wind speed of 175 km/hour was estimated, with a maximum gust of approximately 280 km/hour. As December 24-25 was a period of nip tides, the maximum storm surge was only about 2 metres.

The city life was completely paralysed, communications disrupted and heavy damage was inflicted on coastal structure and plantations.

WMO Tropical Cyclone Project

The alarming toll of human lives and the damage caused by tropical cyclones evoked world-wide concern in recent years and led to close collaboration among the concerned nations and the United Nations agencies. The United Nations Economic Commission for Asia and the Far East (ECAFE), in collaboration with the World Meteorological Organization, initiated a joint programme in 1968 for the mitigation of typhoon damage in the ECAFE region. Regional programmes with similar objectives were also initiated in other areas of the world affected by tropical cyclones.

At the end of 1970, the UN General Assembly in its memorable Resolution 2733 (XXV) recommended to WMO "to take further appropriate action for mobilizing capable scientists, technologists and other pertinent resources from any or all nations towards obtaining basic meteorological data and discovering ways and means to mitigate the harmful effects of these storms and remove or minimise their destructive potentials".

In response to the UN resolution and fully sharing the concern it expressed in regard to the devastating effect of tropical cyclones, the Sixth Congress of WMO in 1971 decided to set up a WMO Tropical Cyclone Project which came into operation in 1972.

The primary objectives of the project are:

a) Strengthening the present capabilities of detection, tracking and forecasting of tropical cyclones;
b) Making more generally available the techniques of quantitative storm-surge forecasting;
c) Strengthening flood-forecasting capabilities, particularly with respect to flooding associated with tropical cyclones;
d) Improving tropical cyclone warning systems;
e) Providing support to disaster prevention and community-preparedness and related activities;
f) Providing basic data on risk of loss by winds, storm surges and floods to those who need them for development planning or other purpose.

At the Seventh Congress in 1975 WMO reaffirmed that the Organization, acting in concert with the governments concerned and with other international organizations active in the field of disaster prevention and relief, will further increase its efforts to reduce the deadly toll of tropical cyclones and the accompanying floods.

Meteorological services to coastal activities

Information relating to wind, sea and swell, visibility, air and sea temperature and ocean currents is relevant to a wide variety of coastal activites. Local effects resulting from configuration fo the coastline and geographical features, both natural and man-made, assume particular importance. As a basis for specialized meteorological services in support of coastal activities, it is therefore necessary to conduct meso-scale studies of local climatology, taking into account the physical geography of the area in general and the coastal zone in particular.

Marine activities in coastal areas tend to be more concentrated and problems resulting from the volume and variety of such activities require special attention. These activities differ sometimes from one country to another and may even vary from one part of the coast to another. Therefore, while the services required to meet the needs of each specialized activity may differ, there are a number of general principles which apply to all such services:

1) Efforts should be made to learn the weather-sensitive aspects of the user's operations;
2) The meteorological parameters of particular significance to the operation should be emphasized;
3) Times and frequency of issue and means of delivering the information should be determined in consultation with the users;
4) Adequacy of services should be periodically checked.

Services for fishing

Fishing operations in coastal areas and off-shore waters are particularly affected by weather onditions. Fishing vessels are generally small and are vulnerable to high winds and waves, as well as to ice accretion in cold weather. In addition, the speed of a fishing vessel is usually much slower than that of weather system and even with advanced warning of an approaching storm, fishermen are not always able to avoid its effects.

Meteorological factors affect fishing operations not only from a safety viewpoint but from an economic one as well. There may be good stocks of fish in certain areas but if poor weather conditions prevail these areas may not necessarily be the best fishing grounds. Other areas less rich in fish may provide more economical fishing simply because of good weather. Hence a special meteorological service includes advice on areas of favourable weather for fishery operations in addition to warnings of bad weather in areas concerned.

Meteorological information provided to fishing operations include (1) general weather situation including significant deterrations if any anticipated in areas (2) winds with particular emphasis on speeds exceeding 15 knots (3) waves with particular reference to heights exceeding one metre (4) fog, its time of occurrence and duration, including warnings for visibility below 6 km. (5) areas where ice accretion is expected and (6) an outlook for 24 hours.

Warnings on deterioration of weather conditions in areas of prospective fishing operations are issued as soon as the need becomes apparent to enable wide dissemination among the fishing community. This helps in preventing fishermen from going to sea, if bad weather is predicted or to finish fishing because waiting for good weather is apparently not commercial. In some countries fisheries and local officials take steps to announce the warnings on megaphones and by other physical means among fishermen inhabiting remote coastal areas, where otherwise normal communication facilities are non-existent. For dissemination of warnings to fishermen at sea, use is made of coastal radio stations, radio facilities used for the general public, police wireless, VHF marine radio broadcasts and recorded telephone announcements.

Services for fixed or floating installations at sea

Activities connected with oil and gas drilling and production platforms have increased considerably since 1960. The operations have spread all over the globe and nowadays it is not uncommon that highly sophisticated platforms are being operated in temperate, tropical and polar latitudes, under extreme weather conditions, in water depths sometimes down to several hundred metres.

Strong winds and waves and sometimes ice accretion constitute a hazard to drilling operations.

A platform or installation at sea is normally constructed to withstand the effects of winds and waves. Nevertheless, information on these elements is needed for the associated operations involving helicopters and supply boats. The drilling equipment is particularly vulnerable while being towed from one site to another. In such operations the platform legs are lifted and lowered at the new position later again. Consequently, the instability of the whole system increases in this phase. Especially during this operation, information about the height and period of waves becomes critical. Wave, swell and wind information, sometimes for many days in advance, are equally critical during the installation phase of sea constructions like research platforms, lighthouses etc. The installation, repair, and sometimes the use of coastal structures, docks, dikes, bridges, piers in the coastal zone require forecasts or warnings of sea, swell, surf, winds, tides, and currents.

In accordance with the Convention of Safety of Life at Sea (SOLAS), some countries have established rules in their national mining legislation with which the company operating the manned platform should comply. Examples of these rules, dealing specifically with meteorology and with reference to manned platforms, are:

- that meteorological observations shall be made on the platform at standard times specified by the Mining Authority, with instruments installed and paid for by the company;
- that the meteorological observations shall be recorded in a logbook;

that the meteorological observations shall be transmitted to the Meteorological Service situated in the same country as the Mining Authority, in the manner prescribed for reports from ships.

These rules are particularly significant as they bind the operating company to provide the data to the Meteorological Service of the same country. There have been instances when some of the foreign contracting firms engaged in harbour constructions or drilling operations have taken away the data to their own country, thus depriving the local Meteorological Service of the essential coastal data needed for several purposes.

Services to special transport in coastal areas

The term special transport applies to a wide range of operations and includes towing and installation of highly complex production platforms and harbour facilities, the salvage of damaged ships etc. In the past decade the need for meteorological information, in the form of spot forecasts or forecasts for several days, for special transport in coastal areas has grown steadily.

Meteorological information for special transport include

(1) wind direction and wind speed to an accuracy of less than 5 knots

(2) direction and height of waves to an accuracy of one decimetre

(3) air and sea temperatures

(4) visibility and

(5) deviation of water level in tides.

Services in support of pollution clean-up operations

Incidents involving the spilling of oil or other pollutants frequently constitute a problem to coastal areas and communities in many respects. Actions necessary to contain the area of pollution, to minimize its effects and to clean up the affected areas require meteorological services of a special form in addition to other services pertinent to the operation. Usually such pollution incidents call for immediate action and it is essential that arragements should be available for alerting the Meteorological Service on a stand-by basis, so that no time is lost in putting the plans into effect.

If the pollutant is present in waters beyond the coastal zone, the primary meteorological service required is the prediction of the movement of the pollutant. This anticipated movement is directly related to the existing winds, waves and current systems and advice is therefore provided on the direction and speed of movement of the pollutant and the extent to which the spread of the harmful substance may be expected.

If it is expected that the pollutant will ultimately affect the coastal areas and perhaps threaten coastal communities and installations, the clean-up operations will need specific meteorological services which include

(1) detailed and forecasts

(2) analysis and prediction of sea state together with maximum wave heights expected

(3) information on pertinent currents in the area

(4) air and sea temperatures

(5) visibility

(6) forecasts and warnings directly related to the safe and efficient deployment of personnel and equipment.

Service for recreational boating

Boats used for recreation are of many sizes and shapes and are manned, in many instances, by crews relatively unfamiliar with the dangers of boat operations. These crafts are particularly vulnerable to instability phenomena such as sudden strong winds associated with thunderstorms and squalls. The warning criteria are, therefore, considerably lower than those for ocean-going vessels. Further meteorological factors often associated with a small-scale weather system cannot in general be predicted more than a few hours in advance or may not become evident until detected by radar. In addition, there are factors associated with the sea-land interface, particularly where the coast is rugged and strongly influences the local wind patterns. Here is to mention sudden fog which can be dangerous for inexperienced people.

Services for beach activities

The need for beach forecasts is mostly for recreational activities. The geographical characteristics of beaches in a country may differ. For certain beaches easterly winds may be unfavourable, for others westerly winds. The variation in wind direction may greatly influence the recreational potentialof beach activities. Usually the information provided includes air temperature, wind direction and speed, cloudiness, coastal sea water temperature, times of high and low water and surf on the coast.

In many countries there is an increasing demand for specialized reports and forecasts of surf conditions at local beaches. The requirement for these services has two equally important aspects, viz. safety and recreation. Dangerously high surf can be a serious hazard to small boats and to beach property. By contrast, the sport itself requires adequate surf to permit its enjoyment.

A surf forecast generally include

(1) height of breakers (i.e. surf) average and maximum

(2) period of breakers

(3) height and direction of swell.

Services for harbour approaches and harbours

The geographical position of a harbour sometimes necessitates the issue of weather bulletins for the harbour area.

The range of information given in such a bulletin may be wide.
Examples are:

(1) presence of a local wind (mistral, bora, sirocco, pampero etc.)
(2) surf and breakers at the entrance of harbour
(3) water-level anomalies
(4) visibility
(5) precipitation (of special importance to loading and discharging activities)
(6) wind gusts during thunderstorms (for cranes, docking and launching activities)
(7) waves and swell at harbour approaches and
(8) air temperature (for loading and discharging activities).

User groups in general prefer short-term forecasts (6-18 hours) which give the meteorological information in more detail than that provided in the general forecast.

Conclusions

In general, an efficient marine forecast and information service go hand in hand with all forms of coastal zone development and there is bound to be a rise in the demand for better, more frequent and more localized forecasts; and for more extensive and more accurate climatological data to facilitate national economic development, all physical development being dependent to some extent on climatological factors that must be quantified and systematized. At present the meteorological services in many countries are inadequate in meeting the growing demand for information and forecasts required at national level. To ensure the useful role of the Meteorological Services in national development, the following conditions should be achieved:

a) It is of prime importance that governments engaged in organizing or expanding national development in various sectors, including economic development of coastal areas, should, as an essential requirement, strengthen the national Meteorological Services, according to their national requirements, to enable them to discharge their responsibilities effectively and efficiently.

b) The need for professional training of meteorological personnel cannot be over-emphasized; this training should be arranged in close relation to the role expected of the Meteorological Service. On the part of the meteorologist who is to deal with meteorological applications to several coastal activities, he must be aware of the overall socio-economic development plans of the country to enable him to prove a reliable adviser in discussions with authorities directly responsible for the development.

c) Scientific research on the cause and characteristics of important weather phenomena that affect the coasts is essential for improving the warning services and other protective measures. Meteorological Services must take upon themselves to carry out basic study and research for developing suitable forecasting techniques. Such knowledge should also be made available to other countries in need of such information. Adequate national facilities should be provided for such studies. For instance, studies on storm surges would involve installation of tide-gauges or other high water measuring devices in the coastal regions. Also, early visits by a survey team of experts immediately after inundation could provide very valuable data.

d) WMO provides technical assistance in order to assist meteorological services in developing countries. Countries interested in such technical assistance through UNDP and WMO should take the initiative to have projects for development of meteorological and hydrological services included in the "country programmes".

e) Finally, international collaboration is sure to play a significant role in meteorological reserch aimed at improving our understanding of the atmospheric processes, thus enlarging the scope of applications of meteorology in providing ever-increasing services to all forms of national developme it.

For all these reasons WMO is very interested in co-operating with the United Nations and other Agencies in the coastal area development programme and in fostering adequate parallel development of meteorological support programmes to the benefit of countries on the whole.

THE FUNCTIONS OF INTERNATIONAL FISHERY ORGANIZATIONS

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Meaningful plans for the development of fisheries must be based on sufficient scientific knowledge of the potential of the fish stocks, their behaviour and the recruitment from year to year. In areas where fishing intensity has reached a high degree the maximum sustainable yield can only be maintained by management measures. That means regulations and restrictions for the fishery. Effective management requires even more detailed scientific knowledge for the fish stocks. This need for scientific knowledge and observation as a basis for development and management is universally recognized and I need not spell out all the arguments. The Food and Agricultural Organization (FAO) and many individual states have sponsored many scientific programmes in order to promote the development of fisheries.

Most fish stocks live in vast ocean areas adjoining the coasts of various countries. Almost 90 per cent of all sea fish is taken on shelf areas; however some important species like tuna spend most of their lives in the open ocean. Many stocks whether groundfish or pelagic migrate over long distances. Spawning grounds are often far away from the feeding grounds. Therefore individual coastal states, even highly industrialized countries, are not in a position to do all the research which is necessary for meaningful development and management.

In Europe the need for cooperative research efforts was recognized already at the beginning of this century. At that time we did not yet have problems of overfishing but coastal states wanted to promote the development of their fisheries. Therefore in 1902 they founded the International Council for the Exploration of the Sea (ICES). The main task of this first international scientific body of the world was to coordinate the fishery and oceanographic research of member states in order to achieve an optimum benefit from their research capacities for the fisheries.

Before the second world war fishing intensity in the North-East Atlantic reached a stage where management measures became necessary. For this purpose the states participating in the North-East Atlantic fisheries agreed on a convention and set up a regulatory body which developed to the present North-East Atlantic Fisheries Convention (NEAFC). The necessary scientific data for management are provided by ICES.

Today we have international fishery bodies for most ocean areas in the world. In most cases we do not have the

European system of one body for scientific research and another for regulatory measures but one organization carrying out both functions.

Even in areas where the development of fisheries is the main aim of the states concerned it is not sufficient to base plans on a single comprehensive scientific survey. Continuous scientific observations should go hand in hand with the development of the fisheries - not only to give useful advice to fishermen on annual recruitment and movements of the stocks but also in order to enable governments to direct the fisheries in such a way as to avoid the creation of excess capacities and overfishing.

The need for the creation of the existing international fishery organizations resulted among others from the international law of the sea under which only a narrow belt of coastal waters was under the exclusive jurisdiction of coastal states whereas the rest of the oceans covering the major fishing grounds was - as high seas - equally open to fishermen from all nations. Here the principle of freedom of navigation and fishing applied. Under this legal system a rational utilization of fish resources was only possible through international cooperation. The 1958 convention on fishing resulting from the First Law of the Sea Conference in Geneva provided a set of rules for this cooperation and tried to strike a balance between the interests of coastal states and other states wishing to utilize the living resources of the high seas.

The new Law of the Sea emerging from the present United Nations Third Law of the Sea Conference, especially the 200 mile economic zone concept, will give coastal states not only great opportunities but at the same time considerable responsibility for the rational use of the ocean resources in their economic zones. However, from what I said about the need for cooperative research efforts one can easily see that the new regime will not change the basic situation, namely that the individual coastal state is not in a position to do the necessary scientific work alone. Even states like Canada and the United States have already indicated to us that they would like to continue with us the existing cooperation in fishery research in the North-West Atlantic.

With regards to management the situation will change somewhat with the new Law of the Sea because with a 200 mile economic zone coastal states can gain jurisdiction over most of the major fishing grounds of the world.

But in most cases the individual economic zone will not cover the space in which the fish stocks move. One coastal state may gain control over the breeding ground of a species while another state in the region gains control over the feeding grounds of the young fish and perhaps a third state may gain control over the feeding grounds of the adults. Besides, the stocks may stay quite a while in an area of the high seas outside 200 miles. Therefore the need for continued international cooperation and management becomes evident. I shall illustrate this by some examples:

a) An essential prerequisite for management measures is the compilation and evaluation of the scientific data on the regulated species. If coastal states which control the same stock want effective management they must reach a common understanding on the scientific basis of management.

b) The same applies when it comes to the question which measures have to be taken, and especially when the total allowable catch (TAC) has to be decided. According to the provisions of the Single Negotiating Text (SNT) the coastal state shall have the right to set the TAC for its economic zone. But how can a coastal state fix a meaningful TAC if other states in the region control part of the same stock and have other ideas about the degree of utilization (full, maximum or optimum), or in cases of over-fishing they may have different ideas about the speed of recovery they aim at. So if the decision of one coastal state shall not jeopardize the policy of the other states then all states concerned have to sit together and agree on the basic facts and objectives.

c) An international agreement on the TAC may also be important to avoid disputes about the question whether and to what extent there is a surplus in economic zones to which the coastal state according to the SNT shall give access to other states. We have recently had an unpleasant experience in negotiations on fishing rights for German boats. The coastal state concerned declared that we had to reduce our fishing to a large extent because the coastal state's fishery needed practically all the allowable catch. A national research institute of that state produced a paper with TACs for the individual stocks. After we added the TACs we arrived at a figure which corresponded exactly to the total catch of the state in the preceding year. However, no reference was made to existing international scientific findings for that region. It was too evident that the so-called scientific paper was a political one. If the figures had been based on the work of the existing international research body for the region we would have had no argument because there the findings and arguments of national scientists are subject to a thorough international expert discussion and in the end we get highly reliable and unbiassed scientific evidence. This should be desirable for all parties concerned and avoids mistrust and cheating.

Besides the need for a common unterstanding on the scientific facts and their evaluation and agreement on the TAC which I just illustrated there is also a need for continued international cooperation with respect to the following matters:

- definition of the areas to be covered by management measures;
- evaluation of the interaction between different stocks and the fisheries based on them;
- membership in fishery bodies;
- decisions on the type of regulatory measures to be taken;
- the allocation of catches;
- enforcement measures;
- the development of procedures which prevent delay in the introduction of necessary measures, including the settlement of disputes;
- consideration of conflicting ocean uses;
- protection of the environment against pollution.

This is in no way a complete list but from the items mentioned above we can conclude that even under a new Law of the Sea with extended jurisdiction of coastal states there will be not only considerable scope but also great need for international cooperation. It seems natural and convenient to use the existing fishery bodies for this purpose.

While the existing fishery bodies have often failed to achieve adequate management because member states refused to follow majority votes or because of compromises that may come out of the new Law of the Sea giving coastal states so much power that they can - if they agree among themselves - ensure proper conservation and management. They can also reserve to themselves that part of the total allowable catch which they need for the maintenance and development of their fishing industry. They can also establish priorities in the use of resources and in relevant research programmes. They will have a strong bargaining position when it comes to the question who may participate in the use of the so-called surplus.

Because of the new and strong position of the coastal states, the role and function of the existing fishery bodies will have to be revised. New rules must be developed for the special role of the coastal state and the role of the non-coastal states in the deliberations and especially in the process of decision-making in international fishery organizations. It has been suggested that within the regional fishery organizations a special committee should be established so that coastal states may meet in order to coordinate their policies concerning matters which stem from their special legal positions (e.g. priorities in research programmes, volume of TAC, needed amounts for their fisheries, regulatory measures concerning fishing gear, enforcement).

Regardless of the changes of the Law of the Sea the cooperative research efforts in all fishing areas of the world must be strengthened or at least be maintained.

Therefore all states which have hitherto participated in such research or which are in a position and willing to participate should be encouraged to do so. Fishery bodies which consist mainly of developing countries should receive financial and technical aid from all available sources, as FAO tries especially for the FAO-sponsored fishery bodies. The planned international fund for agricultural development (IFAD) should also support such cooperative efforts of regional fishery bodies in the development and management of fisheries.

Active contributions from non-coastal states can best be secured if the coastal states give them adequate incentives, for example, if they allow them a reasonable participation in the fishery. In any case it should be established as a principle that states which have access to the economic zone of other states must contribute adequately to the necessary research as well as to the enforcement measures in that area.

A basic requirement for good cooperation in international fishery organizations is mutual confidence. Coastal states should avoid too much discrimination of other states in the exercise of their new extended jurisdiction because otherwise they may take away any incentive for active cooperation of these states. The position of coastal states under the new Law of the Sea is strong enough to safeguard their rights and privileges. Moreover a generally recognized body like FAO could draw up certain rules and guidelines for the conduct of work in international fishery organizations that could help to avoid conflicts between member states.

The existing international fishery organizations could play a useful role in facilitating a smooth transition from the existing Law of the Sea to the new regime and the changes that are to come about. It would of course be appropriate for the Law of the Sea Conference to provide proper rules for this transition expecially since we expect a rather radical change. However, from the results which have emerged so far from the Conference it must be expected that many crucial questions will remain unanswered. Therefore the states concerned will have to find practical solutions in a pragmatic manner. While everybody will recognize the legitimate interest of the coastal states to reap the benefits arising from extended jurisdiction, every effort should be made in the interest of all mankind to avoid a fall in the overall fish production during the transitional phase by sudden drastic disruptions of the existing pattern of fisheries. It would be an enormous economic waste if existing modern fleets had to be tied up or sent to the scrap yards while at the same time new capacities are to be built with considerable investments and capital aid. This danger eally exists. In view of the uncertainties about the future fishing opportunities of the German fleet I have been asked several times whether it would not be wise to launch a government programme for the liquidation of the German trawler fleet before this branch of the industry runs into difficulties. Other countries with a highly advanced fishing industry might find themselves in a similar position. Such a development, however, could adversely affect the desired progress in technology and the transfer of such technology to areas where fisheries will be developed. One way to meet this problem and to avoid a fall in world fish production would be to combine capacities and skills of developed nations which will be loosing fishing opportunities with the technological requirements of developing coastal countries which are gaining resources and wish to develop their capacity to harvest them. Regional fishery organizations could play an important role in identifying needs and chances in bringing together suitable partners. They could encourage joint ventures and promote the twinning of research institutions in developing and developed countries.

Experience from the industrial sectors shows that we can accelerate the development of an industry considerably if we only give the industry a chance and some incentives. Even if governments employ highly skilled and highly paid experts they will normally achieve less than if they bring businessmen together who set up a joint firm, one partner bringing in the know-how, technology and experience in marketing while the other partner provides the resources manpower and some other basic facilities. At least this applies to possible cooperation with western countries where most of the know-how, skill and technology in the field of production and processing and marketing are developed by and are in the hands of private industry, whereas western governments do only most of the fishery research.
So if you give firms of developed countries a fair chance to participate in the development of fisheries you achieve the quickest and most effective transfer of technology. My country did the same after the distractions of the last world war and up to now through this policy. we are profiting from the highly specialized and sophisticated technology which is being developed in other countries, for instance the technology resulting from the United States space programme.

The cooperation on the industrial level could well be supported by cooperation among the governments in the field of research and scientific observation either bilaterally or in the regional fishery bodies.

We have recently concluded an agreement with another country which might serve as an example for such an approach. In this agreement the Federal Republic of Germany undertook a comprehensive fishery survey of the coasts of the partner country to provide reliable data on the nature and potential of the resources available. It was envisaged that the scientific expedition should be checked later on by a second survey of the same area in which two boats would fish under economic conditions to test the economics of the fishing operations, the possibilities for processing etc. It was agreed that joint ventures shall be formed if the expedition shows that a viable fishery can be developed. Scientists and experts from the partner country participated in all stages of the programme; part of the catches from the expedition were processed in different ways and tested on the local markets. It was also agreed that a certain part of the future produc-

tion could be exported to Germany because we have a consider-
able demand for imports.
Each developing country must of course decide itself how it
wants to develop its fishing industry. However, individual
development programmes of coastal states in a region may hav
considerable impact on the overall situation and the exploi
tion of the resources and it would be useful for coastal
states to use their regional fishery organizations as a for
for consultation and coordination of their national program
The organizations can not only support fishery development
fishery research but also take advantage of relevant marine
science programmes of other agenices. They could also make
efforts to give advice on the economic and social impact of
national development programmes and organize training acti-
vities in all relevant fields.

The activities of fishery organizations will vary from
region to region, depending on the geographical conditions,
characteristics of the resources and the categories of mem-
ber countries. The necessary adjustments required by the ne
Law of the Sea should be made as quickly as possible to avo
a vacuum in fishery management and development.

Being from a country with highly developed deep-sea
fisheries I have talked mostly about them. However, many
developing countries place main emphasis on the development
of their coastal fisheries. Here the need for international
cooperation in the management of resources applies as well.
The development of sea fisheries in Thailand demonstrates h
quickly we can arrive at the maximum sustainable yield and
run into overfishing problems. Only in the case of small
subsistence fisheries, I dare to say, have they little impa
on the resources. Their development will probably remain
primarily the task of local governments in the framework of
local development projects and they not require so much the
attention of international management. Nevertheless regiona
fishery bodies could assist the development of small-scale
fisheries by promoting the exchange of experience and advic

But if coastal states gain control of the 200 mile
economic zone they are well advised that they not only giv
attention to coastal fisheries but also explore the deep-se
fishery resources and the chances for their utilization.
Even if the coastal state does not need all the fish, deep-
sea fisheries may provide a chance for developing exports
and thus earn foreign exchange.

If a coastal state wants to develop fisheries for expo
again cooperation with the fishing industry of developed
countries is the best way to achieve entry into foreign mar
kets because such firms know the products and the quality
which are wanted and they have the know-how to produce such
products. May I give you an example for what should be avoi

In recent times cheap frozen fish products from Latin-
American countries have been offered on the European marke
They were bought because they were cheap. But the quality w
so poor that consumers refused these products after the fi

experience and many consumers refused all frozen fish for a while so that our producers complained. Finally severe import restrictions were imposed - to the detriment of many other countries which export fish to the Common Market.

Why was the quality so poor? Because the coastal states had been advised it would be best for economic and employment reasons to produce fish with small trawlers and have the catch processed ashore.

But in that particular area it would have been much better to take the fish into trawlers which are equipped with modern freezers and could be processed immediately on board.

Even in the case of Iceland, with its cool climate, you can process only catches from coastal waters on land bases. As soon as you catch in deeper waters, which requires longer voyages it is much better to process on board the fishing vessel. Iceland has banned modern freezer trawlers recently but in talks with young Icelandic skippers they confirmed that in the long run they will need freezer trawlers if they want to benefit economically from their 200 mile zone and to maintain their position with quality-minded foreign markets.

To sum it up: If we want full utilization of the ocean resources in the interest of mankind we must maintain and wherever possible, develop fisheries at all levels, subsistence and artisanal fisheries, coastal and deep-sea fisheries. The proper development and management of fishery requires continued research and a considerable transfer of know-how and technology. The geographical distribution of the resources and the jurisdiction over them on the one hand and the present distribution of capital, know-how and technology on the other hand require manifold international cooperation which can best be achieved through international fishery organizations. Cooperation with international fishery organizations must be adapted to the new Law of the Sea and their efficiency must be improved so that the organizations can live up to our expectations.

LABOUR INTENSIVE CONSTRUCTION FOR SHORE EROSION CONTROL

Mauricio Porraz
President
Mexican Committee of
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Three types of technology for erosion control have been developed in Mexico:

1. "Bolsaroca", which uses permeable hydraulic bags filled "in situ" with sand;
2. "Bolsacreto", consisting of waterproof flexible forms-works of various shapes, with possible reinforcing;
3. "Colchacreto", mortar mats with controlled thickness which can be articulated slabs or filtering units.

Laboratory tests are classified as: textile, synthetic fabrics and their weathering; concrete mortar and field quality control; hydraulic, experimentation and wave channels, mobil bottom flume channels and wave tanks in four different laboratories.

There have been a number of projects initiated and structures built since 1971 in the Pacific Coast and the Gulf of Mexico. Total volume of these structures is approximately 35,000 m^3 bolsaroca and 170,000 m^3 bolsacreto.

The costs involved for these structures vary according to: a) intensive local labour and primitive methods, and b) minimizing manual labour and utilizing more machinery, the average figure being approximately US$ 63.00 per metre^3 of bolsacreto (1975-76).

A comparative analysis between specific structures which use quarry stone (including 30 km·transport) and bolsacreto can be made. The advantages of the technology described are seen in the actual cost reduction (60 %) and in the shorter time required for execution (75 %). In addition, some estimated costs per meter of shore erosion control structures, including marginal structures, revetments, groin fields and submerged dikes will be given. The advantages and disadvantages of the technology will be discussed.

In conclusion, the technology has proven to be satisfactory for developing countries and can be easily modified to minimize the need for high wages, providing necessary facilities and equipment. In many cases the technology described is more economical, as well as practical.
In general, a project can be completed in a considerably shorter time and at a reasonable cost.

Introduction

For many developing countries, the lack of proper access roads and the great distances make it impossible to bring heavy construction equipmentto most of the sites where the structures to combat erosional effects need to be built. For the same reasons transporting quarry stone is uneconomical and other conventional methods become very expensive, leaving a large quantity of coastal villages and interesting developing projects without any hope of solving their erosion problems.

Approximately six years ago a group of Mexican engineers carried out an extensive research and development program in hopes of solving worldwide erosion problems. As a result, several systems for erosion control, called "operational designs systems", or "ODS Technology" were developed.

The concept of using synthetic fabrics for this purpose had been proven in Europe some time ago, but the idea of applying simple and practical construction procedures with the rational use of local resources, both natural and human, was found to be suitable for Mexico and is easy to apply in other countries.

The "ODS Technology" method for erosion control benefits areas where it is utilized in two ways: (1) the expenditure of a substantial portion of t[illegible] investment in tapping the local unskilled labor market for construction, and (2) the protective structures themselves. Therefore, the "ODS" method is a tremendously practical and a socially benefitting process of erosion control over both the short-and the long-term.

The methods and elements of "ODS Technology" are covered and protected by several patens issued and pending in the U.S.A., Mexico, Latin America and many other countries.

Description of the operational design systems

Bolsaroca (R)

Consits of hydraulically confining sand inside large synthetic fabric permeable bags. The equipment required may cost less than US$ 400. Obtaining elements already placed "in-situ" from 3 to 30 tons within a few minutes.

Bolsacreto (R)

Consists of synthetic fabric bags which are flexible, waterproof and adaptable to reinforcement. These act as temporary forms for concreting blocks up to 25 tons underwater, in areas of currents and in wave action zones, also minimizing losses and contamination of the mixture. The mixing and pumping equipment is relatively light and portable (less than US$ 10,000).

There are several types of elements, standard, with reinforced protuberances for better interlocking, and empty cylindrical spaces which may be filled later with the reinforced concrete interconnecting element.

Colchacreto (R)

Consists mainly of two layers of high-strength synthetic fabric incorporating spaced threads interwoven in both layers insuring a pre-determined thickness after being filled with grout or mortar. It is used for consolidation of slopes and beds of river channels and sea shores.

Colchacreto is adaptable for use in different applications consisting of five types that can be shaped and combined in accordance with specific requirements: "A" Articulate, for soils subject to settlement; "E" constant thickness, for stable subsoil conditions; "I" adaptable to the landscape; "O" for protecting and ballasting cylindrical elements such as pipelines; "U" filtering unit, for support of coastal structures.

Other systems

Several other processes utilizing the "ODS Technology" principle are in development stages: "Alambroca (R)", high-strength cylindrically-shaped plastic mesh which is filled by hand with granular material and rolled by gravity to the site; "Fibrocontrol (R)", fabrics with integral ballasting and floating devices to be placed under water as a flexible and permeable curtain; "Panelestace (R)", oriented, water jet drive - in piles with synthetic fabric screen to build permeable-control groins for rivers; "Eolipantalla (R)", specially designed synthetic screens for reduction of particle movement caused by wind; "Fijasol (R)", high polimerisation plastic compound which creates a three-dimension permeable screen for soil stabilization; "Filtroleaje (R)", flotation control modules that may be used for several erosion control purposes.

Description of Laboratory Tests

Synthetic fabrics

Since 1971, intensive and exhaustive laboratory tests have been carried out to establish the effect of the sun (ultra violet and Gamma rays) on the different synthetic fabrics used in "ODS". These tests were conducted primarily at the laboratories of the Materials Research Center at the National University of Mexico using radioactive cobalt in a gammacel 200 for intensive weathering tests, and at the laboratories of Celanese Mexicana, S. A. In order to reproduce the Tidal-Zone effect, some modifications were done in an "atlas" phateometer submerging the samples alternately in a salty solution and exposing them. On Polyester I-CE-785 a loss of 20 % of strength is expected after 15 years of sun exposure. In field observations, we have noticed some deterioration after 3 years but still at a rate less than that observed in the laboratory. Normally, the Bolsaroca is coated on the exterior with asphalt emulsion.

Concrete

Since 1971, the Mexican Cement & Concrete Institute, A.C., has helped us with its laboratory. The maintenance of quality control for almost all the projects is done by the National Laboratory for Construction. Some government agencies have their own laboratories.

Hydraulics

The Ministry of the Navy through the General Direction of Maritime Works at its Hydraulic Laboratories in San Juan Ixhuatepec made a series of tests in a wave channel previous to the first applications.

The hydraulic laboratories of the National Politechnical Institute, jointly with the Consultant Engineering firm "CIFSA", carried out a complete study for an alternate solution in a shore line erosion problem at El Paso Caballos-Corinto in Nicaragua, Central America. Further Laboratory tests were made at the Hydraulic Facilities of the Experimental Engineering Department of the Ministry of Hydraulic Resources, using a mobile bottom flume channel in order to study the scouring at the end of the groins. "ODS" elements had given excellent results in minimizing this effect. Immediate field application followed in several rivers in the Papaloapan River Commission with satisfactory functioning thus far.

At the Engineering Institute in the National University of Mexico, an important research program is presently being carried out. We expect to obtain enough data to publish design criteria for coastal structures built with Bolsacreto. At the same time, a systematic field data report on the behavior of the already existing structures (some almost 5 years old), will provide the complementary information for this publication.

The wave channel can reproduce waves up to 9 m high and periods from 6 to 20 seconds. The scale of lines are 1/60. Up to now, slopes 1:2 and 1:1 are being tested.

Small polyethelene bags filled with "mastic" represents a 3 ton Bolsacreto with a density of 2130 kg/m^3. Up to now the failures are due mainly to sub-pressure effects as in some tests where waves larger than 4 m can originate differences of water level close to 3.5 m.

In the event some settlements at the end of the slope occur, one element may be separated and the unbalanced hydrostatic and hydrodynamic effects move it out as the friction factor is quite low in the model bags.

This phenomenon has not been observed for waves up to 2.5 m high, nor in the field data obtained from the existing structures.

Description of field work in Mexico

Ist Period

The first field work started in 1971, after preliminary tests at Revolcadero Beach near Acapulco in the Pacific Ocean near Salina Cruz Harbour. An experimental groin to reinforce the formation of a "tombolo" was built with

Bolsaroca (about 70 m long) to link a deliberately sunken ship with the coast line. The project was developed by the engineers of the Mexican Navy and has been a big success thus far.

Immediately after, in 1971, two Bolsaroca breakwaters (250 m and 50 m) were constructed in less than two months to protect a communication channel to the Gulf of Mexico at Rio Lagartos, Yucatan. In two separate occasions, in 1973 and 1975, the length was increased with Bolsacreto by 350 m as the volume of littoral drift accumulated.

Eleven groins of Bolsaroca (30 m each) were placed to stop shore erosion at the fishing village of Holbox, Quintana Roo, during the spring of 1972 and reinforced in 1974.

At Progreso, Yuc., 7 Bolsacreto groins of 20 m were placed during the summer of 1972 for stabilization of a tourist beach.

Also in 1973, between Azteca's Island and the left bank of Grijalva River at its mouth near Frontera Harbour, a 900 m dike was constructed using 7 ton Bolsaroca.

All of these projects were supervised by the General Direction of Maritime Works from the Ministry of Navy.

2nd Period

Near PEMEX's offshore oil platforms of Santa Ana, in the Gulf of Mexico, is a sheltered harbour of Sanchez Magallanes, which was formed with two Bolsacreto Breakwaters started in late 1972. The first phase was completed in early 1974, and a second phase was built in the summer of the same year, adding length to the structures according to the budget possibilities. In 1976, the West Breakwater attained 470 m. in length and the East Breakwater 380 m. This is a project of the Mexican Navy.

The Nautla River, near its mouth, was eroding the national Gulf Highway at Casitas'Village. For several years conventional solutions were unsuccessfully used. In 1973, a 450 m long revetment of Bolsacreto was made for the Ministry of Public Works (SOP). The protection effect is still excellent.

Two experimental groins of 50 m, each of Bolsaroca, were built at La Pesco Harbour near Soto la Marina, Tamaulipas, in the spring of 1973 for the Navy.

Two groins and a submerged dike (120 m) of Bolsaroca were placed at Puerto Marquez Gro., for stabilization of a tourist beach for private owners.

For the Ministry of Hydraulic Resources (SRH) 3 Bolsaroca groins were made at Camichin, Nay., on the San Pedro River near its mouth in the summer of 1973.

On the road to San Blas, Nay., the eroded piles of highway bridge (SOP) were repaired and protected with Bolsacreto, both at the same time.

On the Papaloapan and Tesechoacan Rivers 15 groins (20 to 25 m) of Bolsacreto were built for the erosion control program of the Papaloapan River Commission (1973-74).

For the Ministry of Public Works (SOP) 5 groins of Bolsacreto at an average length of 70 m were built at Coahuayana River in the state of Colima, 1974.

Also for the Highway Department of SOP a revetment of Bolsaroca 100 m long was built at Rio Salado, Puebla, 1974.

For the Mexican's National Railroad Co. a marginal protection of 80 m long was constructed near Jalapan, Ver., in 1974.

In a tourist development project on the Pacific Coast at Estero del Chino, Nay., two Breakwaters of 7 ton Bolsacreto (285 and 300 m) were constructed for a sheltered harbour, 1974-1975.

For an important thermoelectrical plant at Campechi II the structures for receiving cooling water and for discharging it back to the Gulf of Mexico were built with 4 Breakwaters (2 at 180 m and 2 at 250 m). The Federal Electricity Commission's Engineers specified Bolsacreto and the job was completed in almost 100 working days in the autumn of 1974. The sand had to be transported from Champoton, 80 km away.

In the State of Tabasco, also for the Federal Electricity Commission, a 160 m bank revetment was built in the Mezcalapa River to protect a transmission tower from erosion in 1975.

The National Aquaculture Plan, initiated in 1971, calls for improvement of the ecological conditions of coastal lagoons in our country. At the top of the list of priorities, is the necessity to open the flow of water between the ocean and these lagoons. Some structures are required to keep the mouths of the lagoons open, due to the littoral drift, and they are made primarily with Bolsacreto. Following is a list of the locations:

La Machona, Tab.	1975	(2 jetties 120 m each plus 8 40 m groins)
Tupilco, Tab.	1975	(2 jetties 100 and 180 m)
Tabachines, Ver.	1975	(2 jetties 120 m each)
Colorado, Nay.	1976	(jetties 100 m each)
Centro, Sin.	1976	(2 jetties 100 m each).

Normally for the Gulf Coast projects, the design wave was around 3 m. Nevertheless, the registered waves on several occasions exceed 4.50 m in height generated by the Northern Gulf Hurricanes.

The estimated volumes of Bolsaroca that have been placed since 1971 are around 35,000 m^3 and for Bolsacreto approximately 170,000 m³.

Projects started in 1976: two Bolsacreto breakwaters (200 and 150 m), at Campeche Camp, 100 m jettey and 200 m marginal revetment (Bolsacreto) at Mocambo, Ver., two breakwaters (100 and 50 m) of Bolsacreto to form a shelter harbour at Telchac, Yuc., 10 km of marginal Bolsacreto protection for a coastal road on Huivulai, Son., revetments of Bolsacreto of 200 m. for the Texcoco Lake Commission, revetment of Colchacreto for the districts of Low San Juan and Bravo.

Projects outside of Mexico: several projects are either successfully finished, under construction, or soon to be started at Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, Panama, Colombia, Ecuador, Peru, Venezuela and Brazil.

In Afro-Asia are projects which will start this year in Egypt, Pakistan and Sri Lanka. Other projects are now being studied for other African and Arab countries and the far East. We are presently in the preliminary stages.

Costs

Extensive use of local labor

A job can be accomplished producing functional effectiveness with a minimum expenditure, utilizing local skills, materials and mobilization of problems. The procedure is simple, practical, and primitive but it is possible to obtain reasonable quality control.

For a two-mixer (one sac) with a 30 HP pump, employing an average of 20 local workers, the estimated unit cost per cubic meter of Bolsacreto is US$ 62.00 (including materials, equipment, labor and 30 % administration and profit).

Minimizin the use of labor

Given the availability of a pre-mix plant in the area, and reasonable access to the work site for the mix-trucks, the need of labor at higher wage rates can be minimized, and the estimated cost per cubic meter of Bolsacreto might be around US$ 64.00 (including materials, equipment and 4 workers from US$ 4.00 to US$ 8.00/hour).

Analysis of comparative costs

For example, in constructing a breakwater 450 m long and up to 4.50 m deep, the conventional solution with quarry stone is 6.00 m wide on a crown at + 4,00 m high with both slopes 2:1. The Bolsacreto reduces the crown to 1.80 m wide at + 2.00 m high and slopes 1.5:1.

If the distance required to transport the quarry stone is about 30 km, 1975-76 costs might be around US$ 17.00/m³ for the nucleus, US$ 27.00/m³ for the 2nd layer and for the shelter, 10 ton rocks US$ 35.00/m³.
The conventional solution US$ 1.21 millions, est. time 13 months. "ODS Technology Bolsacreto" US$

est. time 90 days. "ODS" Technology (by steps, the full project) US$ millions, est. time 35 days (1st step).

In the "ODS" Technology, relatively light equipment is required that will not incur substantial mobilization costs, as is the case in other conventional solutions. This allows the possibility to build the erosion control structures by steps and with a minimum investment (24 % of the conventional solution for the 1st step). Within a few working days (35) the structure will be operating, leaving the other steps for later dates when ever they are required.

Shore erosion control structures

It is necessary to establish whether the structure will be a delaying type, for prevention or permanent protection. The more important point in beach building is "an adequate evaluation of the supply of sand".

Where the natural conditions make sand available, by the littoral drift a groin-field might be successful and the cost per running meter of coast line may vary from US$ 10.00 to $ 18.00. Controlling the erosion in a shore line subjected to a wave action is not a problem to be solved by a catalog order. But generally, for the marginal structures, the cost, depending on site conditions, can be from US$ 100.00 to $ 150.00 /m, for submerged dikes of Bolsaroca, from US$ 20.00 to $ 100.00 /m.

In some coast lines, but mainly for protection of inlets, channels, or rivers, the cost of mortar-filled and placed Colchacreto flexible slab-mats will depend upon the thickness and runs from US$ 8.00 to $ 15.00 /m.

Discussion of ODS Technology

Bolsaroca could be a most attractive solution to make full scale low cost experimental structures and if the results obtained are not as wanted, they can be easily dismantled without problematic works remaining on site.

Bolsaroca will also perform as an excellent temporary means of protection and can obviously be quickly accomplished for emergency situations.

Bolsaroca offers a unique answer for coastal and jungle areas where no access roads exist and the transport of the needed equipment and cement is difficult or impossible.

On submerged structures, as the ultra-violet effect is reduced and no vandalism might be expected, interesting possibilities are offered thanks to their flexibility once in place.

Bolsacreto is a more permanent and more suitable solution and the structures built with it are highly recommended over use of a vertical sea wall on open coast locations. However, in all applications it will be necessary to establish whether the use of the synthetic fabric filter is required in order to minimize the scouring and bedding removal by an imbalance of hydrostatic and hydrodynamic pressures, reducing the settlement of any element or a part of the structure producing undesirable or unattractive results. Each specific project will require a reasonable evaluation of the probable wave conditions in order that the structure should survive without heavy damages. Additionally, it is necessary to establish the type of Bolsacreto, size and weight, the manner of laying up and the shape and dimensions of the structure. In some cases it might be important to minimize the reflection of impinged wave energy, while in others, the need of a deflective sea-wall device on top of the structure might be required to reduce the run-up effect.

Colchacreto is also an interesting possibility thanks to the large field of applications and the rational and combined answers for specific erosion problems.

After almost 5 years experience, building several projects with "ODS" technology elements, in many cases, the waves and the ocean conditions exceeded those of the design without significant damages: Hurricane Brenda, 1973, on Sanchez Magallanes' Breakwaters, Hurricane Carmen, 1974, on Campeche's Breakwaters, Hurricane Fifi, 1974, on a Guatemala's Navy marginal structure near the border with Honduras, Hurricane Olivia, 1975, el Chino's Breakwaters, etc.,

Conclusions

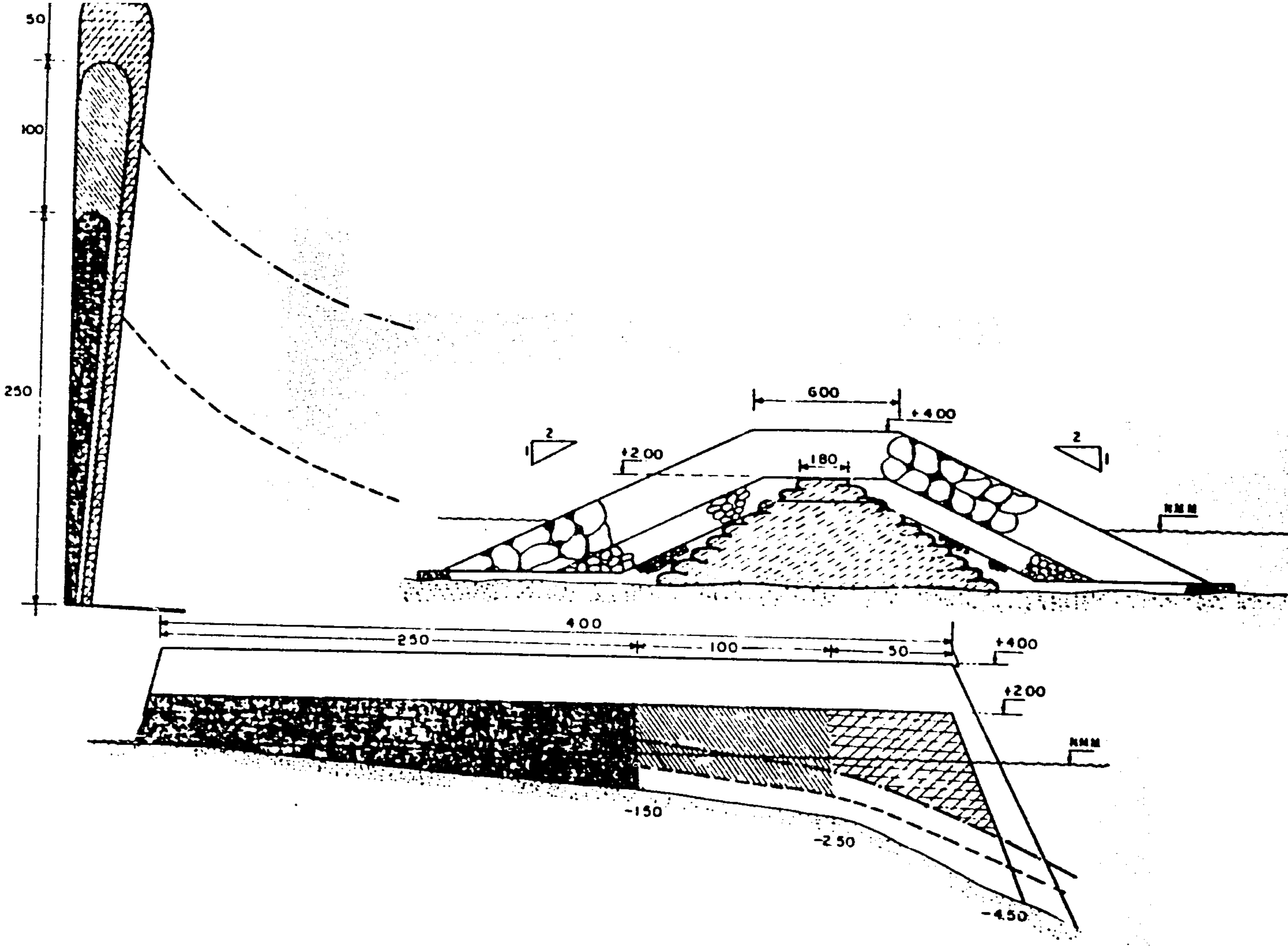
The "ODS" technology was created to be used in areas where the local labor is reasonable cheap, and as a solution of unemployment in those areas, with excellent results after 5 years of experience in a large number of projects in Mexico and Latin America on the technical, economical and social benefit aspects.

This system can easily be adapted to other countries including those with higher wage rates by minimizing the need of labor with the use of a pre-mix plant, keeping the costs on reasonable levels.

Also "ODS" technology will be the only possibility for regions where adequate rocks are not available, or the quarry locations are too far away from the work site.

In some cases the "ODS" technology's solution will certainly be more economical than other conventional solutions. For many other cases, this system is better than conventional for its unique and practical features on common bases of functional performance.

The "ODS" technology has a long-term advantage as it is possible to fulfill the requirements of the project in a considerably shorter time at a reasonable cost commensurate with the solution.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THE INTEGRATED SURVEYS FOR THE COASTAL AREA DEVELOPMENT

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Introduction

The importance and the role of the Coastal Zones have been amply dealt with. They have been mankind's most significant sources to satisfy our needs for food, transport, energy and recreation.

In the course of our history, we have taken the available resources for granted, practically without exercising any restrictions on their exploitation. The new activities were planned with fast returns in mind, regardless of their possible deteriorating effect on the immediate and broader environment.

Now, with the immense possibilities of our technical skill and with the far-reaching consequences that may follow, we have created a fragile ecosystem around us, where every new activity must be carefully planned, and the impact of all the new steps systematically and methodically investigated.

The United Nations and the respective countries have decided to draw up regional development and management plans for the coastal areas in order to establish the indispensable framework of the future economic activities (Fig. 1).

The integrated survey and the regional development plan

Although the purpose of this paper is to deal with the integrated surveys, it would be illusory to enter into any analysis or descriptive details without considering the most important element, namely the development planning in the process (Fig. 2).

The integrated survey is not a series of pre-determined activities but a dynamic process which is conditioned and monitored by the interrelation of the objectives. The objectives are framed in the Development Plan, and they are, in turn, dependent on the synthesis of parameters established during the integrated surveys.

The adjustment of project objectives is thus an essential component of the process and will affect the procedure of the survey.

Before the actual commencement of the survey, a framework of the Development Plan is constructed. It is a wide spacious model, consisting of the general political, economic, environmental and institutional elements, based on available data and on a review of the sectorial goals.

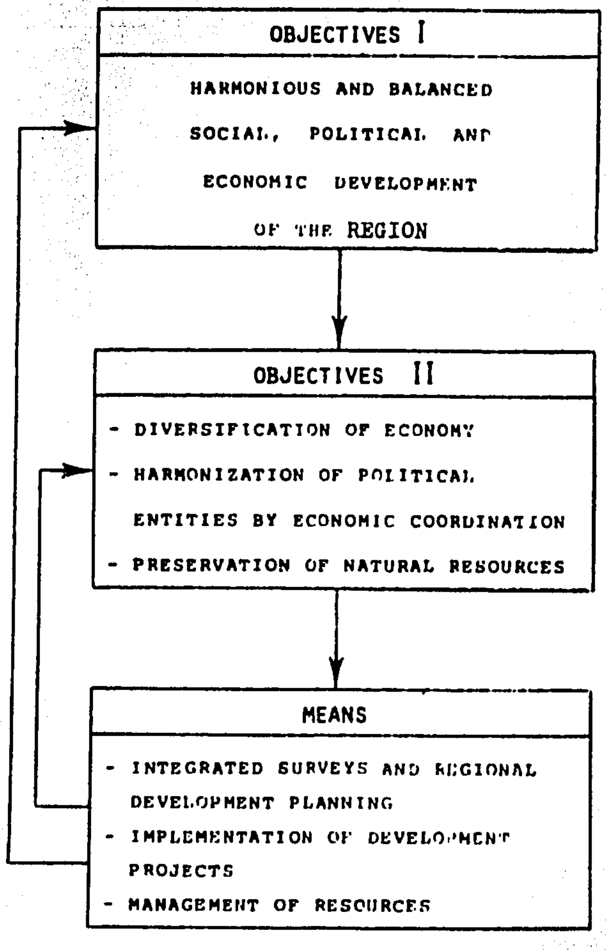


Fig. 1. Coastal area development planning

SIMPLIFIED FLOW DIAGRAM OF THE COASTAL AREA DEVELOPMENT PLANNING PROCESS

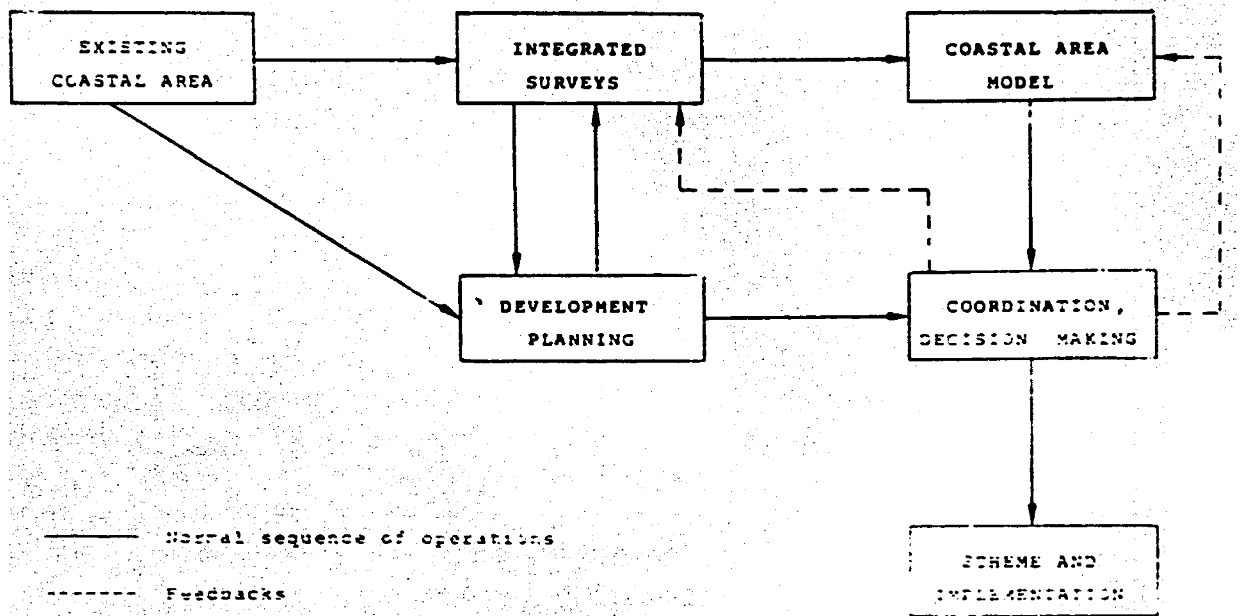


Fig. 2

This plan outlines the development strategy and can be considered as the first approximation of the Final Development Plan, which will be refined and, subsequently, made operational during the course of the different phases of the project (project: Development Plan + Surveys together). The role of the integrated survey is thus to make the development programming operational by integrating its multidisciplinary fact-elements into coherent results from which the optimal decisions are deduced by systematic means.

The specific characteristics of the I. S. for the coastal areas

The specific characteristics of a coastal area make the comparison with the integrated surveys, which have already been carried out in any other part of the world, fairly difficult.

As a rule the areas or regions subjected to Development Planning and integrated surveys have a homogeneous characteristic either from the geographic, geomorphologic, political, economic or legislative point of view. In many case, most of these factors are homogeneous.

Concerning its geometric extension, a coastal area is already unusual: it may be a narrow space thousands of miles long where the width is practically in no proportion to the length - as in the case of the West-African coast, or it might cover a comparatively broad sea-land area as in the case of the Arab-Persian Gulf which constitutes one bio-economic unit with its shallow waters.

Generally speaking one may say that the width of a coastal area is determined seawards by the continental shelf and landwards by the distance covered by the direct influence of the economic activities concentrated on the shore.
These dimensions are in fact unknown at the beginning of a project. Their limits are one of the first subjects to be studied during the course of the survey. The principles of selection are actually laid down in this seminar.
Politically and legislatively several countries exercise their sovereign authority and rights and often in a conflicting context. From the economic point of view, the situation is even more specific. Most integrated surveys used to cover underdeveloped or developing region where one dominating factor determines the boundaries. This dominating factor is either physical or can be expressed in socio- or purely economic terms, and the goals mostly concern the desire of raising the standard of living.

The problem lies more on the survey and coordination of the already developed special needs than on the search for new areas to be developed. Coastal areas have the oldest tradition in the exploration of their resources and our real trouble began when the enormous uplift in the level of resource-potential occurred.

Another peculiarity in some areas is the scanty population of each state and of the whole region. The obvious consequences of this on the market and industrial development with special regard to the labour conditions may add to the characteristic problems of a coastal area.

Furthermore, contrary to the customary cases, an abundance of experts are presently operating in the coastal regions: technologist and scientists, foreign and local research groups - sponsored by national and international organizations - all engaged in carrying out surveys, studies and research work assisted by sophisticated and up-to-date equipment.

If we read a list of ongoing activities, it would give an idea of the financial efforts and the deep concern felt by the population of the region with regard to their future. But it would also show that most of the activities are generated by sectorial goals, aiming at sectorial benefits. It is inevitable that many acitivities contradict, interfere with, or even overlap the others, and it is also inevitable to conclude that the only sound solution is the establishment of a comprehensive regional development programme.

The great dimensions of the survey require a large number of experts in several survey teams.
To organize work and to get the individualistically inclined experts to cooperate constitutes a special problem which can only be approached methodically.

These are some of the factors composing the particular background of the integrated surveys for the coastal regions.

The conditions which should precede the operation of the integrated surveys

The purpose of this paper is to outline the technical properties of the integrated survey. But one should bear in mind that the survey is a dynamic process, where the programme is continuously adjusted to the needs and problems derived during the process.
There is another essential element of the survey we have to observe, i. e., the urgency of the case. It would be impossible to organize and perform the survey efficiently if correct intermediate decisions could not be made and, yet, within a reasonable period of time.

Therefore, it is a pre-requisite to have a decision-making organism which has jurisdiction over the affairs concerning regional development, planning and survey. This body, we shall call the development committee, which might consist of a ministerial committee of the 8 countries involved and the U.N. It should possess full responsibility over information, assignment control and the financing of research work making intermediate decisions on the one hand during the execution of research work, and on environmental issues on the other. The statute of this body is to be clearly defined. The formation of such a committee is a specific problem which we will not develop in this paper, but we would like to mention that there are already some examples in other parts of the world which function with more or less success (see Basin Committees in West-African).

But we stress the point that for any hope of a successful operation, the establishment of such an organization is imperative. We would further state that, if the founding of that body were not possible, the chance of creating or implementing a sound regional development programme would be extremely small.

The organization and the activities of the survey

The primary technical condition of the survey is the existence of the first framework of the development plan, outlining the general development strategy.

The guiding priciple in the organization of the survey is that a basic team of multidisciplinary experts be formed to conduct the survey from the beginning until the completion of the project. From time to time, according to necessity, other specialists might be called upon to carry out specific studies, but the basic team should remain unchanged.

Another survey group, carrying out applied scientific research, might work simultaneously on specific problems where the goals are not necessarily pre-determined. The results of this survey would be employed during the implementation of the project and for the derivation of long-term objectives. We shall call this an all comprehensive survey.

The basic survey can be broken up into four phases which coincide with the stages of progress of the development planning, and form an integrated part of them.

All the phases comprise the following elements:

a) identification of conditions;

b) identification of needs;

c) determination of the scale of investigations;

d) data acquisition;

e) data processing;

f) feedback;

g) presentation of results.

Point a refers to the development planning and to the actual physical conditions of the survey.

Point b is the identification of the extent of the survey. The objectives are defined with an estimate of the possible interrelations between the survey-results and the project-objectives.

Point c The definition of the pack of information to be obtained, needs a methodic approach, due to the extreme complexity of the survey aims and also the interrelation between the different goals. On the other hand, the economy of the survey and the urgency of the development (expecially the priority issues) require a clear definition of the proper scale of all the activities. A technically and scientifically sophisticated survey is a delicate and costly procedure, where the costs grow with an increased degree of proportion to the growth of the scale, so that a random or intuitive definition of it might cause considerable loss of time and money.
Only when in possession of the right scale can one apply a systematic programming. Then a network planning will be drawn up, showing the logical coherence of all the operations.

Point d establishing the necessary information by way of investigation, research and collection of data; identification of the interactions of the different disciplines and determination of their qualitative and quantitative parameters. The experts perform a team work integrating their individual research with the intermediate results of the other team members. If necessary, the time schedule will be adjusted to new requirements which might occur during the execution of the survey.

Point e and f The data processing should preferably be performed during the field investigation periods, except where the economy of the work requires other facilities for that. The data reflect the objectives of the development plan, the objectives determining the collection and processing of the data.

If necessary, the objectives would be re-appraised and the survey process adjusted, modified or complemented accordingly. This intermediary adjustment is an essential operation of the survey.

Point g The results will be presented in the form of interim and final reports, then built into the development plan and further processed in order to establish the objectives of the next phase or eventually the development programme.
The interim reports summarize and deal extensively with the outcomes of the survey. The final report - smaller in volume - gives an overall view of the whole project and further refers to the technical documents of the project. This system improves the communication between members of teams and guarantees closer contacts with the decision-makers.

The four phases of the survey

Parallel to the stages of the development planning we phase out the survey (see flow diagramm - Fig. 3).

Phase I - Preliminary survey:
Inventory of existing data, collection information on ongoing activities, also by editing, distributing and working out questionnaires, summing up survey potentials, compiling basic information for the outline of the provisional designation of the coastal development area and definition of the perceived needs.

The operational outline of the following phases is drawn up.

If terms of reference are required, they can be prepared after a pre-survey or fact-finding mission, during which a primary identification of the problems and the delineation of the methodology can be achieved.

The priorities for an all-comprehensive survey group are to be established to execute the applied research programme. This scientific team will carry out its programme parallel to the survey, and partly independent of the other survey team or teams, in which the work is carried out according to a fixed-schedule and with precisely defined goals (although the planning may be continuously adjusted). The goals of the scientific team are long-term objectives and the intermediate findings will define the extent of the survey.

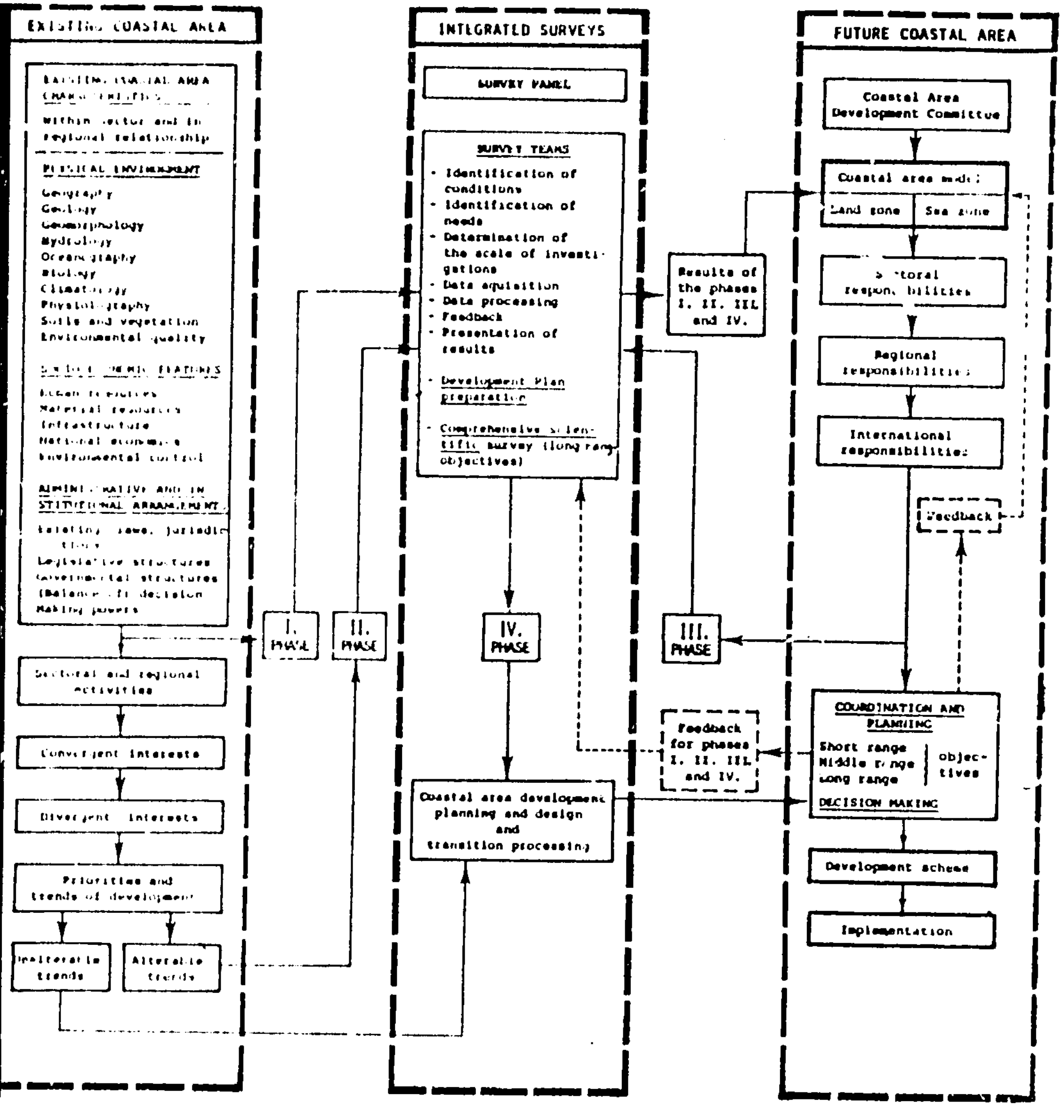
Phase II - Reconnaissance survey:
Identification and inventory of the natural and human resources, economic, social, political and environmental data. Sectorial and regional economic objectives are studied and inventorized, the goals and trends of developments evaluated. Analysis is made of the converging, diverging and conflicting nature of the economic activities within or between sectors. The socio-economic justification of development trends are reviewed and the alternative development possibilities are identified. The sectorial priority projects and needs are surveyed.

Phase III - Feasibility studies:
Selected development possibilities are examined. The model of the coastal area development is constructed and the sectoral, regional and international responsibilities in the development goals identified. Feasibility studies of the selected development projects are made.

COASTAL AREA DEVELOPMENT

THE INTEGRATED SURVEY IN THE COASTAL AREA DEVELOPMENT PLANNING PROCESS

FLOW DIAGRAM



LEGEND : ——— Normal sequence of operations
– – – – Feedbacks

Fig. 1.

Phase IV - Detailed survey:
Detailed economic studies of selected projects are undertaken and final recommendations are drawn up with their socio-economic justifications. The regional development programme is established. Final adjustments and drawing up of the implementation programme are made.

The members of the survey teams

The basic survey team is the main advisory panel of the regional ministerial committee; we call it "survey panel". It consists of experts of various disciplines, members of the U.N. services and, if possible, local counterparts. The U.N. can ensure the technological and scientific assistance with competent specialists from the U.N. system. The participation of local experts can be beneficial to the survey and to the subsequent implementation of the project. One of the advantages is that the concept of the whole project will become known in the governments, ensuring the follow-up of the programme. The other advantage, not direct to the survey emerges later during the implementation of the training and educational programme, when the local experts who took an effective part in the survey, can be of useful assistance.

One must however bear in mind, that the first requirement for participating in the team is technical proficiency and personal ability.

The survey panel and the survey teams

The responsibilities of the survey panel are threefold:

- the organization and management of the integrated survey,
- the preparation of the regional development plan,
- the co-ordination between the regional committee, the United Nations and the survey and research teams.

The members of the survey panel are also individually involved with the practical work of the survey and the Development Plan. They prepare the planning of the survey and work out budget proposals for the committee. Purposeful use will be made of the advanced scientific and technical methods.

The panel will regularly meet with the regional committee and will issue monthly progress reports.

The number and composition of survey teams will be defined after the collection of background information concerning existing data and ongoing activities.

One of the first activities of the survey panel is to draw up the technical specifications and, thereafter, establish a data centre where all the collected information will be stored after classification and codification. The data centre will be used later for monitoring economic activities.

The structural model of the survey

Many of the important variables in the survey do not lend themselves to quantitative evaluation, but it would be highly undesirable to leave them out. SORCA has, over some years, developed a methodology which has been successfully applied in many projects, oriented to the analysis of large socio-politico-economic systems.

Structural models are capable of processing non-quantifiable variables by means of ordinal analyses, this property being an important complement to the concept of the traditional models.

We have attempted to outline in Appendix I a Structural Model for the integrated survey:

- with regard to the appraisal of the assignments for the presentation if the complexity of the project,
- with regard to the economy and urgency of the operations: for the definition of the extent and of the scale of the survey activities during the different phases.

OUTLINE OF THE STRUCTURAL MODEL

Introduction

Apart from other inadequacies, the traditional development planning methods are more particularly handicapped by

(1) the non-existence of overall studies that compound all relevant factors and interrelationships in one formulation;

(2) the over-abundance of studies of local or specific interest which are generally undertaken to solve emergency problems, their conclusions thus being unfit for generalization.

The comprehensive, logical and scientific approach of systems analysis lends itself admirably to supplementing these shortcomings, in that it enables us to apprehend the whole complexity of phenomena in an overriding system and to situate them in their proper space and time dimensions. A system then is a collection of various elements which affect other elements and are in turn affected by them. The integration of these elements enables the system to perform its functions.

THE STRUCTURAL APPROACH

General remarks

The system concept entails that of goal-seeking action. Indeed, we will be confronted by choices throughout the development sequence of the system, i. e. as from its conception up to its operation, and will have to elucidate these choices at the various stages where they occur.

To analyse a system, we proceed in three stages:

(1) first, we represent the problem by an adequate formulation and define all relevant objectives;

(2) then we describe the system by means of an inventory and an analysis of its component factors and the nature of their interactions;

(3) finally, we describe and explain the behaviour of the system by means of a single or mixed model; depending on the nature of the problem, the vector of the objectives and the available means of action; we may either have to construct an overriding or a specific model.

The point of the structural approach to the analysis of economic development programs lies in the fact that we apply the very techniques of systems analysis as from the first stages of our investigation.
In other words, we compound these first stages into an overall model which we regard in turn as the premise of our further investigations.

Presentation

Definition

Structural models are a means to describe complex, non-recurrent economic phenomena which entail non-quantifiable variables and imply several interacting parameters and decisions (functional relations).

These phenomena are mainly non-deterministic and occur in a highly contingent context. Traditional mathematical formulations fail to represent them adequately.
The advantages of the elaboration of the graph of the functional relationships lie in:

(1) its normative properties: at any moment, the graph shows how the random and decisional variables are structurally interconnected, thereby emphasizing those interrelationships that may have been disregarded or neglected.
In summary, the graph is inducive of initiatives.

(2) its dynamic properties: the graph enables us to evaluate the consequences
   (i) of fluctuations of the random variables and the decisions that ought to be made accordingly;
   (ii) of actions upon decisional variables and the sequence of ensuing decisions.

Characteristics

Structural models are characterized by the following properties:

(1) Non-quantifiable factors, vectorial and tensor variables are incorporated in the model, as from its first conception phase.
Very often non-measurable or non-assessed variables are disregarded mistakenly. The drawback of such simplifications is that the reality which ought to be represented by the model is distorted accordingly.

(2) Mathematical relations are introduced in conjunction with others that are mainly logical, giving the dependency relation of one variable vs. several others.

EX. (1) deterministic mathematical relations:
e. g., useful capacity of an infrastructure - traffic volumes - degree of saturation.

(2) logical relations:
e. g., overall demand for recreational facilities is determined by:

- industrial structures and development,
- the structures and development of socio-cultural features,
- the localization of labour and housing centres,
- the evolution of the GNP
- the growth in population
- the growth in the volume of tourists.

(3) The approach followed is more heuristic than algorithmic, but algorithms are re-introduced in the operational phase.

Each problem, characterized by its own original properties, demands the construction of a specific model which has to be

(1) dynamic: capable of generating its own evolution,
(2) capable of relating (or predicting) the behaviour of the system,
(3) operational: capable of revealing the available actions.

Structure

The structure of such a model is made up of convergent variable and factors on one hand, and their interrelationships on the other. Decision graphs are then isolated from this structure.

Variables and factors

There are various variables which play a predominant, though not exclusive, role; we should like to call them the key-variables.

We can classify the variables as follows:

(1) key and non-key variables,
(2) decisional and random variables,
(3) quantifiable and qualifiable variables,
(4) tensor, vector, or scale variables

Functional relationships

When we consider the variables in the system, we find that they are structurally related to many others.

By integrating these relationships, we can now compose a network which is the very essence of our model.

To elaborate this network, we consider all the variables in a dependency position one after another. In each of the general relations, we can now study the binary relations between a given dependent variable and each of those on which the first depends.

If we consider these binary relations as a whole, we can now proceed with the operational exploitation of the primary network which we have defined in the first stage.

Types of relationships

The above-mentioned relations are not of the same nature; they are distinguished into

(1) direct causality relations: relations in which the factors stand to each other as cause and effect.

e. g., the increase in industrial activities results in the increase in the polluants.

(2) conditional relations: relations in which the factors,

though not of direct impact on the dependent variables, nevertheless condition their level, thus acting as constraints.

e. g., the selection of shipping routes is conditioned by the topographic formation of the sea bottom.

(3) relations of decisional influence: relations in which the factors only cause the anticipated effect when we make a given decision.

e. g., the growth of a market due to the changes in the customs-policy of neighbouring countries.

Decision Graphs

We must bear in mind that human (decisional) factors have a very great impact on these graphs.
The relationships of decisional influence are indeed very sensitive to the structure of the decision centres, so that inadequacies in this matter may

(1) short-circuit the network as a result of breakdowns in certain relations of influence,

(2) induce unanticipated reactions, resulting in unconscious distortions of the relationships,

(3) delay the induced decisions, thereby occasioning dephased and/or undesired reactions.

On the basis of the network of these relationships and bearing in mind their nature, we can now trace the logical path, followed by the decisions as it springs off from the controlable motor-variables taken one after another as the starting-point of our progress.

Each of these decision graphs corresponds to a primary decision enabling us to

(1) anticipate the outcome of each individual decision, its effects and new ensuing options.

(2) find one (or more) combination(s) of decisional factors that may assist us in improving the achievement of our objectives.

Elaboration

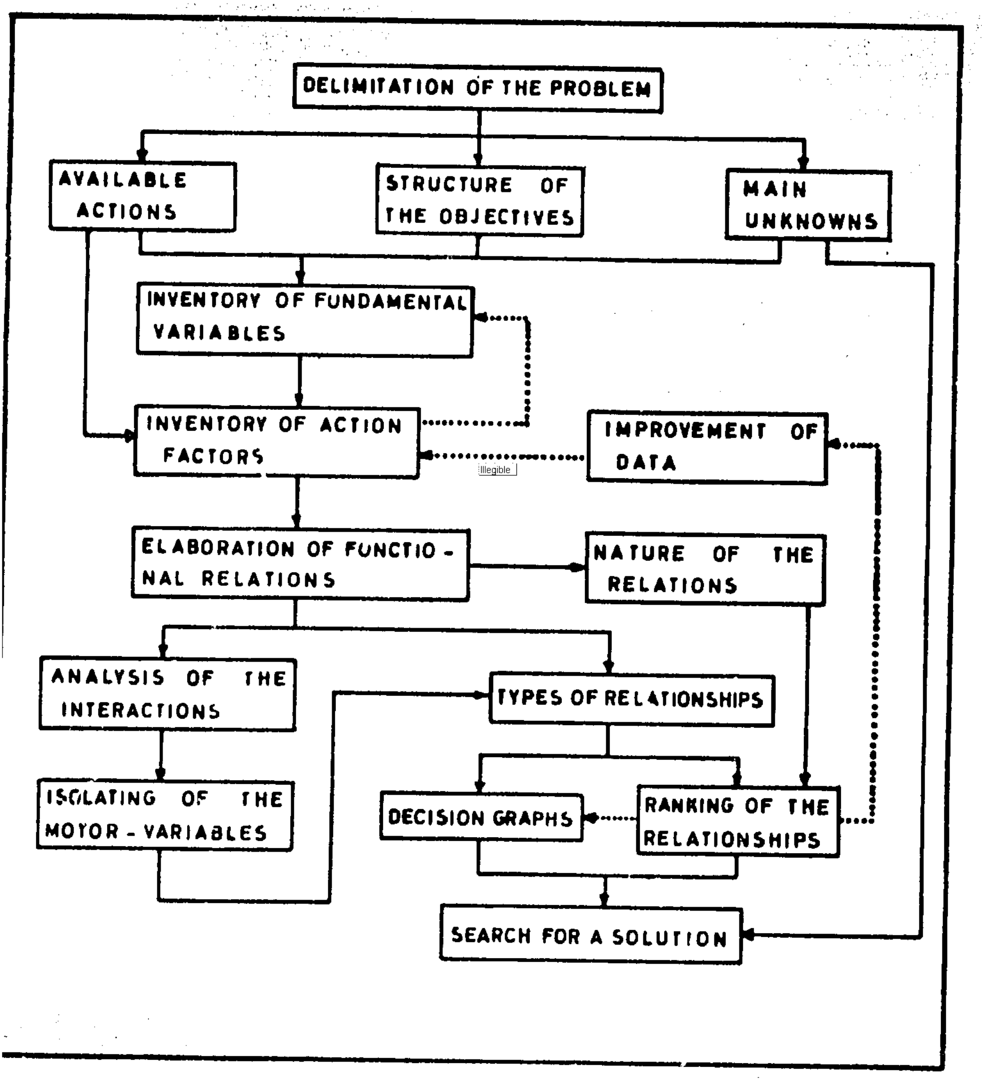
Fig. 4 summarizes the sequence of the elaboration of an overriding model and the following management tools.

Ranking of the relationships

The nature of the variables is conditioned by the vector or scale properties and the quantifiable or qualifiable character of certain variables. As a result we will have to isolate the real motor-variables and formulate their relationships. These relationships can then be distinguished into:

(1) primary relations, i. e., between motor-variables

(2) secondary relations, i. e., between motor-variables and depending variables.


DELIMITATION OF THE PROBLEM
AVAILABLE ACTIONS
STRUCTURE OF THE OBJECTIVES
MAIN UNKNOWNS
INVENTORY OF FUNDAMENTAL VARIABLES
INVENTORY OF ACTION FACTORS
IMPROVEMENT OF DATA
ELABORATION OF FUNCTIONAL RELATIONS
NATURE OF THE RELATIONS
ANALYSIS OF THE INTERACTIONS
TYPES OF RELATIONSHIPS
ISOLATING OF THE MOTOR - VARIABLES
DECISION GRAPHS
RANKING OF THE RELATIONSHIPS
SEARCH FOR A SOLUTION

Les Plages Artificielles

L. Tourmen
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Lorsque l'on aborde l'étude des problèmes posés par l'aménagement et le développement des zones côtières, on est inévitablement amené à parler des plages dont l'évolution pendant la dernière décennie a été considérable.

En effet, depuis plusieurs années déjà, la notion de vacances est pour bon nombre de personnes indissolublement liée à "plage et soleil" entraînant un accroissement spectaculaire du tourisme balnéaire. D'où ces concentrations saisonnières d'estivants, concentrations d'autant plus grandes que les jours de liberté et les sites agréables sont comptés.

Devant cet "engouement" pour le bord de mer et ces invasions périodiques de certains littoraux maritimes, les autorités locales, voire nationales, des pays très développés, ont été contraintes de réagir, soit en aménageant les sites existants, soit en essayant de créer de nouvelles plages.

C'est ainsi qu'est née la notion de plage artificielle.

Il nous faut cependant remarquer ici que la motivation principale ayant entraîné la conception et la réalisation de la première plage artificielle, à Cannes, n'a pas été le besoin d'un lieu de baignade agréable, mais la nécessité d'élargir la plate-forme de circulation littorale - la Croisette - devenue insuffisante pour le trafic automobile estival. C'est en essayant de résoudre ce problème technique - cet élargissement ne pouvait en effet que se faire vers le large au détriment de la plage existante - que SOGREAH a eu l'idée de procéder d'abord à l'ensablement artificiel de la plage pour en augmenter sa largeur. Ensuite seulement on élargirait la chaussée. C'est ce qui fut fait à la satisfaction des usagers, automobilistes ou baigneurs.

D'une manière générale, on peut avancer sans trop de risques de se tromper que la décision d'aménager un site au moyen d'une plage artificielle est toujours prise sous une "contrainte" (tourisme, urbanisme, circulation,...) et ne résulte pas d'une étude de rentabilité au taux particulièrement interessant. En effet les coûts d'établissement de tels aménagements sont élevés et ne sauraient être amortis et rentabilisés par les seuls utilisateurs. C'est d'ailleurs l'importance de ces coûts qui est le seul facteur limitant pour des projets qui ne semble plus devoir poser de problèmes techniques insolubles pour l'ingénieur bien expérimenté.

SOGREAH qui depuis plus de trente ans maintenant étudie et résout les problèmes liés à l'aménagement des littoraux, a été concernée très tôt par la conception, les études et la réalisation des plages artificielles.

Nous allons décrire successivement les divers types de plages artificielles, les principes généraux d'aménagement et donner une description de quelques réalisations. On s'apercevra ainsi de la complexité d'un tel aménagement, car les facteurs à prendre en compte sont nombreux puisqu'il ne s'agit plus d'une simple amélioration d'un site naturel, mais d'un véritable complexe de loisirs, s'integrant dans le schéma général de développement de la région.

LES DIVERS TYPES DE PLAGES ARTIFICIELLES

GENERALITES

Les caracteristiques d'une plage devront repondre aux imperatifs dictés par la confort et la sécurité des baigneurs d'une part, par la protection éventuelle des équipements ou infrastructures côtières d'autre part.

Cette plage sera caractérisée par :

- un matériau meuble de granulométrie suffisamment fine pour ne pas être désagréable aux usagers ;
- une largeur de plage émergeante suffisante (20 à 30 m) pour assurer la protection de l'arrière-plage et offrir aux usagers des aires de jeux et de repos ;
- une pente de profil suffisamment douce pour ne pas être dangereuse ;
- enfin, pour limiter les risques de pollution, une plage doit rester vive, c'ést-à-dire soumise à une houle résiduelle suffisante pour éviter la formation d'algues et vases qui prolifèrent en eau stagnante sur les fonds inertes.

LES PLAGES SEMI-ARTIFICIELLES

Ces plages sont créees par l'action de certains ouvrages établis de manière à provoquer l'apparition d'une plage à partir des éléments meubles existant naturellement sur le site. On peut citer la plage de Carnon sur le littoral Languedoc-Roussillon (Fig. 1), la plage située à l'est du Port José Banus près de Marbella en Espagne (Fig. 2), la plage de Taifor sur le littoral méditerranéen du Maroc (Fig. 3). Pour ces plages, aucun apport artificiel de sable n'est pratiqué : c'est la houle elle-même qui, modifiée dans sa propagation par des ouvrages judicieusement disposés, remanie le stock de matériaux en place et le redistribue en faisant émerger de nouvelles plages.

LES PLAGES ARTIFICIELLES A ELEMENTS MEUBLES NATURELS

Ces plages sont realisées à l'aide d'apports artificiels d'éléments meubles d'origine naturelle, mis en place sur une infrastructure plus ou moins complexe. On peut citer ainsi la plage de la Croisette et la plage située au Sud du Port Canto à Cannes (Fig. 4 et 5), la plage de Las Fuentes en Espagne (Fig. 6), les plages situées à l'ouest du port José Banus en Espagne (Fig. 2).

LES PLAGES ARTIFICIELLES A ELEMENTS MEUBLES ARTIFICIELS

Pour ces plages, les éléments meubles sont d'origine artificielle : le plus souvent, il s'agit de concassés

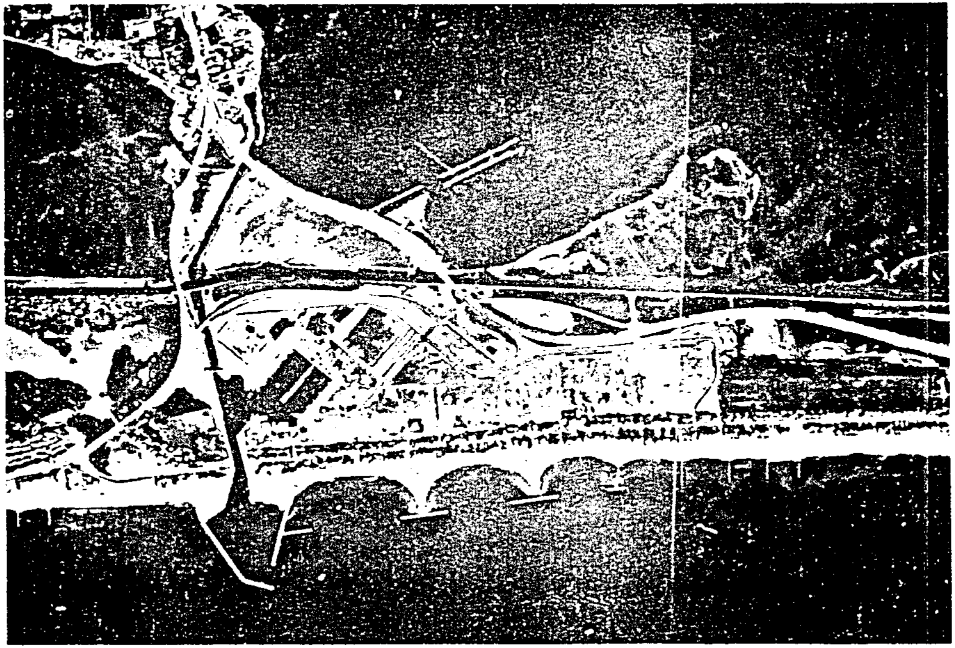

Fig. 1: Plage de Carnon

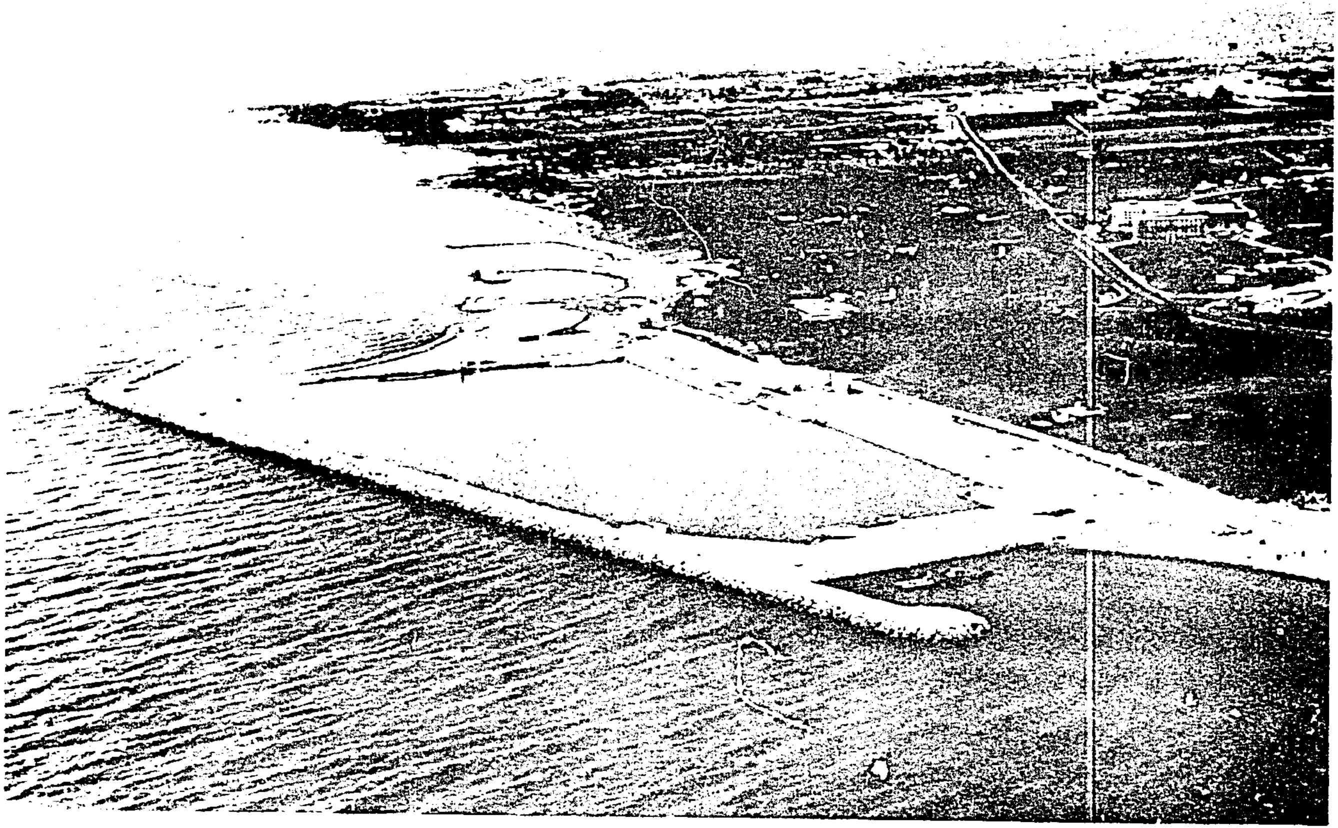

Fig. 2: Aménagement de Andalucia-Nueva à Marbella en Espagne.
- Au premier plan à droite la plage semi-artificielle
- Au deuxième plan au-delà du port José Banus les plages artificielles

Après

Avant

TAIFOR (Maroc)

Fig. 3: Plage du Taifor au Maroc.

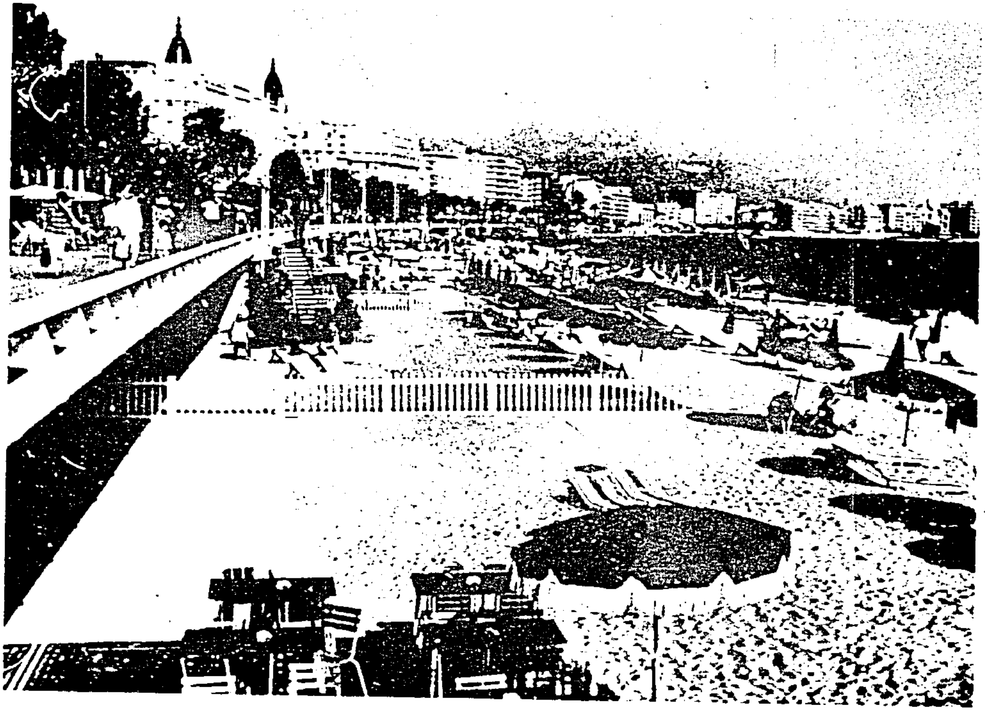

Fig. 4: Plage de la Croisette a Cannes.

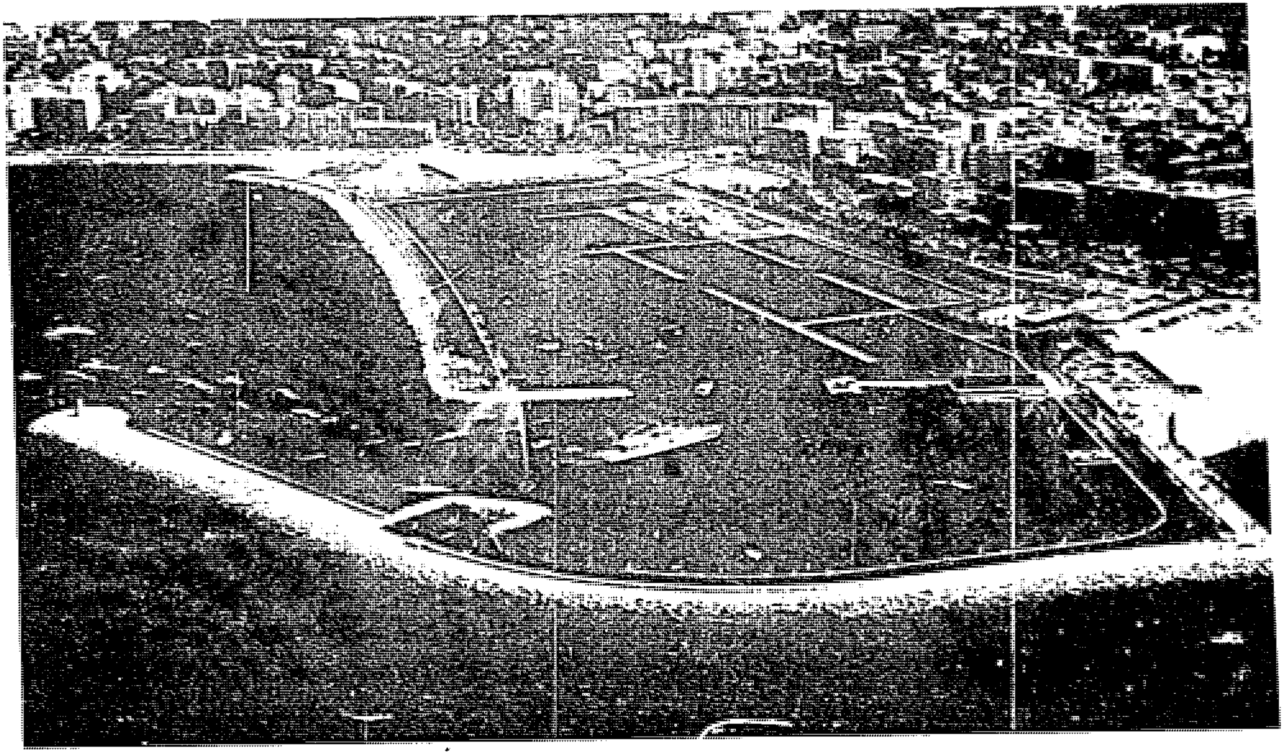

Fig. 5: Plage située au Sud du Port Canto à Cannes.

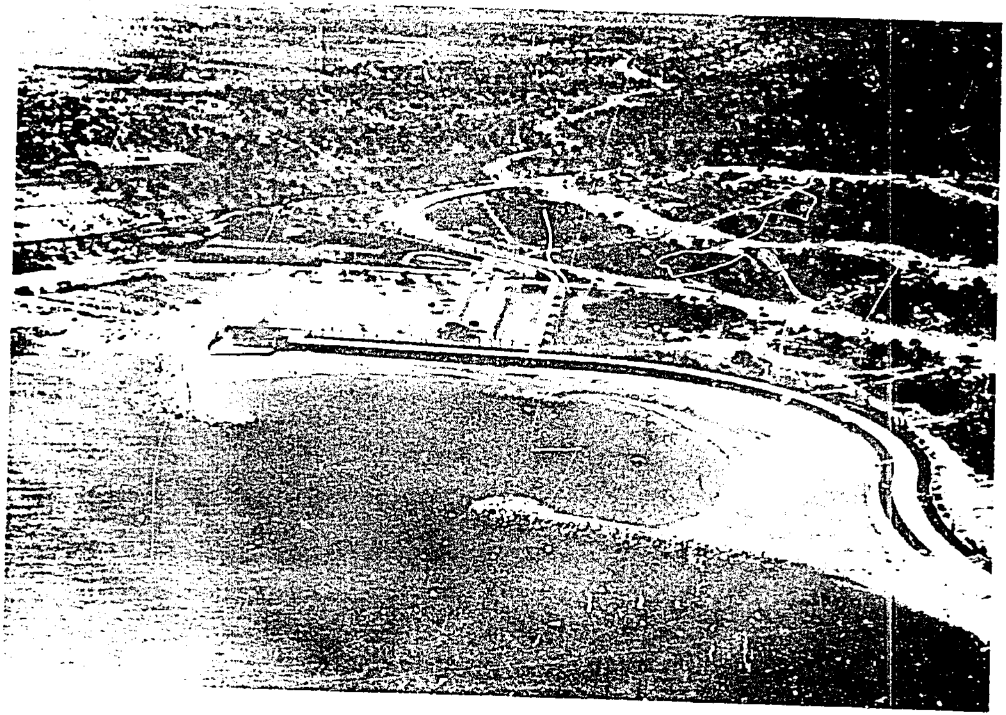

Fig. 6: Plage de Las Fuentes en Espagne.

de rochers de dureté moyenne (calcaire dolomitique, débris coralliens, etc.). Cette nouvelle technique, imaginée par SOGREAH, a été utilisée pour la première fois en 1967 pour la plage du Larvotto à Monte-Carlo (Fig. 7). On peut egalement citer les nouvelles plages de Menton (Fig. 8) ainsi que les futures plages de l'aménagement du Prado à Marseille (Fig. 9).

Fig. 7: Plage du Larvotto à Monte-Carlo.

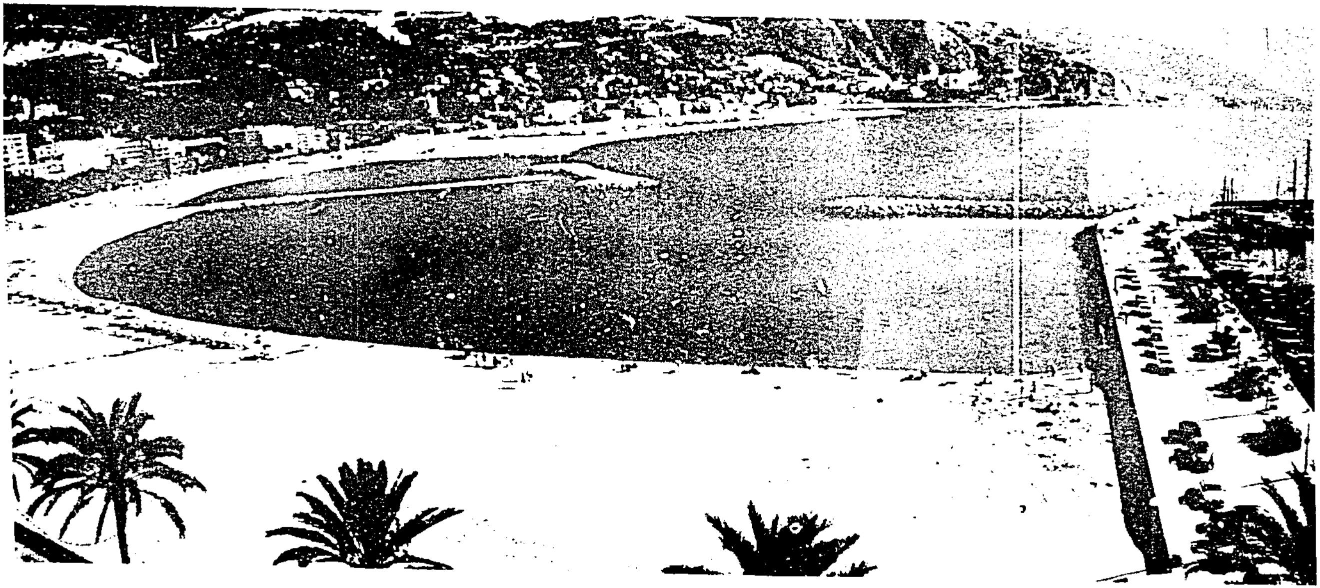

Fig. 8: Plage de Menton.

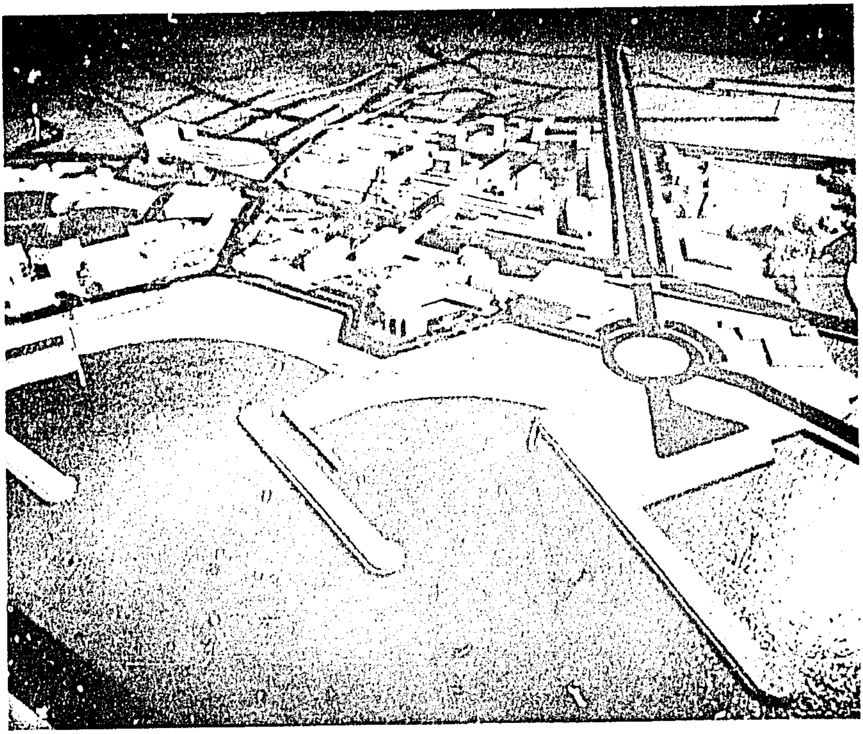

Fig. 9: Plage du Prado à Marseille.

LES PRINCIPES GENERAUX D'AMENAGEMENTS DES PLAGES ARTIFICIELLES

La Fig. 10 donne schématiquement un apercu des diverses dispositions qui peuvent être utilisées pour realiser une plage artificielle. Le choix de l'une ou l'autre de ces dispositions ou de la combinaison de plusieurs d'entre elles dépend des caractéristiques particulières du site, des conditions d'attaque de la houle, des éléments meubles dont on peut disposer pour les apports.

D'une manière générale, on peut dire que :

- plus la houle à prendre en compte est faible, plus les éléments meubles disponibles présentent une granulométrie elevée;
- plus le littoral d'origine présente une pente douce, moins l'infrastructure exigée par l'aménagement d'une

plage artificielle sera importante et donc moins elle sera coûteuse.

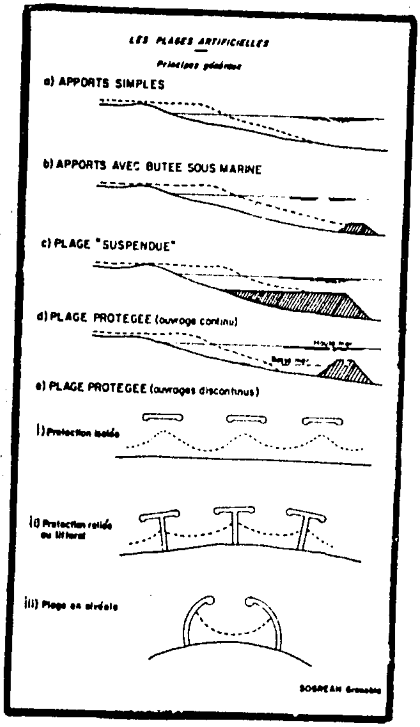

Fig. 10: Schéma des principes généraux de création des plages artificielles.

Nous allons passer en revue rapidement les diverses dispositions de la figure 10 en donnant pour chacune d'elles des exemples de réalisation.

APPORTS SIMPLES

D'est le cas le plus simple. La granulométrie des matériaux d'apport doit être plus elevée que celle des matériaux en place. Exemple : la Croisette à Cannes (Fig.4) ; Sausset-les Pin ; Cap d'Ail.

APPORTS AVEC BUTEE SOUS-MARINE

Cette disposition est utilisée nôtamment lorsque le matériau disponible presente la même granulométrie que le matériau en place. Elle est également utilisée lorsque le littoral d'origine présente une pente trop forte pour le matériau disponible bien que dans ce cas on préfère souvent la disposition c. Exemple : plage située au sud de Port Canto à Cannes (Fig. 5).

PLAGE "SUSPENDUE"

Cette disposition conduit en fait à créer un fond artificiel réduisant sensiblement la pente du littoral d'origine. Cette disposition permet d'utiliser un matériau d'apport de granulométrie assez réduite. Il faut noter que la plateforme sousmarine qui supporte la plage a un effet limitant sur les plus fortes houles, car celles-ci déferlent lorsqu'elles l'abordent. Par contre, les faibles houles se trouvent légèrement amplifiées. Exemple : plage du Larvotto à Monte-Carlo (combinée avec la disposition e_{ii}) (Fig. 7).

PLAGE PROTEGEE PAR UN OUVRAGE CONTINU

Avec une telle disposition, c'est la houle que l'on atténue systématiquement par pré-déferlement. Cette disposition est surtout conseillée pour des mers à marée, l'ouvrage de protection étant arasé au voisinage de la mi-marée. Le renouvellement de l'eau de la plage peut alors se faire correctement. Exemple : plage de Las Teresitas à Santa Cruz de Teneriffe aux Canaries (Fig. 11).

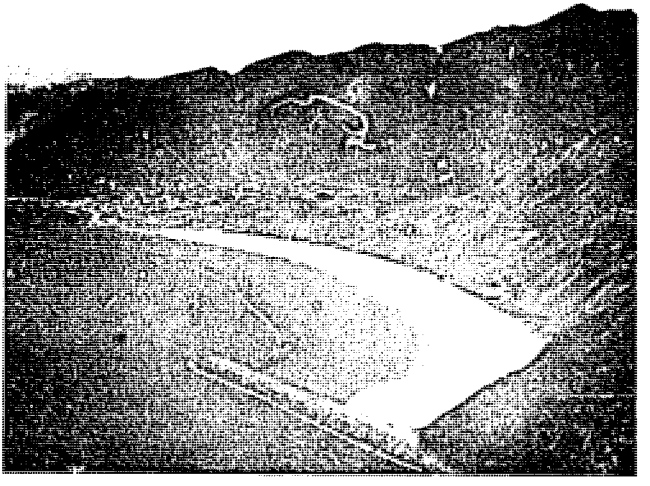

Fig. 11: Plage de Las Teresitas à Santa-Cruz de Teneriffe aux Canaries.

PLAGE PROTEGEE PAR DES OUVRAGES DISCONTINUS

Cette disposition se déduit de la précédente par l'ouverture de brèches plus ou moins importantes dans la protection continue.

Cette disposition peut être utilisée pour les mers sans marée comme pour les mers avec marée. Pour cette disposition, l'attenuation de la houle est obtenue notamment par diffraction à l'intérieur des alvéoles ainsi determinées. Exemple : plage du Larvotto à Monte-Carlo (combine avec la disposition c (Fig. 7) ; plage de Menton (Fig. 8) ; plage du Prado à Marseille (Fig. 9) ; plage de Saint-Jean-de-Luz ; plage de Las Fuentes en Espagne (Fig. 6) ; plages situées à l'Ouest du Port José Banus en Espagne (Fig. 2) ; plage de Arma di Taggia en Italie.

On peut noter que la disposition e permet de traiter de manière très satisfaisante le problème de la jonction d'un port (de plaisance, le plus souvent) et d'une plage, que celle-ci soit artificielle ou non. Cette disposition mise au point par SOGREAH lors des études de conception du port Canto à Cannes (Fig. 5) a été reprise depuis par la plupart des ports de plaisance de la Côte d'Azur.

Toutes les dispositions signalées ci-dessus peuvent se combiner entre elles pour donner des infrastructures de plus en plus complexes.

Le coût des plages artificielles est très lié au choix de ces dispositions. Il peut varier depuis environ 100 F par m2 de plage émergée pour des apports simples et depasser 500 F par m2 de plage émergée pour des plages où il est nécessaire de combiner plusieurs des dispositions ci-dessus (littoral à pente forte, houles fortes, matériaux disponibles de faible granulométrie, etc.).

DEUX EXEMPLES DE REALISATION DE PLAGES ARTIFICIELLES

PLAGE DE LA CROISETTE A CANNES

Stabilité du littoral de la rade de Cannes

Le littoral de la rade de Cannes se développe entre deux limites rocheuses qui isolent une zone à l'interieur de laquelle on peut considerer les phénomènes côtiers comme independants de ceux interessant la côte adjacente.

Les apports naturels penetrant dans la rade de Cannes et venant se déposer sur la plage sont extrêmement réduits, celle-ci est dans un état d'équilibre statique.

La comparaison des relevés effectues en 1897 par le Service Hydrographique de la Marine et les relevés effectues en 1960 par SOGREAH ne montrait qu'une faible évolution ne conduisant pas à des mouvements importants de matériaux sur la plage elle-même. D'autres éléments tendant à montrer la stabilité de la plage avaient pu être mis en évidence. Par exemple, les fonds sous-marins étaient tapissés de vegetation jusqu'aux profondeurs de l'ordre de 4 m, ce qui était signe d'une certaine stabilité. Enfin, des épis étanches disposés sur la plage de la Croisette depuis plusieurs années ne donnaient aucun signe d'accumulation importante dans un sens déterminé, ce qui dénotait l'absence d'un transport logitudinal prépondérant important.

Tous ces éléments tendaient à prouver que la plage de la Croisette se trouvait en moyenne dans un état d'équilibre statique, tout au moins à l'échelle d'une cinquantaine d'années.

Cet état d'équilibre est indispensable pour pouvoir réaliser dans de bonnes conditions un ensablement artificiel En effet un tel ensablement ne pourrait donner des résultats durables sur un littoral en équilibre dynamique.

CARACTERISTIQUES DE LA PLAGE DE LA CROISETTE

Le profil type de la plage, à partir de la laisse et jusqu'à une profondeur de l'ordre de 2 m, présentait une pente voisine de 5 %. Après cette première partie, la pente était beaucoup plus faible (1 à 2 %). Cette deuxième partie se poursuivait jusqu'aux fonds recouverts de végétation.

Les analyses granulométriques des échantillons de matériaux montraient qu'il existait une certaine relation entre les pentes et les cotes des fonds d'une part et le diametre 50 % des echantillons d'autre part.

Pour une pente de l'ordre de 5 %, le diametre 50 % de grains est de l'ordre de 0,2 à 0,3 mm, tandis que pour une pente de l'ordre de 1 à 2 % le diametre 50 % est de l'ordre de 0,05 à 0,1 mm. Ces considérations concernant la granulométrie de la plage avant aménagement ont été très intéressantes lors du choix du matériau d'apport.

ETUDES PRELIMINAIRES DE LA POSSIBILITE D'ENGRAISSEMENT DE LA PLAGE

POSITION DU PROBLEME

Il s'agissait d'étudier la mise en place sur le profil-type d'un volume de sable tel que la nouvelle laisse obtenue soit dans une position stable, avancée d'une trentaine de mètres sur la laisse actuelle. Les services techniques de la mairie de Cannes avaient, en effet, estimé qu'un élargissement de 20 à 30 mètres pouvait être considéré comme suffisant.

LE SABLE D'APPORT

La dimension des grains du sédiment d'apport était à comparer avec celle des grains déjà en place afin de pouvoir en déduire si le sable proposé pouvait être utilisable dans de bonnes conditions. La constitution du sédiment d'apport devait être également examaninée afin de rejeter les éléments où la proportion des particules deplus faible densité était importante.

On peut dire qu'en règle générale, à égalité de densité, un sable d'apport tiendra d'autant mieux sur une plage donnée que les dimensions de ses grains seront importantes par rapport à ceux que l'on trouve sur place. Ceci est vérifié sur la plage de la Croisette elle-même, qui n'est en fait qu'une plage artificielle elaborée peu à peu par des déblais divers. En effet, comme nous l'avons constaté, les sédiments les plus gros restent en haut de la plage.

Si on pratique un apport artificiel avec des sédiments plus fins que ceux se trouvant sur place, on risque fort de les voir disparaître progressivement vers les zones plus profondes. Il est, par exemple, impossible de transformer, sans aménagements spéciaux, une plage de galets en une plage de sable par apport de matériaux sur la laisse.

Les services techniques de la mairie de Cannes avaient fait effectuer, parallèlement à nos études, des prospections afin de déterminer les possibilités d'obtenir en quantité suffisante un sable de bonne qualité.

Le problème consistait à étudier la stabilité d'un engraissement artificiel d'un profil réalisé à l'aide d'un matériau de granulométrie voisine ou de préférence légèrement supérieure à celle du sable en place.

LES ETUDES EXPERIMENTALES A ECHELLE REDUITE

Afin d'essayer de mieux comprendre ce qui se passerait dans un profil lors d'un ensablement artificiel, nous avons effectué quelques essais dans un canal à houle.

Un tel modèle n'avait pas la prétention de représenter exactement la réalité des phénomènes. Il s'agissait plutôt d'un schéma analogique permettant de mieux comprendre les problèmes mais ne fournissant pas directement de solutions.

Nous avons, dans le canal d'essais, constitué une plage qui peu à peu s'est stabilisée. Lorsque la stabilisation s'est avérée pratiquement complète, nous avons comparé le profil ainsi obtenu au profil-type de la plage de Cannes. Cette comparaison s'est révélée suffisamment satisfaisante, moyennant le choix d'une échelle en plan et d'une distorsion.

Sur le profil ainsi obtenu, nous avons effectué divers essais d'engraissement, ces essais peuvent être classés en trois séries :

- dans une première série, nous avons étudié le comportement d'un stock de matériau, identique à celui formant le profil de base, disposé sur la plage et attaqué par la houle ;
- dans une seconde série, nous avons examiné l'influence sur les évolutions d'un stock de même matériau, d'une butée de pied située à une centaine de mètres du littoral initial ;
- enfin, dans une dernière série, nous avons examiné quelle pouvait être l'influence de la méthode de mise en place du stock de sable sur l'équilibre final.

Au terme de ces essais en canal à houle, il apparaissait qu'un ensablement réalisé avec des apports de granulométrie voisine de celle des matériaux constituant la plage d'origine n'était possible économiquement que si l'on prévoyait la mise en place d'une butée de pied limitant le depart vers le large des matériaux d'apport. Sans cette butée, il serait nécessaire de prévoir des apports périodiques.

Avec la mise en place d'une butée, nous avions estimé que l'on pouvait escompter gagner environ 25 m de large, en sommet de plage, moyennant le dépôt de 200 m3 par mètre linéaire de littoral.

L'EXPERIENCE D'ENSABLEMENT "IN SITU"

Suite aux résultats relativement favorables des études préliminaires en laboratoire et la découverte d'un gisement de sable de granulométrie satisfaisante, les services techniques de la ville de Cannes ont donné leur accord pour la réalisation d'un ensablement artificiel expérimental limité à un tronçon de la plage de la Croisette. Cet ensablement fut effectué aux mois de novembre et décembre 1960.

LE SABLE D'APPORT

Le choix final s'était porte sur un sable provenant d'une région située à 40 km de Cannes, dont la granulométrie et l'aspect étaient particulièrement bien adaptée (Ø 50%=0,7mm)

La qualité du sable disponible pour l'expérience nous a conduit à diminuer le volume de sable à déverser sur la plage, dans de grandes proportions : il a été reduit en effet à 100 m3/ml.

EMPLACEMENT DE LA ZONE EXPERIMENTALE

La zone expérimentale s'étendait au centre de la Croisette sur une longueur d'environ 330 m.

Des limites matérialisées par des épis avaient été prevues afin de réduire l'étalement latéral du sable. Une butée expérimentale réalisée en sacs de nylon remplis de sable avait été disposée sur une longueur d'environ 80 m, localisée au centre de la zone d'essai, à environ une centaine de mètres de la laisse du zéro. Etant donne la granulométrie du sable d'apport, on pouvait s'interroger sur la nécessité d'une telle butée. Le caractère expérimental de cette première tentative d'ensablement nous avait conduit à en recommander la mise en place. Nous verrons que, par la suite, cette précaution ne s'est pas avérée utile.

OPERATIONS DE MISE EN PLACE DU SABLE D'APPORT

Le volume total mis en place a été de 30 000 m3 avec une cadence moyenne journalière de 850 m3 environ.

Sur la longueur de 330 m couverte par la zone expérimentale, il a été mis en place en moyenne 90 m3/ml (mesurés sur camions), soit approximativement un volume de 60 m3/ml de sable mesuré sur place.

Les camions déversaient directement leur chargement de sable sur le haut de la plage en des points spécialement aménagés pour cet usage sur la promenade de la Croisette. Le sable était ensuite repris par un bulldozer qui assurait la répartition du matériau d'apport. Parallèlement à la mise en place du sable, on avait établi les limites est et ouest ainsi que la butée expérimentale.

La mise en place du sable n'a posé aucun problème difficile.

EVOLUTION DU LITTORAL PENDANT ET APRES LA MISE EN PLACE DU SABLE

Les divers relevés effectués pendant et après la mise en place du sable permirent de mettre en évidence une augmentation de la largeur utile de la plage atteignant 15 m en moyenne.

L'ENSEIGNEMENT QUE L'ON POUVAIT TIRER DE L'ENSABLEMENT EXPERIMENTAL

On peut énoncer ci-dessous les enseignements essentiels que l'expérience avait pu fournir :

- un engraissement artificiel de l'ordre de 100 m3/ml conduit bien dans la zone soumise à l'expérience à une avancée de l'ordre de 20 m ;
- la granulométrie du sable d'apport employé était parfaitement adaptée à la consititution d'une plage artificielle à Cannes. La notion de granulométrie des apports est une facteur fondamental dont dépend, pour une grande part, le succès de l'ensablement ;
- la butée qui avait été disposée sur une partie de la zone expérimentale n'avait joué aucun rôle, le sable ne descendant pas jusqu'à elle. Pour un engraissement définitif et total de la Croisette, une telle butée n'était donc pas nécessaire, à condition, bien entendu, qu'il s'agisse d'un sable d'apport de même granulométrie.

En résumé, on pouvait conclure que l'expérimentation effectuée sur place avait permis de vérifier la bonne concordance des résultats obtenus au cours des études antérieures et de ceux fournis par le tronçon de plage ensablé.

On pouvait donc, dès lors, envisager avec confiance la réalisation de l'ensablement total de la plage, car nous disposions pour cela des éléments principaux permettant une bonne détermination des caractéristiques essentielles de cet aménagement,

L'ENSABLEMENT GENERALISE A L'ENSEMBLE DE LA PLAGE DE LA CROISETTE

LE SABLE D'APPORT

Le sable d'apport était de granulométrie identique à celle du sable utilisé en phase expérimentale.

LA DISPOSITION GENERALE DE LA PLAGE ARTIFICIELLE

Si l'on considère n'importe quel plan ou photographie aérienne de la Croisette avant l'ensablement, il apparait immédiatement que le littoral de la plage n'était pas parallèle au trace de la chaussée de la promenade.

Cette discordance provient du fait que le tracé de la promenade suivait plus ou moins de littoral qui existait avant la constitution de la jetée Albert-Edouard et des terre-pleins du Casino.

L'établissement de ces nouveaux ouvrages a introduit dans la forme en plan du rivage une nouvelle condition aux limites qui a provoqué l'évolution de la plage jusqu'à la forme qu'elle présentait avant les travaux d'ensablement.

Il était logique de penser que tout ensablement de cette plage sans préoccupationc spéciales se traduirait par une avancée à peu près égale en tous points, la houle régularisant progressivement toute protubérance qui aurait pu être formée par les apports de sable. Cette avancée ne pourrait donc être modulee en fonction des besoins.

Si l'on désirait disposer d'une trentaine de mètres à l'endroit le plus étroit de la plage primitive, il aurait été necessaire d'établir la même avancée partout ailleurs et en particulier au voisinage de l'extrémité ouest où la plage n'avait nul besoin d'un tel appoint. Une telle méthode aurait conduit donc à un gaspillage de sable important. C'est pourquoi nous avions prévu un cloisonnement de la plage artificielle. Un cloisonnement de la plage en trois tronçons independants nous a paru suffisant et c'est cette disposition que nous avons adoptée en accord avec les services techniques de la mairie de Cannes.

Les cloisonnements ont été réalisés à l'aide d'épis formés d'une double paroi en palplanches métalliques.

Volume de sable mis en place

Au total, les volumes mis en place ont été les suivants :

Parties considérées	Longueur (m)	Volumes mesurés "in situ" (m3)	Volumes mesurés sur camions (m3)
Partie Ouest	420	23 400	35 000
Partie Centrale	320	24 600	37 000
Partie Est	300	22 000	33 000
TOTAL	1 040	70 000	105 000

LA PLAGE ARTIFICIELLE DU LARVOTTO A MONTE-CARLO

LE SITE AVANT AMENAGEMENT

Dans le cadre d'un effort considerable d'équipement entrepris par les autorités monégasques, il avait été décidé de réaliser à Monte-Carlo une place artificielle permettant de doter ainsi le littoral de la Principauté d'un équipement balnéaire présentant des qualités et un aspect en rapport avec la très bonne tenue des aménagements urbains prévus dans cette zone. Avant l'établissement de cette plage artificielle dans la baie du Larvotto, le littoral monégasque n'offrait en effet aucun accès en pente douce à la mer, si ce n'était quelques plages de qualité très médiocre qui s'étaient formées sous l'action de la houle, au voisinage des décharges publiques, à partir de matériaux très hétérogènes et le plus souvent de très mauvaise qualité.

Le littoral, dans la région de la Principauté de Monaco, présente dans son ensemble une structure rocheuse à forte pente.

La zone qui a été amenagée dans la baie du Larvotto est située entre le terre-plein du Sporting et celui du Portier : son développement est de l'ordre de 500 m.

Le littoral du Larvotto était bordé par des plages de matériaux très hétérogènes. Il presentait tout d'abord, jusqu'aux profondeurs de l'ordre de 4 m, une pente de l'ordre de 10 %, cette pente étant assez uniforme tout au long du littoral considéré ; pour des profondeurs comprises entre (-4,00) et (-8,00) il existait une sorte de plateau à pente moyenne plus douce, de largeur variable. Au-delà de la profondeur de (-8,00) la pente des fonds est de l'ordre de 10 %.

La partie émergente de la plage, cloisonnée par quelques épis courts, était constitué par des matériaux divers : blocs de plusieurs kilogrammes, galets, graviers et sables. Tout près de la laisse, on trouvait plus systématiquement des galets de tailles très variables. Plus au large, le sable devenait prépondérant et il présentait une granulométrie très variable d'un point à un autre. Enfin, pour des profondeurs de l'ordre de 7 à 8 m, un herbier apparaissait.

LE NIVEAU DE LA MER ET LES HOULES

Le marnage est faible, celui-ci ne dépasse pas en effet une vingtaine de centimètres.

Des conditions atmosphériques particulières peuvent provoquer des surélévations pouvant atteindre un maximum de l'ordre de 0,50 m par fort vent d'est.

En ce qui concerne les houles, les conditions sont les suivantes :

- les houles régnantes proviennent du secteur ESE. Elles présentent des périodes relativement courtes (5 à 7 secondes) et des amplitudes maximales de l'ordre de 3 m ;
- les houles dominantes proviennent du secteur sud (SSE a SSW au large). Elles présentent des périodes plus longues (7 à 10 secondes) et des amplitudes maximales de l'ordre de 4 à 5 m.

Les épures de propagation de houle montrent que l'angle formé par les directions des houles régnantes et dominantes est encore très notable au voisinage du Larvotto.

On peut donc conclure que le littoral de la baie du Larvotto est battu par des houles de direction sensiblement différente.

LES OBJECTIFS RECHERCHES

Le plan d'urbanisme du quartier du Larvotto prévoyait une avancée sensible vers le large du littoral par rapport à sa situation avant aménagement. Il était prévu, en effet, en avancée par rapport à l'avenue Princesse Grace, une plateforme arasée à (+5,00) et bordée côté plage par un décrochement vertical occupé par les façades des magasins installés sous la plateforme. Il avait été alors convenu d'établir, à partir de cette ligne de façade, une plage présentant une largeur supérieure à 30 m. Le projet était basé sur cette donnée essentielle.

Les Travaux Publics avaient demandé que l'on prévoit au nord-est de l'aménagement un alvéole comportant un épi accostable permettant le débarquement et l'embarquement des passagers de petits bateaux.

L'aménagement devait être conçu de telle manière que l'on puisse disposer du maximum de développement de plage compatible avec le cadre fixé.

LES PRINCIPES QUI ONT GUIDE LE PROJET

- Nécessité d'un remblai sous-marin

La pente des fonds marins, préalablement à l'aménagement, était compatible avec la nature de la plage, constituée principalement par des galets plus ou moins grossiers. Or, il avait été decide de doter ce littoral d'une plage de matériaux relativement fins afin d'en augmenter l'agrément d'utilisation. De tels matériaux ne peuvent demeurer de manière stable sur une plage attaquée par des houles relativement fortes qu'en se disposant suivant les pentes moyennes variant avec leur granulométrie, mais généralement inférieures à 10 %. On ne pouvait donc espérer réaliser au Larvotto une plage de materiaux assez fins sans au préalable corriger la trop forte pente du terrain naturel.

En conséquence, il était nécessaire de prévoir la mise en place, prealablement au materiau de plage proprement dit, d'un remblai sous-marin atténuant la pente de la plage. Ce remblai devait être limité vers le large par un ouvrage a forte pente rejoignant les fonds naturels et presentant une grande résistance à l'action de la houle.

Le rôle du remblai sous-marin, borde vers le large par l'ouvrage de butée, est double :

- d'une part il permet à la plage de prendre un profil d'équilibre compatible avec la granulométrie du matériau d'apport,
- d'autre part il provoque le déferlement des plus fortes houles et diminue ainsi l'énergie abordant la plage proprement dite.

- Nécessité d'un cloisonnement transversal

Les houles abordant la plage du Larvotto peuvent se présenter suivant des directions assez variables. Les éléments meubles des plages artificielles sont donc sollicités transversalement, ce qui conduit, si l'on ne prenait certaines précautions, à des évolutions importantes de la largeur de ces plages.

Ces évolutions seraient gênantes pour l'explcitation normale des plages et de plus, elles pourraient conduire à une parte de matériaux d'apport.

Il était donc indispensable de prévoir un cloisonnement transversal de la future plage destiné à éviter les mouvements longitudinaux des matériaux.

Ce cloisonnement a été realisé au moyen d'épis étanches au matériau de plage. La future plage du Larvotto est donc constituée par une juxtaposition de trois alvéoles indépendants.

A l'intérieur de chaque alvéole, les plages peuvent évoluer légèrement en fonction des houles incidentes. Néanmoins, ces évolutions demeurent faibles et ne devraient pas gêner l'exploitation normale de ces plages.

- <u>Nécessité de disposer des ouvrages provoquant la diffraction de la houle</u>

La diffraction de la houle derrière des brise-lames discontinus sensiblement parallèles au littoral du Larvotto, a été considerée comme très favorable à une bonne stabilisation du matériau d'apport, pour les deux raisons suivantes :

- l'énergie cédée sur la plage proprement dite par la houle est considérablement réduite, puisqu'une partie de l'énergie incidente est arrêtée par les brise-lames ;
- d'autre part, la diffraction réduit dans une forte mesure l'effet des variations de direction des houles incidentes sur le tracé de la plage.

Il faut noter que l'effet de la diffraction est d'autant plus souhaitable que le matériau choisi pour l'apport artificiel est plus fin.

L'effet de la diffraction de la houle derrière les brise-lames permet également d'augmenter sensiblement la longueur développée de la plage au niveau (0,00) ce qui était précisément l'un des objectifs recherchés. En effet, la plage à l'abri des brise-lames se dispose de manière stable, suivant un tracé en plan présentant une courbure plus ou moins prononcée.

LE MATERIAU D'APPORT CHOISI

Le problème de la recherche d'un matériau pouvant convenir à la plage du Larvotto fut très délicat à résoudre.

Après une prospection systématique de sources possibles, parfois fort éloignées de Monaco, on a choisi, essentiellement pour des raisons d'économie, des gravillons concassés provenant de la roche dolomite locale et présentant une granulométrie de 3 à 8 mm. Ce matériau, assez inhabituel pour la consititution d'une plage présentait évidemment des éléments à arêtes vives nuisant à son agrément d'utilisation. Cependant, des essais d'attrition on permis de s'assurer que ces arêtes s'émoussaient rapidement, ce qui permettrait d'obtenir un matériau d'aspect et de forme très acceptables.

On a pu donc envisager l'utilisation de concassés en espérant que l'action de triturations des vagues arrondirait assez vite les éléments anguleux.

Les essais d'attrition ont également permis d'espérer que l'usure permanente des matériaux (au-delà de l'émoussage des arêtes) serait suffisamment réduite pour ne pas imposer des apports periodiques de compensation trop frequents.

LES OUVRAGES D'INFRASTRUCTURE DE L'AMENAGEMENT

L'aménagement comporte trois brise-lames de 80 à 100 mètres de longueur, parallèles au littoral et ménageant entre eux des ouvertures de l'ordre de 80 m. Ces ouvertures sont obturées sous l'eau jusqu'à la cote (-2,50) par des butées sous-marines d'une structure analogue à celle des brise-lames.

Derrière ces ouvrages implantes par des fonds variant de 6 à 10 m, on a mis en place un remblai sous-marin, constitué de tout-venant de carrière, arasé à une cote de l'ordre de (-2,50) ainsi que des épis en blocs de béton fractionnant la plage en trois alvéoles.

MISE EN PLACE DU MATERIAU D'APPORT

Les alvéoles ayant été ainsi préparés, on a procédé à une mise en place progressive du matériau d'apport. Ce matériau, amené par camions, était déversé directement sur le littoral et réparti approximativement par bulldozer.

La mise en place définitive du matériau était assurée par la houle elle-même.

On a ainsi mis en place :

- 34 000 m3 de concassés dans l'alvéole central,
- 46 000 m3 de concassés dans l'alvéole ouest,

soit 80 000 m3 au total.

L'alvéole est, qui présente plutôt un caractère de débarcadère, n'a reçu, pour sa part, que très peu d'apports.

LES RESULTATS OBTENUS

Les travaux ont été entrepris au début de 1965. L'aménagement partiellement mis en service dès 1966, a été achevé en 1967 et a connu depuis un succès incontestable auprès des baigneurs.

Apres cinq années, on a pu constater que le matériau en contact avec les lames s'arrondit progressivement comme cela était prévu.

D'autre part, la forme en plan de la plage a évolué vers une disposition très voisine de celle qui avait été définie lors des études sur la base d'épures de diffraction. Le gain en mer est de l'ordre de 50 m.

On a pu constater que, jusqu'à present, la pente de la nouvelle plage reste forte (10 % environ) au voisinage du (0,00). Mais on peut penser que cette caractéristique, directement liée à la forme anguleuse des éléments d'apport s'atténuera peu à peu au fur et à mesure que les arêtes s'émousseront et que le matériau deviendra en conséquence plus mobile sous l'action de la houle.

En ce qui concerne la perte de substance des éléments par usure permanente, c'est-à-dire au-delà de la phase initiale d'émoussage des arêtes, elle est pratiquement inappreciable.

La réalisation de la plage artificielle du Larvotto montre donc que l'utilisation de matériaux concassés semble être une solution très interessante dans le cas ou un sable de granulométrie convenable n'est pas disponible économiquement.

QUELQUES CONSIDERATIONS DIVERSES IMPORTANTES

Pour terminer cet exposé nous voudrions rapidement évoquer certains points qui possèdent une importance déterminante sur la réussite ou l'échec d'une plage artificielle.

Un de ces points, le plus essentiel à considérer, concerne la pollution. C'est un problème difficile, compte tenu du développement de cette pollution sur les littoraux maritimes. Une plage artificielle peut être polluée de deux façons différentes : les pollutions d'origine externe et les pollutions d'origine interne.

Contre les pollutions d'origine externe, on ne peut généralement pas grand chose. Les hydrocarbures et les corps flottants peuvent être arrêtés par des barrages flottants, mais ce type d'équipement est toujours fragile et coûteux. Il est évident que l'on ne devra envisager d'établir dans un site une plage artificielle que dans la mesure où le littoral avant aménagement est acceptable du point de vue de la pollution. Si tel n'est pas le cas, on devra tout d'abord s'attaquer a ce problème afin de redonner a l'eau une qualité suffisante.

Contre les pollutions d'origine interne, on devra éviter de trop enfermer les plages artificielles et de trop les protéger contre la houle : il est bon qu'une plage reste soumise à l'action des vagues et des vents qui peuvent induire une certaine circulation d'eau devant elle. C'est ainsi qu'un ouvrage protégeant une plage peut être, contrairement à un ouvrage de protection portuaire, relativement perméable aux courants et à la houle. Lorsque le renouvellement de l'eau ne peut être acquis par des moyens naturels, il ne faut pas hésiter à recourir à des moyens artificiels (circulation forcée).

D'une manière générale, on peut remarquer que l'usager d'une plage artificielle se montrera toujours plus exigeant que celui d'une plage naturelle. Il considèrera en effet, avec raison, qu'un aménagement crée spécifiquement pour un usage déterminé doit avoir été conçu de manière a pouvoir offrir le plus d'agrément à ses utilisateurs.

On devra en conséquence apporter un soin particulier aux questions d'urbanisme, d'architecture et de services : les accès devront être faciles pour les véhicules et les piétons, le parking des voitures devra être aisé et sur la plage même on devra pouvoir disposer de toilettes et de douches, de vestiaires, d'établissements de location de matériel de plage (parasols, matelas, pédalos, etc.) d'établissements de restauration, etc.

En concluant, on peut dire que les plages artificielles ne doivent pas être considérées comme de simples améliorations apportées à un littoral afin d'y faciliter la baignade en mer, mais bien comme de véritables complexes de loisirs qui contribuent à la mise en valeur de toute une partie de l'arrière-pays.

IV CONTRIBUTIONS OF UNITED NATIONS

LEGISLATIVE APPROACHES TO COASTAL AREA AND RESOURCE MANAGEMENT

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The need for integrated land and ocean resources development

One of the most promising developments in the United Nations Law of the Sea Conference appears to be that of codifying into treaty law, the seaward expansion of coastal states' sovereignty and jurisdiction. By this, would be the recognition in law of a coastal state's right to establish a 12 mile territorial sea plus a 188 mile exclusive economic zone. Three pertinent questions may be raised: how big an ocean area will a coastal state gain, what resources will there be, and how to manage the area and resources.

While not all coastal states will be in a position to acquire a 200 mile ocean area because of different geographical locations, a majority of the 120 or so coastal states will gain large areas many times bigger than their respective land territories. Table 1 indicates the areas that will be gained by the respective coastal states. 1/
The size of a coastal state's ocean area is determined by such factors as the length of its coastline, geographical location (e. g. facing open ocean or enclosed seas), number and distribution of islands, and boundary delimitations with adjacent or opposite states. Thus, for example, although Zaire is the largest state in Africa (905,063 square miles), it has only 300 square nautical miles economic zone because of its very short coastline. Equatorial Guinea has, on the other hand, an economic zone (82,600 square nautical miles) seven times the size of its land territories (10,832 square miles) even though the land area is comparatively smaller. Countries bordering the enclosed or semi-enclosed seas such as Romania and Bulgaria (Black Sea), Sweden (the Baltic Sea) and Yugoslavia (the Adriatic Sea) have, comparatively speaking, smaller ocean areas than some Latin American countries bordering open seas (e. g. Chile, Brazil and Ecuador). Indonesia and the Philippines have large ocean areas partly because of their geographical location and partly because of the number and distribution of islands. The oceanic countries such as Tonga, Fiji and New Zealand gain the largest ocean areas when the

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1/ The information is based on a publication of the Office of the Geographer of the United States. See International Boundary Study, Series A, Limits in the Sea Theoretical Areal Allocations of Seabed to Coastal States, No. 46, August 1972 Issued by the Geographer.

size of their land territories are considered. Of the top 15 states who stand to gain the largest oceanic space, eight are developing countries (Indonesia, Brazil, Mexico, Chile, India, the Philippines, Portugal and Madagascar).

The wealth of an ocean area depends on the existence of living and mineral resources, which are not evenly distributed throughout the ocean. For example, with the exception of the highly migratory or anadromous species, the richest living resources of the sea are to be found in the shallow shelves or bank areas of the world (e. g. the Canadian Atlantic or North Sea banks) and those areas where upwelling of currents carrying vital plankton to sustain living aquatic resources (e. g. the anchovy fishery off the coast of Peru). Over 90 per cent of the total volume of the world commercial catch is estimated as being taken within 200 miles of land. 1/ A large part of this catch is not by the coastal states themselves, but by distant-water fishing countries, such as Japan, the U.S.S.R., Poland, Spain, South Korea, Thailand, Romania, Federal Republic of Germany and the United States. Japan, for example, hervests as much as 45 per cent of its total catch within 200 miles of other foreign states. The recognition of resource jurisdiction of the coastal states will provide an opportunity for them to institute meaningful management programmes of their own. There are great potentials for countries such as Mexico, Brazil, Argentina and Indonesia in view of their extensive offshore living resources.

Just as living resources are unevenly distributed, offshore minerals also tend to concentrate in specific areas. Countries bordering the Persian Gulf, the North Sea, part of the Aegean, the South China and East China Seas and the Indonesia continental shelves are among the richest areas for hydrocarbons. The Gulf of Mexico, Canadian Arctic Archipelago water, areas of Brazil adjacent to the Delta of Amazon, and areas of Venezuela adjacent to the Delta of Orinoco are presently considered particularly promising regions for oil and gas.

Although the distribution of wealth may be uneven, this 200 mile zone under national jurisdictions will cover as a whole practically all known and presently exploitable mineral resources, all of the world's proven reserves of offshore hydorcarbons, and most of those having potential economic value in the next several decades. 2/ These resources include all offshore sand and gravel deposits, calcium carbonate, placer deposits of tin, gold, platinum, rutile and ilmenite, some phosporite deposits, and metalliferous sediments and brines in the Red Sea.
Since this 200 mile zone covers part of the deep ocean basin, there is potential for commercial mining of manganese nodule particularly around small volcanic islands and archipelagos and the area off the west coast of North and South America.

1/ FAO 1975 Yearbook of Fishery Statistics
2/ "Economic significance in terms of sea-bed mineral resources, of the various limits proposed for national jurisdiction" report of the Secretary-General, A/AC.138/87. 4 June 1974 pp. 27-28

The gain in ocean areas also provides an additional criterion for the assessment of a country's development potential. It is now meaningful to assess a state in terms of its combined land and oceanic area and resources. National economic planning and development will have to include not only land resources but also marine resources. The last column of Table 1 gives some indication of the results when the land and ocean areas are added together. Mexico, Chile, Indonesia, Malaysia, and Tonga, for example, advance their rank considerably when compared with their ranking in land. Australia and New Zealand now possess an even more important place because of their ocean areas.

The most important question posed is how to manage the land and marine resources in an integrated manner so as to obtain the maximum benefit. Coastal area and resource management seems to provide a bridge between the traditional land use and the new zeal for ocean development.

Coastal area is that part where the land, sea and air meet and where they interact with each other, influencing the whole environment. Biologically rich and aesthetically pleasing, this area contains the vast majority of our population, possesses some of the high-grade agricultural land, accounts for the lion's share of our tourist trade, and is the growth pole of our expanding economic activity. The importance of coastal area is even greater when it is viewed in the context of integrated development of land and ocean resource. Coastal area becomes the focal point of land and ocean activities. The traditional land use, town and country planning focus primarily on land problems. A truly integrated management would need to deal with not only the uses and problems of the land, but also those involved in the use of submerged land and waters, maintenance of marine resources and the interactions between land and ocean uses. The objectives of such a management are: to provide a system which will allow conscious and informed choices among development alternatives of the coastal area and its resources, and permit proper planning so as to maintain the quality of the coastal area in order to ensure both sound utilization of its resources and enjoyment of its amenities. The management will bring together the development and preservation of land and marine resources into a focused and integrated mechanism, based upon planning, supported in turn by research. As a result of such kind of management, the utilization of coastal resources takes into consideration the complex factors involved in the coastal area so that long-term, broad-based values are not imprudently sacrificed for short-term benefits.

The extended sovereignty or jurisdiction of the coastal states will necessitate the adoption and implementation of many and different measures. Some of the coastal states will need to establish new limits for the territorial sea, economic zone and continental shelf, and to determine boundaries with their neighbours. This will not be an easy task. Information indicates that, as of today, many coastal states parties to the 1958 Geneva Conventions have not yet even delimited mutual territorial sea boundaries. Few offshore boundary agreements exist in the North Sea, the Persian Gulf, and the waters adjacent to Indonesia where valuable petroleum deposits are known to exist. 1/ The delimitations pertaining to the continental shelf are almost nonexistent since they are generally further seaward. While this might have been the result of a number of political difficulties and/or the limited acceptance over the Geneva Conventions, one must not under-estimate the technical complexities involved. Now that the new limits are even further seaward and the areas included are far greater than before, the tasks become correspondingly more difficult.

A coastal state may also need to make laws and regulations in respect of safety of navigation, marine traffic, protection of navigational aids, cables and pipelines, artificial islands, preservation of the marine environment, prevention of pollution, scientific research, hydrographic surveys, and control of customs, and immigration. Where necessary, sea lanes and traffic separation schemes may also be needed for regulating the passage of oil tankers, and ships carrying nuclear or other dangerous substances. While these laws and regulations may already exist, they must be re-examined in the light of the extended jurisdictions, particularly from the point of view of their enforcement.

Measures and requirements relating to resource management are probably needed most. With regard to living resources, the coastal state will have to determine, inter alia, the total allowable catch without depleting the stocks and its capacity to harvest. Other states may have access to the surplus only in pursuance of such terms and conditions as may be required by the coastal state concerned.
This active requirement of the coastal state with respect to fisheries is due partly to the consideration of world need for protein and partly to the demand of the distant-water fishing states which can no longer fish in those waters where they have previously depended. The need for management of living resources is therefore of paramount importance for most states. Some coastal states will need to deal with such matters as licensing of fishermen, fishing vessels and equipment, species and quota which may be caught, seasons and areas of fishing, type, size and fishing gears that may be used, information required of fishing vessels, training of personnel, transfer of technology, enforcement procedure and methods, and conservation of living resources.

As to mineral resources, the coastal state does not have the obligation under international law to allow other states to explore or exploit its resources if it decides not to.

1/ See Alexander and Hodgson, "The Impact of the 200 mile Economic Zone on the Law of the Sea" 12 San Diego Law Review, April 1975. No. 3 pp. 569-597, and U.N. Legislative Series on National Legislation and Treaties Relating to the Territorial Sea, the Contiguous Zone, the Continental Shelf, the High Seas and the Fishing and Conservation of the Living Resources of the Sea. United Nations Publications 1974

Important issues regarding mineral resources include such matters as the identification of resources, accessability of exploration data, methods of exploitation, and other related problems (such as the environmental impact of exploitation and beneficiation). Each of these very broad items is composed of a wide spectrum of problems, each deserving careful consideration.

Legislative approaches

The Ocean Economics and Technology Office recently made a survey of the legislative measures taken in forty countries. A number of conclusions deriving from this survey may be mentioned here in the hope that they might prove useful in any consideration for future action.

There is a scarcity of special legislation in this regard. In most countries, the coastal area is not considered as a separate entity for purpose of planning or development. The planning of the coastal area remains, on the whole, under the laws governing land uses and town and country planning. Fewer countries have adopted a comprehensive approach to deal with the area and its resources. There exists, however, specific laws or regulations dealing with such problems as waste disposal, zoning, torism, pollution or coastal erosion. As for resource management legislation, it must be recognized that the development and utilization of coastal resources have only quite recently assumed importance. Consequently, management of coastal resources exists in only a few countries and where it does exist it is mostly with respect to some aspects of fisheries and oil exploitation. Greater effort in this area is still needed.

Up to present, in those countries where coastal area and resource planning or management exists, such planning or management is usually with reference to a narrow strip along the shoreline and coastal waters. This is the case, for example, in Cyprus (within 50 metres of the high water marks), Mauritius (from the coral reef to the shoreline of high water marks within one kilometre), Sri Lanka (the strip lying between a distance of three metres landwards and two kilometres seawards from the mean lea level) and Togo (from the high tide within the landwards area of 100 metres). The United States and Norway are probably the exceptions, where a pragmatic approach is adopted. In the United States, the zone extends seawards to the outer limit of its territorial sea and landwards from the shorelines only to the extent necessary to control shorelands, the use of which have a direct and significant impact on the coastal waters. In Norway, shorelands include all land areas where the sea and shoreline retain their importance for the location of vacation and tourist development. For the purpose of effective management and planning and in view of recent trend in the seaward extension of coastal states' jurisdiction, a re-examination of some of the existing delimitation of coastal management might be necessary.

In order to permit effective management and to take into account any significant impact on the shorelands and waters of economic activity in the coastal zone, the landward and seaward limits of a coastal management area should be sufficiently broad. The size of a given management area should be delineated in the light of such factors as the nature of the activity, distance and locality of activities from shore, depth of water of the activity area and the physical and other impact of the proposed activity on other related activities. The management area needed for oil exploitation on the continental shelf would be presumably larger than, for example, that for nearshore dredging of sand and gravels. But nature of the activity should not be the only criterion. One must also consider the environmental effects which may be determined by various physical conditions (e. g. currents, soil, etc.), and the destinies of the raw materials produced. Whether they are intended for export, inland refining, or for internal consumption would also influence the seaward and landward limits. Effective planning and management demand broad consideration and a flexible approach.

A common and salient feature of most of the special legislations in the United States and Europe is environmental in outlook. Their primary concern appears to be the protection of the coast. Take the United States 1972 Coastal Zone Management Act for example. This Act represents perhaps the most comprehensive legislation of its kind. Its basic objective is to provide Federal financial assistance and incentives for the coastal states to study, develop and implement coastal management programmes. 1/ The requirements of the Act seem to focus on the process and it leaves the substance of the management programmes to the states to define. But the state programmes must be committed to the management of the coastal area on a coordinated and comprehensive basis. The Act deals with the process of developing a programme through the establishment of various elements which a state must examine in structuring its coastal zone management programme. These elements include the determination of permissible uses and priority of uses, the types of manpower and programmes required, the identification of areas requiring special attention, and the coordination among the agencies and units of government at all levels with responsibilities for, and concerns with the coastal area.

At present, about 20 of the 30 coastal states have introduced substantive coastal zone management programmes and legislation in a response to the 1972 Act. These programmes and legislation are shaped in the light of their perceived needs and the geographical characteristics of the different states. On the Atlantic side, much attention has been focused on protecting wetlands because of their

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1/ For an analytical treatment of the process of programmes development on the basis of the Coastal Zone Management Act of 1972, see Armstrong, Bissell, Davenport, Goodman, Horshman and Sorensen, Coastal Zone Management: the Process of Programme Development 1974, Coastal Zone Management Institute.

tremendous value to coastal fisheries and other estuarine life and the danger to such estuarine areas from dredging and filling projects and other coastal developments. The Gulf coast states have concentrated on methods of allocation of exploitation rights for their estuarine resources, and have only begun to implement protective measures as effects of overdevelopment have begun to threaten their coastal resources. In the Great Lakes area, shoreland management programmes have been instituted, primarily in response to pressure on their inland lakes. On the Pacific coast, the emphasis has been placed largely on regulating the use of beach areas.

The legislation adopted in the United States in this regard may be classified under the following main categories: coastal zone management, comprehensive planning, site location and power plant siting, shoreland zoning, beach access, wetlands protection, oil shipment, and heavy industry development. 1/ As to the administrativ machinery, the solutions adopted vary very greatly ranging from a total administrative reorganization, creating a single state agency having comprehensive jurisdiction, to interagency groups.

An analysis of the U.S. legislations suggested that a major motivation was to provide protection for the natural environment and scenic values. 2/ Thus about 14 states wished to protect wildlife and fishery, 12 states to preserve or protect coastal eco-system, 11 states to enhance aesthetics, 9 states to protect water resources and to conserve soil resources; 12 states, have laws to regulate coastal growth and development the coastal zone and much of this control is required for environmental protection. While this may be true, one must not ignore the different approaches and emphasis given by the coastal states in the United States. Five distinctive approaches may be identified:

(a) Comprehensive planning: About 15 coastal states have completed or are undertaking major studies of their coastal resources and on methods of their effictive utilization. The results of the studies have been or will be used in the sequential development of a comprehensive management plan and an administrative mechanism to implement it. The planning programmes vary in their basic premises and differ in scope and sophistication.

(b) Functional approach: Washington and Rhode Island, on the other hand, established a functional management mechanism, which is equipped to deal with pressing developmental problems revealed by a quick inventory or survey. The activities are guided by a general statement of management philosophy and

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1/ For a detailed analysis of these programmes and legislation, see Bradley and Armstrong, A description and analysis of coastal zone and shoreland management programmes in the United States, University of Michigan, Technical Report No. 20, March 1972.

2/ See Zwicky and Clark, "Environmental Project Motivation in Coastal Zone Land Use Legislation", Coastal Zone Management Journal, 1973, No. 1 pp. 103-108.

a loose and flexible set of long-range objectives. The programmes are designed primarily to give direct and immediate administrative action, and to avoid an extended pre-planning period.

(c) Temporary moratorium: Some states under strong developmental pressure, e. g. California, Delaware, Oregon, and Texas, have introduced legislation which declared a general or selective moratorium on development within a defined coastal or offshore strip during a planning period short-term development and thereby establish a more favourable climate for long-range planning.

(d) Land zoning: Some of the Great Lakes states, e. g. Wisconsin and Michigan, have chosen to encourage their county governments under the loose supervision of the state, to regulate coastal development through traditional single-use land zoning. The counties have been given a specified period to establish zones for certain permissible uses in a narrow coastal strip.

(e) Expanded responsibility: Some other states (e. g. New York and Maryland) chose to expand the responsibilities of the existing administrative organs to include coastal planning and, to a lesser degree, management functions. They hoped thereby to avoid the normal frictions created by the establishment of a new bureaucracy within the existing administrative structure. The state of Hawaii took a similar approach. It had already instituted a state-wide land-use control programme and after further investigation, it was decided to introduce in addition a coastal zone programme which covered such problems as shoreline set-back, beach access, marine management, and protection of natural areas.

The different approaches adopted in the United States are illustrations of some of the basic methods which could be used by countries with similar geographical location and administrative set-up.

In Europe, the issue of coastal area and resource management has an overtone of coastal protection, though the ultimate goal is to ensure both enjoyment of its amenities and sound utilization of its resources. 1/ On the whole, there does not exist any coastal management programme on a comprehensive basis, comparable to that of the U.S. Coastal Management Act of 1972. Several European countries (e. g. the United Kingdom, France, Ireland, Sweden, Belgium and Italy) have conducted general studies and instituted programmes either covering their entire coast or aimed at the solution of certain problems (e. g. tourism, use of water, or pollution). The measures taken in Europe may conveniently be grouped into three categories.

The first category of measures is the adaptation for coastal area of the town and country planning regulations.

1/ In 1973, the Committee of Minister of the Council of Europe adopted a resolution on the protection of the coastline in which it recommended that the governments of the member states base their policies on the protective measures set out therein.

This is similar to the Great Lakes states approach. 1/ The techniques used include: the establishment of building or non-building zones; the designation of protected zones in which planning schemes are subject to particular regulations; the imposition of building prohibitions or the acquisition of land as methods for controlling urban development in coastal areas; the incorporation of the communication network as part of the general planning; the designation of location for industrial complexes; and the establishment of special regulations for tourism (e. g. public access, camping etc.).

The second category of measures relates to the conservation of nature and historical reserves. Special legislation has been introduced in various countries for the protection of marine flora and fauna in general by the creation of parks or reserves, natural, historical and archaeological sites, and certain species of birds. There are laws and regulations regarding maritime hunting, coastal fishing, for the protection of forests and dunes, and with respect to certain engineering works (e. g. building dikes), extraction of sand and gravel, drilling for minerals, nearshore or on the continental shelf, and for the preservation of the wetlands and coastal marshlands.

The third category of measures taken for the protection of coast in Europe relates to pollution control. There is general legislation prohibiting dumping of harmful substances into the sea, and arranging for regular inspection of the state of the marine environment and of authorized operations and discharges. Specific laws also exist to deal with particular types of pollution problem: e. g. bacterial or chemical pollution, noise, mosquitoes and waste.

Apart from the United States and Europe, a number of countries have recently undertaken special measures regarding coastal area and resources development. It is instructive to note the guidelines recently established in Scotland for the use of the planning authorities in dealing with demand on the coastal areas for oil and gas exploitation. The basic principle is that exploitation can only take place in those areas designated for that purpose. This is to avoid a scatter of industrial development, to permit full use of existing labour, housing and public services, and to ensure the possibility of diversification so as to cushion any subsequent decline. These guidelines appear to be established on the basis of economic, physical and environmental considerations. The guidelines set out various criteria for establishing preferred zones for development or conservation. The preferred development zones are: those areas able to be expanded without incurring the risk of reverse economic or social decline; having some flat land on the coast and in the hinterland able to absorb major development; possessing suitable ports and harbours with some potential for developing the dockside land; or areas where environmental recovery and rejuvenation are feasible. The preferred conservation zones are: those places vulnerable to development because of their scientific,

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1/ See supra (d).

ecological or scenic features; sections of the coastline where an existing or proposed use (e. g. bathing) would be incompatible with major oil and gas development; areas of coast containing small scale communities where expansion might cause serious economic and social problems. Developments are also excluded from the tourist and recreation areas, and areas of the coast with towns and villages whose historic characters should be protected. These criteria can be usefully considered countries who may need to establish guidelines for dealing with demand for development on the coastal areas.

In Israel, in response to the need to preserve the coast and antiquities, to control development, and to ensure public access to the seashore, an Outline Scheme covering an area of 300 square km along the coastal strips was established. The Outline Scheme is binding on all authorities and bodies whose activities are in any way connected with physical planning of those coastal strips, so as to ensure that the development of the coast would be consistent with the directives of the national pllaning bodies, and to prevent haphazard decisions based on local considerations only. While some of the techniques used are based on traditional town and country planning, the scheme is instructive in its overall approach.

The whole coast is demarcated into various areas according to their existing and proposed uses: e. g., residential areas, semi-urban residential areas, central business districts, villages and cemetaries. Different conditions are laid down for each of these categories. Speical areas are assigned for national parks, nature reserves, afforestation, bathing beaches, coastal reserves, hotels, tourism, sports centres, mineral water resorts, jetties, antiquities and archaeological sites. In addition, some areas were designated for communication or for factories or workshops (i. e. industrial zone), engineering plants, power stations, salt plants, reclamation, and agriculture.

In Norway, the coastal area is treated as a separate planning entity only for recreational purpose. The shoreline uses, including development of tourism and recreation, are governed by the Shore and Mountain Planning Act of 1971. There is a general ban on any construction within 100 metres of the coastline. Within this zone, no construction could take place without an approved plan. Certain laws and regulations are also applicable to coastal areas regarding such aspects as free access to the beaches (the 1957 Open Air Recreational Act), site location for power plants and industries or coastal environment protection (e. g. Water Pollution Act 1970, Natural Conservation Act 1970, and the Neighbour Act of 1961).

The Ministry of the Environment is responsible at the national level for the making of environmental protection policy, the establishment of guidelines for pollution control, physical planning, natural conservation and recreation. The Ministry is advised in this regard by various expert groups such as the State Pollution Control Authority, the State Council for Open Air Activities and the State Counsil for the Conservation of Nature. It is expected that gradually the counties will take over some of the responsibilities now administered by the Ministry to ensure effective implementation at the local level. In other words, the planning is at the national level whereas the implementation is aimed at the local level

A coastal conservation law in Sri Lanka has been approved by th National State Assembly in 1976. The introduction of this legislation was in response to the need to combat coastal erosion, particularly along the south-west coast where several miles were lost because of sea erosion. While coastal erosion in Sri Lanka forms part of the natural process because of the tilting of the island, the situation is seriously aggravated by sand and coral mining and by the construction of outlets for drainage. The pollution of coastal waters by human and other wastes degrades water quality and seriously affects the growth of natural reefs. A new division under the Ministry of Shipping, Aviation and Tourism is being organized for the planning and development of the coastal area and for the effective implementation of the proposed legislation.

A draft law for the management and development of the Togolese coastal zone is being considered in connection with the five-year plan. This proposal deals with the development aspects of the coastal zone in the light of Togo's coastal needs and problems, for example, roads, coastal highways, erosion (particularly near Lomé), tourism, the creation of urban zones for petroleum industries and the preservation of forest and agriculture. To ensure recreation and public access, protection zones will be established along the coastal line within an area of 100 metres and along the major river mouths, lakes, ponds, and lagoons.

While the problems confronting the island states, e. g., Singapore, Mauritius and Bahamas, may not be all that different, certain characteristics need to be considered. In Singapore, for example, the coastal area is not treated, for geographical and economic reasons, as a separate planning entity but constitutes an integral part of national planning due to th considerable proportion of the total area occupied by the coastal area. Various laws are applicable to the coastal activities as well as to the state as a whole. The Planning Act and the State Land Act (sand and gravel extraction), for example, apply to the whole country, including the coast; the Foreshore Act and the Prevention of Pollution of the Sea Act are primarily designed to regulate coastal activities. Because Singapore is surrounded by the sea, and the interior of the country interacts intensively with the sea, the increasing pressure on the land resources has forced national planners to look to the coastal area for new possibilities. The reconciliation of the varied and sometimes conflicting requirements of important coastal activities such as port development, recreation, fisheries and the preservation of the ecological balance is one of the challenges faced by the Government. Major land reclamations are carried out in the main island for the development of not only port works but for such other activities as airports, highways, industrial sites, housing complex, parks, mariners and other recreational facilities. Reclamation has also been carried out around offshore island and the reefs. Because of the limited coastal areas which must be given to the priority uses, some of the recreational areas have to be reduced. Offshore islands are being developed for public recreation purposes.

The coastal area of Mauritius is regarded for physical planning purpose, as both a separate entity and as a part of national planning. The coast is dealt with as an entity in respect to recreation, tourism, natural reserves, and seaside residential development. But for housing development, sanitation, water supply and education, the problems in the coastal area are regarded as the same as the rest of that country. They are therefore considered as part of national planning and development.
The Town and Planning ordinance is the principal law governing primarily the reservation of land for roads, transport, communications and other public utility services. On the basis of this Ordinance, existing use pattern of the coast has been analyzed and proposals for future uses are being made. There are separate laws governing protection of historical objects, building construction, sanitary conditions and removal of sand. These laws are applicable to the coast as well as the rest of the island. Special regulations also exist regarding port areas. For example, along Port Louis the coastal land within the city boundary is assigned for harbour and industrial uses only.

In Bahamas, development plans are being prepared on an island-by-island basis, treating the coastal area as a separate planning entity. On the basis of a recent land resource survey, priorities of uses within the coastal area have been assigned to recreation, tourism, harbours, residential development, preservation, and conservation. Zoning orders are issued to cover all areas of outstanding natural beauty, historical and archaeological sites, scenic vistas, parks, and recreation areas. Planning guidelines for the control of land use and development which incorporate the classical treatment of land use, have recently been published. While these guidelines are applicable to areas both inland and shoreland, special rules are established for the coastal area. Thus, for example, the maximum height of building for some of the beach areas in 73 feet as opposed to 45 feet for the city area, whereas in the city area the limit is set by distance (e. g. 15 to 30 feet). The setback requirement for building in the coastal area is not fixed by limit but by requiring "a view of the sea", whereas in the city, the limit is set by distance (from 15 to 30 feet) from the street.

Conclusion

There is a need for an integrated approach to the utilization of land and sea resources. The management of the coastal area and its resources represents a valid approach to the problems involved. It is still a new approach and further refinement is required. This can best be achieved by an exchange of knowledge and collective thinking. Thus far, few countries have taken steps in this direction. It might be useful to collect the relevant materials from the various countries, analyse the techniques employed and establish certain guidelines for future action.

TABLE 1: 200 MILE ECONOMIC ZONE

Nation	Total Land Area (Square miles)	Total Area of 200 mile (Sq. nautical miles)	Total Land Area and of 200 mile (Square nautical)	RANK Land	RANK Ocean	RANK Combined
AFRICA						
Algeria	919,951	40,000	959,951	10	75	14
Angola	481,351	147,000	628,351	21	39	25
Benin	43,483	7,900	51,383	95	106	116
Botswana	222,000		222,000	44		65
Burundi	10,739		10,739	123		142
Cameroon	183,568	4,500	188,068	48	113	68
Central African Republic	241,313		241,313	41		63
Chad	495,752		495,752	19		30
Congo	132,046	7,200	139,246	55	107	80
Egypt	386,872	50,600	437,472	28	67	40
Equatorial Guinea	10,832	82,600	93,432	122	54	99
Ethiopia	457,142	22,100	479,242	24	93	32
Gabon	102,317	62,300	164,617	67	62	72
Gambia	4,003	5,700	9,703	135	112	145
Ghana	92,100	63,600	155,700	72	61	75
Guinea	94,925	20,700	125,625	70	94	85
Ivory Coast	124,503	30,500	155,003	59	80	76
Kenya	224,960	34,400	259,360	43	79	58
Lesotho	11,716		11,716	120		139
Liberia	43,000	67,000	110,000	97	59	90
Libya	679,536	98,600	778,136	15	49	18
Madagascar	230,035	376,800	606,835	42	15	26
Malawi	45,747		45,747	93	-	120

Nation	Total Land Area (Square Miles)	Total Area of 200 mile (Sq. nautical miles)	Total Land Area and of 200-mile (square nautical) ~~combined~~	RANK		
				Land	Ocean	Combine
AFRICA (Cont'd.)						
Mali	464,873		464,873	23		35
Mauritania	419,229	45,000	464,229	27	74	36
Mauritius	787	345,000	345,787	142	17	48
Morocco	171,953	81,100	253,053	51	55	60
Mozambique	303,073	163,900	466,973	34	32	34
Namibia	318,261	145,900	464,161	33	40	37
Niger	489,206		489,206	20		31
Nigeria	356,699	61,500	418,199	30	63	44
Rhodesia	150,333		150,333	53		77
Rwanda	10,169		10,169	125		144
Senegal	76,124	60,000	136,124	78	64	82
Sierra Leone	27,925	45,400	73,325	109	72	111
Somalia	246,155	228,300	474,455	40	28	33
South Africa	471,819	296,500	768,319	22	21	19
Sudan	967,491	26,700	994,191	9	87	13
Swaziland	6,705		6,705	131		146
Tanzania	363,820	65,100	428,920	29	60	42
Togo	21,853	300	22,153	112	121	131
Tunesia	63,378	25,000	88,378	84	88	104
Uganda	91,134		91,134	75		103
Upper Volta	105,869		105,869	64		92
Zaire	905,063	300	905,363	11	122	17
Zambia	290,724		290,724	36		53

Nation	Total Land Area (Square miles)	Total Area of 200 mile (Sq. nautical miles)	Total Land Area and of 200-mile (square nautical) combined	RANK Land	RANK Ocean	RANK Combined
AMERICA, NORTH AND CENTRAL						
Bahamas	4,404	221,400	225,804	133	27	64
Barbados	166	48,800	48,966	148	68	119
Belize	8,866	9,000	17,866	126	104	134
Bermuda	20.59	123,000	123,020.59	154	43	86
Canada	3,851,809	1,370,000	5,221,809	2	5	3
Costa Rica	19,653	75,500	95,153	113	57	98
Cuba	44,218	105,800	150,018	94	46	78
Dominique	290	5,800	6,090	144	111	147
Dominican Republic	18,704	78,400	97,104	115	56	97
El Salvador	8,260	26,800	35,060	127	86	126
Grenada	133		133	149		153
Guatemala	42,042	28,900	70,942	99	83	112
Haiti	10,714	46,800	57,514	124	69	113
Honduras	43,277	58,600	101,877	96	65	95
Jamaica	4,411	86,800	91,211	132	53	102
Mexico	761,601	831,500	1,593,101	13	9	9
Netherlands Antilles	317		317	143		152
Nicaragua	57,143	46,600	103,743	87	70	93
Panama	28,753	89,400	118,153	108	52	88
Trinidad and Tobago	1,980	22,400	24,380	139	91	130
United States	3,628,150	2,222,000	5,850,150	4	1	2

Nation	Total Land Area (Square miles)	Total Area of 200 mile (Sq. nautical miles)	Total Land Area and of 200-mile (square nautical) combined	RANK Land	RANK Ocean	RANK Combined
AMERICA, SOUTH						
Argentina	1,072,067	339,500	1,411,567	8	18	11
Bolivia	424,162		424,162	26		43
Brazil	3,286,470	924,000	4,210,470	5	8	5
Chile	286,396	667,300	953,696	37	10	15
Colombia	455,355	175,900	631,255	25	30	24
Ecuador	105,685	338,000	443,685	65	19	39
Guyana	83,000	38,000	121,000	76	76	87
Paraguay	157,047		157,047	52		74
Peru	496,222	229,400	725,622	18	26	20
Surinam	63,251	29,500	92,751	85	81	100
Uruguay	68,548	34,800	103,348	82	78	94
Venezuela	352,143	106,100	458,243	31	45	38
ASIA						
Afghanistan	251,000		251,000	39		61
Bahrain	231	1,500	1,731	148	119	149
Bangladesh	55,126	22,400	77,526	88	90	109
Bhutan	19,305		19,305	114		133
Brunei	2,226	2,600	4,826	138	118	148
Burma	261,789	148,600	410,389	38	37	45
China, PRC	3,691,502	281,000	3,972,502	3	22	6
Cyprus	3,572	29,000	32,572	137	82	127
India	1,229,737	587,600	1,817,337	7	12	8
Indonesia	735,268	1,577,300	2,312,568	14	3	7

Nation	Total Land Area (Square miles)	Total Area of 200 mile (square nautical miles)	Total Land Area and of 200 mile (square nautical) combined	RANK Land	RANK Ocean	RANK Combined
ASIA (Cont'd.)						
Iran	636,363	45,400	681,763	16	71	22
Iraq	172,000	200	172,200	50	123	71
Israel	7,992	6,800	14,792	128	109	136
Japan	143,574	1,126,000	1,269,574	54	7	12
Jordan	37,297	200	37,297	103	124	123
Kampuchea, Democratic	70,000	16,200	86,200	81	98	105
Korea, Dem. People's Republic of	46,768	37,800	84,568	92	77	107
Korea, Republic of	38,031	101,600	139,631	102	47	79
Kuwait	7,780	3,500	11,280	129	115	140
Lao People's Democratic Republic	91,428		91,428	74		101
Lebanon	4,015	6,600	10,615	134	110	143
Malaysia	128,328	138,700	267,028	57	41	57
Maldives	115	279,700	279,815	151	23	54
Mongolia	604,247		604,247	17		27
Nepal	54,362		54,362	89		114
Oman	82,000	163,800	245,800	77	33	62
Pakistan	342,750	92,900	435,650	32	51	41
Philippines	115,707	551,400	667,107	62	13	23
Qatar	4,000	7,000	11,000	136	108	141
Saudi Arabia	873,000	54,300	927,300	12	66	16
Singapore	225	100	325	147	125	151
Sri Lanka	25,322	150,900	176,222	111	36	69
Syria	71,498	3,000	74,498	80	116	110

Nation	Total Land Area (square miles)	Total Area of 200 mile (Sq. nautical miles)	Total Land Area and of 200-mile (square nautical) combined	RANK Land	RANK Ocean	RANK Combined
ASIA (Cont'd.)						
Thailand	198,455	94,700	293,155	46	50	51
Turkey	301,380	69,000	370,380	35	58	46
United Arab Emirates	32,000	17,300	49,300	107	97	118
Viet-Nam, Dem. Republic of	60,156	22,200	82,356	86	92	108
Viet-Nam, Republic of South	66,280	188,400	254,680	83	29	59
Yemen, People's Dem. Republic of	111,000	160,500	271,500	63	35	56
Yemen Arab Republic	75,290	9,900	85,190	79	101	106
EUROPE						
Albania	11,100	3,600	14,700	121	114	137
Austria	32,374		32,374	106		128
Belgium	11,779	800	12,579	119	120	138
Bulgaria	42,829	9,600	52,429	98	102	115
Czechoslovakia	49,371		49,371	91		117
Denmark	16,615	20,000	36,615	116	95	124
Finland	130,119	25,600	158,719	56	84	73
France	212,973	99,500	312,473	45	48	50
German Democratic Republic	40,646	2,800	43,446	100	117	121
German, Federal Republic of	95,815	11,900	107,715	69	100	91
Greece	50,547	147,300	197,847	90	38	67
Hungary	35,919		35,919	104		125
Iceland	39,702	252,800	292,502	101	25	52

Nation	Total Land Area (square miles)	Total Area of 200 mile (Sq. nautical miles)	Total Land Area and of 200-mile (square nautical) combined	RANK Land	Ocean	Combined
EUROPE (Cont'd.)						
Ireland	26,600	110,900	137,500	110	44	81
Italy	116,303	161,000	277,303	61	34	55
Liechtenstein	61		61	152		154
Luxembourg	999		999	141		150
Malta	122	19,330	19,352	150	96	132
Netherlands	13,967	24,700	38,667	118	29	122
Norway	125,181	590,500	715,681	58	11	21
Poland	120,359	8,300	128,659	60	105	83
Portugal	34,340	517,400	551,740	105	14	26
Romania	91,699	9,300	100,999	73	103	96
San Marino	24		24	153		155
Spain	194,883	355,600	550,483	47	16	29
Sweden	173,665	45,300	218,965	49	73	66
Switzerland	15,941		15,941	117		135
United Kingdom	94,214	274,800	369,014	71	24	47
Yugoslavia	98,766	15,730	114,496	68	99	89
Union of Soviet Socialist Republic	8,647,250	1,309,500	9,956,750	1	6	1
OCEANIA						
Australia	2,967,909	2,043,300	5,011,209	6	2	4
Fiji	7,055	330,900	337,955	130	20	49
New Zealand	103,736	1,409,500	1,513,236	66	4	10
Nauru	8	125,700	125,708	155	42	84
Tonga	270	173,800	174,070	145	31	70
Western Samoa	1,133	28,000	29,133	140	85	129

INTERACTIONS AND CONFLICTS IN COASTAL AREAS

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Introduction

Man has been drawn to the sea as a means to reach beyond his own land. Starting with rafts and oared craft, he progressed to sails to develop commerce along trade routes influenced by ocean surface currents and prevailing winds. Each development created others as the growth in shipping produced an increased need for protected ports and harbours making natural harbours such as estuaries and bays centres for trade. Many of these natural harbours were also productive areas for both agriculture and nearshore fishing and they became focal points for human settlement.

The sea also presented certain dangers for coastal dwellers for erosion, storms and tides threatened their homes and the fertile lands which had been claimed from the sea by drainage and diking. The opportunities and dangers presented by the sea continue to increase today as population growth has accelerated in coastal areas which have had to absorb wastes of all kinds while providing transportation, food, recreation and mineral resources.

The development of coastal areas takes place for a great variety of purposes, with ports and harbours, industry, fishing, mineral exploitation, tourism and recreation among the more important.

The problems in developed coastal areas are often those of over-coming existing conflicts or readily apparent environmental degradation, while in developing countries they may be those of preventing such occurrences in the future. It should be noted, however, that even in coastal areas which are non-industrialized and thinly-populated, the discharge of relatively small quantities of non-treated sewage may cause serious, although quite local, beach pollution even in a relatively undeveloped area. It is very often true that the pollution in developing countries is caused not be development but by the lack of development.

In addition, many developing countries have certain coastal strips which are growth centres subject to the same kinds of environmental degradation and conflicting uses that are more normally associated with areas in the more highly industrialized countries. The opposite situation also exists, for undeveloped coastal areas are present in countries known for the most intense use and abuse of their shorelines. Therefore, it is not appropriate to speak solely of developing countries or developed countries but of the stage of development of specific coastal areas.

The opportunities presented by coastal area development cannot be fully realized unless adequate preparations have been undertaken. Too often the growth of coastal areas has proceeded in haphazard stages because activities were pursued independently and without regard for their interactions or their impact on the environment. The record of contaminated shellfish beds, polluted waters and conflicting demands on a limited strip of shoreline testifies to the inadequacy of planning activities in isolation without consideration of or understanding for the larger systems of which local ones form a part.

Nature of Interactions in the Coastal Area

There is little doubt that the multiple uses of coastal areas interact to varying degrees because of the limited nature of coastal space and the lack of clear boundaries in the water areas. What is not clear is that these interactions are inherently conflicting and mutually exclusive. It is probable that many negative interactions or conflicts result from inadequate planning or lack of environmental safeguards. It is the intention of this paper to discuss this proposition and in so doing underline the importance of sound planning which crosses traditional sectoral boundaries.

Most engineering activities should take place without serious interactions because they involve factors which are all more or less man-made and susceptible to administrative control, although human error or unforeseen natural hazards may cause accidents. Where biological phenomena are involved, there are a larger number of poorly known and unalterable factors, such as oceanographic conditions, biological cycles and water chemistry. The consequences of adverse activity frequently are not immediately apparent or occur in another region far from the source of offense, and when the damage is noticed it is difficult to trace the cause and effect a cure.

In general, the elements which constitute conflicts are: environmental degradation by one activity which adversely affects another; spatial interference between activities over wide areas, at precise points or at certain times; such social factors as the disruption of traditional activities or changes in the original character of the area.

Another conflict arises from the overlapping of intragovernmental responsibilities in coastal planning because government departments are usually organized on a functional basis with few horizontal linkages between them. Such a government structure faces a jurisdictional ambiguity at the shoreline and conflicts are possible at all levels of government. Problems of jurisdiction in the case of oil pollution off the coast may arise between ministries of fisheries, internal affairs, external affairs, tourism and transport and a co-ordinated approach is required.

The impacts of the exploitation of offshore petroleum on the adjacent regions is of great interest now with activities underway in over eighty countries. The study of the problems must include not only environmental concerns but a wide variety of economic and social concerns as well. In order to evaluate the effects of a given development a comprehensive approach must be taken which includes existing activities, both land-based and offshore, traditional attitudes of the population most directly affected, government structure and possible inter-governmental rivalry, economic benefits, and environmental quality.

The issues are highly site specific and national priorities, activities and goals must be taken into account in order to best carry out a programme which will be well received by the government and supported by the people. In order to avoid or reduce conflicts with other on-going activities, it will be necessary to take advantage of existing facilities and information and to collect basic data over a broad spectrum of concerns where gaps exist. However, it must be stressed that lack of data can never be an excuse for not taking action to assess what may be critical problems and take corrective measures.

It must be emphasized that conflicts are not inevitable nor is intervention always necessary to prevent them. In principle, potential conflicts exist between and within nearly every marine activity and with the environment. It is one of the purposes of this seminar to discuss the variety of interactions which can arise between different uses of the sea and to suggest how proper planning and management, basic understanding of coastal processes and activities, and good practice and regulation can minimize the possible conflicts and environmental degradation.

It is possible that most activities which create pollution can be re-designed or altered to reduce the effects but how serious one particular type may be, whether the technology for abation is available, and whether the degree of abatement achieved is worth the cost are questions to be examined in each instance. If oil pollution is endangering fishing and the cost of preventive or clean-up measures is greater than the revenue from the fishing, there may be no economic incentive for pollution abatement.

Many statements have been made and tables published about the nature and degree of conflict between specific coastal activities. Although such summaries and matrix tabulations may be conceptually useful, they are not of practical value for planning purposes. The great majority of conflicts are likely to take place in localized areas of intensive use such as estuaries, straits and enclosed bodies of water and the degree of interaction may depend upon a variety of conditions unique to the area. For example, the ability of the environment to assimilate wastes is referred to as the "carrying capacity" and may be highly variable, thus changing what could be a severe conflict into a minor one. In addition, time factors, such as seasonal use of spawning grounds, may drastically alter the impact of such operations as dredging upon fisheries.

Having dwelt on the negative aspects of interactions in the coastal area, the positive aspects should now be mentioned. The notion of "complementarities" implies not only that conflicts can be reduced but that in certain instances, opportunities exist for mutually beneficial interaction. As the wasteful practices of industrialized societies are re-examined and as the growth rate of activities increases throughout the world, ways of recycling and more efficiently using natural resources are being developed. The properly treated wastes of one process may be a valuable resource to another and the incorporation of such principles into development schemes may create the kind of symbiotic relationship which allows man to live in and use his environment efficiently and compatibly. Other forms of co-operative ventures may remain untapped unless co-ordination and information exchange are instituted across traditional disciplinary boundaries.

Ecological and Coastal Area Systems - An Analogy

Since the great variety of coastal area activities and resources makes an encyclopedic treatment of the subject not only difficult but not very useful, we shall introduce a different approach. An analogy or metaphor will be constructed between the dynamic interactions within natural ecological systems and the interactions which take place in coastal areas. This conceptual model may allow us to put some order into the complexity of interrelations possible and give us an insight into ways of managing them.

Interactions and interdependence are essential within natural ecosystems in order that they can develop stability while never being static. There is much to be learned from these relations for our own planning of coastal area development. The activity levels of a natural ecosystem's individual constituents may fluctuate considerably but the dynamic equilibrium or "balance of nature" is due to the fact that the ecosystem maintains its existence by matched opposition of processes and by regulatory mechanisms which react to protect these processes from disruptions. Would that man's systems would work the same way!

It is suggested that in ways analogous to those in which each animal or plant species performs specific functions and occupies specific habitats thus establishing an "ecological niche", each coastal activity has certain objectives and space requirements. The variability of the environment influences the growth and success of the organism and the same is true of the success of a coastal activity as it makes the best use of the resources available.

Interactions within an ecological community are composed of a multitude of two-species encounters and the simplest type of community interaction is a chain reaction. On land, cats eat rats, rats attack beehives, bees polinate flowers and produce honey. Thus, the population of wild flowers, and the price of honey, is partly dependent on the population of cats. In the sea, food chains are complex and removals, additions or changes in the environment of a species will cause reverberations, large or small, beneficial or harmful, throughout the system. In coastal areas the interrelations may be more subtle, but the loss of a major fishing area or the closing of an international strait could have reverberations on a global scale.

Organisms make use of their environmental resources and it is the purpose of development to utilize natural resources to benefit man. Although "unspoiled" natural areas are themselves a resource, the purpose of coastal area planning is not preservation for its own sake. However, when development affects the resource base to the extent that the "value" of the coastal area is diminished, then the cost of environmental protection must be included in the cost-benefit analysis.

Let us examine the different categories of species interactions in natural systems which may be analogs for the types of interactions which can occur in man's activity. In general, seven major categories are applicable to which we have added some special cases.

1) Neutralism
2) Competition
3) Amensalism
4) Parasitism
5) Commensalism
6) Proto-cooperation
7) Mutualism

Special Cases

8) Restrictivism (including Protectivism)
9) Destructivism (including Suicidism)
10) Omissionism.

1. Neutralism - little or no interaction

Natural Example: coral reefs and sperm whales.

Activities at a low level of intensity may still affect one another especially in cases where pollution occurs. Even within one category of activity, such as recreation, conflicting interests, among water skiers, sailors, swimmers and scuba divers could pose problems if the areas in question are not zoned and regulated. On the other hand, just as two plants can successfully live side by side with their roots in the same soil and two animals, such as crabs and flatworms, can co-exist, different coastal activities can take place without interaction even in close proximity.

Coastal area Examples

i) Recreational boating and commercial fishing -- New England region, U.S.A. Recreational boating, both sail and power, and commercial fishing activity have taken place in close proximity in terms of harbour and vessel support facilities but little interference has occurred. Proper training in the operation of pleasure craft is essential in maintaining this co-operation. The presence of increased numbers of tourists may in fact indirectly assist the commercial fisheries by local increases in the demand for fresh fish and shellfish.

ii) Plans have been announced for the laying of exposed oil pipeline from a single buoy mooring to shore over 265 meters of cobblestones in the North Sea. If clearly marked, then no anchorings should occur in the area and therefore no fracturing. This transfer of oil by tanker may be far less liable to cause pollution than transport by tanker.

2. Competition - interactions in which each agent requires the same limited quantity such as space or land

Natural Example: two predators in the same coral reef.

This is the most common and most serious interaction for it threatens the viability of competing activities as well as the environment supporting them. Two predators competing for the same prey may not have enough to sustain themselves and if the space within which the hunting takes place is limited, relocation may not be possible. Competition may also exist between man and nature as in the exploitation of beach sand needed for both man's cement and natural beach maintenance.

Just as entomologists have pointed out that the worst enemies of social insects are other social insects and the greatest enemies of men are other men, the greatest competition exists within the specific coastal area activity itself. Overfishing is one such example and is representative of a self-destructive phenomena which we will discuss in a later section.

It is a general rule that competition will either lead to the elimination of one species or to the adaptation of one of them to fit a new niche. The degree to which human activities are adaptable to changes in their ways of operating may well determine the capacity of a coastal area for multiple use which is generally considered the most efficient way to use the available resources. Many industrial operations along the coast constitute a visual blight to which is added noise and offensive odours. Such a conflict between man's desire for unspoiled space and development may be inevitable and require a separation rather than an integration of uses.

Man may also find himself in competition with nature as he seeks to exploit coastal resources. The dredging of sand and gravel for construction purposes may interfere with natural beach processes and availability of sand in quantities needed to maintain the current beach profile. In one area a coastal road has been rebuilt three times in the last five years, while within one km upcurrent of the erosional site twenty or more trucks and bulldozers eagerly take away the sand necessary to preserve the beach and the road.

Coastal Area Examples: I am sure that each participant can supply his own examples in addition to those below:

i) Kenya - Hotel versus village development versus traditional fish land areas.

ii) Italy - Overcrowding in restricted areas by settlements for residence, production and infrastructure causing congestion and over-exploitation of resources.

iii) Ireland - Conflict between agricultural uses and urban expansion on one hand and recreational development on the other.

iv) Venezuela - Population pressure leading to overcrowding of recreational beaches and consequent expansion leading to the destruction of mangrove swamps by disposal of untreated waste water and physical encroachment with resultant loss of plant and animal life and possible increased erosion of the coast.

v) Sri Lanka - Trincomalee is a deep natural harbour with an entrance channel over 200 meters deep. Creation of an oil port with tanker berths might conflict with the development of a series of beaches ideal for hotel resort development. Priorities should be set before large investments in either or both directions are made.

3. Amensalism - an interaction in which the growth of one agent is inhibited while the second is unaffected.

Natural Example: The habitat of small barnacles on rocky coasts is reduced by large barnacles although the latter seem unaffected.

The analog of this interaction in the coastal area frequently results from activities which alter the marine environment such as dumping of solid waste, damming of streams and rivers, drainage of agricultural land, which may all affect coastal fisheries and water quality in general. Such actions cause marine pollution although they may have little direct contact with the area they affect. Such activities may also have international implications because of their long-range effects. In addition, the unrestricted development of an activity which grows beyond its original working area or more generally disrupts the environment for other uses qualifies for this category. New entries into the coastal area may also find themselves restricted by activities which interfere with them, sometimes unnecessarily simply because no prior planning for compatibility was done since no true competition exists.

Coastal Area Examples:

i) Estuaries and lagoons are areas of major conflicts of interest between fisheries and industry which favour them as sites for development because of sheltered harbours and easy disposal of wastes into the sea. Fishery value must be judged not only on the basis of established fisheries but on other factors such as the presence of nursery or breeding grounds and the future potential of the area.

ii) Tourism and recreation may conflict with industrial uses if they are not regulated with regard to disposal of wastes. Reduction of amenities is a significant form of pollution even though its economic value may be difficult to estimate. Cities may grow and prosper because of industry and shipping but too many naturally attractive recreational areas have been damaged by disposal of domestic sewage and raw industrial waste, run-off from agricultural land and clearing and filling of mangrove swamps and wetlands.

4. Parasitism - an interaction in which one agent obtains benefits from the substance or food supply of another known as a host, usually without going so far as to cause their demise.

Natural Example: Fish are often afflicted by parasites and parasites which attack man have been identified as a particular form of pollution.

Coastal Area Example:

Competition for the limited supply of fish is well known. Because of the long migrations of some fish, this interaction can occur at great distances and after appreciable intervals of time.

i) One serious dispute in 1970 involved the Atlantic salmon. Salmon-producing countries who had invested in breeding and conservation measures argued that other countries were reaping the benefit by fishing for salmon on the high seas. Similar instances might arise in coastal inlets and at estuary entrances when fish raised upstream enter coastal waters to be caught by fishermen uninvolved in the aquaculture.

5. Commensalism - an interaction in which one agent benefits from an unaffected host.

Natural Example: Several species of fish, clams, worms and crabs live in the burrows of large sea worms and shrimp. They gain shelter and often eat their host's excess food or waste products, but do not seem to affect their benefactors.

In the coastal area, man's waste products are, in certain instances, of possible benefit to certain forms of life in the sea. In addition, certain improvements in onshore or offshore installation such as breakwaters or navigational aids may assist users other than those for whom or by whom they were built. By regulating different activities authorities may ensure that some benefit is derived from a user of coastal resources. In this case, the price for environmental safeguards or other measures leaves the "host" somewhat affected.

Coastal Area Examples:

i) Heat released to rivers, estuaries and coastal waters from industry and powerplants is classified (GESAMP V/10, Annex IV, October 1973) as an important pollutant but it has also been noted that it may have beneficial uses in aquaculture and agriculture. Thermal additions may accelerate growth of fish and shellfish especially during winter months. In 1975, an experiment to determine whether fish can be raised in heated water used to cool coal-fired generating plants was successfully completed in New Jersey, U.S.A. Over 2,000 shrimp were reported to have had a 90 per cent survival rate after one year and over 5,000 rainbow trout grew to commercially marketable size after five months. However, it should be noted that fish living in heated waters may suffer large-scale mortality in winter if the source of the effluent is forced to suspend operations.

ii) Water hyacinth is a common sub-tropical floating weed with long trailing roots that has long been considered a nuisance because it clogs waterways. The plant has, however, been found to absorb many potentially dangerous materials in the water. Scientists are now experimenting with beds of the plant in order to produce a natural filtration system for reducing pollutants, including industrial metals such as cadmium, mercury and lead, as well as hazardous chemicals.

iii) A rather controversial example is the so-called artificial reef effect of such offshore structures as oil platforms. Although it has been argued by industry that platforms form a protective environment conducive to greater productivity it is probable that only small-scale sport fishermen can take full advantage of the concentration of life there. In addition to pipelines and other seabed installations, large-size debris jettisonned from the platforms imperil the trawls of commercial fishermen seeking to fish close to the platforms. Finally, the reef effect probably does not create new fish stocks or enlarge existing ones but only causes a local redistribution of existing stocks. Thus, for commercial trawlers, drilling platforms may have a decidedly negative impact.

6. Proto-cooperation - an interaction that is favourable to both agents.

Natural Example: Crabs often carry coelenterates on their backs and move them from one rich feeding ground to another. In turn, the crabs benefit from the camouflage and protective stingers of their guests. However, not all crabs and coelenterates are mutually cooperative.

This relationship is different from commensalism because both parties benefit, although both could survive without it. These interactions present the opportunities for mutual benefit and for turning conflicts into complimentarities that effective regional coastal area planning snould recognize.

Coastal Area Examples:

i) In many areas of the world there are conflicts between the desire to maintain and preserve wild-natural environments and the desire to expand and develop. In heavily populated coastal areas man-induced changes may have greatest effects on ecological communities as less land remains with each new encroachment on natural areas. At the same time the need to dispose of ever increasing wastes requires additional disposal sites in addition to those on land. The desirability of locating such facilities as airports, power generating plants, oil transhipment, storage and refinery facilities and waste treatment plants in areas remote from urban areas may present an opportunity to use the increasing amount of solid wastes and dredge spoil as construction materials in shallow water, nearshore inner-continental shelf, man-made islands. Such practices would also conserve sand and gravel resources for other high-volume needs such as shoreline nourishment and protection as well as construction aggregate.

ii) In Sumgait on the Caspian Sea in the U.S.S.R., a new purification plant is reported to be able to deal with some 200,000 m^3 per day of effluent from chemical works and oil refineries, yielding polymers and oil residues which can be burnt, providing methane to be fed into the city heating system.

iii) During the early phases of development, economic considerations may result in the installation of a combined system of drainage for both surface water and sewage. Such mixing of sewage with a much larger volume of storm water may sometimes be beneficial, when no treatment is given to the sewage, by greatly increasing its dilution. Water separation to effect water treatment may, however, be made more difficult and costly by this arrangement.

7. Mutualism - an interaction that is both beneficial and necessary to both agents.

Natural Example: Within our own bodies millions of bacteria live in the digestive tract. These organisms depend on their host for food but, in return aid in the digestive process and are necessary for our survival.

Coastal Area Examples:

i) Tourism and recreation in the coastal area require, in addition to a favourable climate, clean beaches, clear water, good road access, cheap land of low agricultural potential for housing, and a good fresh-water supply. These cities which grow and prosper because of tourism must maintain the clean beaches and water and thus proper waste treatment and disposal is beneficial and essential. Desalination is another activity, also requires high quality coastal waters, and may be necessary for growing populations in many arid regions.

ii) Creation of marine parks may not only benefit from preservation of natural areas but encourage other forms of environmental protection, thus ensuring their presence against destruction from other of men's activities.

iii) As noted under neutral interactions, artisanal and small-scale commercial fisheries may benefit from tourists eager to sample the local catch. In some areas the tourist population may be essential for the survival of these fishermen.

Several interactions do not fit into the categories discussed above mainly because man sometimes surpasses both nature's limitations and his own. To maintain the analog structure we have followed, let us continue the scheme with a few interactions not normally encountered in nature.

8. Restrictivism - an interaction in which one agent keeps another from using an area or exploiting a resource although it cannot use it.

Natural Example: Many species, notably predators, establish a territory and try to keep other species out although they may not be competitors.

Coastal Area Examples:

i) Private ownership along coastal strips has denied access to legitimate users in many parts of the world. Although zones below the high water mark may be excluded from private ownership, private lands and roads adjacent to the shore may, in practice, keep others out. In Kenya, blocked public beach access has been called the most common conflict.

ii) Protectivism - a special case of restrictivism where all or nearly all users may be excluded from an area in order to preserve it because it is fragile or because it contains spawning or nursery grounds or a unique physical or ecological setting.

iii) Conservation of coastal areas which permits limited access but no development includes creation of marine parks or delineation and study of an archaelogical site.

9. Destructivism - an intervention harmful to both agents which can be caused by the action of one or both.
Suicidism - a special case of self-destructivism.

Natural Example: Lemmings heading to sea to be drowned.

Coastal Area Examples:

In terms of environmental degradation many of man's activities destroy the resource base upon which his society has developed. The largest percentage of marine pollution is derived from land-based sources and some pollutants have a global impact because of their persistence and wide distribution.

i) Access to lagoons has been opened by building channels on canals across sand spits or coral barriers. The temperature and salinity of the lagoon are changed by this action and this alone has in many instances adversely affected such fisheries activities within the lagoon as shrimping. In addition, the increased shipping may create problems of traffic control and pollution. The need for access to the sea may outweigh the loss of certain resources or activities, but the cost must be weighed versus the benefit. (It has been suggested that in certain instances, the opening of a lagoon to increased circulation from the sea can cause increased circulation and improve the production of an otherwise stagnant body of water.)

ii) Tourists drawn to a coastal area by attractive coral reefs may help destroy this valuable resource by taking home souvenir coral. In areas where coral reefs (live or dead) help protect the coast from marine erosion, mining of the coral may aggravate the erosion.

iii) Erosion along many coasts has become more serious because of man's alteration of the coast such as construction of outlets for drainage purposes, dredging of river mouths and estuaries, construction of dams or installation of badly sited groins, jetties and breakwaters. Mining of sand and heavy metals from the coast may cause losses to the environment comparable to the value of the resource. This economic value should be introduced into the cost-benefit equation that determines the feasibility of the operation. Where possible, the amount of heavy metal sands extracted from the coast should be replenished by suitable beach sands such as from lagoons.

iv) Improperly located sewage outfalls and insufficient treatment of the effluent may emperil recreational beaches or create health hazards by contaminating productive shellfish beds.

10. Omissionism - an interaction not effected by any agent which would have been of benefit to both.

Natural Example: None

Coastal Area Examples:

The number of examples is great because each time an activity is planned from a narrow perspective which does not include consideration of its impacts and interaction in the coastal environment as a whole, an omission has occurred and an opportunity has been lost.

i) The siting of facilities both onshore and offshore requires a basic knowledge of not only the physical characteristics of the area, including climate, winds, precipitation, storm frequency and temperature, oceanography, including currents, wave heights and directions, sediment transport and bottom contours; and geomorphology, including topography, land forms and soil types, but also the concerns of the local communities and special conditions such as archaeological sites and traditional activities.

a) Hotels placed without knowledge of waves and currents which may be in locations where beaches are exposed to direct wave attack making swimming during certain seasons extremely dangerous. Even in apparently protected areas, rip currents can create dangerous conditions for the average swimmer. It is advisable that resort developers undertake studies of wave and current conditions to analyze their strength, direction and location as well as their variability in order to identify areas along the beach where swimming is relatively safe. Subsequent corrective measures such as the installation of breakwaters or groins is costly and would probably spoil the natural setting which made the location in question so attractive for resort development in the first place.

b) Siting of sewage outfalls and dumping locations requires not only surface current information but bottom current strength and direction as well. Knowledge of fish spawning and nursery grounds is also essential to avoid impacts.

c) Beach protection and replenishment efforts may actually exacerbate critical conditions if the studies are not carried out over all seasonal conditions and all important influences on littoral transport are not examined.

ii) Human activities are closely linked to the sea through shallow bodies of water such as estuaries and bays and through wetlands. The filling-in of these wetlands has impacts on fish and other animals for they are extremely productive and frequently are the only unsettled regions in urban areas. Human activities have also polluted many areas because tidal flushing was thought to be much faster and more effective than is actually true.

iii) A survey of the plastic materials accumulating on a private beach in Rhode Island, U.S.A., indicated that the plastic pollutants were mainly a long-product of recreational activities within the immediate area and not household, industrial or agricultural refuse. Thus, the users of the beach were acting to destroy their own resources, thus committing seaside suicide.

Summary

It is hoped that the analogy or metaphor we have constructed has served as a stimulus to seeing the complexity of possible interactions between activities and impacts upon the environment. The point must be emphasized that assessments of development implications must be made before activities begin. A thorough understanding of physical, chemical and biological processes in the coastal area is essential but a knowledge of the other present and future users of coastal space must also be available. However, the lack of data about environmental conditions cannot be an excuse for not taking actions to assess the impact of development on the coastal area.

The recognition of coastal areas as systems subject to many natural and man-produced inputs demands an integrated approach from all those currently dependent upon them and those planning to exploit them in the future. The planning of coastal area development must recognize the limited nature of the resources and space available and should begin with decisions regarding the primary purposes (e.g. industry, ports and harbours, fishing, tourism and recreation, conservation, etc.) for which particular areas are to be used. Multiple use will depend upon the capacity of the environment to support multiple activities and upon communication, cooperation and coordination between the many diverse interests active in the coastal area.

Conclusions

No general statement can be made about the degree of positive or negative interaction likely to take place between activities in the coastal area, but the over-all growth rate of all activities will increase the frequencies with which interactions occur. Localized zones of intensive use are most subject to conflicts whose probability increases with multiple use of such confined areas as estuaries, straits and semi-enclosed seas.

Although most conflicts are likely to be concentrated in localized zones of intensive use, the dissemination in the ocean of small amounts of biologically harmful substances can have wide-ranging and persistent effects.

A rational approach to problems in coastal area development will require information gathering and interpretation followed by analysis and planning on a broad interdisciplinary basis. Due to the variation of local and regional factors as well as the need for considering the sea as an ecological entity, there are good reasons to approach coastal area development and management at many levels: local, national, regional and global.

COASTAL MAPPING FROM SATELLITE ALTITUDES

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Introduction and review

The development of sensors flown on satellites for the detection of natural resources has progressed rapidly during the last years and results gathered by orbiting satellites reached an increasingly large users community. Early experimental flights of instruments, such as those carried on the Nimbus satellites, demonstrated the high potential of remotely sensed data from spacecraft. For example, specific applications were demonstrated for the detection of cold upwelled waters in regions where a potential for the development of fisheries exists.

Due to the low ground resolution of previous satellite data, only large-scale phenomena, such as flooding, areas of vegetation and ice conditions could be investigated. This changed, however, as soon as the ground resolution increased. The Nimbus satellites, for instance, had a ground resolution of about 500 metres for the Advanced Vidicon Camera System (AVCS) while the High Resolution Infrared Radiometer could only detect objects greater than 8 km. The more recent Earth Resources Technology Satellites (ERTS) (now called LANDSAT) are able to detect targets on the ground with a size of about 100 metres.

Table 1 summarizes the most recent sensors which have a potential to gather data which are of interest to the coastal area and offshore region. Some of these are still in an experimental stage and are flown on aircraft. However, with the launching of Nimbus G and Seasat-A, carrying a coastal zone colour scanner (CZCS) and a scanning multi-channel microwave radiometer, environmental data will be monitored for the first time from spacecraft altitudes.

ERTS had as its main payload a high resolution Multispectral Scanner Subsystem (MSS) and a three-camera Return Beam Vidicon Camera System (BV) which provided repetitive acquisition of multispectral data from surface characteristics of the earth. During the ERTS-1 mission, only a few RBV camera images were obtained because of the electronic interferences between the MSS and the RBV. That means that most of the material was monitored by the MSS. The MSS used an oscillating mirror to continuously scan the field in four spectral bands (0.5 - 0.6 µm, 0.6 - 0.7 µm, 0.7 - 0.8 µm and 0.8 - 1.1 µm) while spacecraft motion provided the long-track progression. Data were transmitted as they were acquired (real time) if the spacecraft was in the vicinity of a ground-receiving site. Alternately, at remotly located sites, the data were

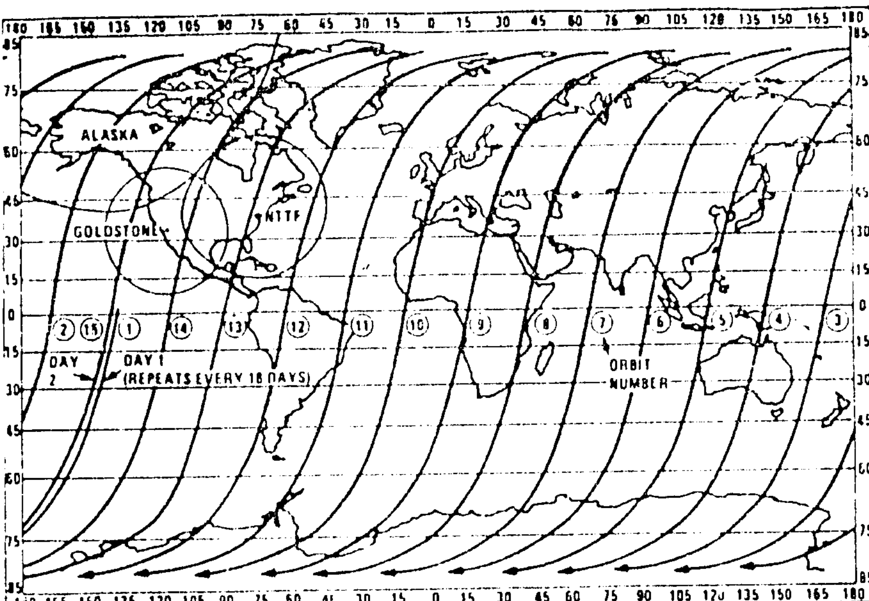
Table 1: Sensors of Oceanographic Interest
(after Apel, 1975)

ABBREV.	SENSOR NAME	WAVELENGTH OR FREQUENCY	SPACECRAFT	SPATIAL RESOLUTION
SR	Scanning Radiometer	Visible & Thermal IR	NOAA 1-4	7 km
VHRR	Very High Resolution Radiometer	Visible & Thermal IR	NOAA 1-4	1 km
VISR	Visible & Infrared Scanning Radiometer	Visible & Thermal IR	GOES	1 - 7 km
AVHRR	Advanced Very High Resolution Radiometer	Visible & Thermal IR	TIROS-N	1 km
MSS	Multispectral Scanner	4 channels, Visible and Reflected IR	ERTS/Landsat	70 m
CZCS	Coastal Zone Color Scanner	10 channels, Visible, Reflected, Thermal IR	Nimbus-G	600 m
ESMR	Electronically Scanned Microwave Radiometer	19 GHz	Nimbus-5	15 km
SMMR	Scanning Multichannel Microwave Radiometer	5 channels	Nimbus-5, Seasat-A	15 - 140 km
Alt.	Short Pulse Altimeter	13.9 GHz	Skylab, GEOS-3 Seasat-A	2 km
Scatt.	Radar Wind Scatterometer	13.4 GHz	Skylab, Seasat-A	25 km
SAR	Synthetic Aperture Radar	1.4 GHz	Seasat-A	25 m

recorded on two wideband video tape recorders with a recording capacity of 30 minutes each and played back over a ground-receiving station at a later time.

ERTS was placed into a near-polar orbit at an altitude of about 490 nautical miles and completed 14 orbits per day with a coverage of the total earth surface every 18 days. Typical ERTS daily ground trace is shown in Figure 1.

Figure 1: Typical ERTS daily ground trace (daylight passes only)



The fast acquisition of multidisciplinary data from an orbiting platform facilitates especially the monitoring of time dependent features, such as near coastal erosion, changes in vegetation, current patterns, plankton blooms, etc., and also has the advantage of being useful in the exploration of natural resources.

The application of remote sensing technology to environmental problems and coastal resources was studied by Thompson, et. al. (1973). Coastal resources, such as productive salt marshes, shell and sand deposits, timber and water were evaluated via remote sensing (photography and infrared scanning imagery). Impact problems related to highway location, dredge spoil placement, industrial and recreational development were considered in light of data acquired at various seasons. Austen, et. al. (1973), studied the application of remote sensing systems in earth resources exploration. The information offers the possibility for more efficient planning and decision-making.

A synopsis of marine resources and ocean surveys from the ERTS-1 programme was made by Greaves (1973). It was demonstrated that sediments are the most visible features and can be used to differentiate water masses. In clear water the bathymetry can be estimated by using contrast enhancement as well as a technique called optical and digital density slicing.

With the increasing demand for fresh water, remote sensing will be an important tool for water inventory and water resources investigations. Land uses related to water resources management can easily be identified and mapped using ERTS-1 data at a scale of 1:250.000 (Salomonson, 1973). Areas inundated by flooding can be mapped at the same scale. The Data Collection System (DCS) on ERTS-1 collected and relayed data rapidly enough to have a significant input in management situations. Size limits for bodies to be detected are in the order of one hectare and rivers as narrow as 70 metres in diameter can easily be detected and monitored. Variations in reflection are attributable to variations in depth and concentration differences in suspended matter, such as plankton and suspended sediments.

Many other studies have been undertaken to demonstrate the applicability of satellite data to natural resources inventory and assessment. Liere (1973), for example, used ERTS imageries for water resources planning in the Lower Mekong Basin and demonstrated that spacecraft data are providing data from areas which have been inaccessible in the past. Included is information on the mechanism of flooding and drainage of the delta, changes in siltation and salinity in the lower delta and fisheries in the estuarine areas. The repetitive coverage by satellites makes the data particularly valuable in studying the gradual transformation of changing regional features.

Geological evaluation of ERTS-1 imagery over diverse geological terrains can also be applied in coastal regions. For instance, geological mapping of terraces of New York State revealed bedrocks and surficial geological information (Isachsen, et. al. 1973). Such information can also be used in the exploration of minerals and petroleum (Saunders, et. al. 1973).

Due to the ground resolution of recent satellite technology, living resources such as fish schools cannot be directly detected. However, environmental factors, which can be correlated with the appearance of marine resources and which can be monitored from space, provide reliable sources of indirect information. Sharma, et. al. 1973, for instance, investigated water and sediment movements and factors controlling the sea mammal distribution.

Kemmerer and Benigno (1973) attempted to relate satellite-acquired imageries to selected oceanographic parameters. Initial results demonstrated that information monitored from space might have important fisheries resource assessment implications in the Mississippi Sound and adjacent offshore waters. In the same analysis, relationships were established between water transparencies, as established from ERTS-1 data and fish availability.

An investigation to establish the feasibility of using data acquired from orbiting satellites to determine the distribution and abundance of oceanic gamefish has been undertaken by Savastano, et. al. (1974). Stevenson and Pastula (1973) used data from ERTS-1 to examine factors affecting living marine resources in the Mississippi Sound. Preliminary results indicated a correlation between back-scattered light and water transparency, changed by chlorophyll and other materials. This allowed eight empirical menhaden distribution models to be constructed taking into consideration parameters such as water depth, transparency, colour and salinity at the surface, thus demonstrating the potential for the management of natural marine resources. Maughan and Marmelstein (1974) in relating ERTS-1 data to transparency and depth of the water also concluded that remotely acquired data can play a role in commercial fisheries.

Management

ERTS data were applied to the protection and management of the New Jersey (USA) coastal environment (Yunghans, et. al. 1974). It was demonstrated that rapid access to ERTS data resulted in the application of computer compatible tapes within 60 hours following the overpass. This operational demonstration of the rapid availability of satellite data and subsequent data processing illustrated the application of spacecraft data in environmental protection and management programmes. Within the programme, computerized analysis techniques have been used for the recognition and monitoring of offshore waste disposal, drift direction and speed and the dispersion rates in the New York Bight area. For example, the density slicing from ERTS data was used to identify the intensity level of acute waste.

Verger and Demathieu (1973) used ERTS data to study the swampy coast of the ocean front of France between Cape Gris-Nes to the south of Arcachon. An assessment of ERTS-1 imagery, as an aid in land resource planning, was reported by Keech et. al. (1974). Land use maps were prepared at a medium-scale and some vegetation complexes could be defined with the spacecraft data.

Water Quality

From the distribution pattern of particulate matter in water, conclusions have been drawn concerning the circulation of water masses in near coastal areas. Magoon, et. al. (1973) concluded that the data from different spectral bands when used in conjunction with other available data are very useful for studying coastal processes and for coastal engineering planning in the Indian River inlet (Delaware, USA).

Similar analysis was done in near coastal waters in Alaska where water flow was inferred from the plumeshape of suspended material. Differentiation between water masses was also detected in channel 4. Suspended sediment plumes which were generated by the Welland Canal and the Genesee River were identified by Pluhowski (1973). Although the Niagara River discharge could not be detected in any of the ERTS-1 frames, the river discharge from the Oswego River was identified after storms but was not visible during lowflow periods showing that high turbidity levels are created by storm runoff.

Sediment distribution and coastal processes in Cook inlet, Alaska were investigated by Anderson, et. al. (1973). The coastline configuration was well-defined in the red band while in the near infrared band, current patterns were visible which were attributed to different concentrations of suspended sediment.

Oceanic tubidity and chlorophyll, as inferred from ERTS-1 observations, were reported by Curran (1973). Curran compared surface ship measurements of chlorophyll concentration with the ratios of channels 4 and 5, as obtained from the ERTS-1 multispectral scanner. It was concluded that the plankton distribution found with ERTS-1 was comparable to the ship measurements.

Upwelling and Currents

Nearly 90 per cent of the world's fisheries are in near coastal waters and in connexion with upwelling ecosystems (Ryther, 1969). Although only a small percentage of the world's oceans are considered upwelling regions, they are the major fishing grounds in the world, off the coasts of Peru, northwest Africa, Somalia and southwest Africa.

For better management of fishing resources, the monitoring of the upwelling areas with chlorophyll-sensing and measurements of additional parameters, such as temperature, to understand the fluctuations in biomass as a function of time and space, are a very promising approach. Estimation of biomass in upwelling areas, including the dynamics of environmental factors, and the determination of the time required for changes to affect the biomass, are criteria for evaluating the potential use of an oceanic region.

Düing and Szekielda (1971) used infrared data to demonstrate that the response time of current systems and upwelling to the wind field can be monitored from orbiting platforms (see also Warnecke, et. a. 1971; Szekielda, 1972). This plays an important part in monitoring fishery potential as well as the management of near coastal processes. Although individual temperature measurements from space are still less accurate than the conventional measurements repeated coverage of a test site with multispectral sensors or the application of statistical methods leads to more precise data (Shenk and Salomonson, 1972; Smith, et. al. 1970; Szekielda, et. al. 1974).

From the ERTS programme, flow patterns and the direction of sediment-loaded surface water could be correlated with the major current systems. Maul (1974) used computers and enhanced images to observe the loop current by colour or sea state effects which are associated with the cyclonic boundary. The observations were in agreement with experimental measurement. In another study, Maul (1973) located the cyclonic edge of the current by surface chlorophyll concentration which contributed to the shift in colour from blue to green in the open ocean. He observed that sea state in the current is frequently higher than in the surrounding waters which have different reflectance in the form of whitecaps and foam.

Upwelling and cold water eddies were investigated by Strong, et. al. (1972) with the NOAA environmental satellite. Upwelling off Mexico's Pacific coast has been detected and cold eddies off Cape Hatteras have been tracked as they move southwest in the Sargasso Sea. Leply, et. al. (1973) determined distribution and flow of water masses at four depth intervals as well as submerged shoals current streamline and the location of areas with vertical water motion.

Satellite imagery was also used by Feleki, et. al. (1973) in the Gulf of Carpentaria (Australia) to study the nearshore circulation and demonstrate that sediment disposal can be studied and mapped on a seasonal basis. The author identified the transport direction for coastal sediment and confirmed a hypothesis about the bi-directional nature of non-tidal currents along the east coast of the Gulf.

Richardson, et. al. (1973) observed Gulf Stream eddies in the western Sargasso Sea. A cyclonic gulf stream eddy was tracked by infrared data and the observations over a time period of 14 months indicated that the eddy moves southwestward at an average speed of one mile per day. Strong and De Rycke (1974) employed the visible channel on the NOAA-II satellite to observe the shoreward edge of the Gulf Stream from Florida to Cape Hatteras. The visible pattern was due to an abrupt change in sea surface roughness as a result of the opposition of waves propagating against the flow of the Gulf Stream.

Feature Classification for Coastal Mapping

Three basic zoning categories have been developed for land and water use (Johnson, Barloga and Barney, 1972):

Category	Activity
Preservation	no development
Conservation	limited development
Development	intensive development

Accordingly, the activities in these categories create different environments whose parameters can be monitored from space.

Preservation areas in general are protected regions where ecologically sensitive flora and fauna and topographic features such as beaches, marshes and dunes are the main categories. Conservation areas, on the other hand, are characterized by extensive land use. Finally, development zones are not considered to be environmentally fragile and include: 1) lands already developed, 2) undeveloped lands vacant for intensive development, and 3) undeveloped lands with some physical limitations.

The sub-categories as well as the priority use in the three categorized zones are summarized in Table 2. Taking into account the common characteristics of the different features in the coastal area, three primary levels, namely water, wetland and land, can be established. A possible further breakdown in secondary and tertiary levels is indicated in Fig. 2.

Weisblatt (1974) was able to detect the primary level for all three classes with an estimated accuracy exceeding 95 per cent. On the secondary level, computerized classification for water discriminated turbidity levels and indicated major water masses and flow patterns.

To detect the tertiary level from spacecraft altitudes, more detailed information on the ground is needed to differentiate between circulation, turbidity and chlorophyll. Wetland classes at the secondary hierarchy level occurred with a high degree of repetition. Marsh classification tends to remain spectrally separable from most other classes. Land feature detection could separate beach features and undifferentiated barrier island vegetation from each other, while no attempt was made to classify on the tertiary level.

ERTS imageries were used for the cartographic mapping of land, at a scale of 1 to 500,000 by Mocneyhan (1973). The map was used to complement existing line maps and to support the revision of existing maps. Objects as small as 100 metres in diameter and linear features as narrow as 15 metres, were detected. In conjunction with automatic pattern recognition, schematic land use categories could be established. For instance, in urban areas three to four different categories were mapped.

For producing classification of imageries and thematic maps, digital data from ERTS are processed using ground truth observations during the overpass, Conrod (1973). The procedure can be handled by contracting the processing, which means that the results may be obtained by personnel who are data users and not data processing specialists. Klemas (1973) applied

Table 2

Categories and sub-categories of zoning for land and water use in the coastal zone (after Johnson, Barloga and Barney, 1972).

PRESERVATION

Subcategory	Priority Use
Class I Waters	Source of potable water
Class II Waters	Shellfish propagation
Marine Grass Beds	Commercial and sport fish propagation
Selected Coastal Marshes	Commercial and sport fish propagation
Selected Coastal Mangroves	Commercial and sport fish propagation
Gulf and Atlantic Beaches and Dunes	Shore erosion protection, recreation
Estuarine Beaches	Shore erosion protection, recreation
Wilderness Areas	Ecological protection
Selected Fresh Water Swamps	Ecological protection and flood water storage
Historical and Archaeological Sites	Cultural enhancement
Other Unique Environmental Features	Aesthetic enhancement, recreation

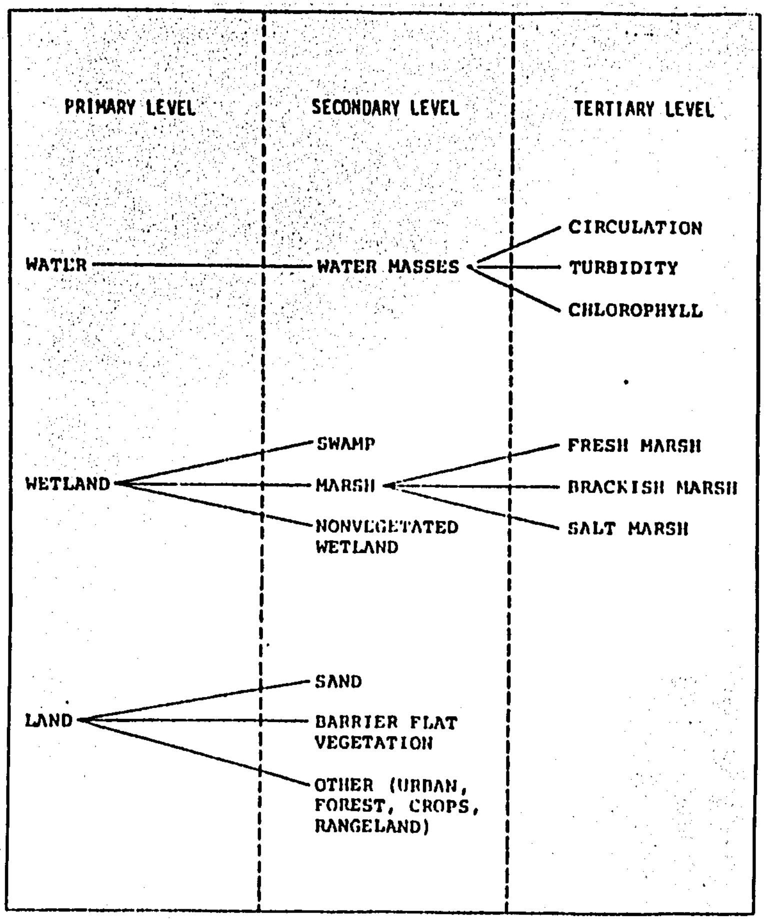
CONSERVATION

Subcategory	Priority Use
Class III Waters	Fish and wildlife propagation, water-contact sports
Aquatic Preserves	Fish and wildlife propagation
Aquaculture Leases	Fish farming
Spoil Islands	Aesthetics, recreation
Hurricane Flood Zone (Special Shoreline Use Zone)	Priority shoreline use given to activities requiring waterfront locations; areas behind the shore are recommended for non-intensive use
River Flood Plains	Non-development (open space, greenbelts, timber, agriculture)
Scenic Vistas	Aesthetics
Forestry and Game Management Areas	Hunting and timber production
Wildlife Refuges	Wildlife enhancement
Parks	Recreation
Marginal Lands	Open space, greenbelts, grazing, timber

DEVELOPMENT

Subcategory	Priority Use
Class IV Waters	Agricultural and industrial water supply
Class V Waters	Navigation, utility and industrial use
Undeveloped Lands Suitable for Intensive Development	Development (if needed)
Undeveloped Lands Suitable for Intensive Development with Corrections	Development (if needed and if economically feasible to correct)
Presently Developed Lands:	
Conflict Areas	Those uses allowed in "conservation" areas
Non-Conflict Areas	Development
Hurricane Flood Zone (Special Shoreline Use Zone)	Priority shoreline use given to activities requiring waterfront locations; areas behind the shore are recommended for non-intensive use

Figure 2: Feature Hierarchy for Coastal Investigations (Weisblatt, 1975)



the classification imagery for ecological, geographical and oceanographic investigation in the Delaware (USA) coastal resources planning. The results obtained by analysis of digital ERTS data are:

1. Statistical outputs indicating the reliability of discriminating eight coastal vegetation and land use classes on a given group of training sets which included:
   a) Mean and standard deviation of response in each class chosen;
   b) Contribution tables indicating importance of each channel in discriminating each thematic class from the background;
   c) Scatter diagrams showing relationships of thematic spectral signatures in spectral space; and
   d) Classification table showing reliability (in percent) of identification of each thematic class.

2. Thematic colour maps at a scale of 1:1,000,000 showing vegetation and land use categories for Delaware's entire coastal zone.

3. Thematic computer plots at specified smaller scales (i.e., 1:24,000) for comparison with existing map data such as U.S. Geological Survey topographic maps.

Kritokos, et. al. (1974) used the magnetic digital tapes of the imagery obtained by ERTS for an analysis of suspended solids in the Potomac River.
Channel 6 was used to determine the water-to-land interface while in channel 5 the existence of three distinct water masses could be detected. Greater reflectivity correlated with high concentrations of suspended solids and regions of low reflectivity could be identified as having lower concentration of particulate material. In another study using ERTS imagery, recognition of beach and nearshore deposition features of Cheasapeake Bay (USA) was reported (Kerhin, 1973).

Littoral drift and the recognition of sedimentation patterns have led to the evaluation of beach and nearshore features in areas of little or no data. ERTS multi-spectral scanner data were used by Flores (1973) for the classification and determination of the aerial extent coastal features on the Texas (USA) coast. Features such as water masses, salt marshes, beaches, forest and vegetation and exposed soil or construction material could be analyzed. The accuracy of the measurements of the percentage of wetland along a salt marsh boundary ranged from 89 to 99 per cent.

Although many countries are not able to invest the capital necessary for the development and the operations of satellites and launch vehicles, they may nevertheless benefit by spacecraft remote sensing programmes, i.e. by collecting data from ground stations. Imageries produced from satellites are also available at a low price. Morley (1972), for instance, reported that the Canadian Air Photo Library markets 9-square inch black and white prints for US$1 each, a black and white transparency for $2, and $3 for a colour transparency. Imagery materials may be obtained from other sources, such as the National Space Data Bank which guarantees the application of spacecraft data at a low price.

V. CONTRIBUTIONS OF UN SPECIALIZED AGENCIES

FISHERIES IN COASTAL AREA DEVELOPMENT:

CONFLICTS AND POSSIBILITIES

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Introduction

The problems of coastal zone management are not essentially different from those encountered in the management of land in inland areas, and stem largely from the existence of externalities - the unintended (negative) result of some avtivity which is not in the normal course of events charged as a loss to the firms producing these effects, e.g. chemical products discharged into a river which affect other users of the river downstream. In extreme cases the effect of one activity can be to exclude entirely the possibility of others, e.g. land reclamation and fishing. Some of these external effects can be easily identified and quantified, but frequently the problem is compounded by their intangible nature and gives rise to the familiar difficulties of attaching a monetary value to tranquility or a rural landscape.

Problems of this nature arise in any land use planning, but they are particularly acute in coastal areas in view of the greater range of human activity possible in such an environment. The land/water interface, with among other advantages its generally milder climate, has frequently provided an inducement to human settlement and by the same token an excellent environment for recreation. Coastal areas are also attractive to industry for a variety of reasons, e.g. oil refineries for the easy discharge of the raw material inputs, and atomic power stations in view of abundant supplies of water.

For some activities there exists a degree of flexibility with respect to its location, e.g. private housing; for other uses such as the trans-shipment of goods and the establishment of harbours such flexibility does not exist. Among these latter activities is fishing, and the culture of aquatic plants and animals. The marine zones of coastal areas are, in relation to the world's oceans as a whole, highly productive and support resources which are the basis for most of the world's major fisheries. This is particularly the case with the shallow inshore waters where plant nutrients are easily renewed from the bottom to the sunlit, upper water layer and where there is an important inter-mix of oceanic waters with fertile waters emerging from river mouths. Moreover, in a few areas (generally along subtropical western coasts) winds and divergent currents produce seasonal off-shore upwellings of nutrient-rich sub-surface waters such areas are biologically the richest parts of the ocean.

The shelf areas of the temperate zone show an average annual production of between 50 and 300 grams of carbon per square metre, values which can be somewhat exceeded in boreal coastal areas with a particularly high supply of nutrients; in coastal upwelling areas primary production reaches 300 g^C/m^2, although the sizes of these high productive areas are small.1/ By contrast the vast oceanic regions produce on average between 10 and 50 g^C/m^2, although there are areas of higher productivity such as the equatorial current systems. Thus, the shelf area and coastal upwelling zones, whilst accounting for only about one-tenth of the ocean surface, yield approximately four-fifths of the world's fish.

The shelf area cannot, however, be equated with the coastal zone. Although there is no unique definition of such a zone, there is general agreement that the main problems associated with the multiple use of such areas occur in waters close inshore, in those areas where land ecology and use have a direct influence on the ecology of the marine environment. The width of such a zone will vary considerably with the physical characteristics of the land, e.g. the influence of some major rivers is felt tens, and in a few cases hundreds, of miles out to sea, but generally along wide stretches of coastline it will not extend many miles beyond the intertidal zone.

The significance of fisheries as a user of coastel resources

During the 1970s the world catch of fish, crustaceans and molluscs has fluctuated from 65 to 70 million tons; over 85 percent of this, or some 55 to 60 million tons, comes from marine waters, the remainder being taken in rivers or lakes or produced by aquaculture in fresh or brackish waters. How much of this catch is taken in coastal waters as defined above is something of a matter for conjecture, but a rough estimate suggests that it might be of the order of 15 to 20 percent. Among the living aquatic organisms substantially exploited in the coastal zone are molluscs (excluding cephalopods), some crustaceans (particularly crabs) and a numer of fish species such as small tunas, for example those taken in the Mediterranean in madragues and shoaling pelagic species which in many parts of the world are still the object of beach seine fisheries. Given that the value of mollusc production (excluding cephalopods) is of the order of \$3.5 million, the total vlaue of all fish, crustanceans and molluscs taken in coastal waters is almost certainly in excess of \$5,000 million annually. In addition the annual value of the harvest of aquatic plants is some \$750 million.

Many fish and crustaceans not normally caught in coastal waters do, however, as Figure 1 indicates, migrate close inshore at some stage during their life cycle, and mangrove swamps and shallow inshore waters provide a habitat for many fishes exploited commercially further offshore at a later

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1/ Hempel, G., Productivity of the oceans

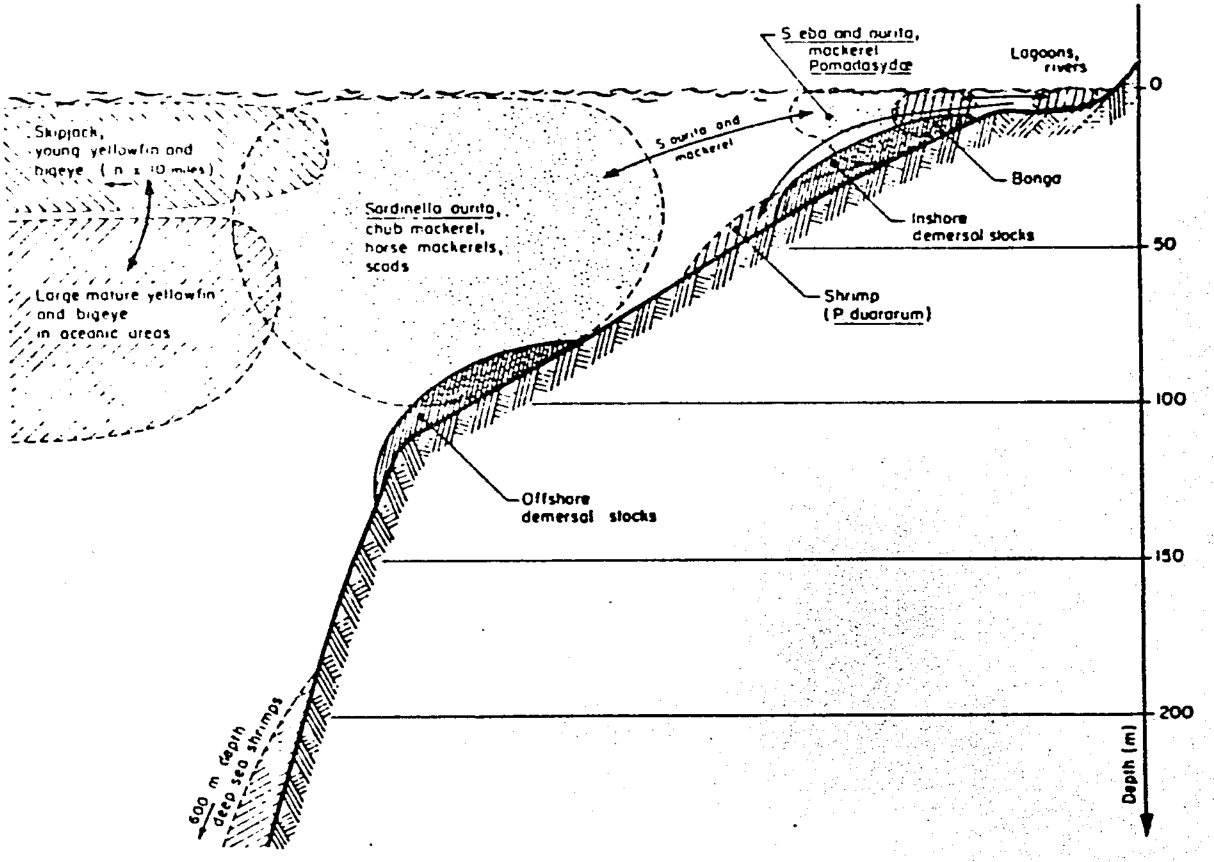

Fig.1 Distribution by depth of species or species groups off the west coast of Africa between 20° N and 15° S

Source: Taken from "Status and Utilization of the Resources". FAO, Rome, FID:CFRA/71/4:44 p.

stage in their growth. In addition diadromous and anadromous fish pass through coastal waters on their way to and from their freshwater environment. Thus, apart from their direct value as fishing grounds coastal waters can have a very significant indirect influence on fisheries production generally.

The recent fluctuations in the world catch have been due largely to sharp changes in the productivity of certain shoaling pelagic fisheries (e.g. herring, anchovies and similar species), much of which is used for fish meal. On the other hand the catch of fish used for direct human consumption has maintained the steady growth of the past two decades. Estimates of the ultimate potential of the oceans range from 80-200 million tons; much of the difference between these extremes centres on which animals are included, and there is fairly general agreement that the potential yield of the types of fish presently harvested (i.e. needing no major technological breakthrough in either catching or marketing to permit their exploitation) is of the order of 100 million tons. The distribution of the unexploited potential varies from area to area and species to species; as a rough generalisation it can be said that the northern temperate waters are most heavily exploited with tropical and southern temperate waters less so. Among the species the most heavily fished are salmon, the prime flat fish, crabs and other crustacea, with cephalopods and the small pelagic fish offering the best prospects for increased catches. Perhaps of gratest relevance to this paper, however, is that it is the truly coastal species which, on account of their ease of access as well as their high value, tend everywhere to be among the most heavily exploited stocks.

Historically fisheries offering a relatively easily available and attractive source of food first developed as a result of coastal settlements, and catches were generally limited to those which could be absorbed by local markets. Although cured fish was an important item of trade in seventeenth century Europe the real impetus to the expansion of fisheries came with industrialisation and the growth in market demand, which took place at the same time as the improvement in communications connecting fishing ports with the main inland markets. It is still this need to meet the food requirements of domestic populations which provides one of the main objectives of fisheries policy throughout the world.

Fish is an important source of animal protein, of calcium and in some cases of vitamins A and D. For some communities - mainly in Asia and West Africa - it is a major source of these items, and for about one-third of the world's population consumption of fish exceeds that of meat; in other areas its main role is to provide variety in the diet. Taking the world as a whole average consumption of fish is presently of the order of 12 kg per head, but this excludes the fish consumed indirectly through the fish meal fed to animals.

In addition to its directly nutritional role many countries regard fish as an important source of foreign exchange. Replies to a questionnaire circulated by FAO to 25 Indian Ocean countries indicated that more than half of them give high priority to the earning of foreign exchange as a policy objective. For a number of countries fisheries products already represent an important element of their exports; these include Iceland for which fishery products account for 80 percent of total commodity trade, and Peru where fish meal represents about one-fifth of such trade. A substantial proportion of the fishery products entering international trade have their origin in coastal waters, e.g. shrimp which is an important component of the exports of India and Mexico and other tropical countries.

Apart from being a source of food and foreign exchange, fishing frequently has an important socio-economic role as a provider of employment. Over a wide range of countries the catching and landing of fish represents at least 2 percent of the total economically active population - a substantial proportion to be involved in the production of one single food commodity - and about the same proportion that is generally engaged in public utilities or in mining and quarrying. In some cases the proportion engaged in fishing is much higher than 2 percent, particularly in small islands, e.g. in the Caribbean and in the South Pacific, and even the highly capital intensive fisheries of Iceland and the Faroe Islands employ well over 5 percent of the total labour force.

Two other factors need to be taken into consideration to appreciate the full socio-economic role of fisheries. In the first place overall national statistics obscure the local importance of fisheries in providing employment in remote areas, where alternative means of livelihood are few or non-existent. Fishing is thus able to maintain the dispersion of employment and to help stem the drift of population to the large urban centres. Secondly, account should be taken of employment in ancilliary trades and industries supplying input to, or utilising the output of, fishing. The categories presently used in most national statistical surveys make it almost impossible to quantify accurately the extent of specifically fisheries related employment in these ancilliary activities, but there are in most countries at least as many people concerned with the processing and distribution of fish as there are in the catching of it. Taking into account also the input industries, i.e. boat building, gear manufacture, etc. it would not be unreasonable to assume a ratio of land-based to sea-going employment of 3:1.

Multiple uses of the coastal zone and their impact on fisheries

Fishing is one of the oldest users of the coastal zone but, as already indicated in the Introduction, with the growth of modern industry and the development of improved communications new uses have been found for coastal resources (and new resources found); in many areas of the world the rate of exploitation of these resources is accelerating. Almost any use of the coastal zone can be a threat to fisheries, but the effect of any development on fisheries will of course depend on its size and location with respect to productive fishing grounds or nursery areas. Some of the main uses of coastal areas which can have an impact on fisheries are detailed below, but clearly not all these possibilities are equally serious or equally likely to occur.

(a) Adverse Effects

Possibly the most widespread potential threat to coastal fish resources is posed by dumping, waste disposal and other forms of pollution such as oil pollution. Among the most common pollutants are the halogenated hydrocarbons, the petroleum hydrocarbons and certain inorganic ompounds, in particular those of heavy metals; also the discharge of biological nutrients, including sewage, can lead to eutrophication - a process by which the water becomes deoxygenated. The lethal effects of these chemicals in high concentrations should not however, obscure the fact that so far their effect on coastal fish resources on a worldwide scale has been rather limited. The most serious case of marine pollution yet recorded is that caused by the discharge of mercury compounds into Manamata Bay, causing death and deformity in those who ate the affected fish. Less serious effects of chemical pollution in fish include population decrease and reproductive failure due to halogenated hydrocarbons and changes in the shape, colour and taste of fish and shellfish due to heavy metals, but the general conclusion to be drawn from a recent wide-ranging review of the problem 1/ is that in spite of the lack of empirical data and the often contradictory nature of available information serious pollution is highly localised and is not yet having any appreciable effect on marine fisheries production.

The position may, however, be rather more serious so far as coastal aquaculture is concerned, especially in industrialised countries. Pollution of coastal waters is reported to have resulted in the closure of 8 percent of the oyster culture grounds in the United States and 25 percent of the potential grounds in Canada. Eutrophication in the Sea of Japan has rendered 20 to 30 percent of the aquaculture areas unusable. Several factors make aquaculture more vulnerable to pollution damage than conventional fisheries. Aquaculture facilities are generally located in coastal areas in close proximity to sources of pollution. This exposes them to greater amounts and concentrations of pollutants than most wild stocks. The crowded, stressful conditions in ponds and enclosures used for aquaculture may render the cultured animals more susceptible to pollutional effects, and concentrations of pollutants which might be tolerated by free ranging organisms may slow the growth and reproduction of cultured animals or may even cause large-scale mortality among them.

The importance of coastal waters as nursery areas for fish and crustaceans has already been referred to, and thus a serious threat to fisheries is posed by land reclamation schemes and the creation of shoreline structures, such as jetties and the bulkheading of tidal wetlands. There is increasing evidence that the destruction of wetlands has a severely adverse effect on detritus production and hence on detritus consumers, such as molluscs, crustaceans and some fishes. In addition shoreline structures can have deliterious effects on nursery grounds by affecting the movement of sediment and by interference with water circulation. Although the silting of lagoons and shoreline erosion takes place naturally, the greatest amount of change in the coastline is the work of man reclaiming land for agricultural purposes, housing, recreation and the development of industry.

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1 / McGreevy, R. P., The effect of increasing multiple use of ocean space and resources on world fishery productivity and extraction.

Much the same sort of effect is brought about by dams and water diversions inland, which affect (often adversely) the esturine and coastal environment. Several cases of this are well documented, e.g. the construction of the Aswan Dam which affected adversely the productivity of the shrimp and sardinella fisheries in the coastal areas off the Nile Delta. In this case there was, even in a purely fisheries context, some offsetting advantage in the production of fish from the newly created lake, but of course the gainers and losers from the change were not the same people - nor can it be assumed that there will always be some compensatory benefits from any such interference with the environment.

Other forms of coastal activity which pose a potential threat to the fishing industry include certain forms of offshore mining, offshore gas and oil developments, submarine cables and thermal pollution. The dredging associated with some mining operations - particularly sand and gravel production - could affect fisheries productivity and fishing operations in a wide variety of ways. An ICES working group on this subject reporting in 1974 considered that the most serious danger in this respect could arise from the effect of disturbance to spawning grounds (which for some species are conelated with gravel bottoms), to benthic organisms, and to possible long-term damage to the sea bed affecting the efficiency of trawling operations. Other forms of mining, such as that of manganese nodules, could have some effect on benthic organisms but the nodules are found at too great a depth for their exploitation to have any serious effects on fishing.

Although the exploration for, and exploitation of, offshore gas and oil has so far proved to have less impact on fisheries than at first feared (at least in the North Sea) these developments do nevertheless pose problems for commercial fishing operations, both in the form of a hazard to navigation and denying areas to fishing operations. Submarine cables present a hazard to the extent that they can become entwined with fishing gear - a somewhat more frequent occurence than might be imagined, there being 68 recorded incidents in the North Atlantic in the past 15 years.

(b) Some Possibly Beneficial Effects

Not all the external effects of alternative uses of the coastal zone are harmful to fisheries. The general economic development of the area can assist the growth of fisheries both by providing an expanding market for fish as well as providing or improving public services, such as electricity, water supply, road, etc., and attracting supporting industries, for example engine maintenance services and facilities for the repair of electronic equipment. In addition, in at least two ways can pollution be turned to advantage to enhance the production of fish.

Controlled use of certain types of organic waste, including sewage, has been found to be beneficial for aquaculture in some areas. The more widespread recycling of sewage in this way depends partly on overcoming aesthetic objections, as well as avoiding genuine danger to public health through infection carried by inadequately treated sewage. In some systems of culture, however, sewage and other organic wastes do not come into contact with the cultured animal but are used only to grow the algae and other organisms on which the animals feed. More generally, considering the fact that acceptable drinking water is recovered from sewage effluents it should also be possible by education to overcome the aesthetic problems associated with the use of organic wastes.

The use of heated water from power stations can also assist the production of fish, particularly in temperate and sub-tropical are s. Besides providing a safe means of waste heat disposal, it has been demonstrated that fish and shellfish production can be greatly increased by growing the animals in ponds or cages fed with such water. By adequate planning in the design stage most of the difficulties in maintaining an adequate supply of uncontaminated cooling water from power stations can usually be overcome.

Conflicts within Fisheries

In addition to the allocational problems posed by the alternative uses of the coastal area, there is a similar problem concerning alternative means of utilising the fishery resource itself. Possible areas of conflict include that between users of different types of gear, between interests concerned with sport fishing and commercial fishermen and between such activities as aquaculture, seaweed gathering and capture fisheries.

(a) Conflicts Between Users of Different Gear

One of the most common conflicts in fisheries is that between users of different types of gear and there is a long history of complaint against the introduction of new fishing methods. Cushing quotes an example of the beach seine fishermen in Cornwall who protested (with justification) that the introduction of the offshore drift netters was taking away their livelihood;[1/] line fishermen have at various times tried to prevent the incursion of trawlers - indeed the opposition to trawlers generally goes back several centuries. In the Northeast Pacific salmon fisheries highly efficient stationary nets have been banned in the interests of offshore fishermen using other gears.

Examples of this type of conflict could be multiplied many times; common to almost all of the protests is the claim that the new gears are destructive, but equally the complaints demonstrate a degree of Luddism and a will to preserve existing economic interests. From an economic standpoint, however, the banning of any more efficient gear (provided it is nottruly destructive in the sense of indiscriminately catching immature fish) means that costs are higher than they need be and there is a real loss in economic efficiency.

In the long run there is no argument to support the prohibition of efficient gear. If the fishing industry (or any segment of it) is denied the possibility of increasing productivity in line with other sectors of the economy, then incomes will fall below those earned in comparable occupations and fishing communities will suffer the very economic and social distress which the prohibition was intended to avoid. Futhermore, the lack of response to technological innovation and progress may deter investors, scientists and equipment manufacturers from attempting to adapt new technology to fishing.

1/ Cushing, D., Fisheries resources of the sea and their management

Differential rates of adopting new technology may also have market-oriented effects. If the coastal fishery is slow to change it may well lose its share of the market to other suppliers who have innovated.

The common property nature of the resource requires, however, that the pursuit of economic efficiency should take place within a framework of regulation, including in particular some means of controlling entry. In an unregulated fishery the effect of an innovation which increases the profit of the innovator is to attract new fishing effort until labour and capital are (on average) earning only their opportunity incomes. If the resource is already fully exploited before the innovation then the effect will be to reduce the total catch - and no benefit will be derived unless employment in the fishery is reduced. It is, of course, this fear which largely motivates opposition to introduction of more efficient methods.

The ease with which fishermen can be resettled in other occupations will, of course, depend on the state of the economy in general. However, in this respect economic development of the coastal zone by offering more opportunities for the redeployment of labour without long migrations can help to make the process of creating a mondern and economically viable fishing industry relatively painless. 1/ In other situations the lack of economic development, and therefore of alternative job opportunities, suggets that the objective of economic efficiency should in the short run be modified for social reasons.

There are in fact many examples of legislation which has been enacted to maintain social stability in fishing communities. It is frequently the case that vessels designed to exploit offshore stocks take advantage of their superior fishing power to exploit inshore waters, which are already intensively exploited by large numbers of coastal fishermen using only primitive methods but who, nevertheless, rely on fishing for their livelihood. In order to protect the inshore fisheries many countries have introduced regulations to keep the larger vessels outside the coastal zone. For example, in Thailand trawling is prohibited within one km of the shore; in Malaysia the regulations allow for a zoning - the most powerful vessels using trawls are permitted to fish only outside 12 miles, less powerful vessels outside 7 miles, etc.

There may in the short run also be strictly conservationist arguments for prohibiting new and highly efficient gear in cases where the level of fishing is at, or approaching, that giving the maximum yield and there is no regulation available to control fishing effort. This point is borne out by recent experiences

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1/ The growth and development of modern industry in the coastal zone adjacent to a fishing port can, of course, also draw labour away from the fishing industry and create crewing difficulties. Although in some cases this has been due to the failure of productivity and thus earnings in fishing to keep pace with those in other industries, the conditions of work in shore-based jobs are frequently more attractive than the long and irregular hours worked at sea.

where a number of technological innovations (e.g. the power block for purse seiners) have been followed by seriously depleted yields from the exploited fisheries (e.g. Atlanto-Scandia herring, and certain mackerel stocks), where no effective control has been exercised on the amount of fishing.

(b) Recreation Uses and Commercial Fisheries

A growing area of conflict in the use of coastal fishery resources is the competition between sports fishermen and commercial interests. The conflict is in many cases a fairly direct one - the number of fish to be taken is finite and those taken by commercial fishermen are not available to be taken by anglers or vice versa. Salmon, in particular, have been a fruitful source of conflict in this rexpect both in Europe and North America and in Scotland, for example, commercial drift netting for this species has been banned in the interests of sport fisheries. There are, however, other less direct interactions which give rise to a conflict of interests. Commercial exploitation of the anchovy off the Western coast of the United States which could yield between 0.75 and 1.0 million tons annually is being seriously limited because of its value as bait, and also since it is the food of some of the most valuable species caught by recreational fishermen.

Problemes of this nature are as yet very largely confined to developed countries. In the United States, where there are now estimated to be some 10 million regular salt water anglers, the growing influence of sport fishery interests has led to the demand for a reappraisal of the objectives of fisheries management. It is argued that in a society which has ceased to be preoccupied with subsistence living the objectives of maximum sustainable yield, with its emphasis on a maximum yield of protein, is no longer appropriate and that the objective should be widened to allow for uses of the resources other than food or industrial purposes, and to include such unquantifiable concepts as the quality of life.

The economic value of some sports fisheries, however, suggests that the objectives of fishery policy might well be widened even in those cases where there is still an urgent need for protein foods. Apart from the fact that most of the fish caught by recreational fishermen are eaten, the income generated by sports fishing is potentially very large and in many cases larger than that obtainable from commercial exploitation of the same resource. Sport fishing is frequently an important reason for visiting an area and, thus, the existence of sport fishing facilities is a considerable asset in developing a region as a tourist area (cf. the coast of Mexico). In 1965 the National Survey of Fishing and Hunting in the USA estimated that the total expenditure of salt water anglers (in connection with angling, but including food and travel, etc). was of the order of $800 million. This compared with the estimated retail value of the much larger commercial catch of around $1,200 million.

(c) Aquaculture and Capture Fisheries

The impounding of coastal lagoons and bulkheading of mangrove swamps, etc. has the same effect on natural free swimming fish stocks, whether the purpose of the impoundment is for the contruction of yachting marinas, housing development or aquaculture. As already mentioned some of these areas may be important nursery grounds for marine fish and shellfish and loss of access to them may affect the survival of juvenile forms and the recruitment of commercial stocks. In case of impoundment for the purpose of aquaculture, however, there is no necessary loss so far as overall fisheries production is concerned - although there will almost certainly be a net loss of welfare to the fishermen involved. The outcome so far as total production is concerned is not always easy to determine before the change; for example, in Madagascar a strong interdependence is reported between commercial penaeid species and mangrove forests, but this relationship does not hold on the west coast of India for the same species of shrimp. Studies aimed at the classification of this relationship in each specific region would, consequently, appear to be an essential prerequisite for the formulation of zoning policies for multiple use of such areas.

Construction of aquaculture ponds in coastal marhes, if too extensive or poorly planned, may block the transport of freshwater and the associated input of marsh primary production into adjacent estuaries and lagoons with a resulting drop in secondary production in the latter. Such effects can be avoided by proper engineering of aquaculture facilities so that serious disruption of natural drainage patterns do not occur.

It is also often argued that large-scale coastal aquaculture based on the collection of larvae and juveniles from coastal nursery areas may eventually affect the magnitude of wild stocks. Although such an eventuality cannot be ruled out, there appears to be no evidence of the wild stocks of milkfish, eels and mullets having been affected as a result of large-scale fry collection. In view of the high rate of natural mortality in nurseries and the relatively small proportion of the larval or juvenile population collected, it is probable that such effects are not likely to be of great significance. Further, as the controlled breeding of cultivated aquatic species becomes more common, collection of seed from natural sources will become of minor importance.

Reconciliation of the Conflicts

As mentioned in the Introduction, most of the problems of coastal zone development have their origin in the existence of external diseconomies, i.e. the costs of individual action which are not taken into account in deciding to take the action. These effects, known variously as externalities, spillover effects or even - neighbourhood effects, are now realised to be a good deal more common than previously accepted in the economic literature and typically give rise to situations where governments are called in to arbitrate "in the public interest". Reconciliation of conflicts is, thus, a matter of the formulation of government policy through the normal political processes, with consumers expressing their preferences through voting and among other ways through organised pressure groups.

The role of government in the reconciliation of such conflicts varies from country to country; in some cases there is almost total control over economic activity in the coastal zone, in others most direct allocational decisions are made through market transactions in the private sector. In those cases where government control is pervasive, net social benefit can be expected to exert a significant influence on the formulation of policy. With the growing complexity of environmental issues, the concept of net social benefit has also been developed beyond the mere discounting of returns at the going rate of interest, and modern cost benefit analysis of large projects with substantial environmental effects now attempts to quantify a wide range of spillover effects.

There are, however, still a number of problems. The evaluation of ecological effects is a rather uncertain process, even if the information on which to base such an evaluation might beavailable. Futhermore, most coastal zone developments have important social implications, e.g. possible exclusion from a beach is an obvious case, or the possible increase in unemployment following a successful campaing against a particular industrial development; in spite of these effects there is as yet no well established agreement on a method for adequately reflecting social values in cost/benefit calculations.

The search for improved techniques in the planning of overall coastal resource utilisation has its parallel in fisheries in the attempts to shift from a concept of maximum sustained yield to a broader objective, allowing for a balance of interests among all users. At the same time tnere is no doubt that in the long run if fisheries is to play a full part in balanced coastal area development then one of the main objectives of fisheries policy should be to ensure that incomes derived from fishing should be no lower than incomes earned in other activities, and this will to an increasing extent imply that the commercial cath chould be taken at the lowest cost.

The complex problems of coastal zone development and management are clearly amenable to a systems approach for their solution. In many areas, however, much of the information that is required to make even the simplest decisions is lacking - in fisheries for example it is quite impossible to quantify the relationship between the reclamation of wetlands and the size of naturally occurring stocks of fish and crustaceans. Much of the information needed is costly to obtain and clearly in this process some form of cost/benefit analysis will be needed to determine the acceptable minimum. Problems of information, however, great as they are should not be allowed to distract attention from the fact that in possible equally short supply is the political will to enforce decisions arrived at scientifically.

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SAFETY OF NAVIGATION IN COASTAL AREAS

Intergovernmental Maritime Consultative Organization
London, England

As the theme of this conference deals with "coastal areas" this paper will attempt to refer briefly to the special problems of coastal navigation and to describe the means for promoting the safety of navigation in such areas.

Dangers involved in coastal navigation

Before outlining the means of promoting safe navigation in coastal areas it is necessary to appreciate the specific problems involved. These are numerous and diverse from place to place, depending on local conditions, the configuration of the land, local weather, etc.

The risks to a ship making a landfall after an ocean passage increase as it approaches the coast. This may best be appreciated by taking as an example the English Channel and North Sea. Ships in the western approaches of the English Channel are converging from all directions and tend to bunch towards the French and English coasts. Once upon the continental shelf they begin to meet fishing vessels and other small craft which increase in number nearer to the coasts; as they proceed further up the Channel the traffic density is gradually increasing. The area is prone to fog, mist, falling rain, snow and other conditions that may similarily restrict visibility, thus increasing the risk of collision. The traffic density reaches a maximum in the Dover Strait where, because of sand banks and shallow water the ships are concentrated either on the French side or the English side, into comparatively narrow lanes. Prior to the establishment of a Traffic Separation Scheme in this area,

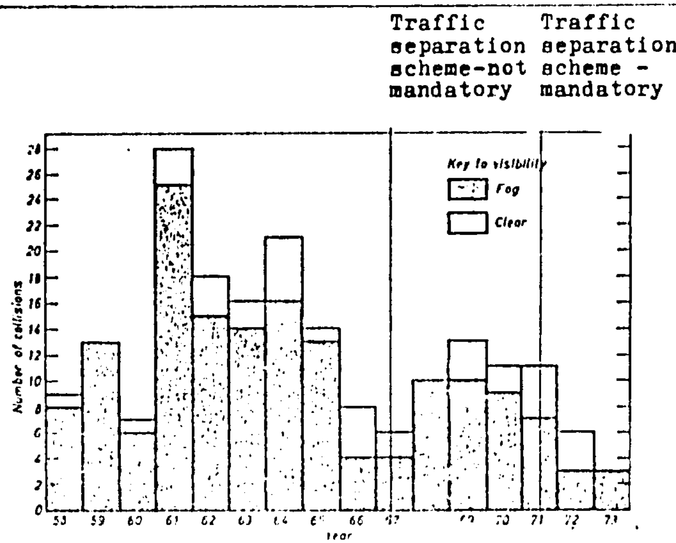

Fig. 1: Dover Strait area - collisions per year

collisions were more frequent and the treacherous Goodwin Sands took their toll of ships that ran aground in fog, many due to the added hazard of the strong and variable set of drift of the tide in that area (See Fig. 1 and Fig. 2). Once through the Dover Strait the traffic density falls as the ships diverge towards their differing destinations; however, the number of fishing vessels increases and in places, drilling rigs also present a hazard.

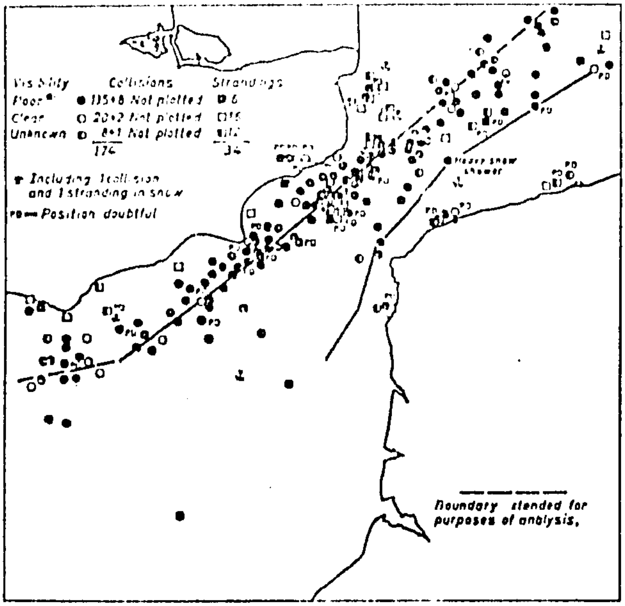

Fig. 2: Casualties all flags (1 Jan. 1958-31 Dec. 1971)

The whole of the English Channel and North Sea is well charted and furnished with navigational aids; information on tide and currents is reliable and weather reports frequent. Where this is not so, the dangers to navigation are much greater.

The next and equally dangerous phase of a ship's voyage is in the approaches to the port. This part of the voyage is normally accomplished by employing a pilot, who is familiar with local rules, tides, channels, positions of dangers, safe anchorages, navigation aids, the most suitable method of berthing, etc. Here the need for suitable navigational aids, charts, information on tides and currents is greatest.

The purpose of traffic separation is, as the term implies, to separate opposing streams of traffic so as to avoid ships meeting on opposite or nearly opposite courses. The result is a reduction in the numbers of ships meeting each other on a collision course, although the cross traffic which also presents a collision hazard cannot be eliminated.

Traffic Routeing Systems

IMCO has been instrumental in establishing internationally standardized traffic separation schemes in areas of the world where shipping congestion is high and, therefore, the risk of collision greater. The essential needs of a traffic scheme are an accurate hydrographic survey and a comprehensive system of navigation aids to mark clearly the limits of each lane and to allow a ship to know its position accurately. The former is necessary since in establishing a scheme freedom of navigation is restrained by channelling ships via a defined route, hence it is essential to know that the route is perfectly safe; this is particularly important if the route is a Deep Water Route i.e. a route recommended for ships of very deep draught. Existing traffic routes approved by IMCO are contained in the publication "Ships Routeing".

The routeing systems which have been adopted so far have the status of a recommendation; they are, however, followed by the majority of ships, particularly in narrow channels and in congested areas. A considerable number of countries have made it an offence, through national legislation, for ships under their flag to go against the general direction of traffic when navigating within a traffic separation scheme.

The new International Regulations for Preventing Collisions at Sea, 1972 have institutionalized the traffic schemes adopted by IMCO and have prescribed rules for the conduct of ships navigating in or near such schemes.This will increase the significance and the effectiveness of this method of navigation as a means of collision avoidance. Vessels are not compelled to navigate in traffic schemes. Wherever the circumstances permit, they may navigate outside such schemes; the rules, however, demand that if and when vessels choose to navigate within or near such schemes they should comply with the specific provisions laid down in the Regulations.

Traffic and routeing schemes are primarily proposed by the coastal countries concerned, examined by a technical body of the Inter-Governmental Maritime Consultative Organization (IMCO), approved by the Maritime Safety Committee of the Organization and finally adopted by the Assembly of the Organization which meets every two years. They subsequently come into force three months after adoption by the Assembly. This procedure ensures that each scheme is examined carefully and justified, debated to the satisfaction of all concerned and widely promulgated. The Internation Hydrographic Organization (IHO) through the national hydrographic services is co-operating by disseminating the necessary information to mariners through the usual means and by presenting the schemes on the navigational charts.

Aids to Navigation

There are many different types of aids to navigation ranging from lighthouses to sophisticated electronic equipment; their need varies from place to place and is dependent on the degree of danger the aids are marking or the type of guidance and information they intend to give to the navigator.

Not only do wrecks, shoals, channels, etc. require to be marked with aids to navigation but also such things as drilling rigs, bridges, power and telegraph lines which require equally protection from ship as ships from them. Some of the most common types of aids to navigation are listed below.

(a) LIGHTHOUSES or lights established on land:
They mark points of landfall or off-shore dangers and provide cross bearings or bearing and range for position determination. The use of coloured sectors is used to show danger zones; they may also have fog signals. If two lights are placed on a certain bearing they provide a leading line. The height of the light contributes to the range of visibility; they are liable to loss of range in weather conditions restricting visibility. They may be unattended, with automatic equipment requiring servicing and fuelling at set periods.

(b) BUOYS and LIGHTVESSELS:
They mark dangers at sea such as shoals, rocks, wrecks, channels etc. Lightvessels, which are always attended and more powerful, are used to mark important junctions and dangers. A specific light rhythm, or distinctive colours or both, serve as an identification characteristic, as is the case for lighthouses. A variety of types of lights is used depending on the purpose of the buoy. Sound signals are carried, operating in conditions of restricted visibility. Buoys in particular, being low, have a limited range and are poor radar targets. They can be used for position determination, as lights on land. As different systems of buoyage have been developed through the years all over the world a study is currently being made by the International Association of Lighthouse Authorities (IALA) and IMCO aiming at the regional harmonization of the various buoyage systems for the benefit of the mariner. The study provides for two basic systems of buoyage.

(c) DIRECTION FINDING BEACONS:
They provide radio bearings for position determination purposes, their main advantage being that they are not affected by weather conditions. In conditions of restricted visibility they may be the only readily available means of position determination. Ships over 1600 gross tons are obliged to carry the appropriate radio-direction finding equipment (DF).

(d) RADAR:
Apart from its use for navigation and anticollision purposes, radar is used for port surveillance and traffic control, in which case it is used in conjunction with VHF radio telephony. It is not affected by weather conditions and provides an indirect indication of the position, course and speed of other ships in the

vicinity as a means of avoiding collisions. It is indispensable for safe navigation in conditions of poor visibility and is mandatory equipment for ships of 1600 tons gross tonnage and upwards.

(e) VHF Radiotelephony:
It is used by port control services for navigational warnings, weather reports, pilotage etc. and in conjunction with radar as mentioned above. Its range is limited to about 30 nautical miles. Although it is mainly a radio communication facility rather than an aid to navigation, its practical use for the above purposes makes it indispensable for ships in the approaches to ports or in the port areas.

Hydrographic and meteorological information

For safe navigation in coastal areas and in the proximity of land the master requires information in more detail and of an increased accuracy. Such information may be classified broadly speaking as weather information and hydrographic information.

In the open sea the weather forecast will enable a ship to evade adverse weather conditions which may cause delays or damage or to avoid, as far as possible, major weather disturbances (hurricanes, typhoons, etc.) which may jeopardize the ship's safety. In coastal areas the possibilities of evasive action are limited while on the other hand, the risks are greater due to the proximity of land and the density of traffic. Weather forecasts therefore have to be more accurate and more frequent to allow the vessel to take all precautionary measures. As the ship is nearing its destination and the port or ports of discharge, the available weather information should include such items as temperature and humidity since these may affect the cargo.

The hydrographic information is presented to the mariner through the navigational chart and through publications such as Notices to Mariners, Pilot Books and Sailing Directions. The chart includes all features at sea or on land which are of some significance to the mariner for safe navigation. Notices to Mariners are the day-to-day means by which hydrographic services notify changes in the information contained in the charts, temporary alterations in the aids to navigation, permanent additions, etc. The accuracy of hydrographic surveys, on which the accuracy of the charts depends, is of paramount importance for safe navigation in coastal areas. The latest edition for each chart should be used and continuous up-dating should be maintained. Charts of suitable scale should be used depending on the area of navigation considering that large scale charts contain more information than those of small scale.

The mariner has at his disposal many other publications (List of Lights, List of Coast Radio Stations, Tide Tables, etc.) which provide him with information essential for safe navigation, particularly in coastal areas.

Radio navigational warnings are used to convey to the mariner urgent information related to safety such as sudden or unexpected hazards to navigation, major weather disturbances, hydrographic information of important nature and other events which may constitute an imminent danger. IMCO and the IHO are at present working on a world-wide plan for the international coordination of promulgating navigational warnings to shipping. The plan for a world-wide system would standardize the procedures for radio warnings, assign co-ordinators for each designated area, etc. Regional plans, based on the world-wide plan, are being established catering to the local conditions of each specific area, indicating details of the area broadcasts, the communication facilities involved, etc.

Ancillary services

Traffic movement within the port area is one of the factors affecting the efficient operation of the port. Congestion in ports, inadequacy of port equipment and facilities, delays in berthing, have a considerable effect on the total cost of transport and place an unnecessary burden on the country's economy. A port control system based on VHF and properly organized would contribute to the efficient planning of the port's functions in addition to improving safety. Such a system complemented by radar surveillance would ensure contact between port authorities and ships, transmit navigational warnings and weather messages, guide ships in conditions of port visibility. Position reporting by ships and plotting should be organized as part of the system to ensure early planning by the port authorities as well as safety of navigation in the congested approaches of the port.

A pilot service is an indispensable feature in almost every port. Qualified masters are licensed as pilots by the national authorities after a certain procedure designed to ascertain that the pilot, in addition to the professional knowledge of handling a vessel, is also acquainted with local conditions which may affect navigation. In most ports pilotage is mandatory for ocean going ships.

A number of international instruments require the coastal state to maintain search and rescue services for the purpose of rendering assistance to ships or persons in distress at sea. The amount of equipment and the personnel which should be available for search and rescue is not specified and it would depend on the country's resources. These resources, however, will not be unreasonably taxed with the setting up of a Rescue-Co-ordination Centre to act as a relay centre for search and rescue communications and to coordinate the activities of the ships which may be available for taking part or may eventually take part in the operation. This role could be fulfilled by a properly equipped Radio Coast Station. An international plan for maritime search ' rescue is at present under study by IMCO in close co-operation with the International Civil Aviation Organization (ICAO). The maritime SAR plan will be parallel and fully compatible with the aeronautical SAR plan. A manual is being prepared intended to assist administrations in organizing their SAR services.

ESTABLISHMENT OF SCIENTIFIC GUIDELINES

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Natural Coastal Systems

The natural environment of coastal areas is the most complex in the world, because the coastal areas consist of naturally complex terrestrial systems and marine systems, plus the manifold interactions between the systems and the variations of the subsystems from place to place. Although a given environment may appear to be quite stable, this stability is in fact typically a state of dynamic equilibrium, with the environment in a delicate balance involving a myriad of natural processes. Hence, Man's development of coastal resources may not only have profound effects on the environment but also these effects cannot be controlled or predicted without a deep understanding of a given environment. The management of Man's relation to the coastal areas must be based on a thorough knowledge of the environment.

The basic scientific approach should be through systems. The concept here is that a given environment is composed of a spectrum of natural systems. Each environment is different depending on which systems are in ascendency. As examples, the marine geological systems are almost all associated with mass transfer. The biological systems should be based on ecological systems. The chemical systems involve mass balances and in situ reactions. The marine physical systems require analysis of environmental parameters such as tide, sunlight and temperature. Each coastal environment requires specific analysis to determine the relative importance of each system.

Coastal resources are both concrete, such as fish or sand, and abstract, such as the aesthetics of beach use. A coastal resource constitutes an element of the coastal natural environment or a sum of such elements. It is a resource because its special or collective properties are of use to society.

For our purposes, there is no distinction between concrete and abstract coastal resources, because the important factors are:

i. identification of the properties useful to society
ii. finding the means to exploit those factors and
iii. controlling the impact of exploitation on the environment.

We shall first discuss the scientific systems involved and then how to handle these in the context of coastal development. An emphasis will be placed on marine systems, but this must not obscure the relevance of terrestrial systems.

Physical processes and systems

The understanding and modelling of the physical systems or physical processes of the coastal environment should be the starting point of all coastal investigations as all other natural coastal systems (geological, biological, chemical) are conditioned by these physical systems and factors. Conservative physical properties such as density, temperature, wave energy, etc., can be considered as systems where quantities are transferred. Examples of physical processes are wind stress, temperature diffusion, mixing, etc., which drive or affect the systems, physical and otherwise. Physical factors of importance in coastal aquatic systems include waves, tides, currents, temperature, density (a function of temperature and salinity), pressure, mixing, sound transmission, light and light transmission, wind and other air-sea interaction, etc.

Considerable progress has been made in recent years in the numerical modelling of coastal circulation, especially in bays, lagoons and estuaries (see, for example, R. Gordan and M. Spaulding, 1974). The models range from highly theoretical to highly empirical. For instance, models for estuaries of complex geometry are quite empirical, using factors such as basin topography, tidal cycle, wind stress, and bottom stress as parameters, and testing the iterative models against known current velocities measures at selected sites in the estuary. Numerical models are very useful when investigating such disparate matters as the distribution of planktonic larvae, the diffusion of thermal plumes from power plants, or the distribution of bottom sediments.

The atmospheric system produces large effects in the coastal area through wind, rain and storms. The wind-driven currents and waves are an ever-present factor modulating the other systems. Hurricanes and typhoons are effective agents for change, especially if there is a large storm surge associated with a high tide at the coast. Progress is being made in modelling and forecasting such storms and conditions.

Chemistry of the coastal aquatic system

The water chemistry of the coastal system is the most complex of all major aquatic systems. It is here that the fresh water of the rivers mixes with the saline water of the sea, yielding a very large range of chemical concentrations and producing various chemical reactions, because of differing chemical equilibria between fresh water and sea water. In addition, there exist coastal waters with special characteristics of their own, such as the acidic and organic waters of marshes and mangrove swamps, the highly saline waters due to high evaporation in desert areas, and of course the polluted water associated with the coastal disposal of organic and chemical waste. Finally, because coastal waters tend to be quite organically productive, the organic and nutrient chemistry of coastal waters is intimately related to the life cycles of marine organisms, especially phytoand zooplankton and coastal seaweeds.

Several different approaches must be used to differentiate these coastal chemical systems. Three useful approaches involve determining mass balances, biogeochemical pathways and residence times. The establishment of the natural mass balance of a chemical element or species involves determining all sources and all sinks of this element. The biogeochemical pathways are those taken by the element from the sources to the sinks. The residence time of a component in sea water (or any other sub-system) is that time that it takes for half of the component to be removed.

Sources in the coastal aquatic system include rivers, local surface runoff, submarine ground water springs, rain, wind-borne materials, the upper oceanic waters and the coastal upwelling of deep, nutrient-rich oceanic waters. The land sources may provide highly organic material. Sinks include the sediments, the atmosphere, the open ocean and organisms. The chemical pathways may be quite simple, such as the simple mixing of riverine and marine sodium ions, or quite complex such as those for dissolved silica in which both inorganic and organic factors are active.

When dealing with pollution, the concepts of chemical mass balance, biogeochemical pathways and residence times are vital for determining the ultimate fate of these introduced compounds. For instance, if the balance cannot be made, then on one extreme a significant sink exists which must be found and accounted for, or at the other extreme an important source of pollution remains to be identified. The biochemical pathways determine the effect of the pollution on the organism. The biogeochemical pathways and sinks determine how nature is dealing with the pollutant. The residence time shows whether the effects will be short-term or long-term.

Marine geological systems

The geological system here is considered to consist of:

1. source
2. transport
3. sink

The system then is concerned with the transfer of matter. The transport may refer to either a mechanism or process. Most research in the past has been devoted to uncovering the process. The stages are reasonably well known (or inferred) now (see, for example, F.P. Shepard, 1973), so that the entire system can be discussed. A large coastal system may consist of several successive sub-systems, where the sink of one becomes the source of the next (see Table 1).

The geological systems of the coastal environment must be considered to be in a state of dynamic equilibrium. As such, a change in one element of the system produces feedback through the system requiring that a new state of equilibrium be attained. Such a change need not necessarily be deleterious but unless the dynamics of the system are understood, the effects cannot be predicted.

Table 1: Components of the coastal geological system

Sources

river and its delta
headlands and eroding beaches
offshore older deposits and transient offshore bars
windblown sediment (usually minor)

Transporting agents

waves
currents
winds

Sinks

aggrading beaches
deeper continental shelf
submarine canyons
transient bars
sand dunes and lagoons behind beaches

Rivers and streams constitute the major source of sediment to the coast. Where the river source is large, deltas form, such as the Rhone, Nile and Mississippi deltas (each of which is different). Note that these deltas are in dynamic equilibrium as well - major erosion has occurred on the Nile delta with the blockage of Nile flow by the Aswan dam. Sinks vary depending on the local sub-system, but a significant amount of sediment is transferred to the deep sea from the nearshore zone by submarine canyons (the head of the canyon acting as a nearshore sink but also as a source for the canyon sub-system). Landslides are locally important sources of sediment along shore cliffs; submarine landslides are a major means of sediment "failure" for initiating sediment transport down submarine canyons.

The process of beach erosion is now understood in the context of multiple sources and sinks of sand with the sand moving under the forces of waves, currents and the wind. The beach itself is an equilibrium feature undergoing dynamic change. A change in any factor has immediate repercussions on the beach.

For a beach, there is an onshore-offshore component of sediment movement and a longshore component. Typically during the winter with its larger waves, the beach is eroded and the sand is transiently stored in an offshore bar, leaving a gravelly beach if such material is available. During summer, the sand is transported back to the beach by the gentler waves (because the backwash of the wave is gentler than the backward thrust), and the beach aggrades. For most beaches (except small pocket beaches), the waves and currents produce a longshore sediment drift component. As long as the sediment source supply is abundant and the ultimate sediment sink is stable, then the year to year character of the beach will not undergo significant change. On the other hand, if the sediment source is cut off (for example, by a newly constructed breakwater), then the beach will erode, because the sand of the beach will continue to be fed into the sink; the results can be disastrous for nearshore construction. Conversely, that same breakwater will act as a trap and the beach will build out on its up-current side.

Modern marine geology cannot be understood without considering the repeated major lowerings of sea level due to continental glaciation(the "ice ages"). The most recent lowering was 130-150 metres about 15,000 years ago. After that time, sea level rose rapidly to near present sea level about 5000 years ago, as the continental glaciers melted, and is still rising very slowly at a few centimetres per year. During lowered sea level, all or most of the continental shelf became land with the result that rivers debouched at the shelf's edge. Moreover, rivers cut deeply into their former beds producing canyons at the present coastline. As sea level rose, these canyons gradually filled - the beachline of course also moved across the shelf so that the present topographic features and sediments of the continental shelf are a mixture of relict river and beach features upon which may be superimposed modification due to modern processes. Just as we find that heavy minerals (magnetite, titanite, gold, platinum, diamonds, etc.) are concentrated in modern beaches, so there are older analogs under relict beaches on the deeper continental shelf.

The following list gives examples of useful or important geological properties, materials and processes of the coastal area with examples of impact:

- Mineral/fluid sources: sand, gravel, lime, heavy minerals, petroleum, fresh water
- Removal of sediment from channels and harbours
- Transfer/importation of sediment for beaches and land fill
- Construction of breakwater, piers and other structures
  - i. may change sediment regime
  - ii. may require knowledge of foundation properties
- Removal/transfer of sediment may/will change sediment regimes and, if in lagoons or estuaries, change the tidal prism which determines the flushing rate
- Oil production may/will require structures and can cause land subsidence (through removal of subsurface oil) with severe results at the coastline
- Coastal landsliding can be induced by a number of factors such as cutting away the toe of the slope, introduction of water which lubricates the slide plane, etc.
- Certain sea floor and terrestrial soil properties favour certain biological resources
- Disasters particular to coastal geology include tsuna-

mis associated with Krakatoa-type volcanic eruptions and with large-scale sea-floor movements associated with certain earthquakes.

Ecosystems

Biological systems/ecosystems are very different from geological systems, but they share the property of dynamic equilibrium. Ecosystems are very much more complicated than geological systems and are by no means completely understood. Nevertheless, significant progress is being made in modelling ecosystems (see, for example, J.H. Steele, 1974). In order to characterize an ecosystem (terrestrial or marine) a large number of factors must be known. As in geological systems, ecosystems are made up of many subsystems which interact with one another. Ecosystems can be analysed in various ways. A common one is to evaluate the energy flow through the system, taking into consideration all inputs and outputs.

One must know the life cycle of individual organisms and its trophic level (i.e., who it eats and who eats it) in the food web. Symbiotic (mutualism) relations must be known.

If an ecosystem is to be characterized, the following parameters ideally need to be measured:

survey to determine:
- the species present (both plant and animal)
- the quantity of each species
- the age of each species
- type of communities present
- niches present

The geological substrate is important for an ecosystem. In the marine environment, such a substrate can consist of gravel, sand, mud (silt and clay), clay, limestone (shells, breccia or solid reef). The substrate may be very simple; as in a sand beach, or very complex, as in a marsh (sediment plus organic matter in various states of acidity, oxygen tension and salinity).

Environmental parameters have a significant effect on ecosystems in their absolute value, their range in value with time and even in their rate of change with time. For example, a simple organism's rate of metabolism is determined by the surrounding temperature, organisms differ in the range of temperature that they can tolerate and an organism may undergo "thermal shock" by too radical a temperature change - a change that might be survived if it had occurred over a longer time interval.

For marine organisms, the important physical parameters (with their changes) include: sunlight (length of day and cloud over), temperature, salinity, turbidity (both as it reflects water clarity and suspended particulate material), water depth (including tidal change), and parameters associated with waves, tides and currents such as periodicity, velocity, trajectories and vorticity. Chemical characteristics of water are vital for marine plants and affect marine animals. Important chemical parameters (with their changes) are: salinity, oxygen, the major nutrients (nitrate, phosphate, silicate), various trace metals (such as copper), and various organic and non-organic compounds which can stimulate or depress. Pollutants typically fall into the last category. Physical parameters of the substrate also affect marine ecosystems: rock versus sediment, sediment grain size distribution, sediment sohesion, sediment permeability, Eh, pH, and lateral and vertical changes.

All of the above have their analogs in the terrestrial coastal ecosystem.

Man can affect the ecosystem in various ways, for example:

- exploitation of single species which affect the overall eqüilibrium
- exploitation of off-shore sand and gravel which may affect the habitat of benthic living resources
- filling of wetlands
- introduction of waste industrial chemicals and poisons
- introduction of organic matter and nutrients
- changes in salinity (e.g., damming rivers)
- changes in temperature (e.g., warm effluent from power plants).

Management of Natural Coastal Systems

Management has been defind as "judicious use of means to accomplish an end" (Woolf, 1975). Thus we must specify the "end" in order to discuss the system of management. On the basis of Unesco's Constitution and its stated objectives I summarize (speaking as an individual) Unesco's overall ends to be (in terms of this talk) the promotion of science through international co-operation for the purpose of ensuring:

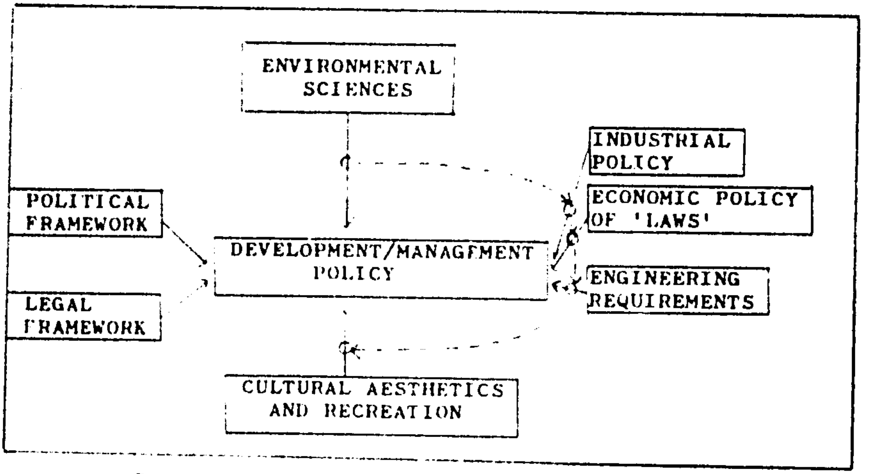
i. the survival of man (both short-term and long-term)

ii. the intellectual, emotional and cultural evolution of man

iii. an enhanced quality of human life (physical, emotional and intellectual).

These goals are relevant to the topic under consideration: "development and management of resources of coastal areas". The topic is not simply economic because an important factor involves the environmental feedback in the development of the resources. Many societies are now requiring that the development meet defined environmental standards. Such standards are based on cultural standards which change as society and, indeed, development evolves. Such standards require that disturbance of the environment can proceed only so far and that an environmental cost be included in the cost of exploitation. The environmental knowledge to assess the state and changes of the environment are acquired through scientific investigation. Thus, the seminar here inherently involves economic, scientific and cultural factors (as well as a host of other factors) (see for example A.S. Msangi and J.J. Griffin, 1974).

Figure 1. Role of environmental sciences in developing a rational coastal zone development/management policy in collaboration with other identifiable input. The diagram suggests how science modulates certain other inputs.



Coastal resources development and management requires a complex interdisciplinary effort to deal with this use of the coastal environment, involving the fields of environmental science, law, economics, demography, etc. (Figure 1). Here we are particulary concerned by the environmental aspect, since human use of the coastal area must react with the environment in accordance with natural laws. The intelligent management of that use can only be done through knowledge of those natural laws and hence through intimate collaboration with the environmental sciences. Diagrams are very useful in outlining (i) the necessary input into a suitable management use policy (Figure 1), (ii) how that use policy is modulated by environmental science (Figure 2) and (iii) the role of the environmental scientist in a development scheme (Figure 3).

Figure 2. Role of environmental sciences in implementation of coastal development/management showing identified categories of coastal use.

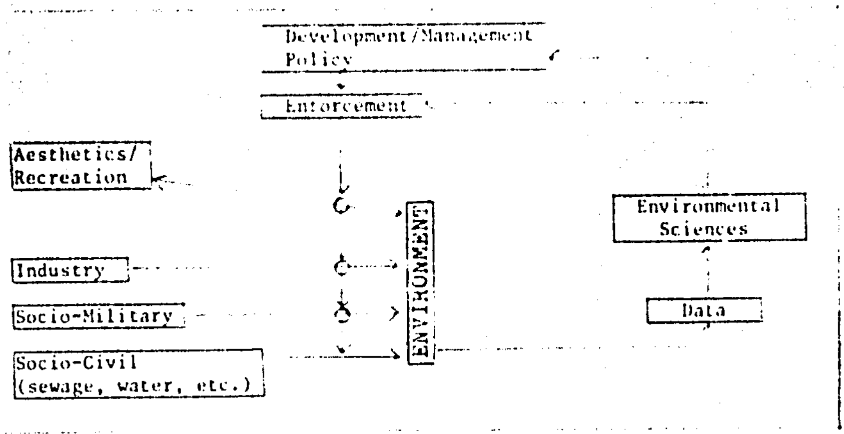
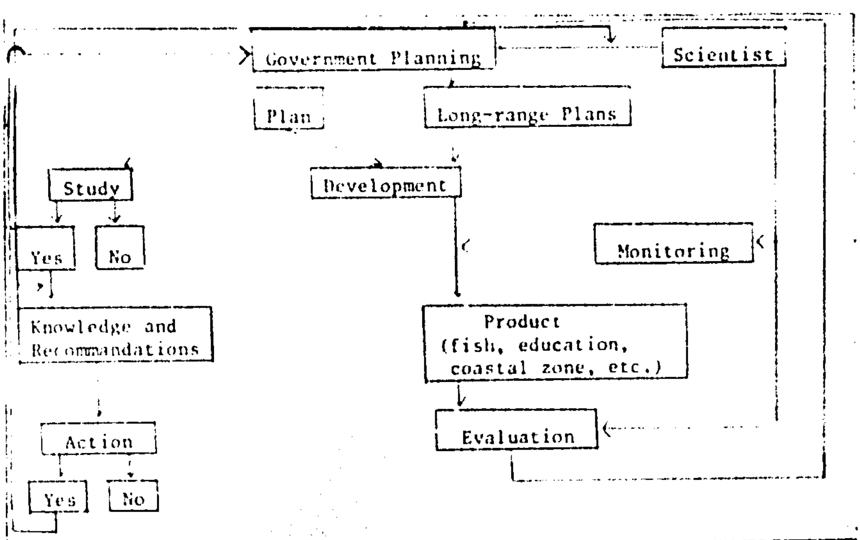


Figure 3. Schematic outline of a scientist's possible participation in a development scheme



A clear distinction must be made between science and applied science/engineering, because the term 'science' is being used rather loosely in modern society. Science as used herein is "a) knowledge covering the operation of general laws as obtained and tested through the scientific method and b) such knowledge concerned with the [physical-biological] world and its phenomena ...." (Woolf, 1975). The scientific method consists of "principles and procedures for the systematic pursuit of knowledge involving the recognition and formulation of a problem, the collection of data through observation and experiment and the formulation and testing of hypotheses" (Woolf, 1975). Applied science is the application of science to "practical use, especially applying general [scientific] principles to solve definite problems" (Woolf, 1975). Engineering is closely related but not necessarily synonymous - it is "the application of science and mathematics by which properties of matter and sources of energy are made useful to man in structures, machines, products, systems and processes" (Woolf, 1975).

In terms of the different aspects of development, science (or better, basic science) has as a short-term goal "intellectual development", while "economic development" only appears in its long term goals. In contrast, "economic development" is a prominent short-term goal of applied science and engineering, while "intellectual development" only appears among the long-term goals. Thus although all these fields of activity require fine skills and intelligence, the short-term outputs are often very different because of different objectives.

It should now be clear that simplistic approaches have no place in dealing with coastal development. The history of coastal development shows that projects which disrupt coastal systems at the minimum, have adverse environmental effects, and at the worst, not only fail to accomplish their developmental objective but make conditions worse. Nonetheless, the coastal system has considerable resiliency and development can succeed if that development is planned and implemented in harmony with the coastal systems. In the following, I assume that this is the required objective.

At a very early stage in coastal planning, a thorough review must be made of the available knowledge base concerning the marine and terrestrial environment of the concerned coastal area. Concurrently, a survey should be made of the coastal area in order to classify the major operative natural systems and their regional context. An analysis of these two inputs will establish where data gaps exist which require long term efforts to fill, such as tidal data, prevailing wind direction and speed, etc. Steps should then be taken to establish research and survey projects to acquire information considered to be high priority. Both basic and applied science approaches may be required. Knowledge required for land use policy is particularly necessary at this stage. A basic identification of coastal resources must be made before exploitation can be considered and the necessary programme for identification of coastal resources should be initiated at this stage.

As coastal planning focuses on specific sites, uses or development projekts (see Table 2), a more detailed scientific approach is required. A detailed analysis is required on how the natural systems will affect the use or project, and vice versa. The systems must first be identified and then evaluated as to importance to design or impact. Gaps in knowledge must be identified. This requires a strong interaction between the scientist, the engineer and the planner. A research programme must be established to acquire high priority data needed for design purpose and to estimate the environmental impact of the development project. Resource surveys will be required to evaluate the specific resource in question. The scientific work at this stage will be highly applied but may be usable for basic science as well, if the supporting research projects are carefully designed. This is particularly useful where the local environmental knowledge base is small, because such research will help support later development projects by providing a better understanding of the concerned natural systems. Trained manpower, resources and data processing facilities are limited in most countries, and effort can only be directed to gathering and processing only a small portion of the environmental parameters. A careful, thorough analysis of the systems at the start of a project will save time, effort and resources during implementation. The relevant parameters and systems should be identified with as much precision as possible (and reviewed as the project progresses) rather than using a shotgun approach. Priorities should be established as to the parameters needing investigation and monitoring.

If the environmental analysis and the project design allow implementation of the project, then a third stage of environmental research should be implemented to monitor and evaluate feedback between the environment and the development project. The specific type of research will depend upon the parameters to be measured and the frequency of measurment. Long-term follow-up may or may not be required depending on the type of development project. For example, little follow-up will be required after construction of a bridge but extensive follow-up may be required to monitor the effects of a power plant's thermal plume in the water or atmosphere.

The scientific analysis at any of the three stages (planning, design or implementation) may reveal major knowledge gaps concerning the fundamental dynamics of a given natural system or sub-system. The time frame of the latter two stages may not allow solution of that problem, with the result that the research is rejected as too lengthy, too complex or too basic. If future development projects deal with that natural system, then a mechanism must be available to support scientific research into such systems. Whether such research is applied or basic is simply a semantic question if the lead time is long.

The effort required for environmental research should not be underestimated. Firstly, environmental research, particularly marine, can be quite expensive in time and funds, and secondly, the development may succeed or fail on the basis of the quality of acquired data. A compensating, simplifying factor is that for most individual development projects, only certain natural systems will be shown to dominate the design and impact, and thus the required data may be able to be restricted to only certain parameters. Well trained scientists and engineers are required so that they can draw on the extensive existing knowledge acquired over the globe in similar environments and apply it to the specific project. Field equipment and properly equipped scientific vessels and laboratories are required to measure and analyse the data. If basic and applied environmental research is to be self-sustaining and effective in a country or region, the environmental scientist must be supported by an infrastructure such as the one in Figure 4. Such an infrastructure can be evolved through a development scheme which will produce the necessary human resources needed to develop and manage the coastal resources.

Table 2: Examples of coastal development

Marine

Resource exploitation

- Surface minerals (sand, heavy minerals, phosphate, limestone, etc.)
- Sub-surface petroleum
- Distillation of salt water for fresh water
- Extraction of chemicals from sea water (salt, bromine, magnesium, etc.)
- Direct energy extraction from waves, currents, thermal differences, etc. (of potential use)
- Fisheries
  - Benthic
  - Pelagic
  - Mariculture
- Seaweed harvesting

Construction

- Harbours
- Breakwaters
- Bridges
- Offshore oil wells and terminals
- Power plants
  - Nearshore
  - Offshore, floating (planned)
- Buoys, light towers
- Underwater pipelines and cables

Other uses

- Aesthetics and recreation
  - Beach use
  - Sailing
  - Conservation areas for coral reefs, marine views, etc.
  - Marine scientific research
- Homes on houseboats and yachts
- Transportation of goods and people by sea and air
- Waste disposal (solid and liquid waste, heat)
- Defence zones

Terrestrial (more complex than marine development and classified differently)

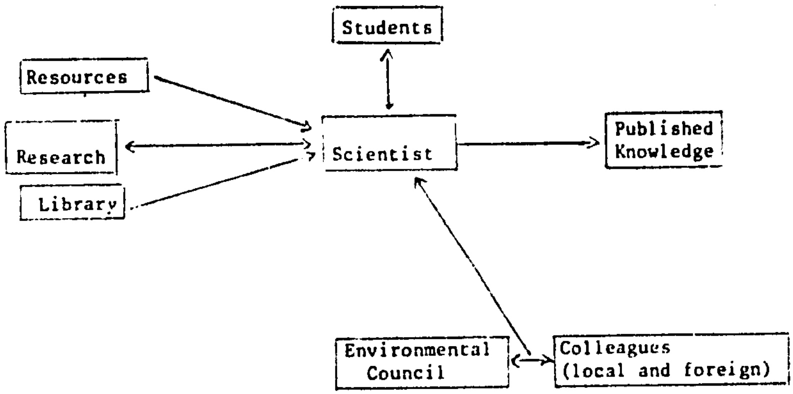
Human habitat

- Life support system
- Recreation and aesthetics
- Social system infrastructure
- Ecology

Goods production/transfer/use
Food production/transfer/use
Energy production/transfer/use
Water production/transfer/use
Mineral production/transfer/use

Waste production/transfer
Land surface use
Transportation = transfer (roads, railroads, airports, pipelines, wires, etc.)
Construction to support above

Figure 4. Necessary structure and activities for a productive, effective scientist whose half life is 10 years



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RELEVAMIENTO Y MONITOREO DE LOS PARAMETROS COSTEROS

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Introducción

Varios especialistas durante este seminario presentarán sus puntos de vista sobre aspectos específicos del manejo de la zona costera que creo permitirán formarse un cuadro claro de lo complejo de esta tarea, propio de la misma naturaleza de la zona costera, pero que al mismo tiempo darán una pauta sobre los fundamentos científicos sobre los que se debe apoyar este manejo.

He tratado, leyendo los resúmenes de esos especialistas, de ver si ellos cubrían los aspectos de este programa que considero básicos y que proveen el marco adecuado para poder desarrollar la componente ambiental que será el tema de mi disertación. Creo que ésto se ha logrado, pero a título de repetir algunos conceptos ya expresados, prefiero sintetizar los puntos que considero básicos en toda estrategia que apunte al uso de la zona costera para el beneficio humano.

El primer aspecto que estimo debe ser de fundamental importancia en las consideraciones de las autoridades de gobierno que deban adoptar la decisión de desarrollar y explotar la zona costera en su valor geopolítico. No cabe duda alguna ya que el ambiente costero es una de las más valiosas posesiones con que cuenta un Estado. Este es un hecho ya reconocido por casi todos los países en desarrollo con litoral marítimo y la mejor prueba la tenemos durante la realización de las varias Conferencias que se vienen efectuando con motivo de la Ley del Mar. La solidez de los fundamentos en sus presentaciones, la consistencia en sus actitudes, así como la intensidad con la que defienden sus posiciones revelan un reconocimiento acabado del valor de sus márgenes continentales.

Los geopolíticos clásicos en su deseo de sistematizar el análisis del valor geopolítico de una región han fijado una serie de parámetros que pueden proveer una buena estimación cuantitativa de ese valor geopolítico. Estos parámetros son: situación geográfica relativa, población, recursos, por mencionar algunos. Como ejercicio propio me he dedicado a aplicar esta técnica a las regiones costeras en general y a varias de ellas en particular y debo admitir que el resultado fue siempre positivo, es decir, que no caben dudas en el rol importante que juega el ambiente costero en el desarrollo integral del país. Con ésto quiero simplemente llevar a la mente de las autoridades que deban adoptar decisiones que existen muy poco riesgo de equivocarse al decir sobre la conveniencia de desarrollar el margen continental. La prioridad de cuándo ésto debe hacerse cae lógicamente dentro de una problemática nacional de mayor escala.

La segunda pregunta que cabe formularse ahora es la siguiente: ¿cuál es la naturaleza y alcance del problema a resolver? Un rápido análisis a los mismos parámetros que fijaron su valor geopolítico muestran la existencia de problemas disciplinarios de orden económico, social y ambiental de bastente complejidad y con un grado tal de interacción que hace materialmente imposible, o mejor dicho, nada recomendable el analizarlos independientemente. El hacerlo así invita al desastre. Por ejemplo, la zona costera se congestiona rápidamente, con picos de población en la época de verano; se produce una verdader competencia por espacio entre los distintos usuarios del mar; surgen problemas por lo tanto de planificación urbana y organización del transporte; la conservación de la calidad del medio ambiente se hace más difícil que en tierra adentro; el interés local puede estar en conflicto con el nacional, lo que produce inconvenientes en las distintas legislaciones que se adopten; se pueden producir implicaciones indeseables de carácter regional que afecten a otros estados; y otras series de problemas menores, todos ellos íntimamente relacionados.

De ésto se desprende que el problema hay que atacarlo con las técnicas modernas del "análisis de sistemas".

No soy un experto en análisis de sistemas, pero siento mucho respecto por sus realizaciones e intuyo sus limitaciones. Es evidente que este estudio que va a incluír a especialistas de distintas disciplinas y áreas de la ciencia trabajando simultáneamente tendrá como meta el comprender el funcionamiento de todo este gran sistema en la forma más cuentitativa posible y proveer las herramientas para que su comportamiento sea armónico particularmente durante la etapa de su desarrollo, que es cuando las variables del mismo cambian rápidamente y a menudo en forma independiente. Dentro de la moderna científica, ésto significa el tratar de formular un modelo matemático factible de ser resuelto con las técnicas actuales de computación. Evidentemente, ésto sería el desideratum en logros y permitiría efectuar un desarrollo armónico compatible con la bondad del modelo y eliminaría decisiones basadas en palpitos o inspiraciones que carecen de bases científicas que los justifiquen.

Ahora bien, la confección de tal modelo no es tan sencilla como las palabras lo sugieren. El primer llamado de atención nos lo debe de dar el hecho de que la región a modelas constituye lo que en ciencia se llama una "interfase". En efecto, el sistema natural de una zona costera constituído por tierra emergida, playa, agua y tierra sumergida es particularmente muy complicado y representa uno de los casos bien notables de interfases. Este término tiene connotaciones muy especiales en todas las ramas de la ciencia, del arte y de los asuntos humanos. La resolución de problemas de "áreas límites" o interfases es complicada por principio. Esto se agrava aún más cuando se pretende cuantificar el problema, como es el caso de la modelación matemática. Fenómenos de todo orden que fuera de la región límite tienen un comportamiento lógico, lo que en términos matemáticos se conocen como "comportamiento lineal", se transforman en la interfase en procesos no lineales que desafían a las facilidades técnicas disponibles y al ingenio humano.

Durante el desarrollo de este seminario algunos de los especialistas de las varias disciplinas o áreas formularán modelos matemáticos de sus respectivos problemas. A ellos les caben las consideraciones arriba mencionadas, lo que influye considerablemente en la bondad de los mismos. No es posible que una simple integración de los mismos lleve al modelo deseable del sistema total, sino que, como lo manifestado anteriormente y es además uno de los requerimientos del análisis de sistemas, es necesario el trabajo simultáneo de los varios especialistas.

El tema de mi desertación trata con la componente ambiental de este gran sistema. Es una de las tantas variables, y el propósito último de la misma es tratar de llevar a ustedes los estudios a realizar en la zona costera, para poder comprender su funcionamiento en condiciones naturales y predecir su comportamiento cuando sus variables son afectadas por distintas causas. En otras palabras, trataré de analizar el estado presente del arte o mejor dicho las posibilidades y limitaciones para poder modelar el ecosistema compuesto por medio ambiente y sus fenómenos naturales, sus recursos y el impacto en el mismo de su desarrollo y explotación por parte del hombre. Este modelo permitirá proveer las bases científicas para un desarrollo armónico de la región, explotación racional de sus recursos y otros usos del ambiente marino. Además se integrará como la componente ambiental del estudio del sistema más amplio mencionado al principio.

El Problema Ambiental

Antes de entrar al problema específico de los parámetros ambientales a observar y monitorear para comprender los fenómenos marinos costeros, considero conveniente llevar al auditorio no familiarizado con el mar cuáles son las características generales del medio marino, para luego poder concentrarnos con más fundamentos en la zona costera.

Las aguas del océano constituyen una cortina casi impenetrable a la radiación electromagnética. La luz visible es capaz de penetrar la superficie hasta poca profundidad, después de la cual es dispersada y atenuada en grado tal que las imágenes no pueden ser reconocidas. Es, sin embargo, más permeable a la energía acústica, que puede ser propagada a través de distancias considerables, aunque la estratificación normal de las aguas tuerce y distorsiona las ondas sonoras, haciendo que el océano se comporte como un pobre auditorio. El medio marino está en movimiento continuo y poco se sale del espectro de sus variaciones. Esta condición del océano crea esfuerzos mecánicos en estructuras sumergidas, plataformas y vehículos muy diferentes a los que se producen en tierra. Además, las variaciones son de tal magnitud que lo que realmente cuenta son los máximos esfuerzos que deberán soportar las estructuras por cortos períodos de tiempo por acción de las corrientes, movimiento de las olas de superficie u ondas internas o por ondas sísmicas. Se suma a todo ésto la característica de alta corrosión del medio marino. La actividad electrolítica y biológica crea problemas muy distintos a las acostumbrados en tierra. Los organismos vivos se fijan a las estructuras sumergidas, las perforan, producen ruido, las socavan y generan una serie de problemas indeseables. Estas características, como se menciona arriba, se aplican al medio marino en general. Muchas de ellas, al tener lugar en las aguas poco profundas del margen continental o en la playa misma se amplifican y complican notablemente. Entran a jugar entonces las complejidades que se mencionaron de las interfaces.

Conviene en este momento definir el alcance que doy al término de zona o ambiente costero. Esta región se extiende desde la línea de playa sujeta a la acción de las olas y que se puede extender aún más tierra adentro según sea la influencia del medio marino, hasta el borde exterior del talud continental, incluyendo por lo tanto la plataforma continental. Esta definición es consistente con la región donde existe el mayor porcentaje de recursos y usos del mar; de las factibilidades técnicas de desarrollo y explotación y con el concepto de mar patrimonial actualmente sustentado por los países en desarrollo. A este ambiente geográfico debemos agregarle los recursos en él contenidos y los distintos usos que el hombre hará de él para completar el cuadro a modelar. Conviene describir los posibles usos del hombre, pues el objetivo fundamental del modelamiento del ecosistema marino servirá para proveer las bases científicas para la aplicación racional de esos usos. Ellos son: explotación de recursos renovables (biológicos) particularmente pesquerías; explotación de recursos minerales líquidos y sólidos; transporte, tráfico marítimo y su correspondiente infraestructura marina; turismo, amenidades y conservación de ambientes marinos particulares; reservorio de los residuos producidos por ciertas actividades del hombre; servicios marinos incluyendo navegación, comunicaciones y apoyo meteorológico; y finalmente investigación científica.

Es conveniente destacar que la región más intensamente usada y que es además la más accesible de la zona costera es donde la tierra se junta con el mar.

Todos estos variados usos del medio marino por el hombre afectarán el ecosistema a modelar. Por lo tanto, el desafío que tenemos por delante es "comprender el comportamiento del ecosistema constituído por el medio geográfico físico con todos sus fenómenos asociados y por los recursos renovables y no renovables allí existentes que como todo sistema natural dinámico se encuentran en lo que llamamos "equilibrio dinámico". La comprensión de este comportamiento debe tener una excelencia tal como para conocer el impacto que las actividades del hombre en el uso variado del mar producirá a este estado de equilibrio dinámico natural. Solamente entonces estaremos en condiciones de realizar un verdadero "manejo" de la zona costera. El problema a resolver es realmente formidable.

Veamos ahora las características particulares de la zona costera y los fenómenos ambientales que tienen lugar en la misma y cuya comprensión es fundamental para la comprensión del ecosistema. Para ellos analizaremos una porción de la costa expuesta en el litoral marítimo. Los estuarios y lagunas y esteros marinos constituyen casos especiales de la zona costera y no se justifica en el presente trabajo considerarlos al detalle.

Cada ecosistema costero opera dentro de los límites de una o varias cuencas formadas por la estructura geológica de la costa, a saber: una línea de costa recta, un fiordo produndo y rocoso, un río afectado por la marea o una laguna o estero poco profundo.

Las características de la costa emergida y el fondo de la cuenca están relacionadas geológicamente y fijadas por su forma, tamaño y profundidad de los cuerpos de agua costeros. Sin embargo, estas resistentes características geológicas son modificadas en mayor grado por las fuerzas dináminas del flujo de agua, olas y viento, erosión y sedimentación y por los efectos de la vegetación.

Veamos primeramente la zona más dinámica de la interfase que es además, como se ha dicho antes, la más accesible y usada; me refiero a la playa. La playa está constantemente en movimiento, cambiando su configuración calladamente y moviendo incansablemente su posición, grano por grano de arena hasta haber desplazado enormes masas de arena. Esto plantea problemas muy complejos de conservación. Esta cualidad dinámica de la playa ha sido bien sintetizada por un fisiógrafo que dijo: "Una playa es un depósito de material que está en tránsito ya sea a lo largo de la costa o hacia afuera o adentro de la orilla".

El agente principal responsable de este permamente cambio en la playa es el trabajo de las olas, aunque en algunas playas el viento mueve cantidades considerables de arena.

No entra dentro del alcance de este trabajo analizar cómo se generan, propagan y disipan su energía las olas del viento; lo que interesa es que las mismas acaban su existencia disipando su energía en la playa a la que evidentemente condicionan. Las que mayor efecto producen en la modificación de una playa son las olas de resaca o mar de fondo y se han normalmente generado muy lejos de la zona de disipación. Estas olas de período considerable dentro del espectro de las olas de viento (10 a 30 segundos) llevan consigo considerable energía que disipan en forma turbulenta al romper en la playa. Esta masa de agua pasa súbitamente de un valor considerable de energía a un valor cero. ¿Dónde va esa energía? ella se distribuye ya sea en forma de momento turbuléntico que levanta y mueve a los granos de arena y en una circulación a lo largo de la costa conocida como corriente costanera o en algo más complicado conocido como circulación costanera. Esta circulación está condicionada a la inclinación con que las olas rompen sobre la playa, a la topografía submarina en la zona próxima a la rompiente y a la forma de la línea de costa. Ahora bien, la dirección con la cual llegan a la costa es un factor climático; la topografía submarina costanera es cambiante por la acción de las mismas olas y la línea de costa es más estable. De todo lo expuesto anteriormente se hace evidente que para poder comprender el comportamiento de las playas y los fenómenos asociados a su variabilidad se hace necesario disponer de un programa elaborado en el espacio y en el tiempo de observaciones de ciertos parámetros básicos tales como: 1) medidas de playas, 2) topografía submarina costera, 3) régimen de las olas de viento, 4) circulación costanera, 5) nivel medio del mar y 6) observaciones meteorológicas. La naturaleza estacional de la variabilidad hace que estas observaciones deban realizarse durante largos intervalos de tiempo.

Conviene destacar aquí que en el caso particular de estuarios, esteros o lagunas costeras, se agregan otros parámetros que afectan el ambiente costero y que se incorporan a la lista antes mencionada y ser monitoreados.

Si trascendemos la zona crítica de la playa y nos ubicamos sobre la plataforma continental que, como hemos expresado antes, constituye parte de la zona costera, encontramos que si bien no se producen los casos dramáticos de la playa, tienen lugar fenómenos ambientales de gran implicancia en el ecosistema. La primera complicación es que los fenómenos oceanográficos son los característicos de las "aguas poco profundas". Esta manifestación tiene una especial connotación en la ciencia oceanográfica, ya que los fenómenos son de mayor complejidad que en el caso de mar profundo. Otro fenómeno de profundas implicaciones biológicas y meteorológicas climáticas es el fenómeno conocido como "sugerencia costera". Está caracterizado por el ascenso de aguas frías del fondo o de cierta profundidad que al estar cargadas de sales nutritivas, la productividad biológica en la capa afótica adquiere valores considerables. La causa de este fenómeno que es en general de carácter localizado e intermitente es la acción del viento predominante que en las épocas de urgencia sopla casi paralelo a la costa. El milagro Peruano de la anchoveta es debido a este tipo de fenómeno.

El programa observacional relacionado a este fenómeno incluye la determinación sistemática del campo de la temperatura superficial de la zona costera y de varios parámetros meteorológicos, en particular el viento.

En cuanto a las técnicas a seguir para el levantamiento y monitoreo incluye el uso de plataformas fijas instrumentadas tales como boyas, buques de investigación y de oportunidad y vehículos aéreos tales como aviones y satélites equipados con sensores sofisticados. Dado que los parámetros a monitorear caracterizan a fenómenos altamente variables y de dimensiones considerables, adquieren una gran importancia técnica que tengan capacidad sinóptica, es decir, cubrir grandes áreas simultáneamente. En tal sentido conviene destacar el valor potencial de los sensores remotos desde aviones y satélites, que poseen gran valor sinóptico, muestreo frecuentemente y respuesta multiespectral de un mismo fenómeno. En vista de que el Dr. Szekielda presentará un trabajo sobre este tema, me abstengo de extenderme en el mismo, así como de presentar ilustraciones de los fenómenos de la zona costera, tanto en la playa como en el margen continental.

Deseo destacar aquí en el programa observacional arriba mencionado responde al objetivo final de comprender el comportamiento del ecosistema marino, que incluye no solamente el ambiente físico geográfico descrito anteriormente, sino también los recursos en él contenidos, así como la interrelación entre ambos. Ello implica que será necesario también efectuar levantamiento y monitoreo de esos recursos según las líneas mencionadas para los parámetros ambientales físicos. En este sentido tiene gran importancia el monitoreo de las poblaciones de peces. Estos parámetros son tan valiosos como los físicos para la comprensión del comportamiento del ecosistema y su modelado.

Además, no debe olvidarse que este programa de relevamiento y monitoreo responde a requerimientos de un problema científico de gran complejidad, que es el modelado del ecosistema. Ello nos lleva a plantearnos la pregunta de cómo encarar este desafío científico. En tal sentido, se aplican las mismas consideraciones hechas para el estudio integral del ecosistema costero, incluyendo al hombre y sus actividades efectuadas al comienzo de esta disertación.

Siendo el problema a resolver de carácter multidisciplinario y con interacción entre las distintas disciplinas, se recomienda utilizar las técnicas de "análisis de sistemas". Ello está basado en un principio fundamental de la ecología de que en un ecosistema ninguna parte opera independientemente de ninguna otra. No se aconseja, como a menudo ha sido el caso en trabajos oceanográficos anteriores, la solución disciplinaria de los problemas ambientales. La planificación del experimento científico debe de ser hecha simultáneamente por los distintos expertos en disciplinas o áreas de la ciencia. El enfoque de análisis de sistemas aplicados a problemas ambientales será discutido por otro conferenciante bajo el título de "Los levantamientos integrados para el desarrollo del área costera".

Antes de acabar con este trabajo deseo recalcar sobre la naturaleza y alcance del programa observacional de los parámetros físicos y de los recursos del ecosistema. Como todo sistema natural de gran escala y de naturaleza muy variable con períodos de variabilidad de carácter climático, la red de observaciones cubrirá grandes extensiones y deberán efectuarse durante largo tiempo para que tengan algún sentido. Ello hace necesario que el reconocimiento y monitoreo científico comiencen mucho antes a usar la región. Es por ello que creo firmemente que tan pronto un estado cualquiera reconozca el valor potencial de una zona costera, comience de inmediato el estudio científico de la región según las líneas sugeridas en este trabajo y que ello sea mucho antes de la explotación de la misma. De allí que tenga cierto sentido el asignar fondos adecuados para la investigación oceanográfica, que desgraciadamente es bastante costosa. Sus dividendos son, sin embargo, bien rentables.

Para cerrar este presentación deseo resumir los puntos fundamentales de la misma. Ellos son:

1) La zona costera es uno de los patrimonios más valiosos con que cuenta un estado con litoral marítimo. Su valor geopolítico nacional es indiscutible y debe ser motivo de preocupación de las autoridades responsables el adoptar las medidas para un manejo adecuado de la misma.
2) Esta área tan particular requiere un tratamiento muy particular. Se recomienda aplicar las técnicas de "análisis de sistemas" para encarar el estudio del gran ecosistema que incluye no solamente el ambiente natural y sus recursos, sino también el hombre y los usos que él hará de dicha zona. No se recomienda el efectuar estudios parciales que respondan a un uso particular, dada la interacción entre los diversos usos. El objetivo final de las investigaciones sería el de modelar matemáticamente el comportamiento del gran ecosistema. Si ello se lograra sería posible optimizar todos los usos a hacer de la zona costera sin afectarla. Esto es de una gran complejidad.
3) La componente ambiental y su correspondiente ecosistema marino se caracterizan por pertenecer a un sistema natural en gran escala y muy variable. Ello requiere también estudios interdisciplinarios que deben ser atacados también simultáneamente por los especialistas disciplinarios o de otras áreas de la ciencia siguiendo las técnicas de análisis de sistemas.

El programa observacional se caracteriza por lo extenso del área a cubrir simultáneamente (sinopticidad), por su frecuencia de muestreo y por el largo intervalo de tiempo durante el cual deben efectuarse. Esto implica un apoyo a la investigación científica bien anticipando al uso de la región.

El objetivo final de este estudio es también el de formular el modelo matemático del ecosistema marino, incluyendo en él a los efectos en el mismo producidos por los usos del hombre.

Lo complejo del tema, así como los intereses involucrados en esta zona requieren una especial atención y gran dosis de imaginación de las autoridades responsables.

SANTE PUBLIQUE ET DEVELOPPEMENT DES ZONES LITTORALES

Limites de l'Auto-epuration: Consequences pour l'assainissement-Directives generales d'amenagement des cotes

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INTRODUCTION

L'accroissement démographique et industriel qui caractérisent le siècle dans lequel nous vivons ne sont pas sans poser un certain nombre de questions relatives au bien être et à la qualité de la vie, au respect des équilibres naturels. L'homme directement responsable de la situation prend conscience qu'il détériore son propre environnement à tous les niveaux et que si des mesures énergiques ne sont pas décidées à breve échéance on peut s'attendre à de graves désordres. Cette inquiétude a déjà servi de thème à de nombreux ouvrages les uns objectifs, d'autres relevant davantage du roman futuriste.

On s'accorde à reconnaître que parmi toutes les préoccupations justifiées par l'accroissement des déversements de nuisances dans l'environnement maritime, l'une d'entre elles est marquée par les conséquences que ces contaminations massives et permanentes peuvent avoir sur la santé de l'homme et la salubrité des ressources maritimes dont il se nourrit.

C'est la raison de reconnaitre à l'OMS l'obligation de diriger une partie de ses activités vers l'organisation de la lutte contre les pollutions en général et plus spécialement vers l'élaboration de moyens susceptibles d'assurer la sauvegarde de l'environnement maritime.

Depuis quelques années ceux qui ont été invités à participer aux conférences et aux travaux ont à différentes reprises été séduits par le développement et la diffusion de théories consacrées aux mécanismes de la dilution et de l'auto-épuration. Certains accordant un crédit exageré aux hypothèses et à des expériences peu convaincantes ont trouvé commode de s'en remettre aux bons offices des phénomènes naturels et de leur confier le soin peu couteux de rétablir l'ordre. Cette démarche intéllectuelle n'a eu que de facheuses conséquences, surtout en ce qui concerne les zones littorales.

DEFINITION DE L'AUTO-EPURATION

L'auto-épuration est comme l'indique son nom le retour autonome d'un environnement quelconque à son état naturel lorsqu'il a subi un dommage limité dans la grandeur et le temps. Cette notion est capitale, elle conditionne le phénomène. Il va de soi en effet que si les causes de déséquilibre sont multiples, répétées, permanentes, massives, il n'y a plus d'auto-épuration possible. Cette évidence ne semble pas avoir été bien assimilée, malgré son extrême simplicité. L'auto-épuration entre dans les mécanismes généraux de l'"Homeostase" applicable à tous les écosystèmes. Elle n'en représente qu'un cas particulier.

Au niveau du milieu marin, on considère que la sauvergarde de la santé publique et des ressources maritimes ne peut être assurée que si l'environnement obéit à un certain nombre de critères dits "de qualité", choisis parmi des paramètres physiques, chimiques et biologiques. Le dépassement des normes admises par des commissions d'experts conduit à la situation d'environnement "pollue", c'est à dire impropre aux usages que l'on en exige. Le retour naturel aux normes de ce milieu déséquilibré définit donc l'auto-épuration.

Par raison d'espace et de temps le processus ne sera envisagé ici qu'en ce qui concerne les agents microbiens pathogénes représentés par les bactéries, parasites et virus, ce qui limite le sujet aux problèmes de santé posés par la pathologie infectieuse et parasitaire qui comptent parmi les plus préoccupants actuellement.

Les autres problèmes de santé publique que pose la consommation de poisson et de fruits de mer contaminés par des agents toxiques ne feront pas l'objet d'un exposé détaillé mais le processus indiqué pour la pathologie infectieuse est aussi valable, mutatis mutandis, pour le cas de la concentration des agents toxiques d'origine chimique.

CARACTERES ESSENTIELS

Un déséquilibre peut être brutal, mais passager. C'est le cas d'un déversement intempestif, accidentel, d'un produit quelconque.

A l'inverse il peut être modeste, mais continue, permanent ou bien encore permanent et massif. Il est facile dans ce domaine de laisser l'imagination concevoir tous les degrés dans la nature et le débit des polluants.

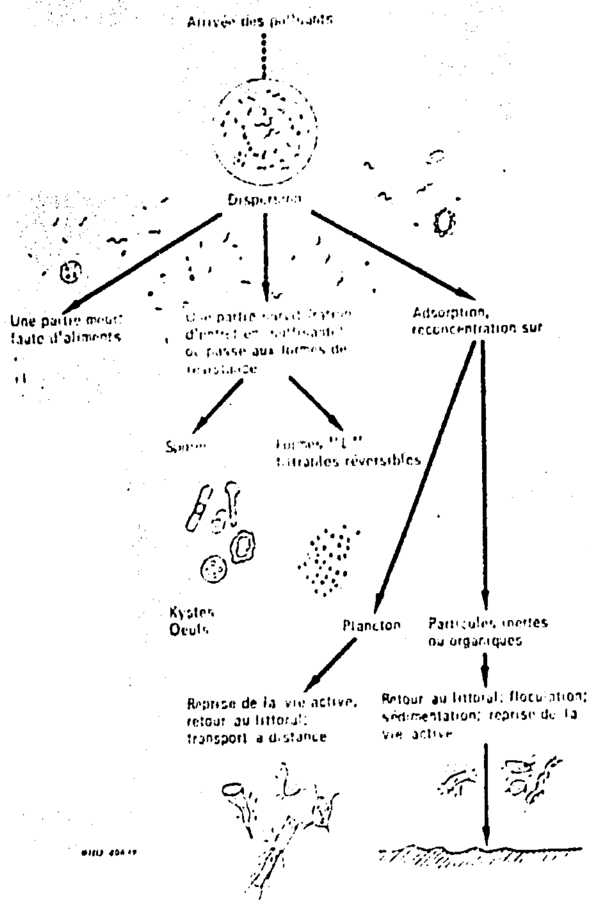
Ils sont de toute façon toujours rapides, immédiats. A l'inverse les mécanismes naturels de neutralisation ont obligatoirement contre eux: la lenteur, la complexité, les inhibitions, les défaillances inhérentes à tous les processus biologiques, en un mot ils souffrent de nombreuses incertitudes et de mises en défaut.

LES MECANISMES AUTO-EPURATEURS (Fig. 1)

On les reconnait multiples, aussi est'il impossible d'attribuer l'auto-épuration à un seul facteur. On convient d'en distinguer trois categories: facteurs physiques, chimiques et biologiques.

(i) Physiques: L'action des facteurs tels que la lumière, radiations diverses, temperatures, pressions, demeure modeste. Il est en effet démontré que les radiations bactéricides ne

FIG. 1. DEVENIR DES MICRO-ORGANISMES DANS LE MILIEU MARIN



pénètrent le milieu aquatique que sur quelques centimètres de profondeur. La lumière par contre joue un rôle considérable sur la productivite primaire et sur les migrations planctoniques. C'est à ce niveau qu'il importe de la considérer, car le plancton est un vecteur de polluants microbiens; comme il en sera parle dans la suite de ce propos. Les températures relativements basses interviennent en ce sens qu'elles ralentissent les activités biochimiques des bactéries hétérotrophes mésophiles et leur croissance, mais elle ne les neutralise pas. Il existe des bactéries et des virus dont la resistance dans le milieu extérieur est extrêmement faible, c'est le cas des Myxovirus, des Haemophileae, des Neisseria, des Tréponèmes, par exemple. Cette faible résistance constitutionnelle explique d'elle même leur disparition d'un milieu pollué. Mais il s'agit là de groupes microbiens réduits, assez inhabituels que l'on ne risque en aucun cas de retrouver dans des émissaires, des égoûts, ou autre vecteur artificiel. D'une façon générale le froid contribue plutôt à la conservation des microbes.

L'un des facteurs physiques les plus efficaces doit être recherché dans l'adsorption. L'hétérogénité de l'environnement hydrique est telle que les microorganismes ne peuvent pratiquement pas y conserver leur autonomie. Ils en tirent du reste profit. En effet les particules flottantes vivantes comme le plancton, organiques tels que déchets en suspension ou enfin minérales fixent par adsorption les éléments solubles qu'elles concentrent à leur surface, et tous les microorganismes présents qui errent dans le milieu aquatique en quête d'un support. Les germes ainsi fixés sont bien entendu apparemment éliminés du milieu, en tant que populations autonomes, libres, mais ils sont concentrés, rassemblés, pris en charge par les particules au niveau desquelles ils "gîtent" au sens écologique du terme. Ils trouvent sur ces gîtes un refuge favorable à leur survie et même à leur développement. De nombreux documents expérimentaux en apportent le témoignage.

D'autres facteurs physiques suivent dans leur action l'adsorption dont ils complètent les effets. Il s'agit de la floculation, dispersion et sédimentation. Les éléments fixés sur les particules en subissent inéluctablement la destinée les pérégrinations. Dans beaucoup de circonstances elles sont dispersées vers le large, suivent les courants côtiers ou de haute mer, ou encore elles sont entrainées vers le fond où elles sédimentent ou floculent selon la composition du milieu. Les agents pathogènes suivent la loi commune. Si les analyses de routine ne permettent pas de les retrouver dans les eaux, leur recherche sur les sables et les sédiments, sur les particules flottantes les mettent de nouveau en évidence parfois loin des côtes.

L'auto-épuration physique a donc pour conséquence essentielle le captage des microorganismes dont le nombre relatif diminue si on le calcule par unité de volume, soit pour 100 ml d'eau. Cela signifie que si dans 100 ml d'eau polluée d'E. coli, au taux de 1.000 nous introduisons des poudres inertes, ou n'importe quelle particule: plancton, argile, par exemple, le nombre d'E. coli diminuera rapidement, il sera en quelques heures réduit à quelques unités ou à 0 selon les qualités de l'adsorbant et sa quantité. L'eau est apparemment débarrassée des bactériés polluantes libres. En ce sens restreint il y a auto-épuration, les qualités bactériologiques de l'eau obéissent aux normes de qualité décidées par les experts, mais il est non moins primordial de comprendre que les E. coli sont toujours présents dans le milieu, et qu'il en est ainsi de tous les agents pathogènes Salmonelles, Virus, parasites, entre autres. L'adsorption ne les détruit pas, elle les concentre et leur offre des conditions de survie et même de développement. Cela signifie également que toute agitation des sédiments remettra ces particules chargées de germes en suspensions, que des "tensio actifs" pourront les liberer de leurs réfuges et les disperser de nouveau dans l'environnement. Telles sont les limites de l'auto-épuration physique dont le complément est la filtration sur les couches sableuses.

(ii) L'épuration chimique

Ce mécanisme a été à differentes reprises envisagé avec des fortunes diverses. Il fait encore le sujet de discussions dont on deploré parfois le manque d'objectivité. Le milieu marin doit son originalité à la présence d'éléments chimiques considérés comme "majeurs": NaCl, Mg, des sulfates, bromures, en sont des exemples, et à des éléments mineurs: très nombreux, oligoéléments, répresentés pratiquement par tous les cations et la majeure partie des anions. Cette composition n'intervient pratiquement pas dans l'auto-épuration. La majorite des bactéries, des levures, champignons inférieurs, virus, sont totalement indifférents aux salinités habituelles des océans. Le nombre de bactéries halphobes est réduit à quelques unités, il n'interesse que quelques germes parasites obligatoires tels que Neisseria Haemophilae. Tous les autres germes supportent la moyenne de 3,5% en NaCl, se comportent souvent en halophiles préférentiels (Staphylococcus aureus, Listeria monocytogenes, Vibrions, quelques anaerobies de gangrène, certaines Enterobactéries en sont des exemples) en indifférents, euryhalins ou halotolérants.

Les autres éléments de l'eau de mer n'interviennent pas plus que les sels minéraux majeurs dans l'auto-épuration.

(iii) On a invoqué l'activité spécifique de substances organiques sécrétées dans l'eau de mer par le plancton ou des microorganismes variés appartenant aux microbiocénoses autochtones. Tout cela est maintenant dépassé, désuet, la théorie du pouvoir antibiotique et bactéricide des eaux de mer doit être définitivement abandonnée. Elle porte malheureusement la responsabilité de l'installation de nombreux déversements directs sur le littoral maritime, notamment au voisinage de stations balnéaires, de zones conchylicoles, dangereusement polluées. Elle fut le prétexte à la transgression des lois de non déversement dans la mesure ou les responsables de l'aménagement du territoire se sont laissés abuser par cette théorie que rien ne permettait cependant d'accréditer. Elle est en fait basee sur des expériences qui souffrent de défaillances techniques à différentes reprises dénoncées.

(iv) Il reste toutefois dans ce domaine quelques faits positifs qu'il importe de remettre en mémoire. On reconnait l'existence dans les mers, comme partout ailleurs dans la nature, d'organismes capables d'élaborer des substances antagonistes susceptibles de s'opposer au développement des bactéries. Toutefois ces substances bien identifiées, ne peuvent être élaborées que dans des conditions de développement que sont rarement réalisées dans la nature, à l'exception de quelques microenvironnements et de conditions climatiques très spéciales. Les résultats qui ont été obtenus "in vitro" ne peuvent en aucune façon être transposés à l'environnement. L'accord des écologistes est sur ce point unanime. Les produits ne sont sécrétés que par de petits groupes très spécialisés de microorganismes, seulement dans des conditions alimentaires d'abondance. Ces produits sont immédiatement dilués ce qui rend leur activité pratiquement nulle.

(v) S'il fallait absolument trouver un substratum chimique à l'auto-épuration il serait plus raisonnable de s'orienter vers les "carences" énergétiques, de chercher non pas ce qu'il y a mais ce qu'il manque. La vie microbienne comme toute vie cellulaire est intimement liée à la notion d'aliment. Aucun développement n'est concevable sans facteurs énergétiques. Les bactéries polluantes appartiennent au groupe des chimio organotrophes, allochtones exigeants. Le milieu maritime est caractérisé par sa pauvreté en matière organique assimilable puisqu'il n'en contient que quelques milligrammes par litre. Si cette dose est très inférieure à la ration de croissance. Elle suffit au maintien de la survie des bactéries entéritiques pendant plusieurs jours et même plusieurs semaines selon les circonstances. La résistance des bactéries allochtones dans le milieu extérieur est conditionnée par leur résistance propre aux privations, au jeune, par leur structure, leur constitution. Cette résistance, cette vitalité, entrent dans les caractéristiques de chaque groupe microbien. Les germes pathogènes survivent donc toujours un certain temps après leur arrivée dans le milieu marin, les moins doués disparaissent évidemment les premiers, c'est le cas par exemple des bacilles responsables de la dysenterie. Mais cette disparition est en général relativement lente si on la compare à la rapidité de leur irruption dans l'environnement. Il en résulte qu'en cas de contaimination permanente et massive, l'ensemble de la mortalité bactérienne ne peut en aucun cas compenser la masse des apports. C'est précisément la situation de bien des zones littorales. L'auto-épuration est dépassée. La disproportion entre la rapidité des pollutions et la lenteur de l'auto-épuration est on le comprend considérable.

(vi) Les facteurs biologiques

Ils sont encore plus complexes et capricieux tant ils sont intriqués et dépendants les uns des autres. A ce niveau il est indispensable pour comprendre l'auto-épuration de résumer ce que l'on sait des biocénoses en général, et des microbiocénoses en particulier. Ce chapitre l'un des plus importants mériterait à lui seul de longs développements. Il n'en sera dit que l'essentiel:

Lec microorganismes sont organisés en communautés que l'on définit en écologie comme étant des microbiocénoses. Elles comprennent des protistes, des champignons inférieures, des levures, des algues bleues (Cyanophycées) des bactéries et des virus. On y distingue des bactéries autochtones hôtes habituelles d'un écosystème donné et des bactéries allochtones, de passage, accidentellement présentes, ou polluantes. Les polluants pathogènes retiennent la possibilité de provoquer des maladies sporadiques, endémiques ou épidémiques, transmissibles par le milieu qui les conserve et en facilite la diffusion. Cet aspect de la pollution des eaux intéresse tout spécialement la santé publique et l'on s'en préoccupe depuis fort longtemps. Le rôle des eaux impures dans la transmission des maladies n'avait pas échappé aux anciens. Avec les progrès de la microbiologie cette partie de l'épidémiologie s'est considérablement développée. On savait dès 1885 que les bactéries pathogènes se raréfient au fur et à mesure que l'on s'éloigne des côtes et des zones polluées. Le principe de l'auto-épuration, du retour à l'équilibre était donc posé (NICATI et RIETSCH, de Marseille 1886, de GIAXA de Naples 1889). Très rapidement on s'aperçut que cette raréfaction était certes le fait de la dispersion et de la dilution, mais aussi d'une certaine "concurrence vitale" dont les grandes lignes avaient été tracées par DARWIN (1859), la lutte pour la vie se révélait une réalité applicable même au niveau des infiniments petits. C'est donc sur cette base que furent entreprises de très nombreuses recherches- pour tenter de comprendre dans quelle mesure la "lutte" entre les microorganismes pourrait contribuer à l'auto-épuration.

(vii) De toutes ces recherches on retiendra l'action envisagée par des bactéries et des virus. Les Bdellovibrio, et les Myxobactéries se nourrissent de bactéries qu'elles détruisent et dont elles provoquent la lyse. Des virus qualifiés de "bactériophages" très répandus dans la nature attaquent eux aussi les germes pour les détruire.

Il ressort de toutes les expériences rapportées sur ces sujets et de ce que l'on sait des conditions de vie de ces prédateurs bactériens et viraux qu'ils ne peuvent exercer leur activité que dans des conditions très particulières de nutrition et de développemnt. Il en resulte la encore que les resultats obtenus au laboratoire, aussi brillants qu'ils soient, ne peuvent être transposés à la nature. On se retrouve dans la même situation que pour antibiose.

Les prédateurs bactériens existent indiscutablement mais dans les conditions naturelles leur activité devient nécessairement très modeste, réduite à des écosystèmes limités, riches en matériaux organiques. C'est le cas de quelques sédiments et d'eaux très fortement polluées. Même dans ces conditions les processus n'atteignent jamais les résultats escomptés, ou que laissaient supposer des expériences de laboratoire.

(viii) C'est aussi l'occasion de rappeler l'importance en écologie des phénomènes de compétitions alimentaires entre les populations constituant une communauté. Ces mecanismes sont eux aussi très étudiés par les microbiologistes. On retiendra pour établi que là encore les mécanismes demeurent relativement modestes dans les conditions naturelles. Il est même connu que grâce à la loi du nombre, si importante dans la dynamique des populations, et à l'apport de matériaux organiques (eaux d'égouts) la compétition tourne parfois à l'avantage des bactéries polluantes chimioorganotrophes, ce qui va à l'encontre de l'auto-épuration. Tout enrichissement du milieu aquatique en matière organique se traduit rapidement par une prolifération microbienne, une consommation accrue d'oxygène la mise en conditions d'anaerobiose de l'écosystème et la prolifération d'anaerobies putrides indésirables. Les germes allochtones disparaissent, seuls persistent les polluants aerobies, anaerobies facultatifs et les anaerobies stricts.

Il existe des prédateurs plus évolués que les bactéries et les virus, ce sont les microphages que l'on rencontre dans les populations planctoniques, chez les ciliés, les flagellés, les amibes, on compte aussi des limivores du benthos qui absorbent de grandes quantités de bactéries, de nombreux représentants du benthos entrent dans cette catégorie.

Le zooplancton consomme le phytoplancton et les bactéries dont il est chargé en surface. Il y a donc bien prédation en ce sens que les germes présents dans l'eau en sont retirés, mais la encore ils ne sont par nécessairement détruits.

Le phénomène de microphagie observé au niveau des populations de ciliés et des protistes confirme cette absorption. Si certaines bactéries meurent, sont assimilées, d'autres survivent, sont mises en réserve et sont transmises a la descendance de ces microphages qui se comportent en porteurs en reservoirs et en vecteurs d'agents éventuellement pathogènes. Il est parmi dans ce domaine d'établir des comparaisons entre les cycles bactériens observés chez invertébrés terrestres, chez les arthropodes en ce qui concerne les virus et certaines bactéries, ou des parasites et ce que l'on peut observer au niveau du zooplancton marin. Tout comme les organismes terrestres il se révèle un reservoir naturel et un transporteur eventuel d'agents pathogènes. Des preuves en sont maintenant établies.

Ces planctons contaminés, consommés par les fruits de mer, les coquillages, tuniciers, oursins, par exemple, constuent des maillons importants des chaines de transport des polluants dont ils favorisent en outre la concentration et la survie.

Là encore on conçoit les limites de la "prédation" dans les mécanismes de l'auto-épuration, dont l'importance peu à peu se dépouille. Certes l'eau est moins chargée de microbes, mais ceux-ci encore une fois ne sont pas détruits.

Il sont "ailleurs" toujours disponibles et infectants.

LE BILAN ET L'AUTO-EPURATION

L'auto-épuration ne peut être niée, elle est une évidence, mais on doit la reconnaître sigulièrement limitée dans le déroulement de ses mécanismes et de ses effets. Un grand nombre de facteurs y contribuent, dont il est facile de concevoir les inégalités, la lenteur et les défauts. On retiendra pour essentiel en ce qui concerne les problèmes de santé publique, qu'à une certaine distance des zones polluées, les phénomènes physiques d'adsorption, de dispersion, de dilution, de sédimentation réduisent indiscutablement la densité des germes pathogènes ceux ci sont en modeste part definitivement éliminés des microbiocénoses. Cette élimination est la conséquence de la faible vitalité et de la faible résistance constitutionnelles des bactéries, des virus ou parasites considérés. Il est inutile dans ce cas de rechercher d'autres mécanismes pour rendre compte de leur disparition. La majorité des autres germes par contre est en fait "mise en réserve" au niveau de refuges variés où ils survivent et se multiplient pendant de longues périodes. En ce sens les eaux sont, vers le large, partiellement épurées, mais la pollution littorale constamment entretenue n'est plus en aucun cas résorbée par les mécanismes auto-épurateurs.

Beaucoup d'évènements contribuent à la remise en circulation des bactéries ou virus polluants ou à leur accumulation au niveau éminemment dangereux que constituent les fruits de mer, ce qui est plus grave et préoccupant pour les hygiènistes.

LE POINT DE VUE DE LA SANTE PUBLIQUE

Il était indispensable de faire le point des connaissances concernant le devenir des polluants pathogènes déversés dans l'environnement maritime et de retenir les seules observations indiscutées. La recherche des solutions qu'il importe de proposer pour résoudre les problèmes de santé publique invite à se garder des théories et des extrapolations même les plus séduisantes. Il faut s'en tenir aux faits d'observation et à la considération de la nature. L'hygièniste raisonne en écologiste, ce qui l'oblige à considérer "l'histoire naturelle" des micro-organismes. Il va de soi qu'il ne peut la comprendre que s'il est au préalable instruit de la microbiologie fondamentale, toutefois les problèmes qu'il doit résoudre se situent à un autre niveau d'observation. Aucun aspect ne peut exclure les autres ou prétendre à une autre priorité que celle qui lui est imposée par les circonstances. En l'occurence, il s'agit ici de sauvegarder l'environnement maritime et la santé publique. On passe simplement d'une préoccupation à une autre.

LES PROBLEMES FONDAMENTAUX

Les deux interrogations posées face à la pollution du milieu maritime concernent:

(1) les risques que courent ceux qui fréquentent des plages et stations balnéaires polluées.

(2) le danger de consommer des fruits de mer élevés dans des zones suspected ou récoltés par des amateurs au cours de pêches sauvates, ou encore vendus sans contrôle, soit sur les marchés, soit "à la sauvette" par des marchands occasionnels.

Ces deux chapitres sont très largement développés dans des rapports et des monographies qui ont été diffusés au cours de ces 20 dernières années. On en retiendra l'essentiel.

DANGERS DES BAIGNADES EN EAUX POLLUEES

L'accord complet est loin d'être réalisé sur ce point puisque les opinions des experts consultés sont divisés. Toutefois un certain nombre d'observations sérieuses, quelques enquêtes correctement conduites, la raison, le bon sens, les enseignements classiques de l'épidémiologie médicale et de l'hygiène, permettent d'affirmer que la pollution d'un environnement hydrique quel qu'il soit, par des bactéries, virus or parasites pathogènes constitue indiscutablement un danger pour toute personne réceptive fréquentant cet environnement. Ce qui est reconnu exact pour l'air et le sol, l'est avec la même rigueur pour les milieux aquatiques, la mer ne peut faire exception à cette règle.

Un certain nombre de publications apportent des témoignages qu'il est difficile de réfuter. L'OMS s'est particulièrement penchée sur ce problème et par toute une série d'études et des réunions d'experts en est arrivée a des conclusions valable à présent.

On déplore l'insuffisance des enquêtes épidémiologiques et des études consacrées à la pathologie des bains de mer. Les practiciens se sont dans l'ensemble peu intéressé à ces aspects de la médecine. Une des tâches actuelles des responsables de la santé publique est justement de susciter un peu plus d'enthousiasme et de constituer des groupes de travail à prédominance médicale.

Il ne fait aucun doute que les baing en eau contaminée, que les séjours sur des sables souillés sont à l'origine de maladies telles qu'otites, sinusites, conjonctivites, d'affections mycosiques cutaneo-muqueuses, de fièvres éruptives, de gastro-entérites, de manifestations pulmonaires aigues dues à des enterovirus, plus rarement d'affections touchant les méninges et le système nerveux. Les étiologies virales rendent les diagnostics difficiles dans les circonstances où elles se deroulent. Les enfants payent le plus lourd tribut à ce chapitre de la pathologie infectieuse.

LES ENQUETES EPIDEMIOLOGIQUES

Elles ne peuvent être conduites que par des équipes de spécialistes avertis: cliniciens, biologistes, épidémiologistes, immunologistes. Ceux ci doivent être au courant de tout ce qui concerne le mécanisme de l'infection, de l'état de réceptivité des sujets, de l'immunologie, du portage sain, des maladies inapparentes, et autres incidences intéressant la pathologie des maladies transmissibles. C'est affaire de médecins, ils portent l'entière responsabilité des enquêtes et des conclusions.

LE CAS DES FRUITS DE MER

La transmission de maladies aux consommateurs de fruits de mer est une notion solidement établie depuis l'antiquité. Si on ne discute plus ce problème, il existe encore sur le plan pratique peu de mesures réellement efficaces pour réduire le nombre d'accidents. Des lois, décrets, ordonnances règlent les conditions d'élevage, d'entrepos, d'expédition, de distribution, de vente, d'épuration, de conservation des fruits de mer livrés à la consommation. Leur application souffre de regrettables défaillances dans la majorité des pays. Aussi assite-t-on encore à l'entretien de foyers endémiques et à des poussées épidémiques de gastro entérites, d'affections typhoparatyphoidiques, et surtout à l'expansion des hépatites virales dont les maximums se situent un mois à un mois et demi après les périodes de consommation maximale de coquillages. On doit citer aussi l'installation de foyers de choléra importés par les moules sur quelques points de la Méditerranée. Loin d'avoir diminué, ces affections d'origine coquillère sont au contraire en voie de croissance. Elles inquiètent à justetitre les responsables de la santé publique et de l'OMS (voir fig. 2 et 3).

FIG. 2 CYCLE DE PROPAGATION DES VIRUS

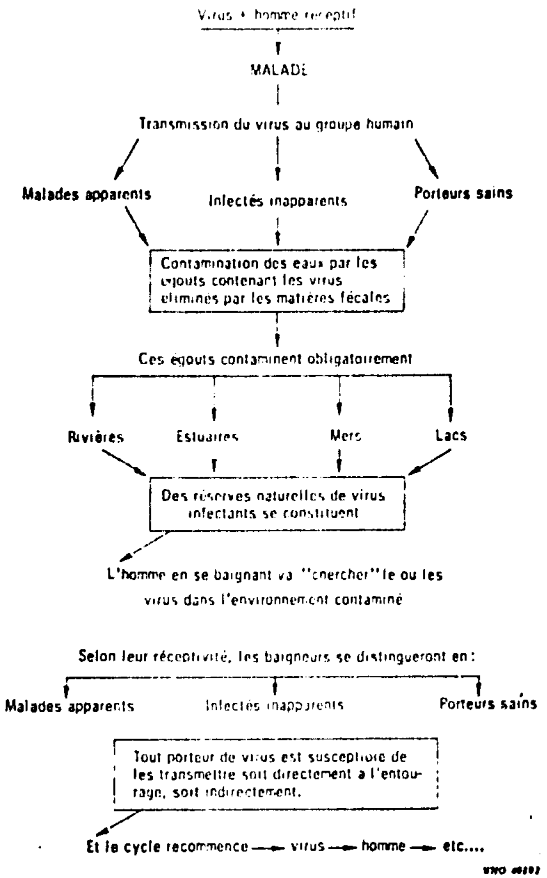
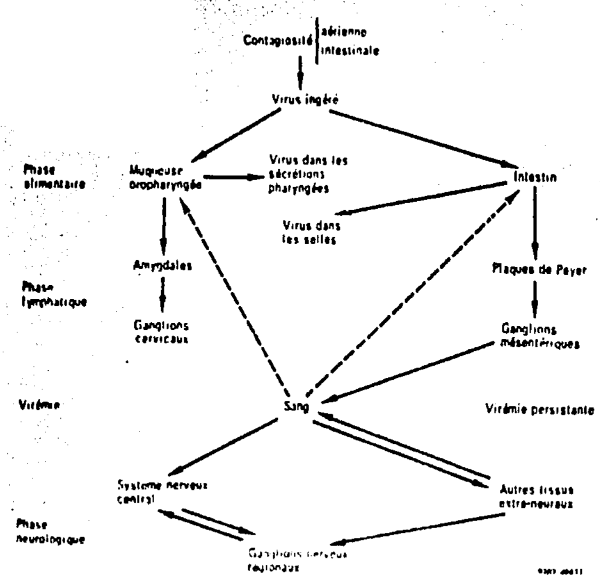


FIG. 3 CYCLE ÉPIDÉMIQUE DES PICORNAVIRUS



D'après le modèle de Sabin A.D. (Science, 1956 123, 1151) et Bodian, D. (Science, 1955, 122 105).

L'ORIENTATION ACTUELLE DES MESURES A PRENDRE

Devant cette situation de pollution croissante, continue, massive, multiple, non resorbable, devant laquelle les mécanismes de l'auto-épuration sont manifestement impuissants, les autorités responsables ont pris conscience de l'urgence qu'il y avait d'entreprendre une action d'envergure, aussi efficace, que possible. L'OMS en accord avec l'UNEP, des projets localisés tels que celui dont S.A.S. le Prince de Monaco est l'instigateur (RAMOGE-1972), des projets de la FAO et autres organismes, des mouvements nationaux, régionaux de défense de l'environnement, commencent petit à petit à faire poindre l'espoir de mesures intéressantes et positives. Dans ce domaine il convient de distinguer deux ordres d'activités:

(i) Certaines équipes ont pour mission de contrôler les pollutions, de les repèrer, d'en apprecier les risques en fonction de leur nature, de leur ampleur, de leur débit, de leur rémanence et de leurs mouvements. Ces équipes de surveillance sont en place dans de nombreux pays. On en connait les activités. Les résultats de recherches sont régulièrement publiés dans quelques pays.

La tâche de ces equipes de travail est considérable. Les projets actuels de l'OMS et du PNUE proposent même de les étoffer et de les aider, de les faire mieux connaître d'officialiser leurs activités en intéressant certaines d'entre elles aux programmes et projets en cours d'organisation (Genève 1975).

Il s'agit de contrôler, de surveiller et de localiser les sources de pollution de toute nature. Ce premier point n'est plus discuté. Il répond à un besoin, il suffit d'ajuster aux nécessités actuelles ce qui existe déjà.

(ii) Le second volet, rélativement nouveau, est le développement des moyens de lutte coordonnés contre les pollutions du littoral et des zones d'estuaires. Il s'agit d'une tâche considérable. Il serait raisonnable de la considérer comme une actualisation de notions anciennes mais tombées dans l'oubli. Un réveil de ce qui someillait dans les consciences.

En effet, constater les pollutions, les déplorer, demeure une attitude très naturelle, mais en soi inefficace. Il convient d'aller plus loin et de passer à l'action. La priorité doit être donnée à tout ce qui concerne cette orientation vers la nécessité d'agir (Fig. 4).

L'OMS avec le concours de l'UNEP a décidé de prendre des mesures. Un rapport général consacré à la situation en Méditerranée a récemment encore tracé les grandes lignes que devra suivre cette action. Le principe est basé sur la notion de "Gestion des déchets". L'homme du XXème siècle doit se rendre maître des nuisances en tant que responsable de l'intégrité de son environnement. Une technologie commence à se développer pour laquelle le terme de "Rupologie" ou science du déchet, a d'une facon general ete bien acueilli. Il resume en effet l'ensemble des connaissances relatives aux dechets, aux ordures. Sela signifie que chaque dechet, chaque type de nuisance, doit être étudié dans le détail pour en tirer les procèdés de neutralisation, de destruction ou de transformation, voire d'utilisation. Ce programme aussi vaste que séduisant a déjà retenu l'attention d'un certain nombre d'organismes, notamment des industriels, des biochimistes, des chimistes, des microbiologistes, des agriculteurs, des éleveurs. Congrès, revues spécialisées, colloques apportent autant de témoignage encourageants. Le mouvement est lancé et semble devoir prendre une accélération de bon aloi.

L'OMS a donc élaboré un programme qui propose à la fois la recherche fondamentale et les réalisations pratiques. Des commissions étudient les différents déchets industriels, alimentaires, urbains, pour en tirer le maximum. Le slogan "Assainir en s'enrichissant" a séduit certaines industries. Chacune d'elles en s'implantant devra être instruite des procédés susceptibles de résorber ses propres nuisances. Toute une technologie de la rupologie est en cours d'élaboration. Elle sera en définitive la seule voie capable de conduire à des solutions positives et au respect des lois qui interdisent les rejets dans la nature. L'application en est certes difficile, le pari vaut la peine d'être tenu.

(iii) La stratégie devient plus claire, elle s'appuie en effet sur des bases solides:

(a) Les mécanismes de l'auto-épuration étant largement dépassés, ce processus naturel ne doit plus en aucun cas

Fig. 4 PROGRAMME D'ASSAINISSEMENT D'UNE RÉGION LITTORALE

Holysmologie

Cartographie

Océanologie (courants, marées, estuaires)

Populations
Fixes Saisonnières

Activités
Tourisme - Industrie
Hydrocarbures -
Aquaculture -
Pêche - Elevages
Cultures intensives
Pollution physique
(thermique, atomique)

Déchets

Nature — Volume — Débit — Devenir (diffusion - dispersion)

Rupologie

Mesures à prendre
pour appliquer l'interdiction des rejets

Destruction
Combustion
Enfouissement
etc.

Utilisation directe
Matériaux de construction
Immersion des carcasses de voitures ou leur fonte
Utilisation des débris ligneux (cultures de champignons)
Récupérations

Transformation
Biodégradations
Utilisation de résidus pour la nourriture du bétail
Commercialisation de produits finis, d'enzymes, etc.

Les pouvoirs publics interviennent à tous les niveaux pour faciliter la réalisation des recherches, financer les programmes de rupologie qui contribuent à la destruction, neutralisation ou utilisation des nuisances.

être invoqué pour excuser le déversement des nuisances dans les océans. L'attitude jusqu'ici adoptée par certains responsables devient condamnable vis à vis de la société. Il existe des lois précises interdisant les rejets, on en souhaite l'application sans dérogations.

(b) Pour permettre le respect des lois il est non moins important de donner aux responsables les moyens de les appliquer. Des équipes en place surveillent et évaluent les pollutions. Les dangers que font courir les contaminants aux baigneurs, aux consommateurs de fruits de mer ne peuvent plus être niés ou minimisés. L'accroissement du nombre d'infections d'origine hydrique, diffusibles, endemo-épidémiques oblige à prendre au sérieux les mesures d'assainissement les plus élémentaires.

(c) Pour permettre aux villes, aux industriels de ne plus polluer il convient de mettre en place des équipes de coordination, de centres d'études, des installations experimentales, des centres d'instruction accessible aussi bien aux scientifiques qu'aux praticiens.

Il est souhaité que la priorité soit donnée maintenant à cette discipline que constitue la "gestion des déchets" que son développement et que ses réalisations soient assurés le plus rapidement possible.

Telles sont les grandes lignes des projets qui par leur ampleur tiendront lieu de conclusion.

L'homme a le devoir de rester maître de ses nuisances et de maintenir l'équilibre de son environnement. La technologie actuelle lui en assure les possibilités. Il suffit de vouloir, et les Océans seront assainis.

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VI FINAL SESSION

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Statement made by the Director
for the Centre for Natural
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United Nations
New York

Vladimir Baum

It is an honour and a pleasure to have the opportunity to address this distinguished assembly at the close of what I know to have been a tightly organized and very demanding ten days of meetings, and I should add, a few nights too.

For centuries man has been drawn to the sea and the shores have exerted great attraction on the enterprising spirit with their challenge and promise. However, only relatively recently did the United Nations Economic and Social Council turn its attention to the development potential of the land-sea interface and the international community has become aware of its rapidly intensifying uses as well as of the conflicts these uses may create. Thus, the problems of coastal resources development and management have confronted you with a number of difficult tasks and choices which might easily have taken weeks to define had it not been for the range and depth of knowledge and intellect which you collectively have brought to bear within a well planned and structured format under which you have laboured.

I am confident you will agree that your efforts have not gone unrewarded. For judging by the results of your work, as reflected in the Seminar report, you have gone well beyond concepts and definitions. Based on your own experience, you have not only identified problems of priority concern but have developed a realistic and practical orientation for national and international measures aimed at their solution. In this sense, your Seminar was perhaps a modest but nonetheless tangible contribution to international co-operation in a world too often divided.

In stressing the action orientation of your work, however, I do not wish to understate what your deliberations have yielded on the conceptual side. By giving operational significance to the concept of the "coastal area," you have affirmed the validity of the concept, you have refined it, tested its strengths and weaknesses, its flexibility and limitations as a conceptual bridge, and have, so to speak, spanned and linked land and sea, which though physically distinct, merge for planning purposes. Of course, you have also sounded a note of caution against easy generalizations, given the diversity of local conditions. You have clearly stressed the importance of applying new approaches of horizontal integration along this unique nature-given marker. At the same time you have understood that, in real life, the imperatives and the constraints of the environment have to be reconciled with political , economic, and social considerations, and with administrative boundaries which more often than not do not conform with an ecological entity or unit.

Allow me, at this stage, to place your Seminar within the wider context of the world community's concern with the management of natural resources.

As one of the main pillars of development, natural resources - their exploration, exploitation, and utilization - have been one of the important areas of the United Nations activities for more than 25 years. This is also an area where quite a few tangible results have been achieved - though this activity has enjoyed only modest visibility. The scope of UN activities in this field has steadily expanded but this trend has been given added stimulus by the pressures and dislocations to which the world economy has been subjected in recent years. Although the industrialized countries are now emerging from the recession, its stark lessons remain vivid. Moreover, the poor countries, which had been particularly stricken by the effects of the recession and related price movements, have a long way to go to recover and to resume what we hope must be their forward march. These conditions coupled with the concomitant shifts in economic power and political influence have led to two special sessions of the UN General Assembly and to the call for the establishment of a new economic order.

In order to improve the position of the developing countries, the Sixth Special Session had put a great deal of emphasis on the broadening of their natural resources base and on a more rational management of these resources. The Seventh Special Session had then opened the way for negotiations between the industrialized and developing countries on terms under which these resources would be traded. Consequently, these are the problems which still - to a large extent - underlie the North-South dialogue in Paris and which were close to the heart of the debates on commodities at the recently concluded Fourth Session of the United Nations Conference on Trade and Development held in Nairobi. In the broadest sense, we could add that the Conference on Human Settlements now drawing to its close in Vancouver, groping with problems of urban misery and the still continuing attraction to the city slums of millions of poverty-stricken peasants, is yet another facet of the same quintessential problem: mankind confronted both with a need for a more equitable distribution of resources, for a more rational management of its natural endowment. At the risk of overwhelming you with a long listing of conferences, assemblies and meetings, I would just like to mention that the Law of the Sea Conference in its own sphere is also trying to make some headway towards a harmonization of resources policies. Moreover, the United Nations Water Conference to be held next March in Argentina will have for its main theme the whole range of topics associated with policy making in this vital sector of the natural resources field.

This is then the setting in which our Seminar has taken place addressing itself to just one aspect of the tasks before us.

At the risk of oversimplifying, one could say that the United Nations has three main functions in the sphere of economics. Firstly, it should and does provide a forum for negotiations. Secondly, it should be and is a vehicle for economic and technical co-operation. And thirdly, it should be in a position to collect and disseminate all relevant information to make enlightened negotiations possible and to promote co-operation on the basis of objectively established facts. In our interdependent world only if the United Nations will be able properly to perform these functions shall we have a chance to proceed gradually towards the distant ideal - the eventual harmonization of natural resources policies to serve global needs in a rational, equitable, and efficient manner.

In the real world, in moving towards this ideal, we must be satisfied to proceed on less than a grandiose, that is to say, bit-by-bit basis, without losing sight of the final aim to which each individual effort is designed to contribute.

Your Seminar, which I would say has in its way well exemplified some of the functions I described a few moments ago, is one in a chain of such discrete efforts in the field of natural resources. It is, however, also a unique and in a very real sense groundbreaking effort for it is the first meeting of representatives of developing countries convened by the United Nations to deal specifically with coastal zone resources management.

I am confident that the results of your work will provide the impetus and serve as a basis for a full range of follow-up activities in your countries and among them.

On behalf of the United Nations, I wish to express my special thanks to those who contributed to this Seminar sharing their experiences and presenting highly specialized papers. The interaction between specialists and participants from the various countries as well as the recommendations which have come forth from this meeting have again confirmed our conviction of the usefulness of this type of gathering which provides the opportunity to examine in depth specific problems. I sincerely believe that you all have helped us to understand far better than before the promise and the problems of coastal areas.

In concluding, on behalf of the Secretary-General of the United Nations, I would like to extend my thanks to our most hospitable hosts, the German Foundation for International Development, as well as to the authorities of the city of Berlin (West) for the excellent arrangements making the accomplishment of our task possible and for the atmosphere which made our stay so pleasant during this Seminar on Development and Management of Resources of Coastal Areas.

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